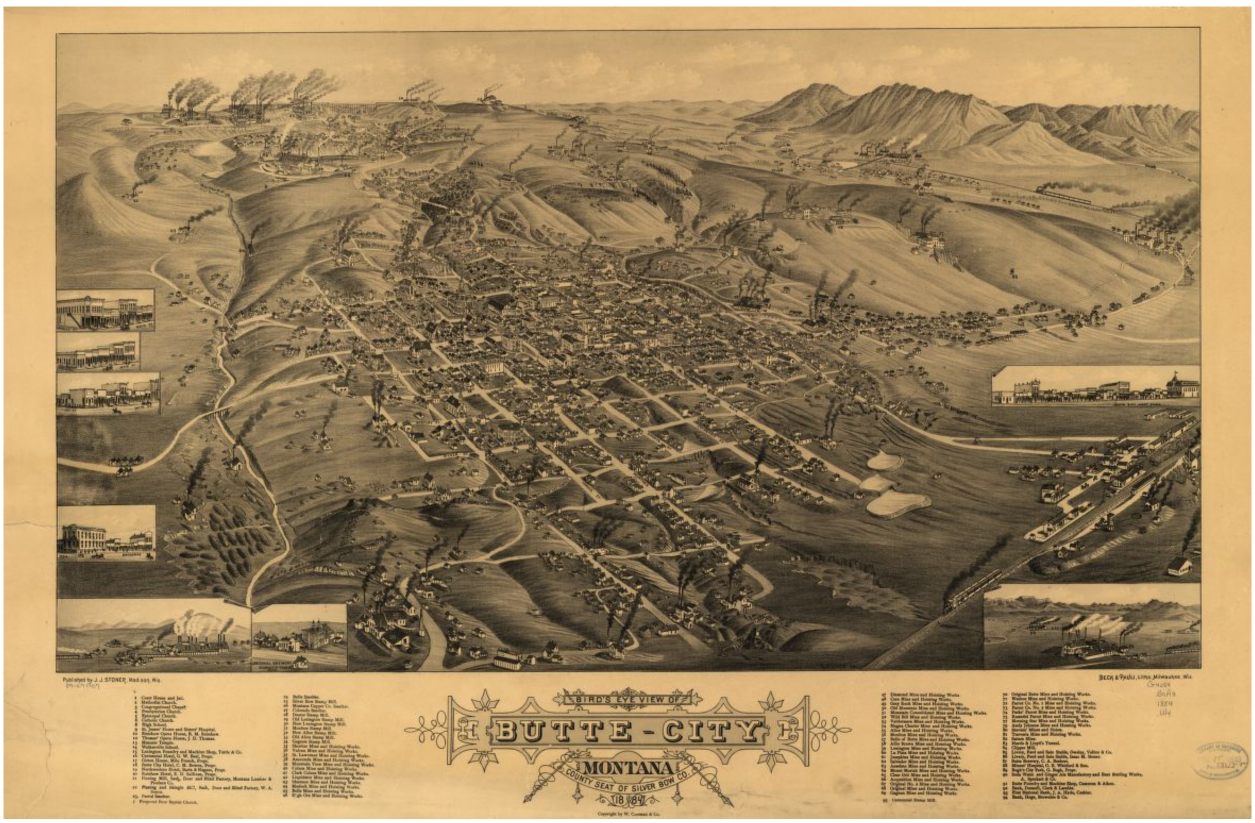
Final - Silver Bow Creek and Clark Fork River Metals TMDLs



May 2014

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ACRONYMS

Acronym	Definition
ARAR	Applicable or Relevant and Appropriate Requirements
ARM	Administrative Rules of Montana
AU	Assessment Unit
BMP	Best Management Practices
BPSOU	Butte Priority Soils Operable Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
DEQ	Department of Environmental Quality (Montana)
DQO	Data Quality Objectives
EPA	Environmental Protection Agency (U.S.)
FWP	Fish, Wildlife & Parks (Montana)
GIS	Geographic Information System
HHS	Human Health Standard
ICIS	Integrated Compliance Information System
IR	Integrated Report
LA	Load Allocation
MCA	Montana Code Annotated
MOS	Margin of Safety
MPDES	Montana Pollutant Discharge Elimination System
MR	Montana Resources, Inc.
MSD	Metro Storm Drain
NLCD	National Land Cover Dataset
NPL	National Priorities List
OU	Operable Unit
ROD	Record of Decision
STORET	EPA STOrage and RETrieval database
SWMP	Stormwater Management Program
TI	Technical Impracticability
TIE	TMDL Implementation Evaluation
TMDL	Total Maximum Daily Load
USFS	United States Forest Service
USGS	United States Geological Survey
WLA	Wasteload Allocation
WWTF	Wastewater Treatment Facility
WWTP	Wastewater Treatment Plant

DOCUMENT SUMMARY

This document presents Total Maximum Daily Loads (TMDL) for metals in Silver Bow Creek and the mainstem Clark Fork River above the mouth of the Flathead River. These streams are 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.

The project area encompasses approximately 270 river miles in western Montana, extending from the mouth of the Flathead River to the headwaters of Silver Bow Creek. This includes the upper 240.4 miles of the Clark Fork River and the 26.7 miles of Silver Bow Creek (**Figure DS-1**). The project area is restricted to the river corridor, although it passes through several existing TMDL planning areas (TPAs): Upper Clark Fork, Clark Fork – Drummond, and Middle Clark Fork. Tributary stream in these TPAs are addressed in separate TMDL documents, as are major tributary TPAs such as the Little Blackfoot River and Flint Creek.

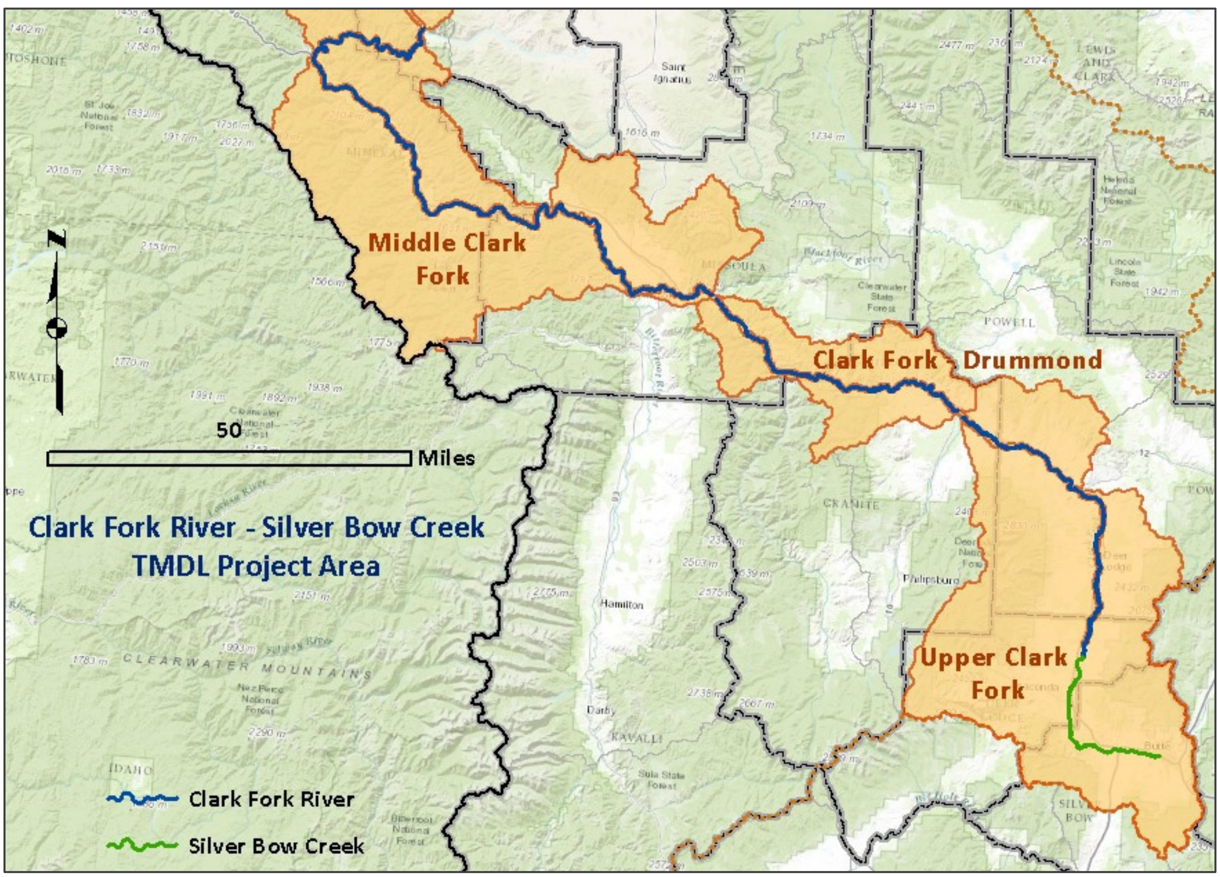

Figure DS-1. Silver Bow Creek and Clark Fork River Project Area

DEQ determined that Silver Bow Creek and the Clark Fork River do not meet the applicable water quality standards. Although DEQ recognizes that there are other pollutant listings for these streams, this document addresses only metals (see **Table DS-1**). While arsenic is a metalloid, it is treated as a metal 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, 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, elevated metals concentrations in irrigation or stock water may affect agricultural uses. DEQ's water quality assessment methods are designed to evaluate the most sensitive uses for each pollutant group addressed within this document, thus ensuring protection of all designated uses and/or aquatic life. Thus, only these uses are linked to impairment determinations on **Table DS-1**.

Implementation of most water quality improvement measures described in this plan is based primarily on government agency remedial action and best management practice implementation, in addition to permitting of point source discharges.

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 Silver Bow Creek and Clark Fork River TMDL Project with Completed Metals TMDLs Contained in this Document

Waterbody and Location Description	TMDL Prepared	TMDL Pollutant Category	Impaired Uses
Silver Bow Creek, from headwaters to mouth (Clark Fork River)	Arsenic	Metals	Drinking Water
	Cadmium	Metals	Aquatic Life
	Copper	Metals	Aquatic Life
	Lead	Metals	Aquatic Life, Drinking Water
	Mercury	Metals	Drinking Water
	Zinc	Metals	Aquatic Life
Clark Fork River, from Warm Springs Creek to Cottonwood Creek	Cadmium	Metals	Aquatic Life
	Copper	Metals	Aquatic Life
	Iron	Metals	Aquatic Life
	Lead	Metals	Aquatic Life
Clark Fork River, from Cottonwood Creek to Little Blackfoot River	Cadmium	Metals	Aquatic Life
	Copper	Metals	Aquatic Life
	Iron	Metals	Aquatic Life
	Lead	Metals	Aquatic Life
	Zinc	Metals	Aquatic Life
Clark Fork River, from Little Blackfoot River to Flint Creek	Arsenic	Metals	Drinking Water
	Cadmium	Metals	Aquatic Life
	Copper	Metals	Aquatic Life
	Iron	Metals	Aquatic Life
	Lead	Metals	Aquatic Life, Drinking Water
	Mercury	Metals	Drinking Water

Table DS-1. List of Impaired Waterbodies and Their Impaired Uses in the Silver Bow Creek and Clark Fork River TMDL Project with Completed Metals TMDLs Contained in this Document

Waterbody and Location Description	TMDL Prepared	TMDL Pollutant Category	Impaired Uses
Clark Fork River, from Flint Creek to Blackfoot River	Arsenic	Metals	Drinking Water
	Cadmium	Metals	Aquatic Life, Drinking Water
	Copper	Metals	Aquatic Life
	Iron	Metals	Aquatic Life
	Lead	Metals	Aquatic Life, Drinking Water
	Mercury	Metals	Drinking Water
	Zinc	Metals	Aquatic Life, Drinking Water
Clark Fork River, from Blackfoot River to Rattlesnake Creek	Arsenic	Metals	Drinking Water
	Cadmium	Metals	Aquatic Life
	Copper	Metals	Aquatic Life
	Iron	Metals	Aquatic Life
	Lead	Metals	Aquatic Life, Drinking Water
	Zinc	Metals	Aquatic Life
Clark Fork River, from Rattlesnake Creek to Fish Creek	Copper	Metals	Aquatic Life
	Iron	Metals	Aquatic Life
	Lead	Metals	Aquatic Life
Clark Fork River, from Fish Creek to Flathead River	Copper	Metals	Aquatic Life
	Iron	Metals	Aquatic Life
	Lead	Metals	Aquatic Life

1.0 INTRODUCTION

This document presents an analysis of water quality information and establishes Total Maximum Daily Loads (TMDLs) for metals problems in Silver Bow Creek and the Clark Fork River. This document also presents a general framework for resolving these problems. The project area encompasses approximately 270 river miles in western Montana, extending from the mouth of the Flathead River to the headwaters of Silver Bow Creek. This includes the upper 240.4 miles of the Clark Fork River and the 26.7 miles of Silver Bow Creek. The project area is restricted to the river corridor, although it passes through several existing TMDL planning areas: Upper Clark Fork, Clark Fork – Drummond, and Middle Clark Fork. Tributary stream in these TPAs are addressed in separate TMDL documents, as are major tributary TPAs such as the Little Blackfoot River and Flint Creek.

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:

- 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 2 years the Montana Department of Environmental Quality (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 A-1** in **Appendix A** identifies all impaired waters for Silver Bow Creek and the Clark Fork River from Montana's 2012 303(d) List, and includes non-pollutant impairment causes included in Montana's "2012 Water Quality Integrated Report." **Table A-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 TMDLs 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

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.

1.2 Water Quality Impairments and TMDLs Addressed by this Document

Table 1-1 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 prior to this project identified new metals impairment causes. These impairment causes are also identified in **Table 1-1** and noted as not being on the 2012 303(d) List (within the IR). 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 40 TMDLs (**Table 1-1**).

Although DEQ recognizes that there are other pollutant listings for Silver Bow Creek and the Clark Fork River without completed TMDLs (**Table A-1** in **Appendix A**), this document only addresses those identified in **Table 1-1**. 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 and nutrient impairments for Silver Bow Creek and sediment impairments for the Clark Fork River are addressed in a separate TMDL project and document.

Table 1-1. Metals Water Quality Impairment Causes for Silver Bow Creek and the Clark Fork River Addressed within this Document

Waterbody and Location Description	Waterbody ID	Impairment Cause	Impairment Cause Status	Included in 2012 IR*
Silver Bow Creek, headwaters to mouth (Clark Fork River)	MT76G003_020	Aluminum	Not impaired based on new assessment	Yes
		Arsenic	Arsenic TMDL completed	Yes
		Cadmium	Cadmium TMDL completed	No
		Copper	Copper TMDL completed	Yes
		Iron	Not impaired based on new assessment	Yes
		Lead	Lead TMDL completed	Yes
		Manganese	Not impaired based on new assessment	Yes
		Mercury	Mercury TMDL completed	No
		Silver	Not impaired based on new assessment	Yes
		Zinc	Zinc TMDL completed	Yes
Clark Fork River, Warm Springs Creek to Cottonwood Creek	MT76G001_040	Arsenic	Not impaired based on new assessment	Yes
		Cadmium	Cadmium TMDL completed	Yes
		Copper	Copper TMDL completed	Yes
		Iron	Iron TMDL completed	No
		Lead	Lead TMDL completed	Yes
Clark Fork River, Cottonwood Creek to Little Blackfoot River	MT76G001_030	Cadmium	Cadmium TMDL completed	No
		Copper	Copper TMDL completed	Yes
		Iron	Iron TMDL completed	No
		Lead	Lead TMDL completed	Yes
		Zinc	Zinc TMDL completed	Yes
Clark Fork River, Little Blackfoot River to Flint Creek	MT76G001_010	Arsenic	Arsenic TMDL completed	Yes
		Cadmium	Cadmium TMDL completed	No
		Copper	Copper TMDL completed	Yes
		Iron	Iron TMDL completed	No
		Lead	Lead TMDL completed	Yes
		Mercury	Mercury TMDL completed	No
		Zinc	Not impaired based on new assessment	Yes
Clark Fork River, Flint Creek to Blackfoot River	MT76E001_010	Arsenic	Arsenic TMDL completed	Yes
		Cadmium	Cadmium TMDL completed	Yes
		Copper	Copper TMDL completed	Yes
		Iron	Iron TMDL completed	Yes
		Lead	Lead TMDL completed	Yes
		Mercury	Mercury TMDL completed	No

Table 1-1. Metals Water Quality Impairment Causes for Silver Bow Creek and the Clark Fork River Addressed within this Document

Waterbody and Location Description	Waterbody ID	Impairment Cause	Impairment Cause Status	Included in 2012 IR*
		Zinc	Zinc TMDL completed	Yes
Clark Fork River, Blackfoot River to Rattlesnake Creek	MT76M001_030	Arsenic	Arsenic TMDL completed	Yes
		Cadmium	Cadmium TMDL completed	No
		Copper	Copper TMDL completed	No
		Iron	Iron TMDL completed	No
		Lead	Lead TMDL completed	Yes
		Zinc	Zinc TMDL completed	No
Clark Fork River, Rattlesnake Creek to Fish Creek	MT76M001_020	Arsenic	Not impaired based on new assessment	Yes
		Cadmium	Not impaired based on new assessment	Yes
		Copper	Copper TMDL completed	Yes
		Iron	Iron TMDL completed	No
		Lead	Lead TMDL completed	No
Clark Fork River, Fish Creek to Flathead River	MT76M001_010	Copper	Copper TMDL completed	Yes
		Iron	Iron TMDL completed	No
		Lead	Lead TMDL completed	Yes
Clark Fork River, Flathead River to Noxon Reservoir**	MT76N001_010	Cadmium	Not impaired based on new assessment	Yes

* Impairment causes not in the "2012 Water Quality Integrated Report" were recently identified and will be included in the 2014 IR
** This AU has been redefined as "Clark Fork River, Flathead River to Thompson Falls Reservoir" and excludes the Thompson Falls Reservoir

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 Silver Bow Creek - Clark Fork River corridor.

Section 3.0 Montana Water Quality Standards:
Discusses the water quality standards that apply to the Silver Bow Creek and Clark Fork River 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, and (g) adaptive management strategies to allow for changing water quality conditions.

Section 6.0 Restoration Strategy:
Discusses water quality restoration objectives and presents 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 Silver Bow Creek and Clark Fork River 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 Silver Bow Creek and the Clark Fork River corridors. Unless otherwise noted, geospatial data used for the figures and accompanying discussion is obtained from the Montana Geographic Information System (GIS) Portal (http://gisportal.msl.mt.gov/geoportal/catalog/main/home.page).

2.1 PHYSICAL CHARACTERISTICS

The following information describes the physical characteristics of the Silver Bow Creek watershed and Clark Fork River corridor.

2.1.1 Location

The project area encompasses roughly 267 river miles in western Montana, extending from the mouth of the Flathead River to the start of Silver Bow Creek (**Figure 2-1**). This includes the upper 240 miles of the Clark Fork River and approximately 27 miles of Silver Bow Creek. Silver Bow Creek is formed by the confluence of Blacktail Creek and the Metro Storm Drain (MSD). MSD occupies the former location of the original Silver Bow Creek channel. Extensive 19th and 20th Century mining, milling, and smelting activities obliterated the channel and the Berkeley and Continental Pits isolate it from headwaters catchments, which drain into the Yankee Doodle Tailings Impoundment. The project is restricted to the stream and mainstem river corridor, although it passes through several existing TMDL planning areas: Upper Clark Fork, Clark Fork – Drummond, and Middle Clark Fork. These adjacent upland areas and tributary streams are addressed in separate TMDL project areas. Elevation ranges from approximately 2,500 feet at the mouth of the Flathead River to approximately 5,500 feet in Butte.

2.1.2 Hydrology

Silver Bow Creek is 26.7 miles long. The Clark Fork River runs 240 miles from the confluence of Warm Springs Creek and Silver Bow Creek to the mouth of the Flathead River. The total area draining to the Clark Fork River above St. Regis (approximately 17 miles upstream of the Flathead River) is 10,709 square miles (USGS, Station 12354500 http://waterdata.usgs.gov/usa/nwis/uv?12354500). The United States Geological Survey (USGS) gaging stations on Silver Bow Creek and the Clark Fork River are summarized below in **Table 2-1** and illustrated in **Figure 2-1**.

Table 2-1. USGS Gage Stations on Silver Bow Creek and the Clark Fork River

Station ID	Station Name	Area Drained (miles^2)
12323250	Silver Bow Creek below Blacktail Creek, at Butte	125
12323600	Silver Bow Creek at Opportunity	343
12323750	Silver Bow Creek at Warm Springs	473
12323800	Clark Fork near Galen	651
12324200	Clark Fork at Deer Lodge	995
12324680	Clark Fork at Gold Creek	1,760
12331800	Clark Fork near Drummond	2,501
12334550	Clark Fork at Turah Bridge, near Bonner	3,641
12340500	Clark Fork above Missoula	5,999
12353000	Clark Fork below Missoula	9,003

Table 2-1. USGS Gage Stations on Silver Bow Creek and the Clark Fork River

Station ID	Station Name	Area Drained (miles^2)
12354500	Clark Fork at St. Regis	10,709
12389000*	Clark Fork River near Plains*	19,958*

*Station is located below the mouth of the Flathead River

Figure 2-1. USGS Gages

Streamflow follows a hydrograph typical for the region, and is 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 tributary streams go dry. Streamflow generally begins to rebound in October and November when fall storms supplement the base-flow levels. Example hydrographs are provided below, based on the gages at Opportunity and Missoula.

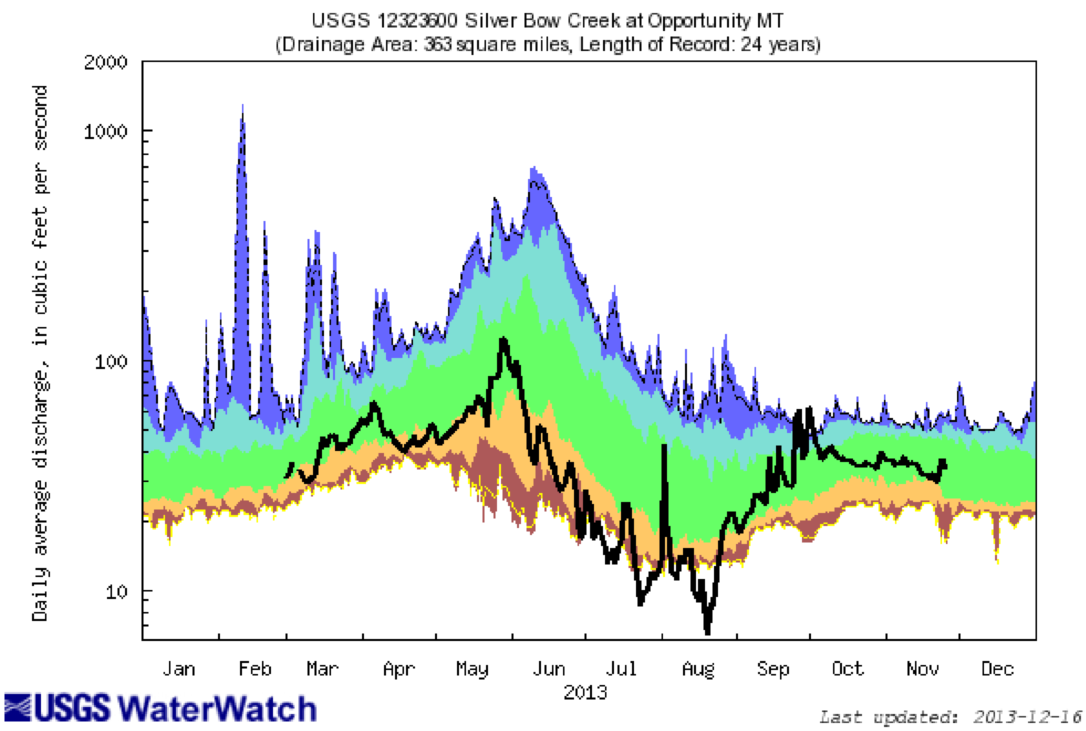

Figure 2-2. Hydrograph at Silver Bow Creek at Opportunity

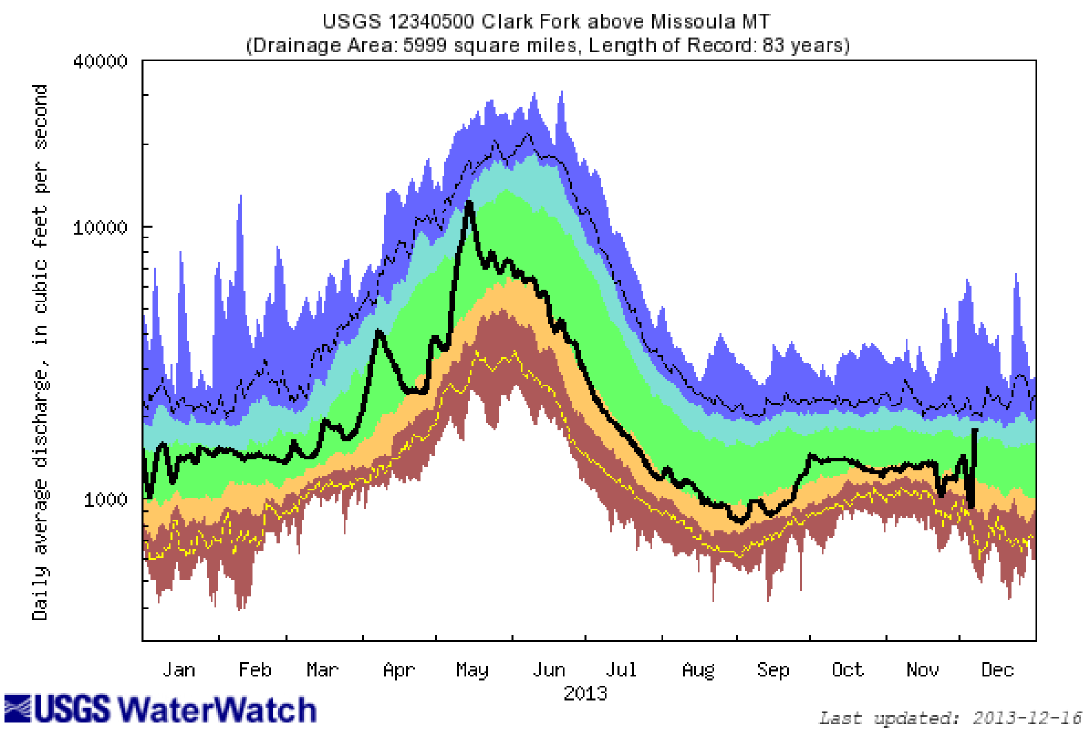

Figure 2-3. Hydrograph at Clark Fork River above Missoula

Explanation - Percentile classes

lowest-10th percentile	5	10-24	25-75	76-90	95	90th percentile -highest	Flow
Much below Normal		Below normal	Normal	Above normal	Much above normal		

2.1.3 Climate

Silver Bow Creek and the Clark Fork River span a wide section of western Montana intermontane basins. The climatic end members are the Upper Clark Fork Valley, a mid-elevation intermontane basin typified by cold winters and mild summers, to the Plains Valley, a lower elevation intermontane basin typical of the Northern Rockies with warm summers and cool, humid winters (Kendy and Tresch, 1996). Average precipitation ranges from 10 to 12 inches per year in the Upper Clark Fork Valley to 20 to 24 inches per year at the lower elevations near the Plains Valley. May and June are consistently the wettest months of the year and winter precipitation is dominated by snowfall.

2.2 Ecological Profile

These waterbodies flow through the Middle Rockies and Northern Rockies Level III ecoregions (Woods et al., 2002). The Clark Fork River passes into the Northern Rockies ecoregion near Alberton.

2.2.1 Land Cover and Land Use

The river corridor includes a wide range of land uses. Since this project addresses only the mainstem river corridor rather than upland areas or tributary watersheds, DEQ queried the 2001 National Land Cover Dataset (NLCD) (Homer et al., 2007) within a 100-meter buffer of the river's centerline. Land use and cover excluding the "Open Water" category is summarized below in **Table 2-2**. Riparian vegetation classes comprise the majority of the land use along the banks.

Table 2-2. Land Use and Land Cover along Silver Bow Creek and the Clark Fork River

NLCD Cover Type	Acres	Percent of Total
Woody Wetlands	4,034.45	22.2%
Herbaceous	3,231.83	17.8%
Shrub/Scrub	2,986.97	16.4%
Evergreen Forest	2,960.29	16.3%
Hay/Pasture	1,639.04	9.0%
Developed, Low Intensity	1,179.36	6.5%
Developed, Open Space	1,009.22	5.6%
Emergent Herbaceous Wetlands	486.15	2.7%
Developed, Medium Intensity	455.46	2.5%
Barren Land	87.62	0.5%
Cultivated Crops	74.06	0.4%
Developed, High Intensity	20.46	0.1%
Mixed Forest	0.22	0.0%

2.2.2 Aquatic Life

Fish distribution is mapped by Montana Fish, Wildlife & Parks (FWP) and reported on the Internet via the Montana Fisheries Information System site (Montana Fish, Wildlife and Parks, 2013).

Silver Bow Creek has recovered from sterile conditions in the mid-20th Century and is now mapped with longnose sucker, slimy sculpin, rainbow trout, brook trout and westslope cutthroat trout. The trout species are rated rare in abundance.

The Clark Fork River hosts many more fish species, many of which are introduced. Of most interest are bull trout (a U.S. Fish and Wildlife Service Threatened Species) and westslope cutthroat trout (a Montana Species of Concern). Bull trout are reported between river miles 61 and 71.6 and between 75.5

and 294.6. Their abundance is rated rare in both reaches. Westslope cutthroat trout are reported as common between river miles 26 and 37, and 46 and 56. They are reported as rare between river miles 61 and 71.6 and 75.5 to 339.9.

2.3 Cultural Profile

The following information describes the social profile of the Silver Bow Creek and Clark Fork River corridors.

2.3.1 Population

As this project addresses only Silver Bow Creek and the mainstem of the Clark Fork River, population estimates are problematic. However, populations of communities located along Silver Bow Creek and the Clark Fork River are reported in the 2010 Census as:

- Butte-Silver Bow: 33,525
- Deer Lodge: 3,111
- Drummond: 309
- Clinton: 1,052
- Turah: 306
- Bonner: 1,663
- Missoula: 66,778
- Alberton: 420
- Superior: 812

2.3.2 Land Ownership

The majority of the land that Silver Bow Creek and the Clark Fork River flow through is privately owned. Exceptions to this include county and state rights-of-way for bridge crossings, FWP fishing access sites, and U.S. National Park Service property at the Grant-Kohrs Ranch Historic Site.

2.3.3 Transportation Networks

The Silver Bow Creek and Clark Fork River corridor hosts a number of major transportation routes, including Interstate 90 and railroads. These routes parallel and cross the waterbodies in many locations. In some areas, the transportation networks restrict the stream channel. Conversely, there are also reaches along which roads and railroads are set back from Silver Bow Creek and the Clark Fork River.

2.3.4 Mining History

Metals mining in the Summit Valley began in the 1860s like many other districts, with small-scale gold mining of placer deposits. However, within a few decades the Butte district had become the world's leading producer of copper. The Butte area featured mining, milling and smelting on an industrial scale seldom seen in the United States.

Mill tailings were disposed of in and alongside Silver Bow Creek for decades. Major floods in the early part of the 20th Century washed large volumes of tailings downstream, and redeposited them in streambank and streambed deposits of Silver Bow Creek and the Clark Fork River. Tailings deposited in the then-newly constructed Milltown Reservoir dramatically reduced the reservoir's storage capacity (Smith et al., 1998).

2.3.5 Remediation History

Congress passed the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in 1980. CERCLA established that parties responsible for releasing hazardous substances could be held liable for subsequent remediation. CERCLA also created a tax on the petroleum and chemical industries. Funds generated by the tax went into a trust fund known as the "Superfund", which became the commonly used name for the CERCLA program. The purpose of the fund was to pay for government cleanup when no responsible party could be identified and compelled to perform or pay for remediation. Information about the CERCLA program is available from a database known as CERCLIS (the Comprehensive Environmental Response, Compensation, and Liability Information System).

The Clark Fork Basin sites were added to the National Priorities List (NPL) of CERCLA sites in 1983. These included the Silver Bow Creek Site, the Milltown Reservoir Site and Anaconda Smelter Site. The Silver Bow Creek Site was redesignated the Silver Bow Creek / Butte Area Site in 1987, and the Milltown Reservoir Site was redesignated the Milltown Reservoir / Clark Fork River site in 1992. Each of these sites is subdivided into several operable units (OUs) in order to focus on the particular sources, contaminants and challenges specific to each OU.

The Silver Bow Creek / Butte Area Site includes seven active OUs:

- Streamside Tailings OU01
- Butte Mine Flooding OU03
- Warm Springs Ponds Active Area OU04
- Rocker Timber Framing and Treating OU07
- Butte Priority Soils OU08
- Warm Springs Ponds Inactive Area OU12
- West Side Soils OU13

Several other former OUs have been merged into the Butte Priority Soils Operable Unit (BPSOU). Also, the Clark Fork River / Downstream OU was transferred to the Milltown Reservoir / Clark Fork River Site.

The Milltown Reservoir / Clark Fork River Site includes three OUs:

- Milltown Drinking Water Supply OU01
- Milltown Reservoir Sediments OU02
- Mainstem Clark Fork River OU03

Also, while neither Silver Bow Creek nor the Clark Fork River flow through the Anaconda Smelter Site, it borders the Clark Fork River and includes several major tributaries, such as Warm Springs Creek.
The general locations of these sites are shown below in **Figure 2-4**.

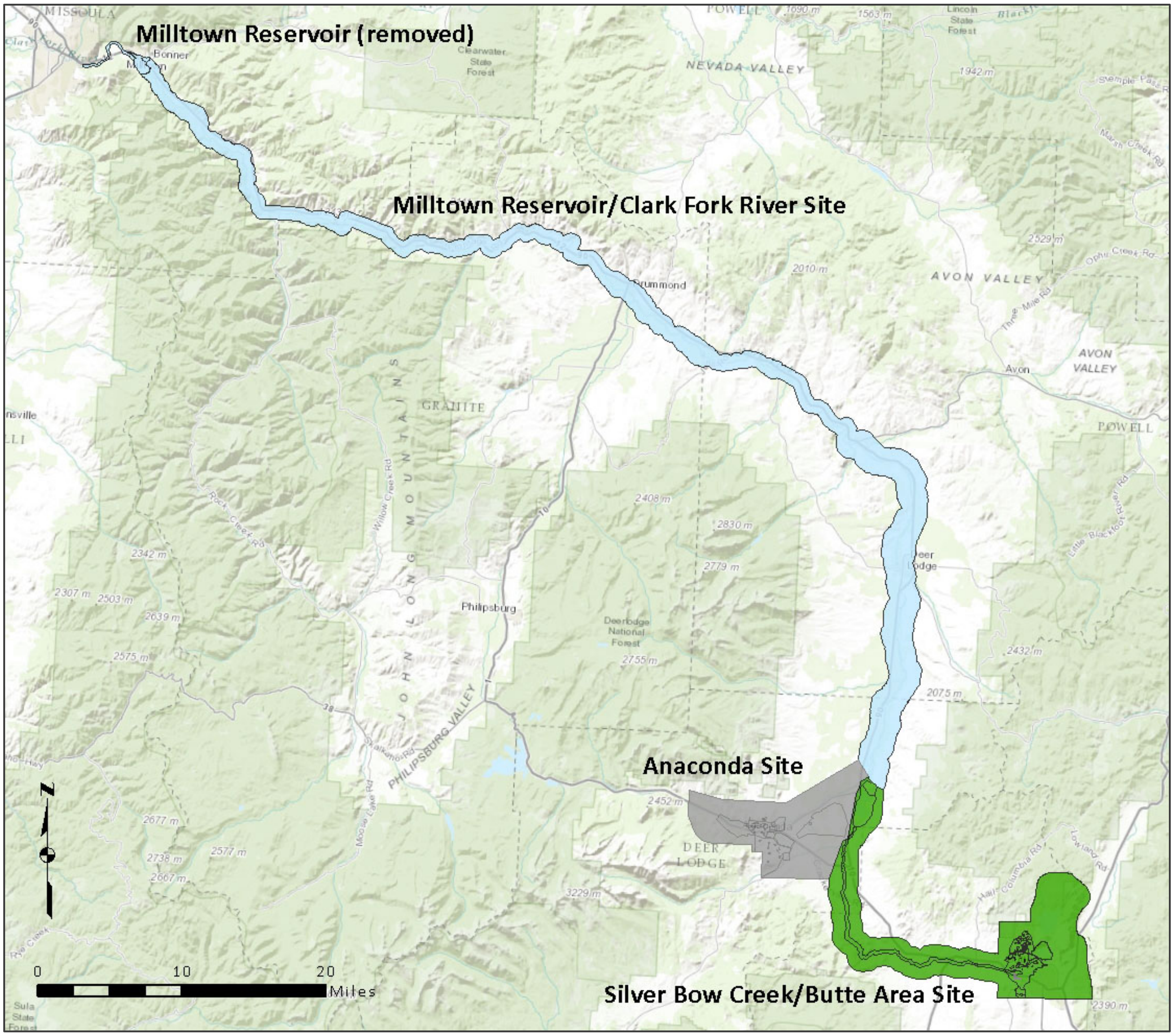

Figure 2-4. Superfund Sites in the Upper Clark Fork Basin

3.0 MONTANA WATER QUALITY STANDARDS

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

Montana's water quality standards 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. The components that do 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 Montana Code Annotated (MCA)), Montana's Surface Water Quality Standards and Procedures (Administrative Rules of Montana (ARM) 17.30.601-670), and Circular DEQ-7 (Montana Department of Environmental Quality, 2012a).

3.1 SILVER BOW CREEK AND CLARK FORK RIVER CLASSIFICATIONS AND DESIGNATED USES

Waterbodies are classified based on their designated uses. All Montana waters are classified for multiple uses.

Silver Bow Creek is an I-classified stream. The State of Montana's goal for I-classified waterbodies is for them to support all potential uses (ARM 17.30.628(1)). Therefore, Silver Bow Creek is assessed for the same uses as a B-1 classified stream and TMDLs are developed to support both aquatic life and drinking water uses. 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.

The Deer Lodge Valley reach of the Clark Fork River is divided into two segments. The segment between the confluence of Silver Bow Creek and Warm Springs Creek and Cottonwood Creek is classified C-2. The reach from Cottonwood Creek to the Little Blackfoot River is classified C-1. Waters classified C-1 and C-2 are to be maintained suitable for: bathing, swimming, and recreation; growth and (marginal for C-2) propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply (ARM 17.30.626 and 627).

The Clark Fork River downstream of the Little Blackfoot River is classified as B-1. 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 (ARM 17.30.607(1)(a)).

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 ARM 17.30.607 through 17.30.628.

DEQ's water quality assessment methods are designed to evaluate the most sensitive uses for each pollutant group addressed within this document, thus ensuring protection of all designated uses (Drygas, 2012). For streams in Western Montana, the most sensitive use assessed for sediment is aquatic life; for temperature is aquatic life; for metals are drinking water and/or aquatic life; and for nutrients is aquatic life and primary contact recreation.

DEQ determined that eight assessment units (AUs) in Silver Bow Creek and the Clark Fork River do not meet the metals water quality standards (**Table 3-1**).

Table 3-1. Waterbodies and Metals-Impaired Uses in Silver Bow Creek and the Clark Fork River

Waterbody and Location Description	Waterbody ID	Use Class	Pollutant Cause	Impaired Use(s)
Silver Bow Creek, headwaters to mouth (Clark Fork River)	MT76G003_020	I	Arsenic	Drinking Water*
			Cadmium	Aquatic Life*
			Copper	Aquatic Life*
			Lead	Aquatic Life*, Drinking Water*
			Mercury	Aquatic Life*, Drinking Water*
			Zinc	Aquatic Life*
Clark Fork River, Warm Springs Creek to Cottonwood Creek	MT76G001_040	C-2	Cadmium	Aquatic Life
			Copper	Aquatic Life
			Iron	Aquatic Life
			Lead	Aquatic Life
Clark Fork River, Cottonwood Creek to Little Blackfoot River	MT76G001_030	C-1	Cadmium	Aquatic Life
			Copper	Aquatic Life
			Iron	Aquatic Life
			Lead	Aquatic Life
			Zinc	Aquatic Life
Clark Fork River, Little Blackfoot River to Flint Creek	MT76G001_010	B-1	Arsenic	Drinking Water
			Cadmium	Aquatic Life
			Copper	Aquatic Life
			Iron	Aquatic Life
			Lead	Aquatic Life, Drinking Water
			Mercury	Drinking Water
Clark Fork River, Flint Creek to Blackfoot River	MT76E001_010	B-1	Arsenic	Drinking Water
			Cadmium	Aquatic Life, Drinking Water
			Copper	Aquatic Life
			Iron	Aquatic Life
			Lead	Aquatic Life, Drinking Water
			Mercury	Drinking Water
			Zinc	Aquatic Life, Drinking Water

Table 3-1. Waterbodies and Metals-Impaired Uses in Silver Bow Creek and the Clark Fork River

Waterbody and Location Description	Waterbody ID	Use Class	Pollutant Cause	Impaired Use(s)
Clark Fork River, Blackfoot River to Rattlesnake Creek	MT76M001_030	B-1	Arsenic	Drinking Water
			Cadmium	Aquatic Life
			Copper	Aquatic Life
			Iron	Aquatic Life
			Lead	Aquatic Life, Drinking Water
			Zinc	Aquatic Life
Clark Fork River, Rattlesnake Creek to Fish Creek	MT76M001_020	B-1	Copper	Aquatic Life
			Iron	Aquatic Life
			Lead	Aquatic Life
Clark Fork River, Fish Creek to Flathead River	MT76M001_010	B-1	Copper	Aquatic Life
			Iron	Aquatic Life
			Lead	Aquatic Life

*It is the goal of the State that all "I" classified waters support all potential uses.

3.2 Numeric and Narrative Water Quality Criteria

In addition to the use classifications described above, Montana's water quality standards include numeric and narrative criteria that protect the designated uses. Numeric criteria define the allowable concentrations of specific pollutants as well as the duration and frequency of exceedances, 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 criteria 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 criteria for aquatic life include chronic and acute values. Chronic aquatic life criteria prevent long-term, low level exposure to pollutants. Acute aquatic life criteria protect from short-term exposure to pollutants. Numeric criteria also apply to other designated uses such as protecting irrigation and stock water quality for agriculture.

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

For the Silver Bow Creek and the Clark Fork River, the lowest relevant numeric criteria are adopted as the target for impairment determinations and subsequent TMDL development. These targets address allowable water column chemistry concentrations. **Section 5.4** defines both the applicable water quality criteria and the subsequent water quality targets.

4.0 DEFINING TMDLS AND THEIR COMPONENTS

A 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.

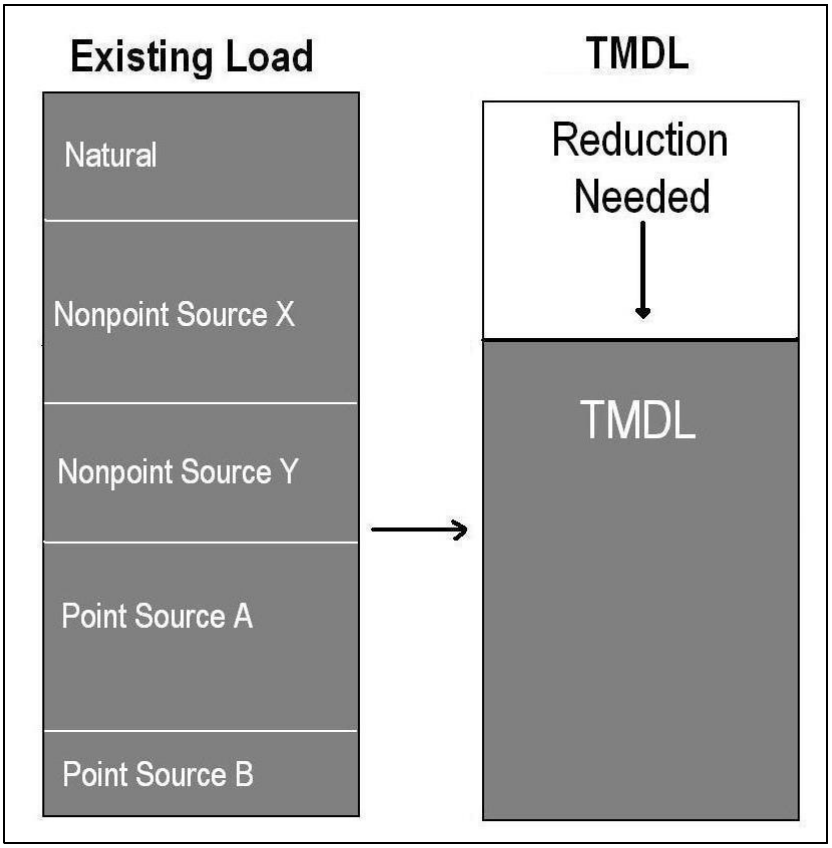

Figure 4-1. Schematic Example of TMDL Development

4.1 Developing Water Quality Targets

TMDL water quality targets are a translation of the applicable numeric or narrative water quality criteria for each pollutant. The same pollutant may have different water quality criteria for different designated uses. Since protecting the most sensitive use will in turn protect all uses, the target is based on the most stringent water quality criterion. For pollutants with established numeric water quality criteria, the numeric value(s) are used as the TMDL targets. For pollutants with narrative water quality criteria, the targets provide a waterbody-specific interpretation of the narrative criteria.

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 Code of Federal Regulations (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 a “TMDL” is explicitly defined as a “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 criteria, 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 CWA. 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 (BMPs) 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.

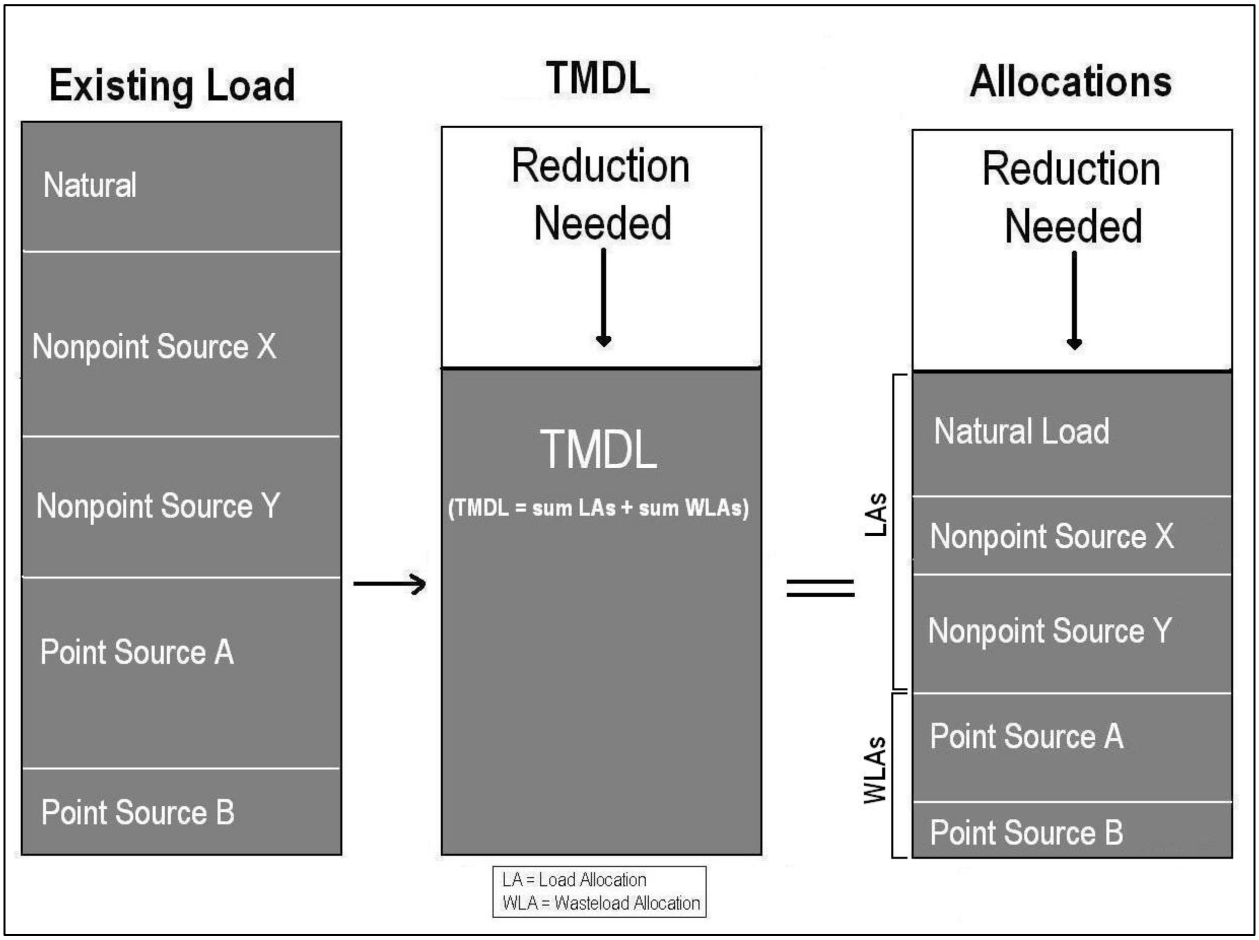

Figure 4-2. Schematic Diagram of a TMDL and Its Allocations

TMDLs must also incorporate an MOS. The MOS accounts for the uncertainty, or any lack of knowledge, about the relationship between the pollutant loads and the quality of the receiving waterbody. The MOS 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). The MOS 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.

4.5 Implementing TMDL Allocations

CWA and Montana state law (Section 75-5-703 of the Montana Water Quality Act) require WLAs to be incorporated into appropriate discharge permits, thereby providing a regulatory mechanism to achieve load reductions from point sources. Point sources related to Superfund sites and operated under CERCLA are not subject to permit requirements under the CWA. However, the performance goals of CERCLA operations are adopted from the same water quality standards provided under the CWA. Nonpoint source reductions linked to LAs are not required by the CWA or Montana statute, and are primarily implemented through voluntary measures.

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, remediation goals are met, or new sources are identified.

5.0 METALS TMDL COMPONENTS

This portion of the document addresses all metals water quality impairments in Silver Bow Creek and the Clark Fork River. It includes:

1. Effects of metals on designated uses
2. Stream segments of concern
3. Water quality data and information sources
4. Water quality targets and comparison to existing conditions for each impaired stream
5. Metals source assessments
6. Metals TMDLs and allocations
7. Seasonality and MOS
8. Uncertainty and adaptive management

5.1 EFFECTS OF METALS ON DESIGNATED BENEFICIAL USES

Metals concentrations exceeding the aquatic life and/or human health standards (HHSs) 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 is a metalloid, it is treated as a metal for TMDL development due to the similarity in sources, environmental effects, and restoration strategies.

5.2 STREAM SEGMENTS OF CONCERN

While smaller streams may be assessed in their entirety, from headwaters to mouth, larger streams are commonly divided into multiple segments for individual assessment. This is appropriate when the stream changes character due to large-scale landscape changes or major tributaries. Silver Bow Creek is a single AU, and the Clark Fork River in this project is divided into eight. For simplicity, Clark Fork River AUs are commonly referred to as 'segments.' Nine waterbody AUs of Silver Bow Creek and the Clark Fork River are listed as impaired due to metals in the 2012 Montana Integrated Water Quality Report (**Table 5-1**).

Table 5-1. Metals-Impaired Segments of the Silver Bow Creek and the Clark Fork River in the 2012 303(d) List

Waterbody and Location Description	Waterbody (AU) ID
Silver Bow Creek headwaters to mouth (Clark Fork River)	MT76G003_020
Clark Fork River, Warm Springs Creek to Cottonwood Creek [CFR01]	MT76G001_040
Clark Fork River, Cottonwood Creek to Little Blackfoot River [CFR02]	MT76G001_030
Clark Fork River, Little Blackfoot River to Flint Creek [CFR03]	MT76G001_010
Clark Fork River, Flint Creek to Blackfoot River [CFR04]	MT76E001_010
Clark Fork River, Blackfoot River to Rattlesnake Creek [CFR05]	MT76M001_030
Clark Fork River, Rattlesnake Creek to Fish Creek [CFR06]	MT76M001_020
Clark Fork River, Fish Creek to Flathead River [CFR07]	MT76M001_010
Clark Fork River, Flathead River to Noxon Reservoir [CFR08]	MT76N001_010

DEQ recently assessed metals impairments to these waterbodies to provide updated assessments for the 2014 IR and to inform TMDL development. These metals impairments are detailed in **Table 1-1**. This table also identifies those metals impairment causes that were identified on the 2012 303(d) List but that DEQ has concluded do not cause impairment based on the updated assessments. The designated use support status of impaired segments is presented in **Table 3-1**. The results of these assessments are summarized below in **Section 5.4**.

5.3 Water Quality Data and Information Sources

The water quality data used in this report were obtained from the U.S. Environmental Protection Agency (EPA) STOrage and RETrieval database (STORET) and from DEQ Remediation Division summary reports. Data provided by STORET come from sampling by USGS, EPA, Tri-State Water Quality Council, TREC (an Atlantic Richfield contractor), and DEQ.

Silver Bow Creek and the Clark Fork River have been intensely sampled and studied over several decades. A thorough review of all the available water quality data is beyond the scope of this document. The water quality data review is limited to the most recent 10 years, with particular attention to the most recent samples, due to the ongoing remediation. This is in accordance with DEQ's data quality objectives (DQO) guidance (discussed further in **Section 5.7**) which specifies that the data used for impairment assessment and target evaluation are no older than 10 years.

The water metals data used for analysis in this report are available electronically from DEQ upon request. Data summaries of relevant water quality parameters for each metals-impaired waterbody segment are provided in **Section 5.4**.

5.4 Water Quality Targets and Comparison to Existing Conditions

TMDL plans must include numeric water quality criteria or *targets* that represent a condition that meets Montana's ambient water quality standards. DEQ compiled the water quality data described in **Section 5.3** 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 5.4.1** presents the evaluation framework, **Section 5.4.2** presents the metals water quality targets used in the evaluation, and **Section 5.4.3** presents the results of these evaluations for each impaired waterbody. A summary is provided in **Section 5.4.4**.

5.4.1 Metals Evaluation Framework

The metals evaluation process includes three main steps:

1. Identify and evaluate all metals sources. Metals sources may be both natural background and anthropogenic (i.e., human-caused). TMDLs are developed for waterbodies that do not meet standards, at least in part, due to anthropogenic sources. The anthropogenic nature of metals sources in these two waterbodies was understood well in advance of this TMDL project.
2. Develop numeric water quality targets that represent unimpaired water quality (**Section 4.1**). 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. Compare existing water quality to the 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 demonstrate no impairment, the waterbody – cause combination will be removed from the 303(d) list.

Using the method outlined above, DEQ's Monitoring & Assessment Section re-assessed metals impairments in Silver Bow Creek and the Clark Fork River in 2013. This work was done both to support TMDL development and to update the assessments for the 2014 IR. The water quality assessment of these stream segments was done in accordance with DEQ's guidance (Drygas, 2012).

5.4.2 Metals Water Quality Targets

The water chemistry targets are based on numeric HHSs and both chronic and acute aquatic life standards as defined in DEQ Circular DEQ-7. Most metals pollutants have numeric water quality criteria defined in DEQ Circular DEQ-7 (Montana Department of Environmental Quality, 2012a). 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 protective application of these criteria to the designated uses is adopted as the water quality target.

Silver Bow Creek is an I-classified stream. The goal of the State of Montana is for I-classified waterbodies to support all uses (**Section 3.1**). As a result, the water quality targets for Silver Bow Creek are the same as for a B-classified stream, which supports both aquatic life and drinking water uses. The Silver Bow Creek drainage is also the subject of ongoing CERCLA cleanup actions. CERCLA includes procedures that can affect the standards applied to the CERCLA actions. For example, a technical impracticability (TI) waiver might be established based on site-specific conditions to waive certain water quality standards for the CERCLA component if meeting the specific water quality standards is not technically feasible for the CERCLA actions. However, at this time, no TI waivers are in place for Silver Bow Creek, and all water quality targets for Silver Bow Creek are the water quality standards as defined within DEQ-7.

The Record of Decision (ROD) for the Mainstem OU of the Milltown Reservoir/Clark Fork River Superfund Site (U.S. Environmental Protection Agency, 2004) includes a TI waiver for copper. The Montana standard, which at the time included a chronic aquatic life criteria of 12 µg/L at 100 mg/L hardness (total recoverable fraction), was waived and replaced with the Federal Water Quality Criteria of 9 µg/L at 100 mg/L hardness (dissolved fraction). However, when translated according to EPA guidance (U.S. Environmental Protection Agency, 1996) 9 µg/L (dissolved) is essentially the same as the current DEQ-7 water quality criteria for copper (9.33 µg/L at 100 mg/L hardness, total recoverable fraction). Therefore, DEQ-7 standards for copper are retained as targets for the segments of the Clark Fork River included within the Mainstem OU.

The two segments of the Clark Fork River above the mouth of the Little Blackfoot River (AUs MT76G001_040 and MT76G001_030) are C-1 and C-2 classified waterbodies. These segments therefore do not have drinking water uses (**Section 3.1**). The human health criteria are not applicable to these segments and the chronic aquatic life criteria are applied as the targets.

The evaluation process summarized below is derived from DEQ's Monitoring and Assessment program guidance for metals assessment methods (Drygas, 2012).

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

- If both the acute and chronic aquatic life target exceedance rates are equal to or less than 10%, then the waterbody is considered not impaired for that pollutant. A minimum eight samples are required, and samples must represent both high and low flow conditions.
- There are two exceptions to the 10% aquatic life target exceedance rate rule: (a) if a single sample exceeds the acute aquatic life criteria 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.

Metals water quality criteria for Silver Bow Creek and the Clark Fork River are presented below in **Table 5-2**. The aquatic life criteria for most metals are dependent upon water hardness values, usually increasing as the hardness increases. **Table 5-2** shows water quality criteria (acute and chronic aquatic life, human health) for each parameter of concern at representative water hardness values of 50 mg/L and 200 mg/L. The criteria are expressed in micrograms per liter (µg/L), which are equivalent to parts per billion. Acute and chronic toxicity aquatic life criteria are intended to protect aquatic life uses, while the HHS is intended to protect drinking water uses. Note that the chronic and acute aquatic life criteria for zinc are identical, and there is only a chronic aquatic life criterion for iron.

The water quality targets are chosen from the criteria in **Table 5-2** as discussed above. The most protective applicable criteria are the basis for the target. For example, for waterbodies that have a designated drinking water use, the human health criterion of 10 µg/L is the arsenic target. For waterbodies that do not have a designated drinking water use, such as the Clark Fork River above the Little Blackfoot River, the chronic aquatic life criterion of 150 µg/L is the arsenic target.

Table 5-2. Metals Numeric Water Criteria Applicable to Silver Bow Creek and the Clark Fork River

Metal of Concern and Symbol (Total Recoverable Fraction)	Aquatic Life Criteria (µg/L) at 50 mg/L Hardness		Aquatic Life Criteria (µg/L) at 200 mg/L Hardness		Human Health Criteria (µg/L)
	Acute	Chronic	Acute	Chronic	
Arsenic (As)*	340	150	340	150	10
Cadmium (Cd)	1.05	0.16	4.32	0.45	5
Copper (Cu)	7.29	5.16	26.9	16.87	1,300
Iron (Fe)*	N/A	1,000	N/A	1,000	N/A
Lead (Pb)	33.78	1.32	197.31	7.69	15
Mercury (Hg)*	1.70	0.91	1.70	0.91	0.05
Zinc (Zn)	66.6	66.6	215.57	215.57	2,000

*Aquatic life criteria are not hardness-dependent

5.4.3 Existing Conditions and Comparison with Water Quality Targets

For each waterbody segment to be included in the 2014 IR for metals (**Table A-1**), DEQ evaluates recent water chemistry data relative to the water quality targets to make a TMDL development determination. DEQ has recently completed several years of water sampling in Silver Bow Creek and the Clark Fork River for the purpose of reassessing the metals impairment determinations. These data, in conjunction with water quality data collected by other programs and government agencies within the last ten years provide the basis for the metals target evaluations below.

The current conditions are not static and remediation is resulting in water quality improvement that is evident within the 10-year timeframe used by DEQ. This improvement has been recently documented by the USGS (Sando et al., 2014). Large scale remediation has been ongoing for decades, and will continue into the future. As a result, the 10-year summary statistics used to describe the degree of impairment are likely to be slightly elevated relative to current conditions. This provides an additional MOS (discussed further in **Section 5.7.2**).

As one component of the remediation, Milltown Dam was breached on March 28, 2008. DEQ's Monitoring and Assessment staff excluded the 2008 high flow water chemistry data from the assessment of the three downstream segments. However, the drawdown process began several years earlier and the USGS (Lambing and Sando, 2009; Sando and Lambing, 2011; Sando et al., 2014) identified an increase in metals concentrations spanning two years prior to and two following the breach. This increase is attributable to the dam removal. Completely excluding data from this period is not feasible, so DEQ recognizes that the sample set of metals concentrations below the former reservoir may be moderately elevated. This is incorporated into the MOS (**Section 5.7.2**).

5.4.3.1 Silver Bow Creek (MT76G003_020)

Silver Bow Creek is included in the 2012 IR with impairments due to metals: aluminum, arsenic, copper, iron, lead, manganese, silver, and zinc. Following more recent data compilation, collection and analysis, DEQ determined that arsenic, cadmium, copper, lead, mercury, and zinc contribute to impairment of this waterbody. TMDLs for these impairment causes are provided in this document. DEQ determined that all targets were satisfied for aluminum, iron, manganese, and silver, therefore no TMDLs are developed for these metals. The 2014 IR will include the updated assessment results for Silver Bow Creek.

Available Water Quality Data

Data used were collected at numerous sample locations by several agencies (DEQ, USGS, Tri-State Water Quality Council) and by TREC, a contractor for Atlantic Richfield, between 2003 and 2012. A subset (Silver Bow Creek at Opportunity) of the data for Silver Bow Creek is plotted below in **Figure 5-1**. This is provided to help illustrate the magnitude and seasonality of target exceedances.

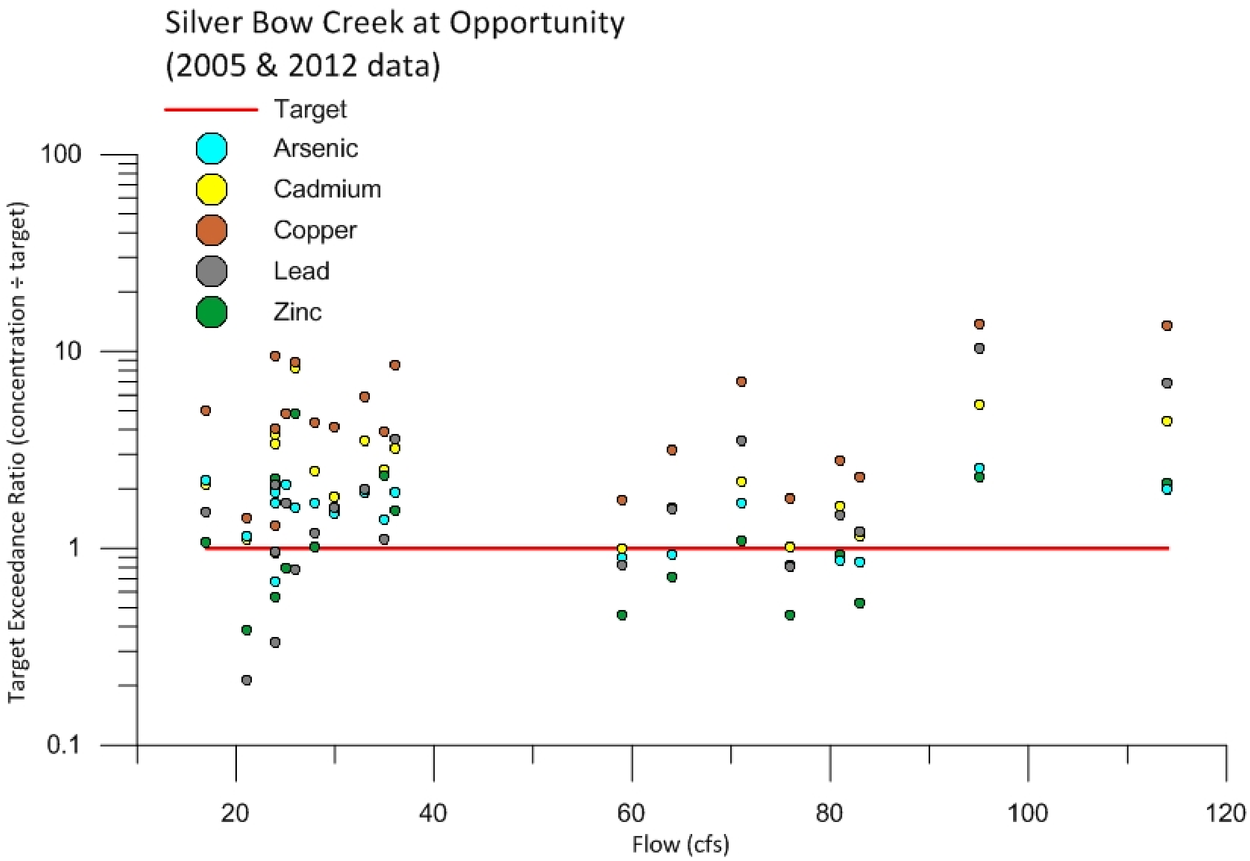

Figure 5-1. Metals Concentrations Relative to Targets at Silver Bow Creek at Opportunity (2005 and 2012)

This figure shows that target exceedances occur throughout the year, under both high and low flow conditions. A similar figure, plotting only the 2012 water quality data (**Figure 5-2**) demonstrates the success of remediation in Silver Bow Creek and in Butte. Low flow water quality is much closer to meeting targets, although exceedances are still common under high flow conditions. Copper consistently exceeds targets by the greatest degree.

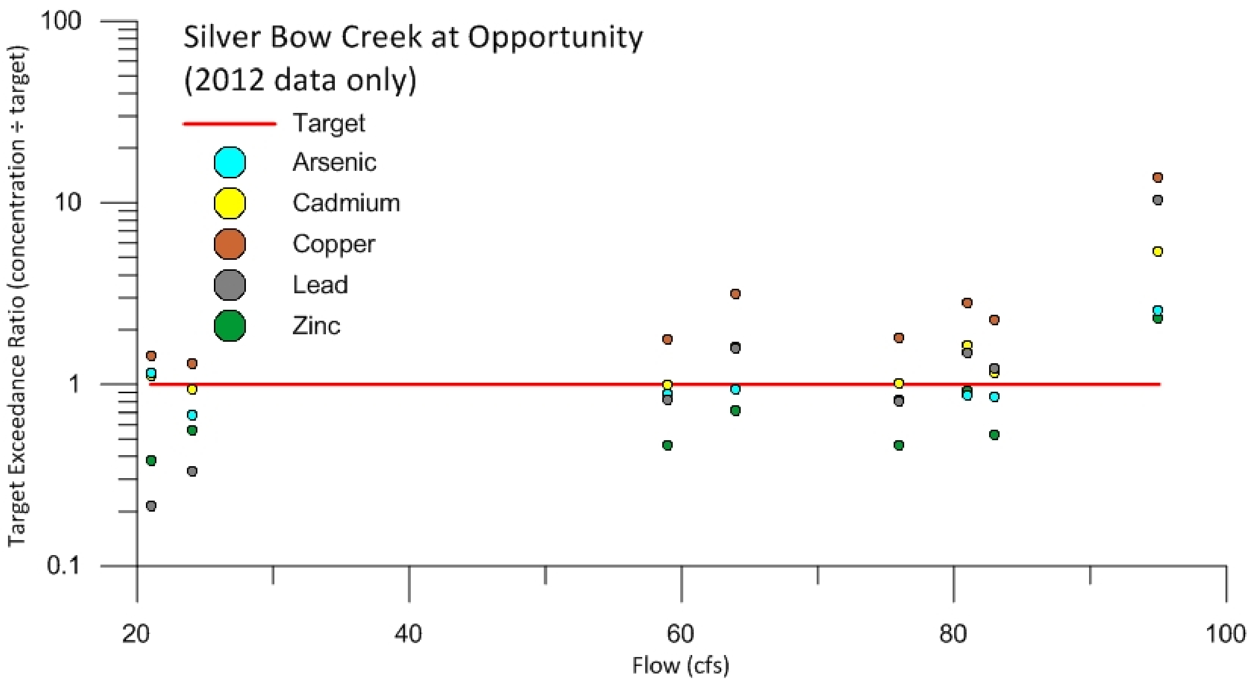

Figure 5-2. Metals Concentrations Relative to Targets at Silver Bow Creek at Opportunity (2012)

The water sample results are compared to water chemistry targets in **Table 5-3** for those metals that require TMDLs.

Table 5-3. Silver Bow Creek Metals Water Quality Data Summary and Target Exceedances

Parameter*	Arsenic	Cadmium	Copper	Lead	Mercury	Zinc
# Samples	202	202	202	202	132	202
Minimum concentration (µg/L)	3.0	0.03	2.4	0.15	0.01	2.0
Maximum concentration (µg/L)	49.5	4.1	192.0	59.5	0.2	1,150
# Acute exceedances	0	0	66	0	0	28
Acute exceedance rate	0%	0%	33%	0%	0%	14%
# Chronic exceedances	0	38	109	29	0	28
Chronic exceedance rate	0%	19%	54%	14%	0%	14%
# Human health exceedances	106	0	0	6	62	0
Human health exceedance rate	52%	0%	0%	3%	47%	0%

*Total recoverable fraction

Comparison of Metals Concentrations to Water Quality Targets and TMDL Determination
Each pollutant is discussed individually. The discussions are summarized below in **Table 5-4**.

Aluminum
Silver Bow Creek is listed as impaired by aluminum in the 2012 IR. Recent data from sampling conducted in 2012 shows no target exceedances. Because no aluminum targets were exceeded, no TMDL is developed and DEQ will remove aluminum as a cause of impairment to Silver Bow Creek.

Arsenic
Silver Bow Creek is listed as impaired by arsenic in the 2012 IR. Analysis of recent water quality data (2003–2012) established a human health target exceedance rate of 52%. Therefore, arsenic remains a cause of impairment and a TMDL is developed for Silver Bow Creek.

Cadmium
Silver Bow Creek is not listed as impaired by cadmium in the 2012 IR. Analysis of recent water quality data (2003–2012) established a chronic aquatic life target exceedance rate of 19%. Therefore, cadmium is a cause of impairment and a TMDL is developed for Silver Bow Creek.

Copper
Silver Bow Creek is listed as impaired by copper in the 2012 IR. Analysis of recent water quality data (2003–2012) established a chronic aquatic life target exceedance rate of 54% and an acute aquatic life target exceedance rate of 33%. The acute aquatic life target is exceeded by greater than a factor of two in multiple samples. Therefore, copper remains a cause of impairment and a TMDL is developed for Silver Bow Creek.

Iron
Silver Bow Creek is listed as impaired by iron in the 2012 IR. Analysis of recent water quality data (2003–2012) established a chronic aquatic life target exceedance rate of 6%. Therefore, iron is determined not to be a cause of impairment and a TMDL is not developed.

Lead
Silver Bow Creek is listed as impaired by lead in the 2012 IR. Analysis of recent water quality data (2003–2012) established a chronic aquatic life target exceedance rate of 14% and a human health target exceedance rate of 3%. Therefore, lead remains a cause of impairment and a TMDL is developed for Silver Bow Creek.

Manganese
Silver Bow Creek is listed as impaired by manganese in the 2012 IR. There are no aquatic life criteria, sediment Probable Effects Levels, or a human health criterion for manganese. Therefore, manganese is determined not to be a cause of impairment to Silver Bow Creek. DEQ will remove manganese as a cause of impairment to Silver Bow Creek and no manganese TMDL will be developed.

Mercury
Silver Bow Creek is not listed for impairment due to mercury in the 2012 IR. However, mercury is an identified contaminant of concern in the Butte Area / Silver Bow Creek Superfund Site's ROD. Therefore, DEQ assessed Silver Bow Creek for mercury impairment using recent (2005–2012) data. Mercury concentrations do not exceed chronic or acute aquatic life targets. However, the human health target is exceeded in 47% of the samples. Therefore, mercury is determined to be a cause of impairment to Silver Bow Creek and a TMDL is developed.

Silver

Silver Bow Creek is listed as impaired by silver in the 2012 IR. Recent data from sampling conducted in 2012 shows no target exceedances. Because no silver targets were exceeded, no TMDL is developed and DEQ will remove silver as a cause of impairment to Silver Bow Creek.

Zinc

Silver Bow Creek is listed as impaired by zinc in the 2012 IR. Analysis of recent water quality data (2003–2012) determined that there is a 14% exceedance rate of the chronic (and acute) aquatic life target, and the acute target is exceeded by greater than a factor of two in multiple samples. Therefore, zinc remains a cause of impairment and a TMDL is developed for Silver Bow Creek.

Silver Bow Creek TMDL Development Summary

As discussed above and summarized in **Table 5-4**, arsenic, cadmium, copper, lead, mercury, and zinc TMDLs are developed for Silver Bow Creek. Mercury is a new impairment. DEQ has concluded that all other metals causes of impairment from the 2012 303(d) List (aluminum, iron, manganese, and silver) are no longer contributing to impairment on Silver Bow Creek. This information is documented within DEQ's assessment files and will be included in the 2014 IR.

Table 5-4. Silver Bow Creek Metals TMDL Decision Factors

Parameter	Arsenic	Cadmium	Copper	Lead	Mercury	Zinc
Number of Samples	202	202	202	202	132	202
Chronic aquatic life target exceedance rate >10%?	No	Yes	Yes	Yes	No	Yes
Acute aquatic life target exceeded by >2x?	No	No	Yes	No	No	Yes
Human health target exceeded?	Yes	No	No	Yes	Yes	No
Human-caused sources present?	Yes	Yes	Yes	Yes	Yes	Yes
TMDL developed?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

5.4.3.2 Clark Fork River: Warm Springs Creeks to Cottonwood Creek (MT76G001_040)

This segment of the Clark Fork River is in the 2012 IR as impaired by metals: arsenic, cadmium, copper, and lead. More recent data compilation, collection and analysis demonstrated the need for cadmium, copper, iron, and lead TMDLs. The 2014 IR will report these metals impairment causes for this segment of the Clark Fork River.

Available Water Quality Data

Metals water quality data were used to compare current conditions to water quality targets. Data used were collected at several sample locations by several agencies (DEQ, USGS, Tri-State Water Quality Council) between 2003 and 2013. Data collected from this segment of the Clark Fork River is compared to water chemistry targets in **Table 5-5**.

Table 5-5. Clark Fork River MT76G001_040 Metals Water Quality Data Summary and Target Exceedances

Parameter*	Cadmium	Copper	Iron	Lead
# Samples	201	201	178	202
Minimum concentration (µg/L)	0.02	4	40	0.33
Maximum concentration (µg/L)	2.06	468	6,960	61.7
# Acute exceedances	0	82	N/A	0
Acute exceedance rate	0%	41%	N/A	0%
# Chronic exceedances	21	115	29	49
Chronic exceedance rate	10%	57%	16%	24%

*Total recoverable fraction

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>Arsenic</u>
The segment of the Clark Fork River from the confluence of Silver Bow and Warm Springs creeks to Cottonwood Creek is listed as impaired by arsenic in the 2012 IR. Arsenic levels exceed the human health criterion of 10 µg/L. However, this segment of the Clark Fork River is classified C-2 and therefore does not have a drinking water use. Arsenic levels do not exceed the chronic aquatic life target. Therefore no arsenic TMDL is prepared for this segment, and arsenic will be removed as a cause of impairment.

<u>Cadmium</u>
The segment of the Clark Fork River from Warm Springs creeks to Cottonwood Creek is listed as impaired by cadmium in the 2012 IR. Analysis of recent water quality data (2003–2012) established a chronic aquatic life target exceedance slightly exceeding 10%. Therefore, cadmium remains a cause of impairment and a TMDL is developed for this segment of the Clark Fork River.

<u>Copper</u>
The segment of the Clark Fork River from Warm Springs creeks to Cottonwood Creek is listed as impaired by copper in the 2012 IR. Analysis of recent water quality data (2003–2012) established a chronic aquatic life target exceedance rate of 57%, and the acute aquatic life target is exceeded by greater than a factor of two in multiple samples. Therefore, copper remains a cause of impairment and a TMDL is developed for this segment of the Clark Fork River.

<u>Iron</u>
Iron is not an identified cause of impairment to the Clark Fork River segment from Warm Springs creeks to Cottonwood Creek in the 2012 IR. However, analysis of recent water quality data (2003–2012) established a chronic aquatic life target exceedance rate of 16%. Therefore, DEQ determined that iron is an impairment cause and will be included in the 2014 IR. An iron TMDL is developed for this segment of the Clark Fork River.

<u>Lead</u>
The segment of the Clark Fork River from Warm Springs creeks to Cottonwood Creek is listed as impaired by lead in the 2012 IR. Analysis of recent water quality data (2003–2012) established a chronic aquatic life target exceedance rate of 24%. Therefore, lead remains a cause of impairment and a TMDL is developed for this segment of the Clark Fork River.

Clark Fork River TMDL Development Summary

As discussed above and summarized in **Table 5-6**, cadmium, copper, iron and lead TMDLs are developed for this segment of the Clark Fork River. Arsenic and mercury concentrations do exceed the human health criteria, but do not exceed the chronic aquatic life targets. Since drinking water is not a designated use for this segment, the chronic aquatic life standards are the relevant targets. Therefore, DEQ concluded that arsenic is no longer a cause of impairment to this segment of the Clark Fork River and that mercury is not a cause of impairment. Nevertheless, loading from within this segment is accounted for in downstream TMDLs. DEQ also assessed this segment for zinc impairment. Zinc concentrations exceeded the chronic aquatic life target in only 3% of the samples, and DEQ concluded that zinc is not a cause of impairment for this segment. This information, also summarized in **Table 5-6**, is documented within DEQ's assessment files and will be included in the 2014 IR.

Table 5-6. Clark Fork River MT76G001_040 Metals TMDL Decision Factors

Parameter	Cadmium	Copper	Iron	Lead
Number of Samples	201	201	178	202
Chronic aquatic life target exceedance rate >10%?	Yes	Yes	Yes	Yes
Acute aquatic life target exceeded by >2x?	No	Yes	N/A	No
TMDL developed?	**Yes**	**Yes**	**Yes**	**Yes**

5.4.3.3. Clark Fork River from Cottonwood Creek to the Little Blackfoot River (MT76G001_030)

This segment of the Clark Fork River is in the 2012 IR as impaired by metals: copper, lead, and zinc. More recent data compilation, collection and analysis demonstrate the need for cadmium, copper, iron, lead, and zinc TMDLs. The 2014 IR will report these metals impairment causes for this segment of the Clark Fork River.

Available Water Quality Data

Metals water quality data were used to compare current conditions to water quality targets. Data used were collected at several sample locations by several agencies (DEQ, USGS, Tri-State Water Quality Council) between 2005 and 2012. A subset (Clark Fork River above the Little Blackfoot River) of the data for this segment is plotted below in **Figure 5-3**. This is provided to help illustrate the magnitude and seasonality of target exceedances.

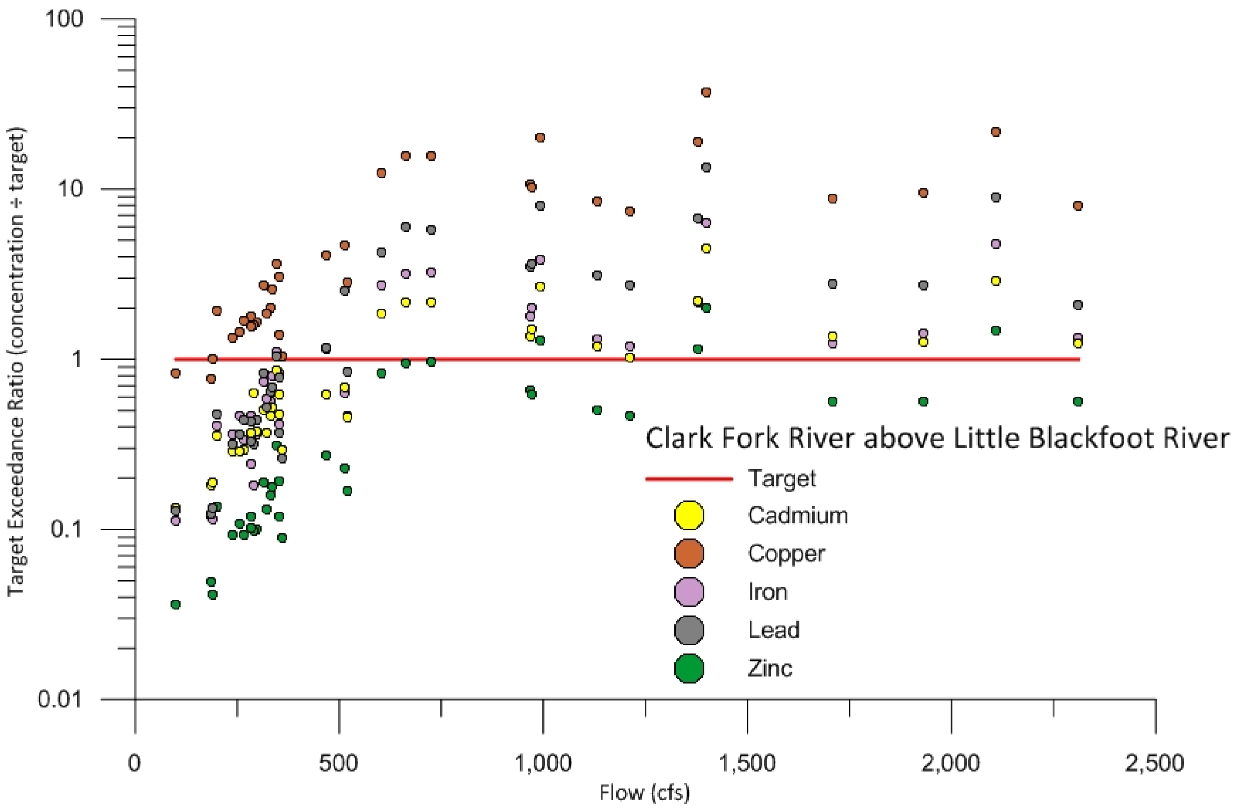

Figure 5-3. Metals Concentrations Relative to Targets above the Little Blackfoot River

All metals impairments for this segment of the Clark Fork River require greater reductions during high flow than during low flow, as shown above in **Figure 5-3**. The targets for cadmium, iron, lead, and zinc are generally met during low flow conditions. Copper consistently exceeds the target by the greatest degree throughout the year, and requires reductions of up to 93% during high flow.

Data collected from this segment of the Clark Fork River are compared to water chemistry targets in **Table 5-7**.

Table 5-7. Clark Fork River MT76G001_030 Metals Water Quality Data Summary and Target Exceedances

Parameter*	Cadmium	Copper	Iron	Lead	Zinc
# Samples	56	56	44	56	56
Minimum concentration (µg/L)	0.061	10.0	80	0.6	4.7
Maximum concentration (µg/L)	1.510	448.0	6,360	63.0	311.0
# Acute exceedances	0	33	N/A	0	6
Acute exceedance rate	0%	59%	N/A	0%	11%
# Chronic exceedances	17	42	18	21	6
Chronic exceedance rate	30%	75%	41%	38%	11%

*total recoverable fraction

Comparison of Metals Concentrations to Water Quality Targets and TMDL Determination
Each pollutant is discussed individually. The discussions are summarized below in **Table 5-8**.

Arsenic
The Clark Fork River from Cottonwood Creek to the Little Blackfoot River was not listed as impaired by arsenic in the 2012 IR. Analysis of recent water quality data (2005–2012) demonstrates that arsenic concentrations exceed the human health criterion. However, this segment is classified C-1 and therefore drinking water is not a designated use. Arsenic levels do not exceed the aquatic life target. Therefore, DEQ determined that this segment of the Clark Fork River is not impaired by arsenic, and no arsenic TMDL is developed.

Cadmium
The Clark Fork River from Cottonwood Creek to the Little Blackfoot River was not listed as impaired by cadmium in the 2012 IR. However, analysis of recent water quality data (2005–2012) demonstrates a chronic aquatic life target exceedance rate of 30%. Therefore, DEQ determined that this segment of the Clark Fork River is impaired by cadmium, and this impairment cause will be added for the 2014 reporting cycle. A cadmium TMDL is developed for this segment of the Clark Fork River.

Copper
The Clark Fork River from Cottonwood Creek to the Little Blackfoot River is listed as impaired by copper in the 2012 IR. Analysis of recent water quality data (2005–2012) established an acute aquatic life target exceedance rate of 59% and a chronic aquatic life target exceedance rate of 75%. The acute aquatic life target is exceeded by greater than a factor of two. Therefore, copper remains a cause of impairment and a copper TMDL is developed for this segment of the Clark Fork River.

Iron
The Clark Fork River from Cottonwood Creek to the Little Blackfoot River was not listed as impaired by iron in the 2012 IR. However, analysis of recent water quality data (2005–2012) demonstrates a chronic aquatic life target exceedance rate of 41%. Therefore, DEQ determined that this segment of the Clark Fork River is impaired by iron, and this impairment cause will be added for the 2014 reporting cycle. An iron TMDL is developed for this segment of the Clark Fork River.

Lead
The Clark Fork River from Cottonwood Creek to the Little Blackfoot River is listed as impaired by lead in the 2012 IR. Analysis of recent water quality data (2005–2012) established that lead concentrations would exceed the human health criterion; however drinking water is not a designated use for this segment of the Clark Fork River. The chronic aquatic life target exceedance rate is 38%. Therefore, lead remains a cause of impairment and a lead TMDL is developed for this segment of the Clark Fork River.

Zinc
The Clark Fork River from Cottonwood Creek to the Little Blackfoot River is listed as impaired by zinc in the 2012 IR. Analysis of recent water quality data (2005–2012) established an acute and chronic aquatic life target exceedance rate of 11%. Therefore, zinc remains a cause of impairment and a zinc TMDL is developed for this segment of the Clark Fork River.

Clark Fork River MT76G001_030 TMDL Development Summary
As discussed above and summarized in **Table 5-8**, cadmium, copper, iron, lead and zinc TMDLs are developed for the Clark Fork River between Cottonwood Creek and the Little Blackfoot River.

Table 5-8. Clark Fork River MT76G001_030 Metals TMDL Decision Factors

Parameter	Cadmium	Copper	Iron	Lead	Zinc
Number of Samples	56	56	44	56	56
Chronic aquatic life target exceedance rate >10%?	Yes	Yes	Yes	Yes	Yes
Acute aquatic life target exceeded by >2x?	No	Yes	N/A	No	No
TMDL developed?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

5.4.3.4. Clark Fork River from the Little Blackfoot River to Flint Creek (MT76G001_010)

This segment of the Clark Fork River is in the 2012 IR as impaired by metals: arsenic, copper, lead, and zinc. More recent data compilation, collection and analysis demonstrate the need for arsenic, cadmium, copper, iron, lead, and mercury TMDLs. The 2014 IR will included these updated metals impairment causes for this segment of the Clark Fork River.

Available Water Quality Data

Metals water quality data were used to compare current conditions to water quality targets. Data used were collected from multiple sample locations by several agencies (DEQ, USGS, Tri-State Water Quality Council) between 2003 and 2013. Data collected from this segment of the Clark Fork River is compared to metals chemistry targets in **Table 5-9**.

Table 5-9. Clark Fork River MT76G001_010 Metals Water Quality Data Summary and Target Exceedances

Parameter*	Arsenic	Cadmium	Copper	Iron	Lead	Mercury
# Samples	102	102	102	89	102	4
Minimum concentration (µg/L)	7.8	<0.08	5.4	33	0.1	<0.01
Maximum concentration (µg/L)	29.0	0.8	152.0	3,030	21.0	0.15
# Acute exceedances	0	0	43	N/A	0	0
Acute exceedance rate	0%	0%	42%	N/A	0%	0%
# Chronic exceedances	0	15	53	23	28	0
Chronic exceedance rate	0%	15%	52%	26%	27%	0%
# Human health exceedances	73	0	0	N/A	6	1
Human health exceedance rate	72%	0%	0%	N/A	6%	25%

* total recoverable fraction, except for mercury (total)

Comparison of Metals Concentrations to Water Quality Targets and TMDL Determination

Each pollutant is discussed individually. The discussions are summarized below in **Table 5-10**.

<u>Arsenic</u>

The Clark Fork River from the Little Blackfoot River to Flint Creek is listed as impaired by arsenic in the 2012 IR. Water chemistry data from recent sampling (2003–2012) demonstrate that arsenic concentrations in this segment of the Clark Fork River exceed the human health target in over half the samples. Therefore, arsenic remains a cause of impairment to AU MT76G001_010, and an arsenic TMDL is developed for this segment of the Clark Fork River.

<u>Cadmium</u>

The Clark Fork River from the Little Blackfoot River to Flint Creek was not listed as impaired by cadmium in the 2012 IR. However, analysis of recent water quality data (2003–2012) demonstrates a chronic aquatic life target exceedance rate of 15%. Therefore, DEQ determined that this segment of the Clark

Fork River is impaired by cadmium, and this impairment cause will be added for the 2014 reporting cycle. A cadmium TMDL is developed for this segment of the Clark Fork River.

Copper

The Clark Fork River from the Little Blackfoot River to Flint Creek is listed as impaired by copper in the 2012 IR. Water chemistry data from recent sampling (2003–2012) demonstrate that copper concentrations in this segment of the Clark Fork River exceed the acute aquatic life target in 42% of the samples and exceed the chronic aquatic life target in 52% of the samples. The acute aquatic life target is exceeded by greater than a factor of two in multiple samples. Therefore, copper remains a cause of impairment, and a copper TMDL is developed for this segment of the Clark Fork River.

Iron

The Clark Fork River from the Little Blackfoot River to Flint Creek was not listed as impaired by iron in the 2012 IR. However, analysis of recent water quality data (2003–2012) demonstrates a chronic aquatic life target exceedance rate of 26%. Therefore, DEQ determined that this segment of the Clark Fork River is impaired by iron, and this impairment cause will be added for the 2014 reporting cycle. An iron TMDL is developed for this segment of the Clark Fork River.

Lead

The Clark Fork River from the Little Blackfoot River to Flint Creek is listed as impaired by lead in the 2012 IR. Water chemistry data from recent sampling (2003–2012) demonstrate that lead concentrations in this segment of the Clark Fork River exceed the chronic aquatic life target in 27% of the samples and exceed the human health target in 6% of the samples. Therefore, lead remains a cause of impairment to AU MT76G001_010, and a lead TMDL is developed for this segment of the Clark Fork River.

Mercury

The Clark Fork River from the Little Blackfoot River to Flint Creek was not listed as impaired by mercury in the 2012 IR. However, analysis of recent water quality data (2012–2013) shows a human health target exceedance. Therefore, DEQ determined that this segment of the Clark Fork River is impaired by mercury, and this impairment cause will be added for the 2014 reporting cycle. A mercury TMDL is developed for this segment of the Clark Fork River.

Zinc

The Clark Fork River from the Little Blackfoot River to Flint Creek is listed as impaired by zinc in the 2012 IR. Water chemistry data from recent sampling (2003–2012) demonstrate that zinc concentrations in this segment of the Clark Fork River do not exceed the chronic or acute aquatic life target. Therefore, zinc will be removed as a cause of impairment to this AU, and a zinc TMDL is not developed.

Clark Fork River MT76G001_010 TMDL Development Summary

As discussed above, arsenic, cadmium, copper, iron, lead, and mercury are determined to be causes of impairment to this segment of the Clark Fork River, and TMDLs are developed for these causes. Zinc was determined not to cause impairment. This information, also summarized in **Table 5-10**, is documented within DEQ's assessment files and will be included in the 2014 IR.

Table 5-10. Clark Fork River MT76G001_010 Metals TMDL Decision Factors

Parameter	Arsenic	Cadmium	Copper	Iron	Lead	Mercury
Number of Samples	102	102	102	89	102	4
Chronic aquatic life target exceedance rate >10%?	No	Yes	Yes	Yes	Yes	No
Acute aquatic life target exceeded by >2x?	No	No	Yes	N/A	No	No
Human health target exceeded?	Yes	No	No	N/A	Yes	Yes
Human-caused sources present?	Yes	Yes	Yes	Yes	Yes	Yes
TMDL developed?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

5.4.3.5 Clark Fork River from Flint Creek to the Blackfoot River (MT76E001_010)

This segment of the Clark Fork River is listed in the 2012 IR as impaired by metals: arsenic, cadmium, copper, iron, lead, and zinc. More recent data compilation, collection and analysis demonstrate the need for arsenic, cadmium, copper, iron, lead, mercury, and zinc TMDLs. The 2014 IR will include these updated metals impairment causes for this segment of the Clark Fork River.

Available Water Quality Data

Metals water quality data were used to compare current conditions to water quality targets. Data used were collected from multiple sample locations by several agencies (DEQ, USGS, Tri-State Water Quality Council) between 2003 and 2012. A subset (Clark Fork River near Drummond) of the data for this segment is plotted below in **Figure 5-4**. This is provided to help illustrate the magnitude and seasonality of target exceedances.

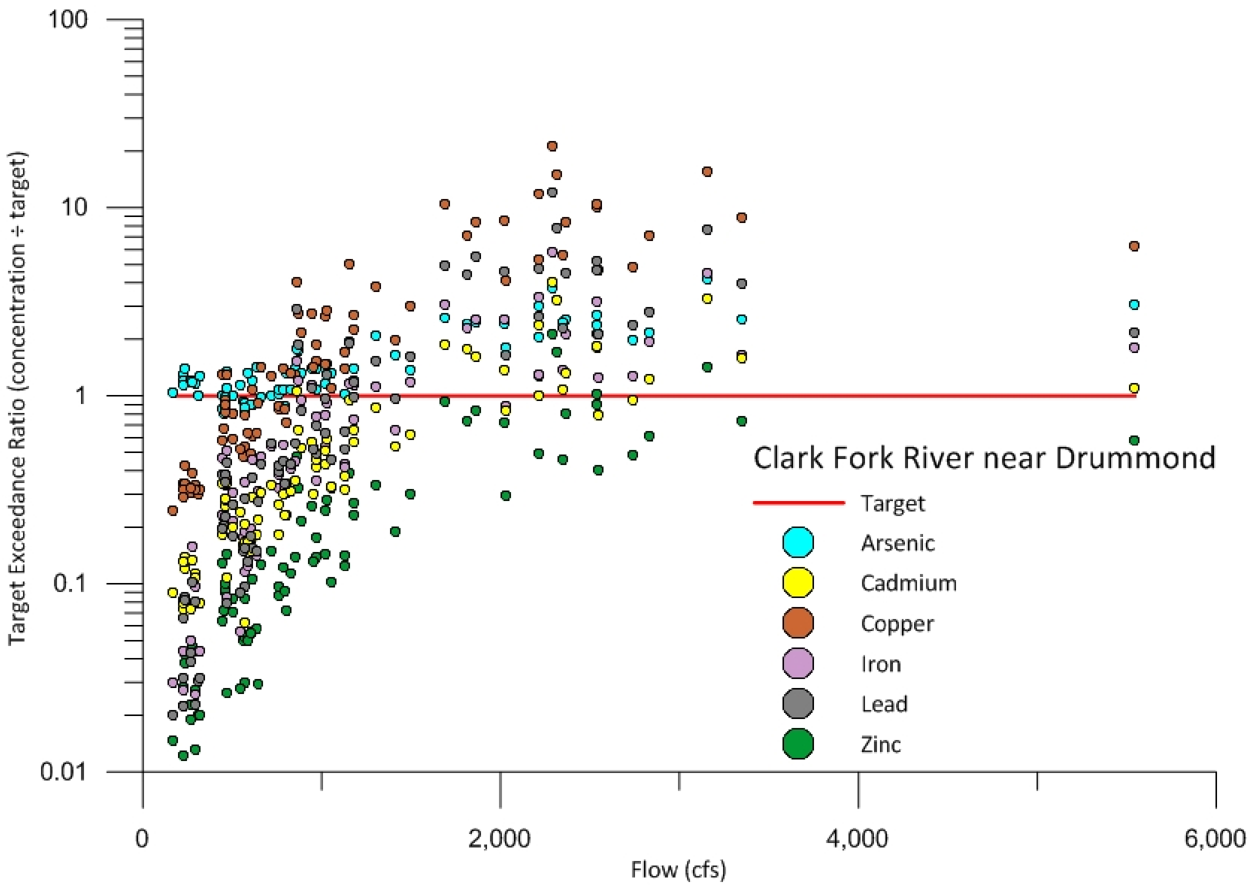

Figure 5-4. Metals Concentrations Relative to Targets near Drummond

All metals impairments for this segment of the Clark Fork River require greater reductions during high flow than during low flow, as shown above in **Figure 5-4**. The targets for cadmium, iron, lead, and zinc are generally met during low flow conditions. Copper consistently exceeds the target by the greatest degree throughout the year, and requires reductions of up to 92% during high flow. Arsenic exceeds targets throughout the year, although concentrations are closer to the target under low flow.

Data collected from this segment of the Clark Fork River is compared to metals chemistry targets in **Table 5-11**.

Table 5-11. Clark Fork River MT76E001_010 Metals Water Quality Data Summary and Target Exceedances

Parameter*	Arsenic	Cadmium	Copper	Iron	Lead	Mercury	Zinc
# Samples	304	303	303	279	303	8	303
Minimum concentration (µg/L)	3	<0.03	2.7	26.0	0.2	<0.1	2.9
Maximum concentration (µg/L)	98.5	10.8	1,120.0	24,800	183.0	0.12	3,290
# Acute exceedances	0	2	138	N/A	1	0	26
Acute exceedance rate	0%	1%	46%	N/A	0.3%	0%	9%
# Chronic exceedances	0	68	174	81	123	0	26
Chronic exceedance rate	0%	22%	57%	29%	41%	0%	9%
# Human health exceedances	35	1	0	N/A	22	1	1
Human health exceedance rate	12%	0.3%	0%	N/A	7%	12.5%	0.3%

*Total recoverable fraction, except for mercury (total)

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**.

Arsenic
The Clark Fork River from Flint Creek to the Blackfoot River is listed as impaired by arsenic in the 2012 IR. Water chemistry data from recent sampling (2003–2012) demonstrate that arsenic concentrations in this segment of the Clark Fork River exceed the human health target in 12% the samples. Therefore, arsenic remains a cause of impairment, and an arsenic TMDL is developed for this segment of the Clark Fork River.

Cadmium
The Clark Fork River from Flint Creek to the Blackfoot River is listed as impaired by cadmium in the 2012 IR. Water chemistry data from recent sampling (2003–2012) demonstrate that cadmium concentrations in this segment of the Clark Fork River exceed the chronic aquatic life target in 22% of the samples. The acute aquatic life target is exceeded by greater than a factor of two in one sample, and the human health target is exceeded in one sample. Therefore, cadmium remains a cause of impairment, and a cadmium TMDL is developed for this segment of the Clark Fork River.

Copper
The Clark Fork River from Flint Creek to the Blackfoot River is listed as impaired by copper in the 2012 IR. Water chemistry data from recent sampling (2003–2012) demonstrate that copper concentrations in this segment of the Clark Fork River exceed the chronic aquatic life target in 57% of the samples. The acute aquatic life target is exceeded by greater than a factor of two in multiple samples. Therefore, copper remains a cause of impairment, and a copper TMDL is developed for this segment of the Clark Fork River.

Iron
The Clark Fork River from Flint Creek to the Blackfoot River is listed as impaired by iron in the 2012 IR. Water chemistry data from recent sampling (2003–2012) demonstrate that iron concentrations in this segment of the Clark Fork River exceed the chronic aquatic life target in 29% of the samples. Therefore, iron remains a cause of impairment, and an iron TMDL is developed for this segment of the Clark Fork River.

Lead
The Clark Fork River from Flint Creek to the Blackfoot River is listed as impaired by lead in the 2012 IR. Water chemistry data from recent sampling (2003–2012) demonstrate that lead concentrations in this segment of the Clark Fork River exceed the chronic aquatic life target in 41% of the samples, and the human health target in 7%. The acute aquatic life target is exceeded by greater than a factor of two. Therefore, lead remains a cause of impairment, and a lead TMDL is developed for this segment of the Clark Fork River.

Mercury
The Clark Fork River from the Flint Creek to the Blackfoot River was not listed as impaired by mercury in the 2012 IR. However, analysis of recent water quality data (2012–2013) shows a human health target exceedance. Therefore, DEQ determined that this segment of the Clark Fork River is impaired by mercury, and this impairment cause will be added for the 2014 reporting cycle. A mercury TMDL is developed for this segment of the Clark Fork River.

<u>Zinc</u>
The Clark Fork River from Flint Creek to the Blackfoot River is listed as impaired by zinc in the 2012 IR. Water chemistry data from recent sampling (2003–2012) demonstrate that zinc concentrations in this segment of the Clark Fork River exceed the acute aquatic life target in 9% of the samples. However, the acute aquatic life target is exceeded by greater than a factor of two in multiple samples and the human health target is exceeded once. Therefore, zinc remains a cause of impairment, and a zinc TMDL is developed for this segment of the Clark Fork River.

Clark Fork River MT76E001_010 TMDL Development Summary
As discussed above and summarized in **Table 5-12**, arsenic, cadmium, copper, iron, lead, and zinc are determined to be causes of impairment to this segment of the Clark Fork River, and TMDLs are developed for these causes. This information, also summarized in **Table 5-12**, is documented within DEQ’s assessment files and will be included in the 2014 IR.

Table 5-12. Clark Fork River MT76E001_010 Metals TMDL Decision Factors

Parameter	Arsenic	Cadmium	Copper	Iron	Lead	Mercury	Zinc
Number of Samples	304	303	303	279	303	8	303
Chronic aquatic life target exceedance rate >10%?	No	Yes	Yes	Yes	Yes	No	No
Acute aquatic life target exceeded by >2x?	No	Yes	Yes	N/A	Yes	No	Yes
Human health target exceeded?	Yes	Yes	No	N/A	Yes	Yes	Yes
Human-caused sources present?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TMDL developed?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

5.4.3.6 Clark Fork River from the Blackfoot River to Rattlesnake Creek (MT76M001_030)
This segment of the Clark Fork River is listed in the 2012 IR as impaired by metals: copper and lead. Data compilation, collection and analysis demonstrate the need for arsenic, cadmium, copper, iron, lead, and zinc TMDLs. The 2014 IR will include these metals impairment causes for this segment of the Clark Fork River.

Available Water Quality Data
Metals water quality data were used to compare current conditions to water quality targets. Data used were collected from multiple sample locations by several agencies (DEQ, USGS, Tri-State Water Quality Council) between 2003 and 2012. A subset (from the USGS station above Missoula) of the data for this segment is plotted below in **Figure 5-5**. This is provided to help illustrate the magnitude and seasonality of target exceedances.

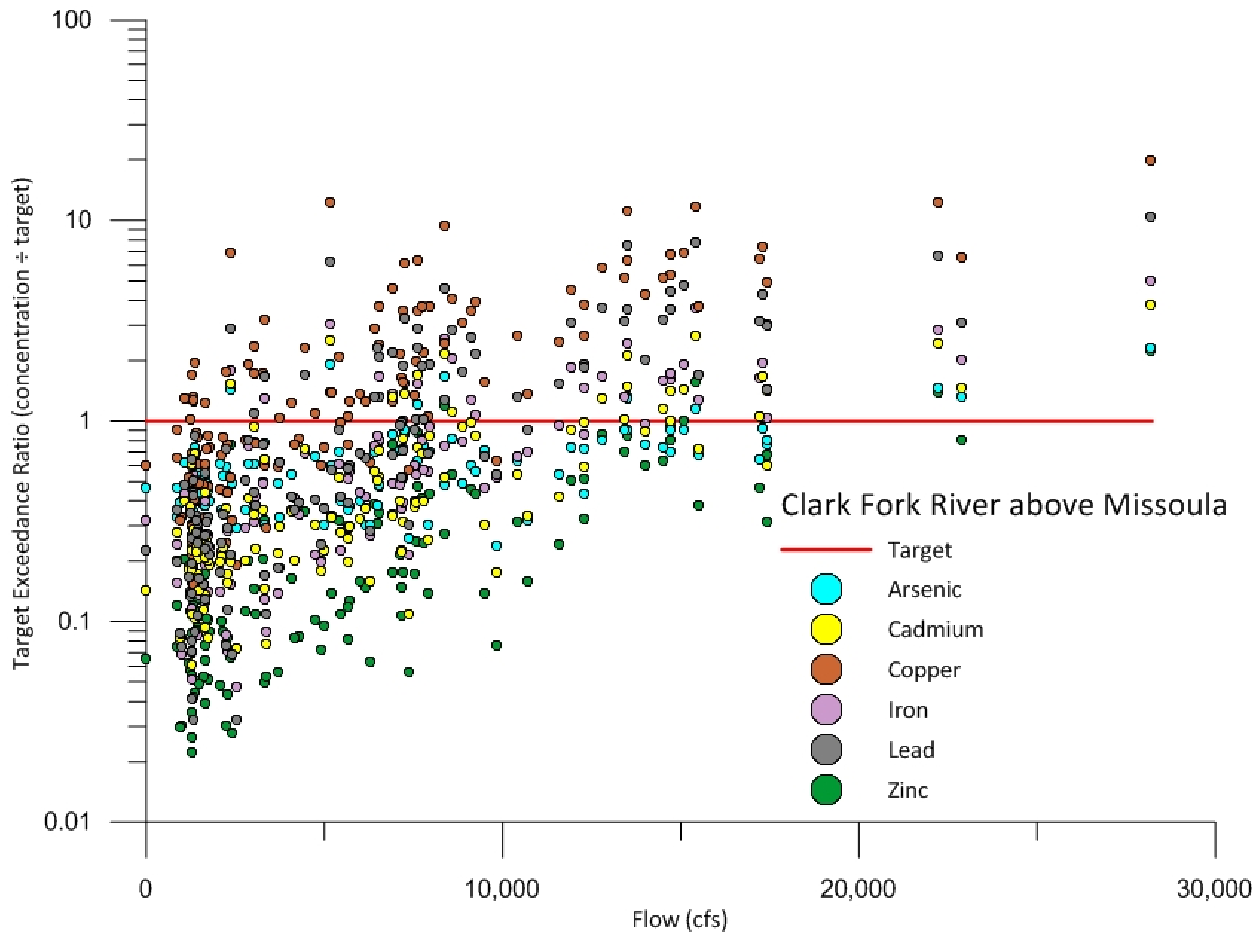

Figure 5-5. Metals Concentrations Relative to Targets above Missoula

All metals impairments for this segment of the Clark Fork River require greater reductions during high flow than during low flow, as shown above in **Figure 5-5**. The targets for cadmium, iron, lead, and zinc are generally met during low flow conditions. Copper consistently exceeds the target by the greatest degree throughout the year, and requires reductions of up to 91% during high flow. Arsenic concentrations are largely below the target, with occasional exceedances under all flow conditions.

Data collected from this segment of the Clark Fork River are compared to metals chemistry targets in **Table 5-13**.

Table 5-13. Clark Fork River MT76M001_030 Metals Water Quality Data Summary and Target Exceedances

Parameter*	Arsenic	Cadmium	Copper	Iron	Lead	Zinc
# Samples	150	150	150	138	150	150
Minimum concentration (µg/L)	2.0	0.02	1.9	42.1	0.1	3.3
Maximum concentration (µg/L)	23.1	0.830	145.0	4,960	23.0	210.0
# Acute exceedances	0	0	61	N/A	0	7
Acute exceedance rate	0%	0%	41%	N/A	0%	5%
# Chronic exceedances	0	18	80	32	49	7
Chronic exceedance rate	0%	12%	53%	23%	33%	5%

Table 5-13. Clark Fork River MT76M001_030 Metals Water Quality Data Summary and Target Exceedances

Parameter*	Arsenic	Cadmium	Copper	Iron	Lead	Zinc
# Human health exceedances	9	0	0	N/A	13	0
Human health exceedance rate	6%	0%	0%	N/A	9%	0%

*Total recoverable fraction

Comparison of Metals Concentrations to Water Quality Targets and TMDL Determination
Each pollutant is discussed individually. The discussions are summarized below in **Table 5-14**.

Arsenic
The Clark Fork River from the Blackfoot River to Rattlesnake Creek was not listed as impaired by arsenic in the 2012 IR. However, analysis of recent water quality data (2003–2012) demonstrates a human target exceedance rate of 6%. Therefore, DEQ determined that this segment of the Clark Fork River is impaired by arsenic, and this impairment cause will be added for the 2014 reporting cycle. An arsenic TMDL is developed for this segment of the Clark Fork River.

Cadmium
The Clark Fork River from the Blackfoot River to Rattlesnake Creek was not listed as impaired by cadmium in the 2012 IR. However, analysis of recent water quality data (2003–2012) demonstrates a chronic aquatic life target exceedance rate of 12%. Therefore, DEQ determined that this segment of the Clark Fork River is impaired by cadmium, and this impairment cause will be added for the 2014 reporting cycle. A cadmium TMDL is developed for this segment of the Clark Fork River.

Copper
The Clark Fork River from the Blackfoot River to Rattlesnake Creek was listed as impaired by copper in the 2012 IR. Analysis of recent water quality data (2003–2012) demonstrates a chronic aquatic life target exceedance rate of 53% and an acute aquatic life target exceedance rate of 41%. Furthermore, 36 samples had copper concentrations that were greater than two times the acute aquatic life target. Therefore, DEQ determined that copper remains a cause of impairment. A copper TMDL is developed for this segment of the Clark Fork River.

Iron
The Clark Fork River from the Blackfoot River to Rattlesnake Creek was not listed as impaired by iron in the 2012 IR. However, analysis of recent water quality data (2003–2012) demonstrates a chronic aquatic life target exceedance rate of 23%. Therefore, DEQ determined that this segment of the Clark Fork River is impaired by iron, and this impairment cause will be added for the 2014 reporting cycle. An iron TMDL is developed for this segment of the Clark Fork River.

Lead
The Clark Fork River from the Blackfoot River to Rattlesnake Creek is listed as impaired by lead in the 2012 IR. Water chemistry data from recent sampling (2003–2012) demonstrate that lead concentrations in this segment of the Clark Fork River exceed the chronic aquatic life target in nearly a third of the samples. Additionally, the human health target is exceeded in 13 samples. Therefore, lead remains a cause of impairment, and a lead TMDL is developed for this segment of the Clark Fork River.

Zinc

The Clark Fork River from the Blackfoot River to Rattlesnake Creek was not listed as impaired by zinc in the 2012 IR. However, analysis of recent water quality data (2003–2012) demonstrates a chronic aquatic life target exceedance rate of 5%, which is below the threshold rate of 10%. However one sample was greater than twice the acute aquatic life target. Therefore, DEQ determined that this segment of the Clark Fork River is impaired by zinc, and this impairment cause will be added for the 2014 reporting cycle. A zinc TMDL is developed for this segment of the Clark Fork River.

Clark Fork River MT76M001_030 TMDL Development Summary

As discussed above and summarized in **Table 5-14**, arsenic, cadmium, copper, iron, lead, and zinc are determined to be causes of impairment to this segment of the Clark Fork River, and TMDLs are developed for these causes.

Table 5-14. Clark Fork River MT76M001_030 Metals TMDL Decision Factors

Parameter	Arsenic	Cadmium	Copper	Iron	Lead	Zinc
Number of Samples	150	150	150	138	150	150
Chronic aquatic life target exceedance rate >10%?	No	Yes	Yes	Yes	Yes	No
Acute aquatic life target exceeded by >2x?	No	No	Yes	N/A	No	Yes
Human health target exceeded?	Yes	No	No	N/A	Yes	No
Human-caused sources present?	Yes	Yes	Yes	Yes	Yes	Yes
TMDL developed?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

5.4.3.7 Clark Fork River from Rattlesnake Creek to Fish Creek (MT76M001_020)

The segment of the Clark Fork River from Rattlesnake Creek to Fish Creek is in the 2012 IR as impaired by metals: arsenic, cadmium, and copper. More recent data compilation, collection and analysis demonstrate the need for copper, iron, and lead TMDLs for this segment of the Clark Fork River.

Available Water Quality Data

Metals water quality data were used to compare current conditions to water quality targets. Data used were collected by several agencies (DEQ, USGS, Tri-State Water Quality Council) between 2005 and 2012. Data collected from this segment of the Clark Fork River are compared to water chemistry standards and targets in **Table 5-15**.

Table 5-15. Clark Fork River MT76M001_020 Metals Water Quality Data Summary and Target Exceedances

Parameter*	Copper	Iron	Lead
# Samples	44	8	44
Minimum concentration (µg/L)	2.0	50	0.50
Maximum concentration (µg/L)	17.0	1,280	4.0
# Acute exceedances	7	N/A	0
Acute exceedance rate	16%	N/A	0%
# Chronic exceedances	9	1	5
Chronic exceedance rate	20%	12%	11%
# Human health exceedances	0	N/A	0
Human health exceedance rate	0%	N/A	0%

*Total recoverable fraction

Comparison of Metals Concentrations to Water Quality Targets and TMDL Determination
Each pollutant is discussed individually. The discussions are summarized below in **Table 5-16**.

Arsenic
The Clark Fork River from Rattlesnake Creek to Fish Creek is listed as impaired by arsenic in the 2012 IR. However, analysis of recent water quality data (2005–2012) demonstrates that neither the aquatic life criteria nor the human health target are exceeded. Because no arsenic targets are exceeded, no TMDL is developed and DEQ will remove arsenic as a cause of impairment to this segment of the Clark Fork River.

Cadmium
The Clark Fork River from Rattlesnake Creek to Fish Creek is listed as impaired by cadmium in the 2012 IR. However, analysis of recent water quality data (2005–2012) demonstrates that neither the aquatic life target nor the human health target is exceeded. Because no cadmium targets are exceeded, no TMDL is developed and DEQ will remove cadmium as a cause of impairment to this segment of the Clark Fork River.

Copper
The Clark Fork River from Rattlesnake Creek to Fish Creek is listed as impaired by copper in the 2012 IR. Analysis of recent water quality data (2005–2012) established a chronic aquatic life target exceedance rate of 20% and an acute aquatic life target exceedance of 16%. Therefore, copper remains a cause of impairment and a copper TMDL is developed for this segment of the Clark Fork River.

Iron
The Clark Fork River from Rattlesnake Creek to Fish Creek was not listed as impaired by iron in the 2012 IR. However, analysis of recent water quality data (2005–2012) demonstrates a chronic aquatic life target exceedance rate of 12%. Therefore, DEQ determined that this segment of the Clark Fork River is impaired by iron, and this impairment cause will be added for the 2014 reporting cycle. An iron TMDL is developed for this segment of the Clark Fork River.

Lead
The Clark Fork River from Rattlesnake Creek to Fish Creek was not listed as impaired by lead in the 2012 IR. However, analysis of recent water quality data (2005–2012) demonstrates a chronic aquatic life target exceedance rate of 11%. Therefore, DEQ determined that this segment of the Clark Fork River is impaired by lead, and this impairment cause will be added for the 2014 reporting cycle. A lead TMDL is developed for this segment of the Clark Fork River.

Clark Fork River MT76M001_020 TMDL Development Summary
As discussed above and summarized in **Table 5-15**, copper, iron, and lead TMDLs are developed for the Clark Fork River between Rattlesnake Creek and Fish Creek. DEQ concluded that arsenic and cadmium no longer contribute to impairment to this segment of the Clark Fork River. This information, also summarized in **Table 5-16**, is documented within DEQ's assessment files and will be included in the 2014 IR.

Table 5-16. Clark Fork River MT76M001_020 Metals TMDL Decision Factors

Parameter	Copper	Iron	Lead
Number of Samples	44	8	44
Chronic aquatic life target exceedance rate >10%?	Yes	Yes	Yes
Acute aquatic life target exceeded by >2x?	No	N/A	No
Human health target exceeded?	No	N/A	No
Human-caused sources present?	Yes	Yes	Yes
TMDL developed?	**Yes**	**Yes**	**Yes**

5.4.3.8 Clark Fork River from Fish Creek to the Flathead River (MT76M001_010)

The segment of the Clark Fork River from Fish Creek to the Flathead River is listed in the 2012 IR as impaired by copper and lead. More recent data compilation, collection and analysis demonstrate the need for copper, iron, and lead TMDLs. The 2014 IR will report these metals impairment causes for this segment of the Clark Fork River.

Available Water Quality Data

Metals water and sediment quality data were used to compare current conditions to water quality targets. Data used were collected by several agencies (DEQ, USGS, Tri-State Water Quality Council) between 2003 and 2012. A subset (from the USGS station at St. Regis, through 2008) of the data for this segment is plotted below in **Figure 5-6**. This is provided to help illustrate the magnitude and seasonality of target exceedances.

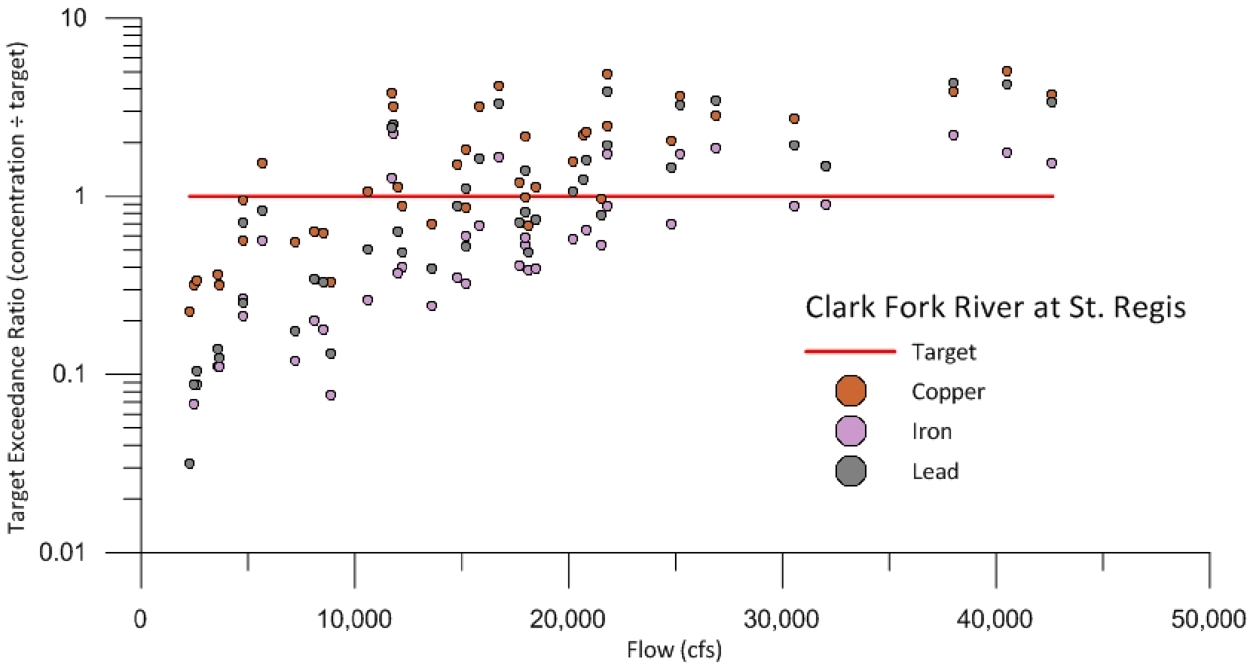

Figure 5-6. Metals Concentrations Relative to Targets at St. Regis

Figure 5-6 shows that exceedances generally occur under high flow conditions, particularly for iron and lead. Copper also demonstrates a relationship to increasing flow, but is more likely to exceed the target at lower flows than the other metals.

Data collected from this segment of the Clark Fork River are compared to water chemistry standards and targets in **Table 5-17**.

Table 5-17. Clark Fork River MT76M001_010 Metals Water Quality Data Summary and Target Exceedances

Parameter*	Copper	Iron	Lead
# Samples	65	66	65
Minimum concentration (µg/L)	1.0	30	0.10
Maximum concentration (µg/L)	27.2	2,230	5.97
# Acute exceedances	23	N/A	0
Acute exceedance rate	35%	N/A	0%
# Chronic exceedances	30	9	21
Chronic exceedance rate	46%	14%	32%
# Human health exceedances	0	N/A	0
Human health exceedance rate	0%	N/A	0%

*Total recoverable fraction

Comparison of Metals Concentrations to Water Quality Targets and TMDL Determination
Each pollutant is discussed individually. The discussions are summarized below in **Table 5-18**.

Copper
The Clark Fork River from Fish Creek to the Flathead River is listed as impaired by copper in the 2012 IR. Analysis of recent water quality data (2003–2012) established a chronic aquatic life target exceedance rate of 46% and an acute aquatic life target exceedance of 35%. Therefore, copper remains a cause of impairment and a copper TMDL is developed for this segment of the Clark Fork River.

Iron
The Clark Fork River from Fish Creek to the Flathead River was not listed as impaired by iron in the 2012 IR. However, analysis of recent water quality data (2003–2012) demonstrates a chronic aquatic life target exceedance rate of 14%. Therefore, DEQ determined that this segment of the Clark Fork River is impaired by iron, and this impairment cause will be added for the 2014 reporting cycle. An iron TMDL is developed for this segment of the Clark Fork River.

Lead
The Clark Fork River from Fish Creek to the Flathead River is listed as impaired by lead in the 2012 IR. Analysis of recent water quality data (2003–2012) established a chronic aquatic life target exceedance rate of 32%. Therefore, lead remains a cause of impairment and a lead TMDL is developed for this segment of the Clark Fork River.

Clark Fork River MT76M001_010 TMDL Development Summary
As discussed above and summarized in **Table 5-25**, copper, iron, and lead TMDLs are developed for the Clark Fork River from Fish Creek to the Flathead River. DEQ concluded that iron is a new cause of impairment on this segment of the Clark Fork River. This information, also summarized in **Table 5-18**, is documented within DEQ's assessment files and will be included in the 2014 IR.

Table 5-18. Clark Fork River MT76M001_010 Metals TMDL Decision Factors

Parameter	Copper	Iron	Lead
Number of Samples	65	66	65
Chronic aquatic life target exceedance rate >10%?	Yes	Yes	Yes
Acute aquatic life target exceeded by >2x?	Yes	N/A	No
Human health target exceeded?	No	N/A	No
Human-caused sources present?	Yes	Yes	Yes
TMDL developed?	**Yes**	**Yes**	**Yes**

5.4.3.9 Clark Fork River from the Flathead River to Thompson Falls Reservoir (MT76N001_010)

In the 2012 IR, this segment is described as the Clark Fork River from the Flathead River to Noxon Reservoir. This segment has been redefined for the 2014 IR. It now extends from the Flathead River to Thompson Falls Reservoir. The original AU (Flathead River to Noxon Reservoir) was in the 2012 IR as impaired by cadmium. More recent collection, compilation and analysis demonstrate that cadmium is not a cause of impairment to the redefined segment (Flathead River to Thompson Falls Reservoir), nor are other metals. Out of 20 water quality samples, there were no exceedances of aquatic life or human health targets.

A new Clark Fork River AU (MT76N001_020) extends from Noxon Bridge to Noxon Dam. More recent data collection, compilation, and analysis demonstrate that cadmium does not cause impairment to this segment, nor do other metals. Out of 20 water quality samples, there were no exceedances of aquatic life or human health targets.

5.4.4 Metals Target Comparison and TMDL Development Summary

Based on the updated metals assessment and target comparison results presented above, 40 metals TMDLs are developed for Silver Bow Creek and the Clark Fork River. These are identified below **in Table 5-19**. Metals causes for which DEQ determined there is no longer impairment are not included in **Table 5-19**. As previously noted, no TMDLs are required for the Clark Fork River between the mouth of the Flathead River and Noxon Reservoir (MT76N001_010 and MT76N001_020) because the updated assessment information revealed no metals impairment conditions. All updated assessment results captured within **Table 5-19** will be incorporated within the 2014 303(d) List and associated 2014 IR.

Table 5-19. Updated Assessment Results and Metals TMDLs Developed for Silver Bow Creek and the Clark Fork River

Waterbody and Location Description	Waterbody ID	Impairment Cause	Included in 2012 IR*
Silver Bow Creek headwaters to mouth (Clark Fork River)	MT76G003_020	Arsenic	Yes
		Cadmium	No
		Copper	Yes
		Lead	Yes
		Mercury	No
		Zinc	Yes
Clark Fork River, Warm Springs Creek to Cottonwood Creek [CFR01]	MT76G001_040	Cadmium	Yes
		Copper	Yes
		Iron	No
		Lead	Yes

Table 5-19. Updated Assessment Results and Metals TMDLs Developed for Silver Bow Creek and the Clark Fork River

Waterbody and Location Description	Waterbody ID	Impairment Cause	Included in 2012 IR*
Clark Fork River, Cottonwood Creek to Little Blackfoot River [CFR02]	MT76G001_030	Cadmium	No
		Copper	Yes
		Iron	No
		Lead	Yes
		Zinc	Yes
Clark Fork River, Little Blackfoot River to Flint Creek [CFR03]	MT76G001_010	Arsenic	Yes
		Cadmium	No
		Copper	Yes
		Iron	No
		Lead	Yes
		Mercury	No
Clark Fork River, Flint Creek to Blackfoot River [CFR04]	MT76E001_010	Arsenic	Yes
		Cadmium	Yes
		Copper	Yes
		Iron	Yes
		Lead	Yes
		Mercury	No
		Zinc	Yes
Clark Fork River, Blackfoot River to Rattlesnake Creek [CFR05]	MT76M001_030	Arsenic	No
		Cadmium	No
		Copper	Yes
		Iron	No
		Lead	Yes
		Zinc	No
Clark Fork River, Rattlesnake Creek to Fish Creek [CFR06]	MT76M001_020	Copper	Yes
		Iron	No
		Lead	No
Clark Fork River, Fish Creek to Flathead River [CFR07]	MT76M001_010	Copper	Yes
		Iron	No
		Lead	Yes

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

TMDLs and allocations for these streams and metals are provided in the following section. The TMDLs developed in this document are illustrated below in **Figure 5-7**.

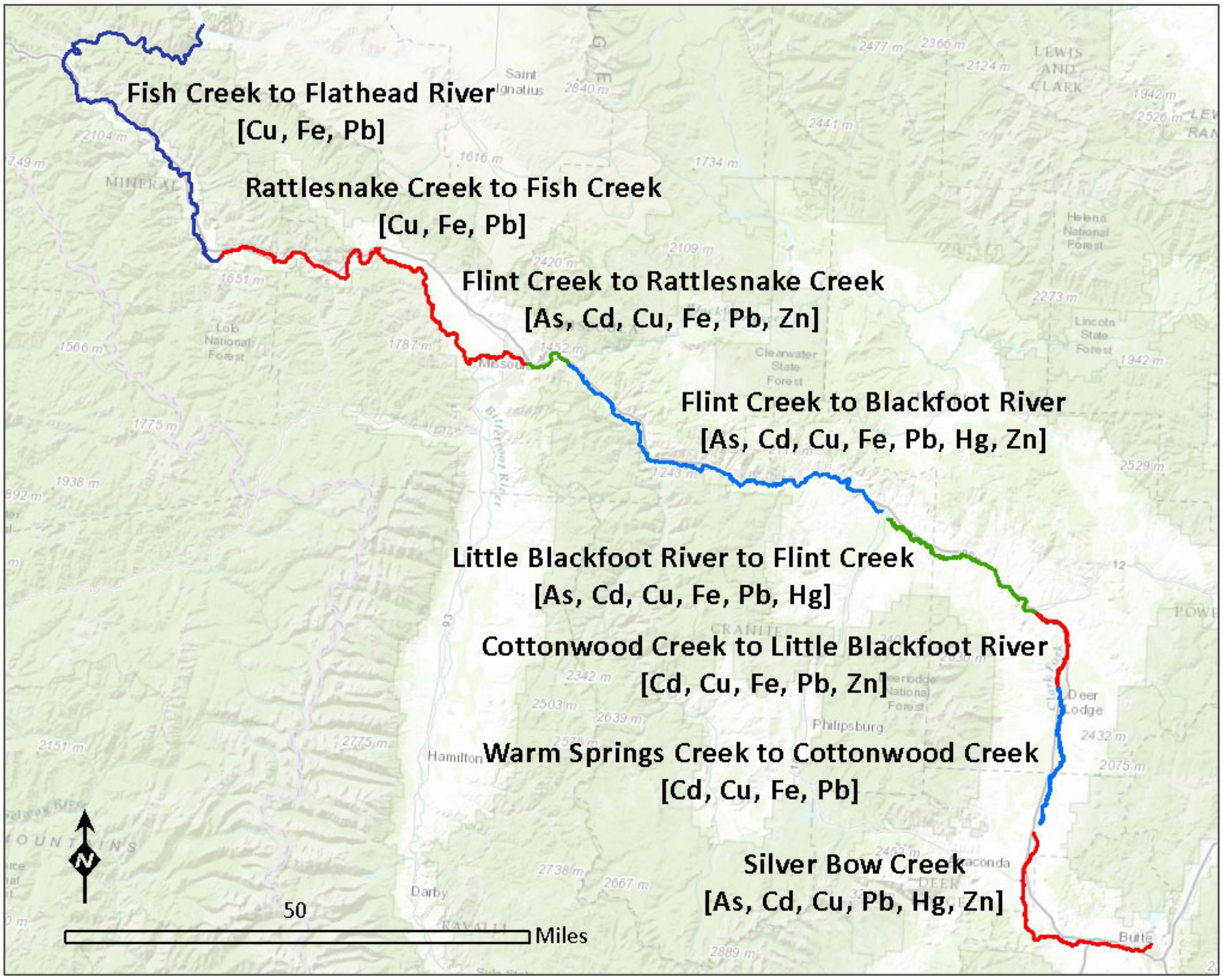

Figure 5-7. Metals TMDLs Prepared for Silver Bow Creek and the Clark Fork River

5.5 METALS TMDLS

DEQ presents metals TMDLs for impaired waterbodies in the Silver Bow Creek and Clark Fork River TMDL Project, summarized below in **Table 5-20**. 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 (cadmium, copper, lead, zinc) in the Silver Bow Creek and Clark Fork River project have standards for protection of aquatic life that vary according to water hardness as defined within DEQ-7 (Montana Department of Environmental Quality, 2012a). Generally aquatic life standards become more stringent as water hardness decreases. Water hardness may vary seasonally, and is commonly higher under low flow conditions when the groundwater baseflow component is more significant. 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 5-8 is a plot showing TMDLs versus flow for impairment causes that are not influenced by hardness. **Figures 5-9** through **5-12** show TMDLs versus flow for the hardness-dependent impairment causes at hardness conditions of 50 mg/L and 200 mg/L. These values represent the typical range of water hardness generally measured in Silver Bow Creek and the Clark Fork River (**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 an MOS 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.

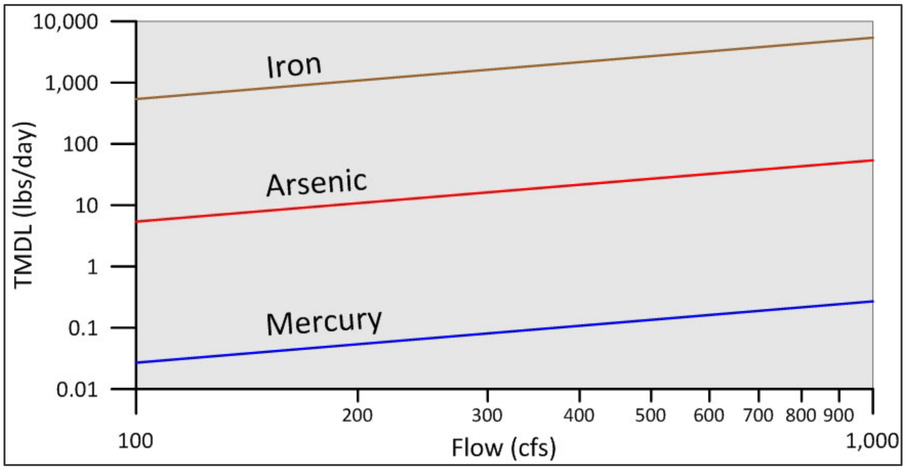

Figure 5-8. Hardness-Independent Metals TMDLs as Functions of Flow

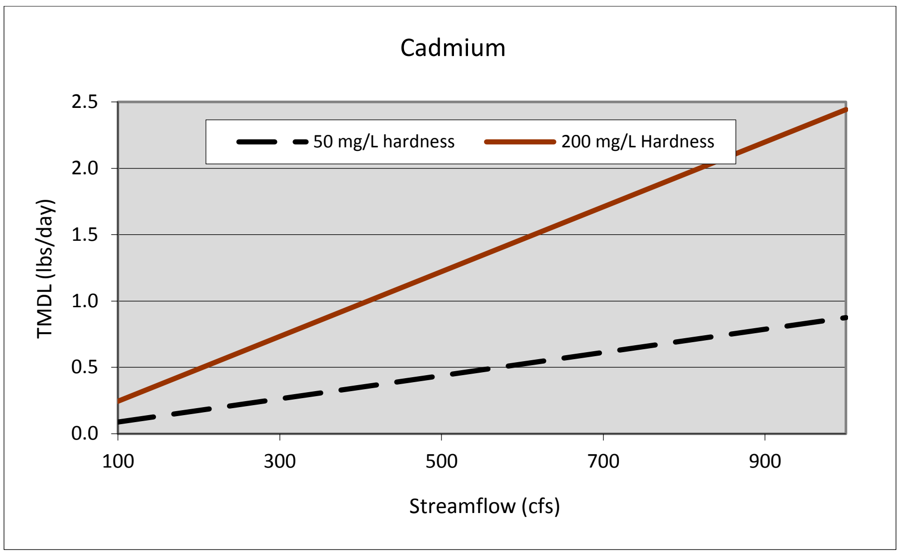

Figure 5-9. Cadmium TMDL as a Function of Flow

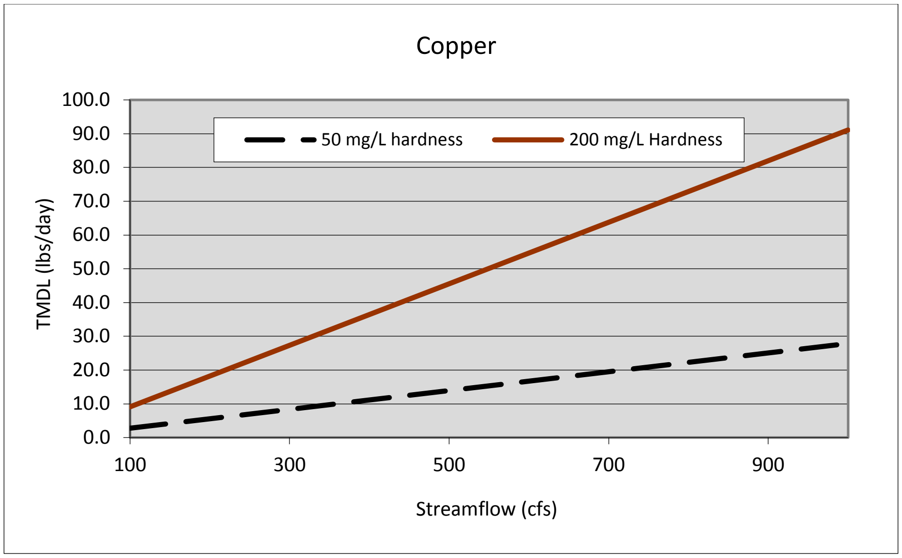

Figure 5-10. Copper TMDL as a Function of Flow

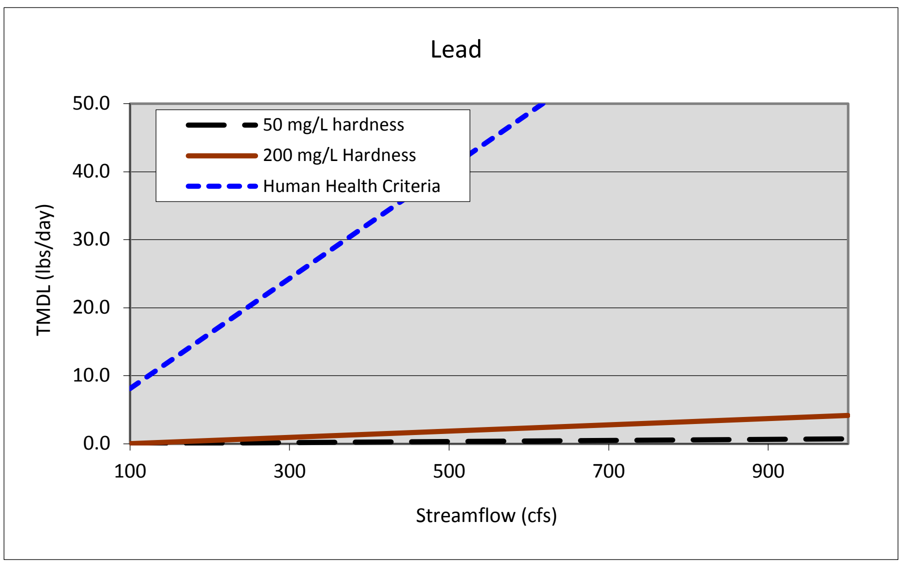

Figure 5-11. Lead TMDL as a Function of Flow

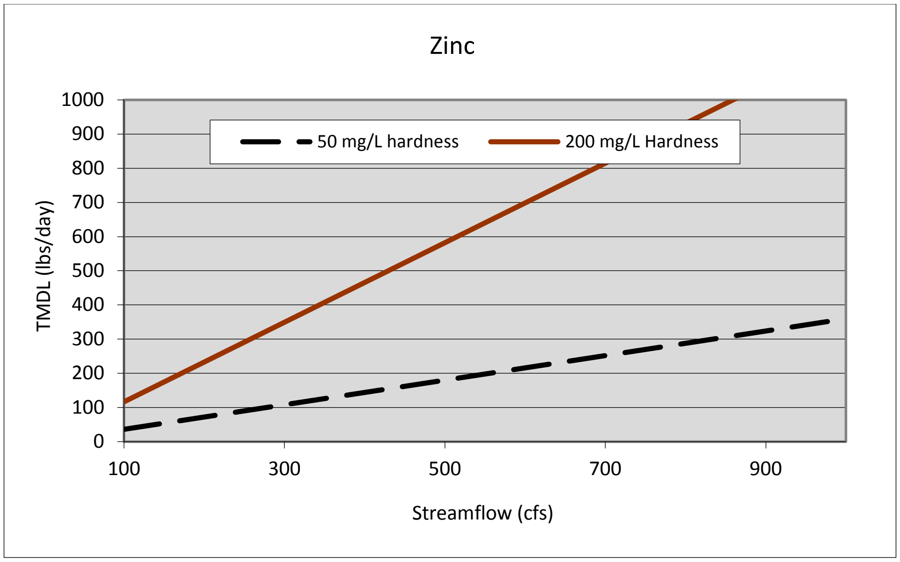

Figure 5-12. Zinc TMDL as a Function of Flow

Table 5-20 provides example TMDLs for each of the 40 waterbody – impairment cause combinations prepared for Silver Bow Creek and the Clark Fork River in this document. The data in **Table 5-20** represent semi-synoptic samples under high flow and low flow conditions, collected in the course of two to three days in 2012. This accounts for seasonal variability by providing the full range of streamflow and water hardness for each waterbody –impairment cause combination. Discharge and hardness data in this table comes from sampling in June and July 2012 (**Appendix B)**. The TMDLs in **Table 5-20** are calculated according to the TMDL equation provided above.

Table 5-20. Example Flows, Targets, and TMDLs

Stream	Station	Discharge (cfs)		Hardness (mg/L)		Impairment Cause	Target Conc. (µg/L)		TMDL (lbs/day)	
		High Flow	Low Flow	High Flow	Low Flow		High Flow	Low Flow	High Flow	Low Flow
Silver Bow Creek (MT76G003_020)	12323600	95	21	160	217	Arsenic	10.0	10.0	5.13	1.13
						Cadmium	0.38	0.48	0.19	0.05
						Copper	13.9	18.1	7.13	2.05
						Lead	5.79	6.02	2.97	0.68
						Mercury	0.05	0.05	0.026	0.006
						Zinc	178.4	231.0	91.52	26.20
Clark Fork River, Warm Springs Creek to Cottonwood Creek (MT76G001_040)	12324200	736	200	106	195	Cadmium	0.28	0.44	1.12	0.48
						Copper	9.80	16.51	38.97	17.83
						Iron	1,000	1,000	3,974	1,080
						Lead	3.43	7.45	13.62	8.04
Clark Fork River, Cottonwood Creek to Little Blackfoot River (MT76G001_030)	12324400	994	189	122	205	Cadmium	0.314	0.461	1.68	0.47
						Copper	11.06	17.23	59.35	17.58
						Iron	1,000	1,000	5,368	1,021
						Lead	4.10	7.93	22.0	8.1
						Zinc	141.8	220.1	761.1	224.7
Clark Fork River, Little Blackfoot River to Flint Creek (MT76G001_010)	12324680	1,730	362	117	183	Arsenic	10	10	93.42	19.55
						Cadmium	0.30	0.42	2.84	0.83
						Copper	10.67	15.64	99.68	30.56
						Iron	1,000	1,000	9,342	1,955
						Lead	3.88	6.87	36.30	13.42
						Mercury	0.05	0.05	0.467	0.097
Clark Fork River, Flint Creek to Blackfoot River (MT76E001_010)	12334550	4,820	1,120	85.8	126	Arsenic	10	10	260.28	60.48
						Cadmium	0.24	0.32	6.29	1.94
						Copper	8.18	11.37	213.03	68.74
						Iron	1,000	1,000	26,028	6,048
						Lead	2.62	4.27	68.14	25.82
						Mercury	0.05	0.05	1.301	0.302
						Zinc	105.23	145.73	2,739	881.4

Table 5-20. Example Flows, Targets, and TMDLs

Stream	Station	Discharge (cfs)		Hardness (mg/L)		Impairment Cause	Target Conc. (µg/L)		TMDL (lbs/day)	
		High Flow	Low Flow	High Flow	Low Flow		High Flow	Low Flow	High Flow	Low Flow
Clark Fork River, Blackfoot River to Rattlesnake Creek (MT76M001_030)	12340500	11,600	2,520	80.8	121	Arsenic	10	10	626.4	136.08
						Cadmium	0.23	0.31	14.47	4.24
						Copper	7.78	10.98	487.04	149.41
						Iron	1,000	1,000	62,640	13,608
						Lead	2.43	4.06	151.93	55.19
						Zinc	100.02	140.82	6,265	1,916
Clark Fork River, Rattlesnake Creek to Fish Creek (MT76M001_020)	C04CKFKR06	24,000*	5,725*	57	81	Copper	5.77	7.1	747.9	219.9
						Iron	1,000	1,000	129,600	30,915
						Lead	1.55	2.12	201.6	65.7
Clark Fork River, Fish Creek to Flathead River (MT76M001_010)	12354500	25,400*	6,600*	55	77	Copper	5.6	7.5	767.7	265.9
						Iron	1,000	1,000	137,160	35,640
						Lead	1.49	2.28	203.9	81.3

TMDL = Flow x Target x 0.0054
Example high and low flow discharge and hardness data from June and July 2012, respectively
*Estimated discharge values based on bracketing USGS gages

5.6 METALS SOURCE ASSESSMENTS

Metals sources in the Upper Clark Fork River basin include a complex assemblage of Superfund sites, point sources permitted under the MPDES, and nonpoint sources. Tributary streams draining headwaters mining districts also contribute metals to Silver Bow Creek and the Clark Fork River.

The basin was the scene of mining, milling, and smelting on an industrial scale, which led to widespread metals contamination. Waste rock was near-ubiquitous in uptown Butte. Waste rock and tailings disposed of within or adjacent to Silver Bow Creek resulted in metals-rich floodplain and streambank sediments in Silver Bow Creek and the Clark Fork River. Smelting in the Anaconda area distributed metals across the neighboring landscape and tributary streams. These metals sources are now included in National Priority List (aka Superfund) sites. The Superfund sites are discussed above in **Section 2.3.5**. Superfund sites relevant to this project are the Silver Bow Creek / Butte Area and Milltown Reservoir / Clark Fork River sites. These sites and their OUs are provided below in **Table 5-21**. The Anaconda Company Smelter Site is adjacent to the project area and includes metals-impaired tributaries such as Warm Springs Creek and Lost Creek, as well as upland areas that drain to the Clark Fork River. However, associated remediation work in these tributaries is separate from work on Silver Bow Creek or the Clark Fork River, which are specifically subject to remediation under the other two Superfund sites.

Table 5-21. Superfund Sites, Operable Units and Related Stream Segments

Superfund Site	Operable Unit	Related Stream Segment
Silver Bow Creek / Butte Area	Streamside Tailings OU1	Silver Bow Creek
	Area One OU2*	
	Butte Mine Flooding OU3	
	Warm Springs Ponds Active Area OU4	
	Butte Reduction Works Tailings OU5*	
	West Camp / Travona Mine OU6*	
	Rocker Timber Framing and Treatment OU7	
	Butte Priority Soils OU8	
	Clark Fork River / Downstream OU9**	
	Butte Residential Soils OU10*	
	Lower Area One OU11*	
	Warm Springs Ponds Inactive Area OU12	
	West Side Soils OU13	
Milltown Reservoir / Clark Fork River	Milltown Drinking Water Supply OU1	N/A
	Milltown Reservoir Sediments OU2	Clark Fork River, Flint Creek to Blackfoot River
	Mainstem Clark Fork River OU3	Clark Fork River, Warm Springs Creek to Cottonwood Creek
		Clark Fork River, Cottonwood Creek to Little Blackfoot River
		Clark Fork River, Little Blackfoot River to Flint Creek
		Clark Fork River, Flint Creek to Blackfoot River

*Now incorporated into Butte Priority Soils OU8
** Transferred to the Milltown Reservoir / Clark Fork River Superfund Site

Several MPDES-permitted wastewater treatment plants (WWTPs) discharge directly into Silver Bow Creek or the Clark Fork River. Additionally, there are two small municipal separate storm sewer systems (MS4s) draining to Silver Bow Creek and the Clark Fork River: one in Butte and one in Missoula. MPDES-permitted discharges are summarized below in **Table 5-22**. Several of these domestic WWTPs do not have effluent limits or sampling requirements for metals. In those cases, the effluent could not be characterized. To estimate the copper and lead loads contributed from these sources, DEQ used a well-studied domestic wastewater facility of similar age and serving similar construction and plumbing: East Helena. DEQ Technical and Financial Assistance Bureau engineering staff provided guidance on this approach (Paul Lavigne, personal communication 2014). Average copper concentrations of 16.9 µg/L and lead concentrations of 1.36 µg/L (Robert Peccia & Associates, 2011) were used for these systems.

Table 5-22. MPDES-Permitted Discharges

Project Stream Segment	MPDES Permit No.	MPDES Permit Name
Silver Bow Creek	MT0022012	Butte-Silverbow WWTP
	MT0000191	Montana Resources, Inc.
	MTR040006	Butte-Silverbow MS4
	MT0027430	Rocker WWTP
	MT0030350	REC Advanced Silicon Materials, Inc.
Clark Fork River, Warm Springs Creek to Cottonwood Creek	MT0021431	Montana Behavioral Health Inc. WWTP
Clark Fork River, Cottonwood Creek to Little Blackfoot River	MT0022616	Deer Lodge WWTP
Clark Fork River, Flint Creek to Blackfoot River	MTG580002	Town of Drummond WWTP
	MTR040007	Missoula MS4*
Clark Fork River, Blackfoot River to Rattlesnake Creek	MTR040007	Missoula MS4
Clark Fork River, Rattlesnake Creek to Fish Creek	MT0022594	City of Missoula WWTP
	MTR040007	Missoula MS4
	MT0000094	John R Daily Inc.
	MT0000035	Stone Container Corp**
	MT0021555	Alberton WWTP
Clark Fork River, Fish Creek to Flathead River	MT0020664	Superior WWTF

*No apparent discharge to this segment
**Inactive facility not currently discharging

Mining was widespread in headwaters areas throughout the Upper Clark Fork River basin. As a result, numerous tributaries to the Clark Fork River and Silver Bow Creek are metals-impaired. The majority of these metals impairments are addressed by approved TMDLs.

Table 5-23. Metals-Impaired Tributaries

Project Stream Segment	Tributary Stream	TMDL Project (EPA Approval Date)	Metals Impairments
Silver Bow Creek	German Gulch	Upper Clark Fork Metals (2010)	As, ~~CN~~, ~~Se~~
	Mill-Willow Bypass	Upper Clark Fork Metals (2010)	As, Cd, Cu, Pb, Zn
Clark Fork River, Warm Springs Creek to Cottonwood Creek	Warm Springs Creek	Upper Clark Fork Metals (2010)	~~As~~, Cd, Cu, Fe, Pb, ~~Zn~~
	Lost Creek	Upper Clark Fork Metals (2010)	~~As~~, Cu, Pb
	Modesty Creek	Upper Clark Fork Metals (2010)	~~As~~, Cd, Cu, Pb
	Peterson Creek	Upper Clark Fork Metals (2010)	Fe

Table 5-23. Metals-Impaired Tributaries

Project Stream Segment	Tributary Stream	TMDL Project (EPA Approval Date)	Metals Impairments
Clark Fork River, Little Blackfoot River to Flint Creek	Little Blackfoot River	Little Blackfoot River (2011)	As, Pb
	Gold Creek	Upper Clark Fork Metals (2010)	Fe, Pb
	Dunkleberg Creek	Upper Clark Fork Metals (2010)	As, Cd, Cu, Fe, Pb, ~~Zn~~
Clark Fork River, Flint Creek to Blackfoot River	Flint Creek	Flint Creek (2012)	As, Cu, Fe, Pb, Hg
	Cramer Creek	Bonita-Superior (2013)	~~Al~~, Pb
	Wallace Creek	Bonita-Superior (2013)	Cu
Clark Fork River, Rattlesnake Creek to Fish Creek	Bitterroot River	Bitterroot River Watershed (pending)	Pb*
Clark Fork River, Fish Creek to Flathead River	Flat Creek	Bonita-Superior (2013)	~~Sb~~, As, ~~Cd~~, Pb, ~~Zn~~

~~Strikethrough~~ denotes an impairment cause not shared by the receiving AU
* TMDL is currently under development in a separate project

The locations of these tributaries are shown below in **Figure 5-13**.

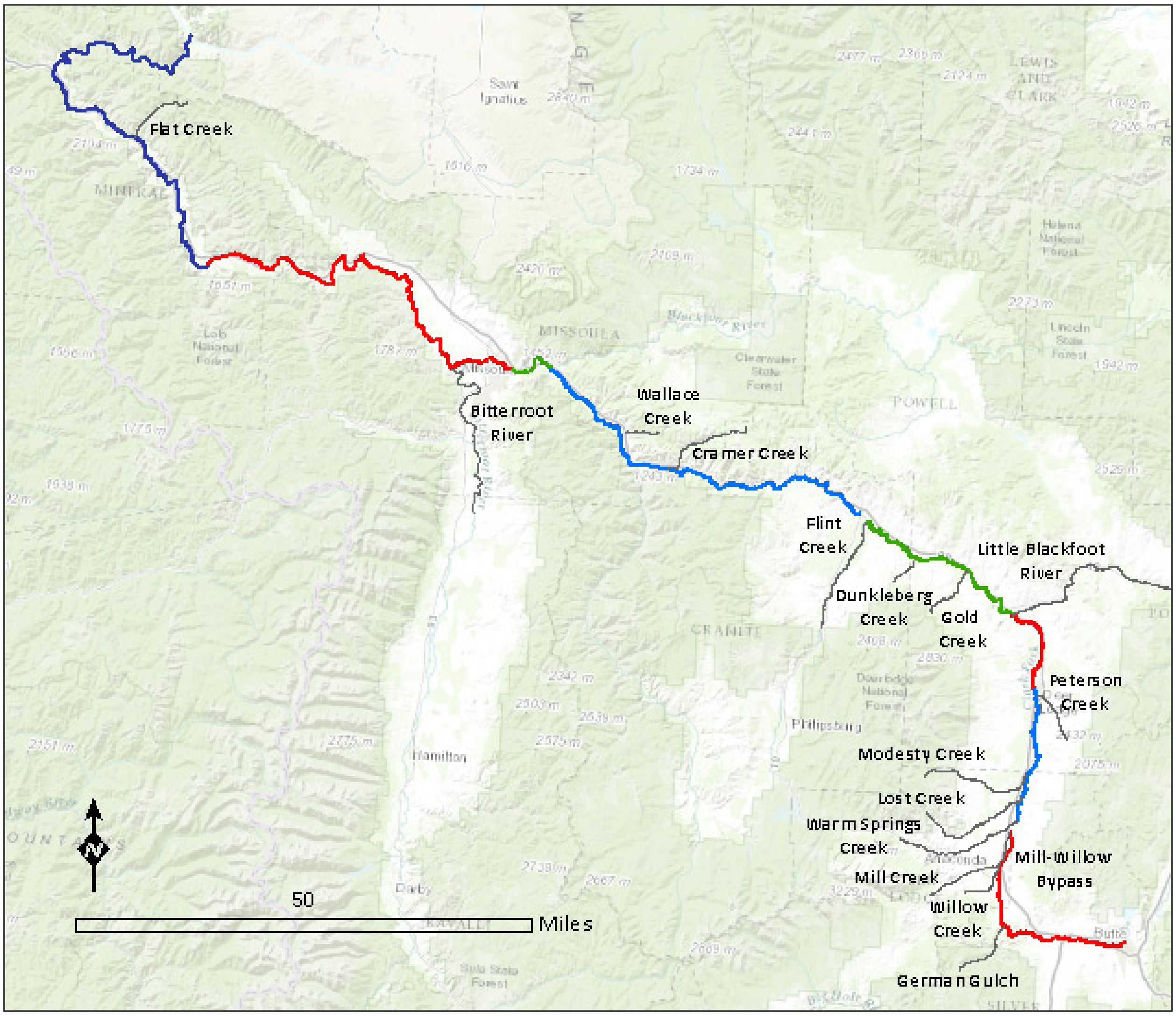

Figure 5-13. Metals-Impaired Tributary Streams

Significant resources have been devoted to understanding the sources, fate and transport of metals in the Clark Fork basin. The USGS, EPA, and others have published many studies over the past four decades. These studies provide the basis for DEQ's source assessments for TMDL development. Many of these studies use copper as a proxy to illustrate sources and transport of trace metals in the basin (Smith et al., 1998; Sando et al., 2014). DEQ uses this convention in this section. This is useful because the other metals share the same sources and their mobility is subject to the same processes. Metals are strongly associated with fine sediment loading and transport throughout the project area (Smith et al., 1998; Sando et al., 2014). This relationship is effectively expressed via the use of the total recoverable fraction as required per DEQ-7. Copper also tends to be the most problematic of the metals contaminants, exceeding targets by the greatest degree. Remedies that address the copper problems will also address the other metals. Arsenic, however, is a metalloid and behaves differently. Arsenic occurs primarily in dissolved phase, and its mobility is subject to different conditions and processes.

The USGS has recently completed a long-term analysis of water-quality trends in the Upper Clark Fork basin (Sando et al., 2014). The study identified trends in sequential 5-year periods (1996–2001; 2001–

2005; 2006–2010). Two conclusions of particular interest are the significant decreases in metals loads in Silver Bow Creek above Warm Springs Ponds, and the large contribution of metals from within the Clark Fork River between Galen and Deer Lodge. This demonstrates that remediation of Silver Bow Creek and Butte is producing measurable water quality gains. It also suggests that the remediation of the Clark Fork River streambanks will result in continued improvement in coming years. Although reductions in metals loads were apparent during the study timeframe, arsenic loads stayed relatively static.

Natural background metals loading is generally considered a relatively minor source of metals. Estimates of natural background loads within the upper portions of the project area are developed for Silver Bow Creek within **Section 5.6.1.5**. For the lower portions of the project area (downstream of the Blackfoot River), where tributary and other flow inputs to the Clark Fork River are influenced less by mineralized geology, natural background is estimated to correspond to one-half the method detection limit for each metal except for iron, which is estimated at 50 µg/L. DEQ considers this a reasonable estimate based on the occasional non-detectable concentrations reported in some samples.

The specific metals sources identified for each AU are described below.

5.6.1 Silver Bow Creek (MT76G003_020) Source Assessment

The major sources of metals to Silver Bow Creek include: legacy mine waste and stormwater runoff in Butte, streamside and streambed tailings along the length of the stream, WWTP discharges and other point source discharges, and impaired tributaries. The locations of these sources are shown below in **Figure 5-14**.

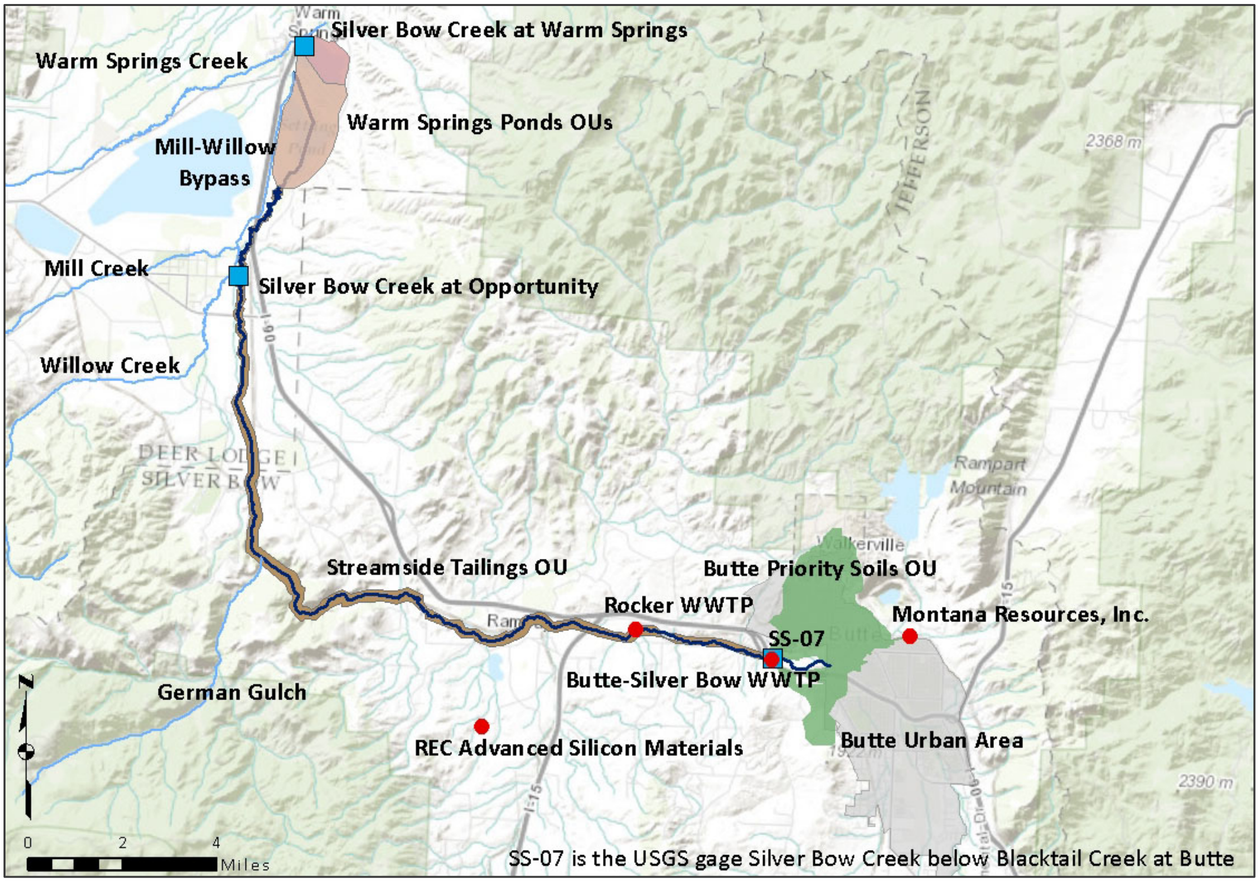

Figure 5-14. Metals Sources to Silver Bow Creek

In the Butte area, metals sources are interrelated. Mine waste remaining on Butte Hill causes stormwater to have higher metals concentrations than stormwater from an equivalent urban area. Similarly, metals concentrations in effluent from the Butte treatment plant are elevated in part because metals-laden water infiltrates the sewer system and adds a metals load to the influent. A good summary of sources in the Butte area is provided in the Surface Water Characterization Report, BPSOU, Butte Area/Silver Bow Creek NPL Site, Butte, Montana (U.S. Environmental Protection Agency, 2008).

In this section, metals sources are introduced programmatically according to the applicable legal framework. However, in **Section 5.6** below, load and WLAs are considered spatially.

5.6.1.1 Superfund Sources Regulated under CERCLA

The entire length of Silver Bow Creek is included within the Silver Bow Creek / Butte Area Superfund Site. Two OUs (Butte Priority Soils and Streamside Tailings) contain the entire length of Silver Bow Creek and are therefore the most important sources to consider. Silver Bow Creek begins at the confluence of Blacktail Creek and MSD. The stream runs through the BPSOU to SS-07 (USGS gage 12323250) and the I-90 bridge, at which point it passes into the Streamside Tailings OU (**Figure 5-15** below).

Butte Priority Soils OU

Although many discrete OUs were delineated within Butte (see **Table 5-21** above), many of them have been consolidated into the BPSOU. This OU now provides the primary framework for addressing metals-contaminated soils and the resultant impacts to stormwater and groundwater. Many waste dumps with metals concentrations posing human health risks were remediated under Superfund removal actions. However, remaining waste rock dumps still constitute metals sources (U.S. Environmental Protection Agency, 2008). Also, waste rock was commonly used as fill and as pipe bedding in historic construction. Its use as bedding for sewer lines brings it into direct contact with stormwater and wastewater. This results in elevated metals concentrations in groundwater, stormwater, and WWTP influent.

Groundwater is intercepted in the groundwater capture system that extends from MSD to Lower Area One to the Butte Treatment Lagoons system, where it is treated. The system adds lime and uses a series of retention basins to precipitate metals as sludge, which is periodically dredged, dried, and sent to a repository. At the end of the system, water discharges to Silver Bow Creek just upstream of the WWTP outfall. Since the ROD specified a traditional water treatment facility for contaminated groundwater, the treatment lagoons are currently operating in demonstration status. This constitutes a point source discharge managed under CERCLA rather than under the MPDES permitting system. The discharge is regularly sampled, and the data demonstrate that the discharge contributes 6.8% of the low-flow copper load leaving the BPSOU (as measured at station SS-06G, located ~100 feet upstream of SS-07) (U.S. Environmental Protection Agency, 2008). Interception and treatment of metals-contaminated groundwater has produced significant water quality improvement in Silver Bow Creek (Sando et al., 2014; U.S. Environmental Protection Agency, 2008).

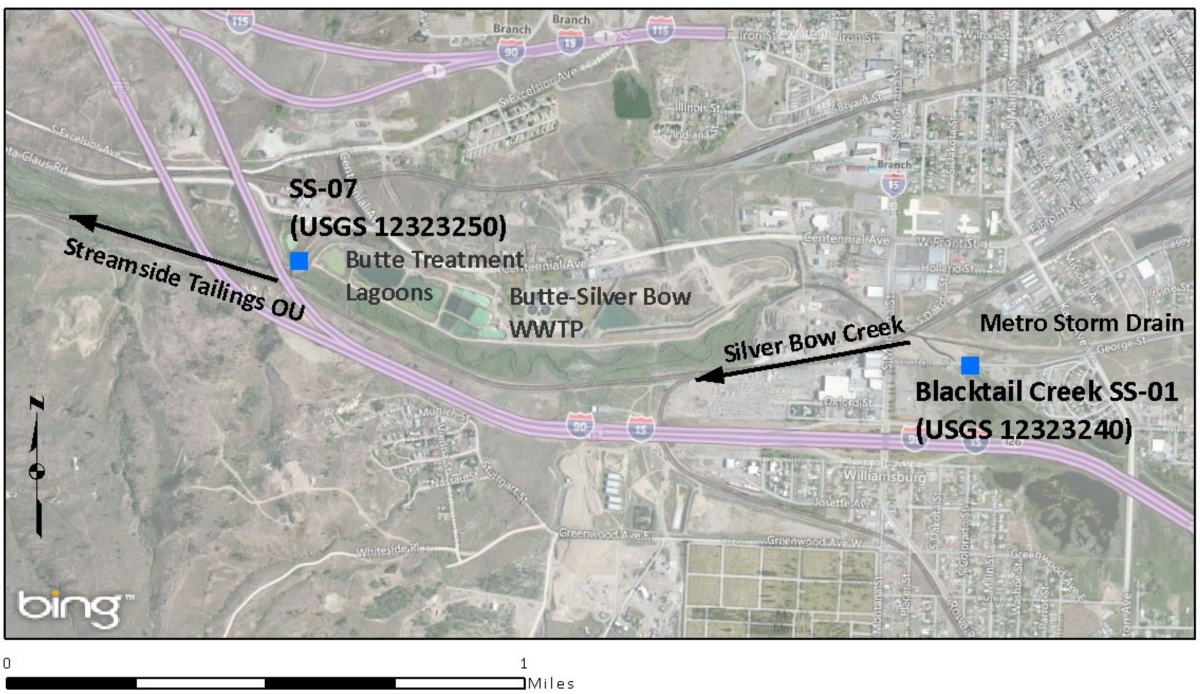

Figure 5-15. Silver Bow Creek through the BPSOU

Stormwater is a major source of metals to Silver Bow Creek, particularly copper. This is recognized in the ROD (U.S. Environmental Protection Agency, 2006) and managing stormwater is an identified critical element of the selected remedy for the BPSOU (U.S. Environmental Protection Agency, 2008; U.S. Environmental Protection Agency, 2011e). The ROD provides for a contingency measure of capturing and treating stormwater within the BPSOU, but whether or not this measure is required is still undetermined. A Stormwater Time Critical Response Action was begun in 1997 and continues to the present (U.S. Environmental Protection Agency, 2008; U.S. Environmental Protection Agency, 2011e).

This program consisted of physical improvements to the stormwater conveyance and retention structures, as well as implementation of stormwater BMPs. Where viable, stormwater drainage has been re-routed to the Berkeley Pit. Some stormwater is impounded near the bottom of some of the major catchments (e.g., Missoula Gulch). The impoundments are unlined, and water that infiltrates is captured by the groundwater interception system. The catchments currently contributing the most copper to Silver Bow Creek via stormwater are located on the east side of Butte Hill: the Buffalo Gulch, Texas Avenue, Warren Avenue, and Anaconda Road/Butte Brewery subdrainages (U.S. Environmental Protection Agency, 2008).

Copper concentrations in runoff are at their highest in early spring, following the first significant snowmelt. This probably reflects a first flush of copper salts that accumulated over the winter (U.S. Environmental Protection Agency, 2008).

Butte Mine Flooding OU

Currently, there is no discharge to Silver Bow Creek related to this OU. This will be the case until either mining operations cease or the Berkeley Pit critical water level of 5,410 feet is reached (U.S. Environmental Protection Agency, 2011c). Future discharge from this OU to Silver Bow Creek (via MSD) will be via the Horseshoe Bend treatment plant. This plant was constructed in 2003. The plant currently treats surface water springs at the base of the Yankee Doodle tailings ponds, which reduces the rate of inflow to the Berkeley Pit. Construction of the plant was triggered by cessation of mining operations by Montana Resources, Inc. (MR) in 2000. MR resumed operations in 2003 when the treatment plant went into operation. Currently the Horseshoe Bend treatment plant effluent is used as process water in the MR concentrator. (The concentrator is permitted to discharge under MPDES, discussed below.) The Horseshoe Bend plant currently processes an average of 4–5 million gallons per day (6.1–7.7 cubic feet per second). The plant will also provide the means to control the critical water level in the Berkeley Pit when that becomes necessary. At that point, the plant will discharge to Silver Bow Creek regardless of mining operations. A performance test was conducted in 2007 to assess whether the plant was capable of meeting State water quality standards. Performance limits (except pH) were met during the test. Another review of treatment plant performance is scheduled before the end of 2018 (U.S. Environmental Protection Agency, 2011c).

Discharge from the Horseshoe Bend plant will be regulated via CERCLA and not MPDES. The discharge connection has not been constructed, and will be located either at the upper end of the MSD near Texas Avenue or at the lower end by the confluence with Blacktail Creek.

Silver Bow Creek Streamside Tailings OU

The Streamside Tailings OU is divided into 20 reaches, which are grouped into four subareas. The subareas general correspond to the major landscape features (U.S. Environmental Protection Agency, 2011f): the valley past Rocker, Ramsay Flats, Durant Canyon, and the Upper Deer Lodge Valley. Remediation and construction began in Subarea 1 (Rocker) in 1999. Construction and remediation of Silver Bow Creek above Durant Canyon (Subareas 1 and 2) was complete in 2008. Remedial work continues in Subarea 3 (Durant Canyon) and Subarea 4.

As of 2012, an estimated 85% of tailings and impacted soil had been removed, and 60% of the stream channel had been reconstructed (Montana Department of Environmental Quality, 2012b). Where remediation and construction have been completed, water quality sampling demonstrates that the water quality goals are being achieved (Bighorn Environmental et al., 2009).

Warm Springs Ponds OUs
Silver Bow Creek flows into the southern end of the Warm Springs Ponds, and flow in Silver Bow Creek is reestablished at the outflow from the ponds. The Warm Springs Ponds are divided into two OUs: the Active Area and the Inactive Area. For this document, they are considered together. Warm Springs Ponds drain into Silver Bow Creek, roughly ½ mile above the confluence of Warm Springs Creek and Silver Bow Creek (i.e., the start of the Clark Fork River). The ponds were constructed by the Anaconda Copper Mining Company in the early 20th Century to capture mine waste transported down Silver Bow Creek (U.S. Environmental Protection Agency, 2011d). The ponds precipitate and capture a significant portion of the metals load in Silver Bow Creek (Sando et al., 2014). However, arsenic is liberated in the ponds (Sando et al., 2014; U.S. Environmental Protection Agency, 2011d), which contributes a significant arsenic load. Arsenic concentrations in the ponds are cyclical, peaking in late summer and early fall. Recent studies conducted by Atlantic Richfield (U.S. Environmental Protection Agency, 2011d) have identified a complex suite of geochemical processes responsible for arsenic cycling in the ponds, related to photosynthesis, nutrients, organic compounds, and seasonal dilution. According to Sando et al. (2014), the reach of Silver Bow Creek between Opportunity and Warm Springs (essentially the ponds) accounts for 11% of the total arsenic load in the Clark Fork River below Missoula.

5.6.1.2 MPDES-Permitted Point Source Discharges Regulated Under CWA

Butte-Silver Bow Small Municipal Separate Storm Sewer System (MS4)
Under EPA's Stormwater Phase II Rule, Butte-Silver Bow is regulated as a small MS4 under a DEQ general permit (MTR040006). The Butte MS4 covers the Butte urban limits. A significant portion of this area is included in the BPSOU, which addresses metals contamination from CERCLA sources. Some area outside the BPSOU may be reasonably addressed under the other Butte Area Superfund Site OUs. These would include east Texas Avenue and the former Bell Smelter. Section 1.B of the permit states: "No discharge of stormwater containing pollutants from small MS4s covered under this General Permit may cause or contribute to a violation of water quality standards" (Montana Department of Environmental Quality, 2009). Butte-Silver Bow has developed construction standards and created a stormwater management plan in accordance with the permit stipulations, and releases a monthly report of stormwater mitigation activities.

Upstream of the BPSOU, stormwater drains to Blacktail Creek. Targets are commonly exceeded in lower Blacktail Creek during stormwater runoff. This is likely due to the combination of urban stormwater and low-hardness rainwater captured in a small headwaters drainage (U.S. Environmental Protection Agency, 2008). However, portions of the Blacktail Creek drainage are within the Westside Soils OU, another part of the Butte Area Superfund Site. The Bell Smelter operated in the late 19th Century near where Harrison Avenue crosses Blacktail Creek, and mine wastes may remain. According to the surface water characterization report (U.S. Environmental Protection Agency, 2008), lower Blacktail Creek contributes from 5% to 25% of the copper load that leaves the BPSOU. Blacktail Creek is not on the 303(d) list of impaired waters.

Butte-Silver Bow WWTP
The Butte-Silver Bow WWTP (MPDES Permit No. MT0022012) is a domestic wastewater treatment facility (WWTF) located at 800 Centennial Drive, Butte. The facility has a permit to discharge to Silver Bow Creek just below the outfall of Lower Area One. The permit provides effluent limits for five metals; cadmium, copper, lead, mercury, and zinc. The WWTP's permit was recently renewed with revised effluent limits that the plant must meet by January 1, 2016. Because Silver Bow Creek is an effluent-

dominated stream with no assimilative capacity due to upstream impairments, the effluent limits are set to achieve compliance with water quality standards at the point of discharge (i.e., "end-of-pipe"). Under high flow conditions, the WWTP discharge contributes only a minor percentage of the overall metals load in Silver Bow Creek. However, under low flow conditions, the treatment plant discharge roughly doubles the instream flow (average discharge is 5.97 cfs), and contributes a higher percentage (~24%) of the metals loads. This is particularly true of copper and zinc (**Table 5-24**). The Butte-Silver Bow facility is a minor source of mercury, with all results from 2010 through 2012 equal to 0.02 µg/L.

Rocker WWTP

The Rocker WWTP (MPDES Permit No. MT0027430) is a domestic WWTF located at 122030 Nissler Road, Rocker. The facility has a permit to discharge to Silver Bow Creek. The permit provides effluent limits for two metals: copper and zinc. The effluent limits were based on a WLA of the chronic aquatic life standard, and become effective January 1, 2017. Based on a review of sampling history captured in the recent permit Statement of Basis, the Rocker WWTP contributes very minor metals loads to Silver Bow Creek. The most significant contribution is zinc, which represents 1.2% of the instream load under low flow conditions.

Montana Resources, Inc.

MR has a MPDES permit (MT0000191) for a single Major Industrial outfall, discharging to Silver Bow Creek via MSD. However, MR does not discharge to Silver Bow Creek under normal operations, and has not since an accidental discharge in 1992. Representative sampling of potential discharge water reported in the permit shows that the contaminants of concern do not exceed targets. If MR were to discharge under the terms of the permit, the discharge should not contribute to impairment based on the reported concentrations.

REC Advanced Silicon Materials, Inc.

REC Advanced Silicon Materials, Inc., has an MPDES permit (MT0030350) for a minor industrial WWTF and stormwater discharge to Sheep Gulch, a tributary of Silver Bow Creek. Sheep Gulch is an ephemeral stream, but the effluent creates perennial flow. The facility is located at T3N, R9W, S35 in Silver Bow County. The current permit was issued in 2010 and provides effluent limits for three metals: copper, nickel and zinc. The previous permit had effluent limits for arsenic, cadmium and lead, but DEQ found that the facility does not have reasonable potential to exceed water quality standard for these metals, and the effluent limits for these were removed. The permit specifies that there is no mixing zone and the effluent limits are set to end-of-pipe. However, the hardness of the effluent (and therefore the receiving water) is high enough that the effluent limits in Sheep Gulch are calculated using 400 mg/L hardness. This results in relatively high effluent limits (for copper, an average monthly limit of 30.5 µg/L and maximum daily limit of 47.5 µg/L). Therefore, the facility is an appreciable source of copper in Silver Bow Creek under low flow conditions (an estimated 7% of the load at Opportunity). Under high flow conditions, however, the load from this discharge is less than 1% of the copper load in Silver Bow Creek.

The permit also provides effluent limits for an outfall to Silver Bow Creek. This outfall (003) has never been used and is an alternate outfall for the effluent normally discharged to Sheep Gulch. REC Advanced Silicon Materials, Inc., wanted to retain the outfall, so effluent limits for copper and zinc were also provided in the 2010 permit renewal. Due to the lower hardness in Silver Bow Creek, these limits are lower than those provided to the Sheep Gulch outfall.

MPDES-Permitted Discharge Load Summaries

The instream total metals load provided in **Table 5-24** is based on data collected in June and July 2012 at the USGS station 12323600 (Silver Bow Creek at Opportunity). This station is located below most metals sources on Silver Bow Creek, although streamside tailings are found downstream, as is the confluence with Mill-Willow Bypass. DEQ selected this station as the example because it is upstream of the complicating influence of Warm Springs Ponds, which acts as a sink for sediment-linked metals. As illustrated above in **Figure 5-1** in **Section 5.4.3.1**, excess metals loading is a problem during both high and low flow in Silver Bow Creek.

Mercury is not included in **Table 5-24** since the permitted sources either have very low concentrations of mercury in their effluent (e.g., Butte-Silver Bow) or do not sample for it. Mercury sources contributing to Silver Bow Creek are poorly understood, but mercury was known to be widely used in early mining and milling practices, particularly in the Alice Mine on Butte Hill (Joe Griffin, personal communication 2013). Mercury is also sediment-linked and therefore behaves similarly to the other metals identified as contaminants of concern in the Butte / Silver Bow Creek Superfund Site. The highest recently reported concentration in Silver Bow Creek is 0.28 µg/L at Opportunity, which is an order of magnitude greater than the concentrations detected in the Butte-Silver Bow WWTF effluent. The mercury concentrations detected just below the mouth of German Gulch were 0.06 µg/L, and 0.09 µg/L.

Table 5-24. Relative Metals Loads in Silver Bow Creek from MPDES-Permitted Discharges

Load Component	Arsenic (lbs/day)		Cadmium (lbs/day)		Copper (lbs/day)		Lead (lbs/day)		Zinc (lbs/day)	
	High Flow	Low Flow	High Flow	Low Flow	High Flow	Low Flow	High Flow	Low Flow	High Flow	Low Flow
Instream Total at Opportunity	12.98 (100%)	1.3 (100%)	1.05 (100%)	0.06 (100%)	98.49 (100%)	2.95 (100%)	30.52 (100%)	0.204 (100%)	210.3 (100%)	9.97 (100%)
Butte-Silver Bow WWTP	<0.15 (<1.2%)	<0.15 (<12%)	<0.033 (<3.1%)	<0.033 (<55%)	0.717 (0.7%)	0.717 (24.3%)	<0.3 (<1.0%)	<0.3 (<100%)	2.42 (1.2%	2.42 (24.3%)
Rocker WWTP	0.00054 (0.0%)	0.00054 (0.0%)	0.00002 (0.0%)	0.00002 (0.0%)	0.003 (0.0%)	0.003 (0.1%)	0.0021 (0.0%)	0.0021 (0.1%)	0.12 (0.1%)	0.12 (1.2%)
REC Advanced Silicon Materials, Inc.	0.038* (0.3%)	0.038* (2.9%)	<0.0011 * (<0.1%)	<0.0011 * (<1.8%)	0.21 (0.2%)	0.21 (7.1%)	0.012* (0.0%)	0.012* (5.9%)	0.69 (0.1%)	0.69 (1.9%)
Remainder: CERCLA; tribs	12.79 (98.5%)	1.11 (85.5%)	1.02 (96.8%)	0.03 (43.1%)	96.85 (98.3%)	2.02 (68.5%)	30.21 (99.0%)	<0.189 (<93%)	207.7 (98.5%)	6.74 (67.6%)

Individual source loads are compared to loads calculated at USGS gage at Opportunity

*Average loads are based on summaries in the 2010 permit fact sheet as permittee no longer monitors for these

5.6.1.3 Metals-Impaired Tributaries

Metals-impaired tributary streams constitute an additional source of metals to Silver Bow Creek. These include German Gulch and the Mill-Willow Bypass (which carries the combined flows of Mill and Willow creeks). The instream metals loads from **Table 5-23** are used to evaluate the relative contributions of metals loads to Silver Bow Creek. The percent reductions and load reductions needed to meet the tributary TMDLs provide insight into the magnitude of the tributary load under both high and low flow conditions, and the degree to which meeting the tributary TMDL would improve metals loading in Silver Bow Creek. A 0% reduction implies no load reductions are needed to meet the tributary TMDL, and although a load is contributed, the added load does not contribute to impairment in Silver Bow Creek since the concentrations are below the water quality target for the given flow condition.

German Gulch

German Gulch (MT76G003_030) has completed TMDLs for arsenic and cyanide. According to the example TMDLs provided in the Upper Clark Fork Tributaries TMDL document (**Table 5-25**), German Gulch has typical arsenic loads of 0.09 lbs/day during high flow, and 0.012 lbs/day during low flow. Load reductions required to meet the TMDL are relatively small and the corresponding loads above the TMDL are minor compared to the overall instream arsenic load in Silver Bow Creek.

Table 5-25. TMDL Examples for German Gulch

Metal	Flow Conditions	TMDL (lbs/day)	Percent Reduction Needed	Load Reduction Needed (lbs/day)
Arsenic	High flow	0.065	29%	0.091
	Low flow	0.011	9%	0.001

Modified from Table 7-49 in the Upper Clark Fork Tributaries TMDL document

Mill-Willow Bypass

Mill-Willow Bypass (MT76G002_120) has completed TMDLs for arsenic, cadmium, copper, lead, and zinc, shown below in **Table 5-26**. The Mill-Willow Bypass carries the combined flows of Mill Creek and Willow Creek, both of which are metals-impaired. These two creeks are the major sources of metals to Mill-Willow Bypass, but metals are also contributed by groundwater seepage from the Warm Springs Ponds and Opportunity Ponds, and pipe drains from the banks of Warm Springs Pond 3 (Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, 2010). Mill-Willow Bypass is an appreciable source of arsenic, copper, and lead. However, since the confluence with Silver Bow Creek is located below Warm Springs Ponds, the copper and lead are somewhat offset by the reduction in total recoverable metals by treatment in the ponds (Sando et al., 2014), discussed below. Mill-Willow Bypass adds a high flow arsenic load of up to nearly 40 pounds/day according to the Upper Clark Fork Tributaries TMDL document (Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, 2010). While this load is based on the highest reported concentration, the Mill-Willow Bypass is a considerable source of arsenic to Silver Bow Creek. Arsenic concentrations in the Mill-Willow Bypass tend to be similar to the concentrations at the Silver Bow Creek station at Warm Springs. The combined effect of Warm Springs Ponds and Mill-Willow Bypass results in a doubling of the arsenic load in Silver Bow Creek (Sando et al., 2014). Meeting the copper and lead TMDLs would result in minor, but measurable, load reductions to Silver Bow Creek during high flows. Meeting the arsenic TMDL would remove significant arsenic loads from the lower reach of Silver Bow Creek during both high and low flow conditions. However, the EPA amended the Anaconda Smelter Superfund Site ROD in 2011 (U.S. Environmental Protection Agency, 2011b) and issued a TI waiver for arsenic in groundwater and surface water in the South Opportunity Subarea (Mill and Willow creeks). Some remedial actions remain to be completed, but the goal is no longer to meet the 10 µg/L human health standard in Mill and Willow creeks. This reduces the likelihood of meeting the arsenic TMDL in Mill-Willow Bypass. However, Mill-Willow Bypass is a B-1 waterbody with no TI waivers, and the approved TMDL and human health standard still apply to it.

Table 5-26. Example Metals TMDLs and Load Reductions for the Mill-Willow Bypass

Metal	Flow Conditions	TMDL (lbs/day)	Percent Reduction Needed	Load Reduction Needed (lbs/day)
Arsenic	High flow	11.556	71%	28.3
	Low flow	0.474	55%	0.58
Cadmium	High flow	0.300	0%	0
	Low flow	0.021	0%	0
Copper	High flow	10.320	50%	5.2
	Low flow	0.799	0%	0
Lead	High flow	3.444	38%	2.1
	Low flow	0.364	0%	0
Zinc	High flow	132.570	0%	0
	Low flow	10.209	0%	0

Modified from Table 7-56 in the Upper Clark Fork Tributaries TMDL document

5.6.1.4 Warm Springs Ponds

Numerous studies (Sando et al., 2014) have demonstrated that the Warm Springs Ponds are a metals sink, due to metals-laden sediment settling out of suspension. However, Warm Springs Ponds have become a source of arsenic in recent years (U.S. Environmental Protection Agency, 2011d; Sando et al., 2014). The fate of the Warm Springs Ponds is subject to Superfund remediation, but is still undetermined.

The effect of Warm Springs Ponds on metals that are largely sediment-linked, like copper, is readily apparent in **Figure 5-16**, which plots metals data from the Silver Bow Creek at Warm Springs station, located just below Warm Springs Ponds. In sharp contrast to the pattern at Opportunity shown above in **Figure 5-1** (**Section 5.4.3.1**, p. 5-5), the metals concentrations are nearly meeting the targets. Arsenic, however, consistently exceeds the target, demonstrating the mobilization of arsenic in the ponds.

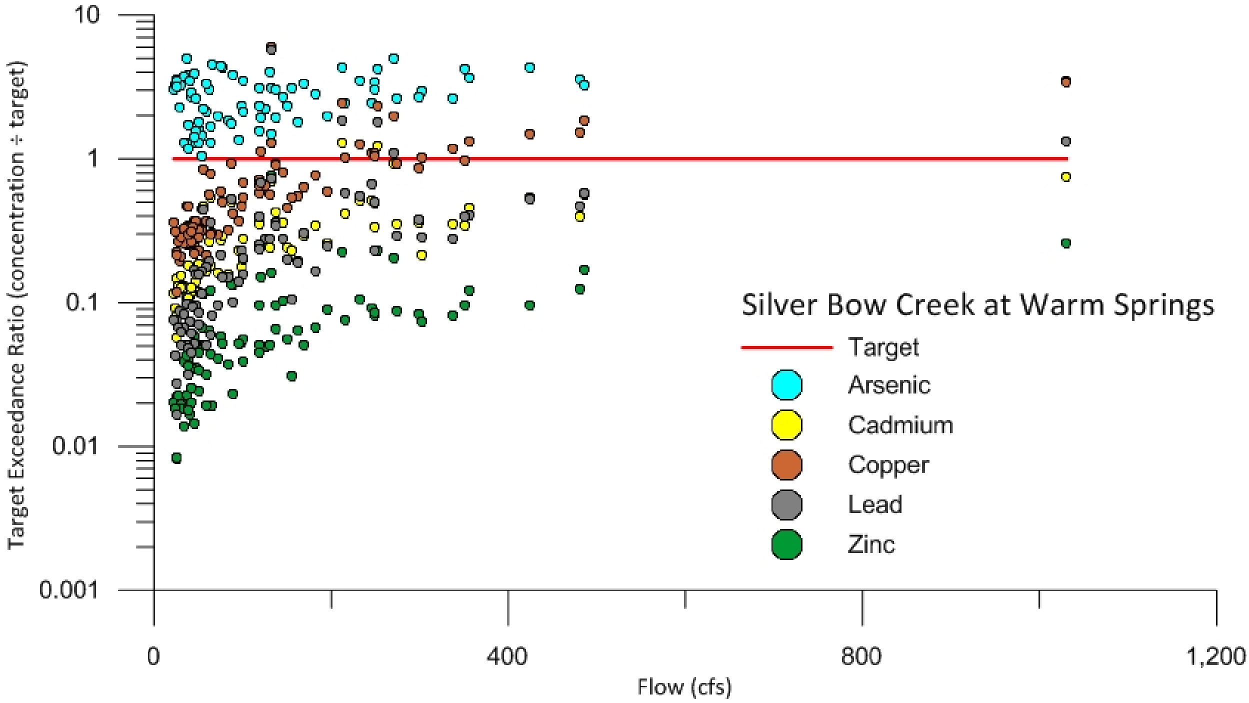

Figure 5-16. Target Exceedances versus Flow in Silver Bow Creek at Warm Springs

5.6.1.5 Background Metals Concentrations

Silver Bow Creek is a headwaters stream draining mineralized geology. As such it likely had some measurable concentrations of metals from geologic sources prior to mining disturbance. The naturally occurring background metals concentrations in Silver Bow Creek are beyond reconstruction. However, streams draining similar areas of similar geology (e.g. the headwaters of the Boulder River) provide some suggestion of what the background concentrations might be. Therefore, concentrations in Bison Creek and the upper Boulder River provide a proxy for the natural background concentrations in Silver Bow Creek. Two sample sites that DEQ used to establish metals background concentrations for the Boulder-Elkhorn metals TMDL project were BE-16 on Bison Creek and BE-28 on the upper Boulder River. The median concentrations of arsenic, copper, iron, lead and zinc from these sites are adopted as the estimates of geologic background concentrations. For cadmium, the method detection level of 0.08 µg/L is adopted as the background concentration. The background concentration for mercury, is based on one-half the detection limit, the same approach used in DEQ's Flint Creek TMDL document (Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau, 2012). This value was chosen based on a statewide analysis of mercury samples. This (enlarged) sample pool was re-evaluated in 2014, and DEQ determined that this estimate was still appropriate.

Table 5-27. Estimation of Natural Background Metals Concentrations in Silver Bow Creek

Site	Date	Arsenic	Cadmium	Copper	Iron*	Lead	Mercury	Zinc
Bison Creek (BE-16)	6/9/2009	5	<0.08	7	490	<0.5	<0.05	<10
Bison Creek (BE-16)	8/18/2009	5	<0.08	4	320	<0.5	<0.05	10
Bison Creek (BE-16)	6/9/2010	6	<0.08	10	790	0.8	—	<10
Bison Creek (BE-16)	7/19/2010	9	0.13	13	2,120	3.2	—	10
Bison Creek (BE-16)	8/19/200	5	<0.08	4	370	<0.5	—	<10
Bison Creek (BE-16)	9/30/2010	4	<0.08	3	300	<0.5	—	<10
Upper Boulder (BE-28)	6/9/2009	4	<0.08	3	320	<0.5	<0.05	<10
Upper Boulder (BE-28)	8/18/2009	4	<0.08	1	250	<0.5	<0.05	<10
Median Concentrations	—	5	—	4	345	2	—	10
Estimated Background	—	**5**	**0.08**	**4**	**345**	**2**	**0.025**	**10**

*All units in µg/L, total recoverable except for iron (mg/L)

5.6.2 Clark Fork River: Warm Springs Creek to Cottonwood Creek (MT76G001_040) Source Assessment

Average metals loads carried by this segment of the Clark Fork River as calculated at the USGS gage 12324200 (Clark Fork at Deer Lodge) are provided below in **Table 5-28**, based on data from 2012.

Table 5-28. Existing Loads (lbs/day) and Associated Concentrations (µg/L)

Flow Condition	Cadmium	Copper	Iron	Lead
High Flow (736 cfs)	3.10, 0.78	874.37, 220	17,050, 4,290	130.3, 32.8
Low Flow (200 cfs)	0.160, 0.15	29.94, 26.8	403.9, 374	3.14, 2.9

This AU corresponds to the upper half of Reach A of the Clark Fork River OU. This reach is characterized by a broad valley with extensive streambank and streamside deposits of tailings. According to the recent USGS water quality trends report (Sando et al., 2014), this reach is the major instream source of suspended metals load to the Clark Fork River.

This segment has both internal and external sources of metals. Tailings are the major internal source of metals. The tailings are predominantly found in sand-sized streambed sediment and in overbank and streambank deposits locally known as "slickens." External sources include the Superfund sites upstream in Butte and Anaconda, as well as metals-impaired tributary streams.

As shown below in **Figure 5-17**, based on samples collected at USGS station 12324200 (which is located just downstream of Cottonwood Creek in the next segment), metals concentrations display a strong relationship to discharge (and therefore seasonality). This is further evidence of the linkage of metals to sediment. Copper concentrations exceed the target throughout the year, but other metals impairments are similarly associated with high flows.

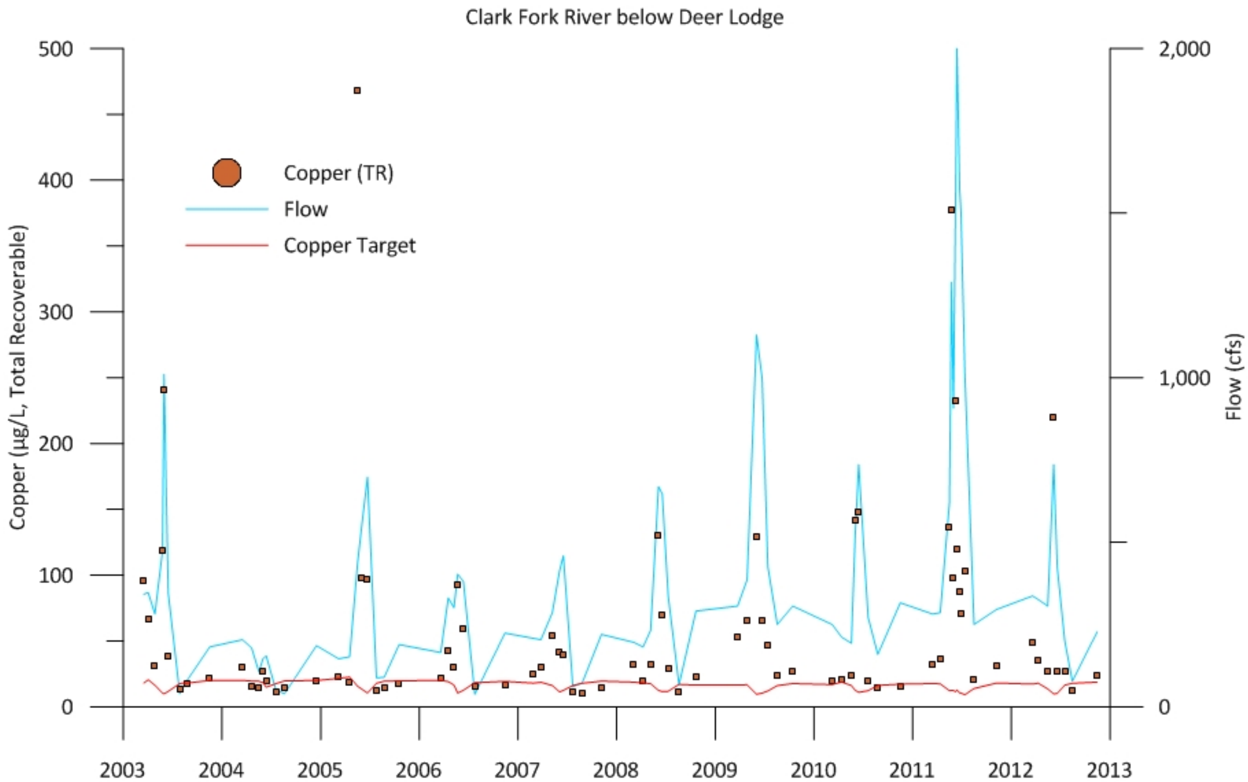

Figure 5-17. Copper Concentrations in the Clark Fork River below Deer Lodge

5.6.2.1 Superfund Sites Regulated Under CERCLA

Warm Springs Ponds
Warm Springs Ponds discharge into Silver Bow Creek approximately ½ mile above the confluence with Warm Springs Creek and the start of the Clark Fork River. While the ponds are discussed above as sources to Silver Bow Creek, any change in their management has the potential to have a considerable effect on metals loads in this segment of the Clark Fork River.

Mainstem Clark Fork River OU
This OU of the Milltown Reservoir / Clark Fork River Superfund Site includes streambank tailings and slickens along the river corridor. Metals loads increase along the length of this AU as this metals load is mobilized by the river. Water quality below the confluence of Silver Bow and Warm Springs Creek is close to meeting targets for trace metals, but metals concentrations are high at Deer Lodge. As noted above, the USGS determined that this reach of the river is the major instream source of metals to the Clark Fork River. The loads contributed in this reach are great enough to effectively mask water quality improvements in Silver Bow Creek (Sando et al., 2014).

5.6.2.2 MPDES-Permitted Point Sources
Montana Behavioral Health, located at 5824 Yellowstone Trail in Galen has a MPDES permit (MT0021431) to discharge from the Galen campus WWTF to an unnamed irrigation ditch, tributary to the Clark Fork River. The permit has no effluent limits for metals, but monitoring for arsenic and copper is required. However, no copper data was available in the EPA Integrated Compliance Information

System (ICIS) database for characterizing this discharge. The discharge is minor, averaging about 0.006 cfs.

The Montana State Hospital WWTP at Warm Springs has a MPDES permit to operate a WWTP. As the system has an average design flow less than one million gallons per day and does not have any significant industrial contributors, it operates under a general domestic sewage treatment lagoon permit (MTG580004). The facility includes three facultative lagoons. The discharge from the system is reported to be 210,800 gallons per day, or 0.326 cfs) (HDR Engineering, Inc., 2011).

Although no water quality data are available to characterize the effluent loads, copper and lead loads may be estimated using the reported discharge rate and typical effluent concentrations from other facilities. Per consultation with DEQ Technical and Financial Assistance Bureau engineering staff, East Helena is used as a proxy, based on similarly aged construction also using copper and lead plumbing (Paul Lavigne, personal communication 2014). Copper concentrations of 16.9 µg/L and lead concentrations of 1.36 µg/L (Robert Peccia & Associates, 2011), along with average discharge rates of 0.006 and 0.33 cfs result in the following estimated loads:

Montana Behavior Health:
Copper: 16.9 µg/L x 0.006 cfs x 0.0054 = 0.00054 lbs/day
Lead: 1.36 µg/L x 0.006 cfs x 0.0054 = 0.00004 lbs/day

Montana State Hospital:
Copper: 16.9 µg/L x 0.33 cfs x 0.0054 = 0.03 lbs/day
Lead: 1.36 µg/L x 0.33 cfs x 0.0054 = 0.002 lbs/day

No data are available to characterize the cadmium or iron loads from these discharges, but they are expected to be similarly small.

5.6.2.3 Metals Impaired Tributary Streams

Other sources of metals to this segment include metals impaired tributary streams: Silver Bow Creek, Warm Springs Creek, Lost Creek, Modesty Creek, and Peterson Creek. Of these, Warm Springs Creek is the most significant source of metals (**Table 5-29**).

Table 5-29. Comparison of Loads from Metals-Impaired Tributary Streams

Load Component	Cadmium (lbs/day)		Copper (lbs/day)		Iron (lbs/day)		Lead (lbs/day)	
	High Flow	Low Flow	High Flow	Low Flow	High Flow	Low Flow	High Flow	Low Flow
Instream Total at Deer Lodge	3.1 (100%)	0.16 (100%)	874.4 (100%)	28.9 (100%)	17,050 (100%)	403.9 (100%)	130.4 (100%)	3.14 (100%)
Silver Bow Creek	0.2 (6.5%)	0.02 (13%)	14.48 (1.7%)	1.69 (5.8%)	690.8 (4.1%)	65.0 (16.1%)	3.1 (2.4%	0.34 (10.8%)
Warm Springs Creek	0.21 (6.8%)	0.08 (50%)	53.8 (6.2%)	1.69 (5.8%)	860.3 (5.0%)	216 (53.5%)	5.24 (4.0%)	1.15 (36.6%)
Lost Creek	-	-	1.51 (0.2%)	0.053 (0.2%)	-	-	0.23 (0.2%)	0.019 (0.6%)
Modesty Creek	0.01 (0.5%)	0.02 (13.8%)	0.58 (0.1%)	0.87 (3.0%)	-	-	0.35 (0.3%)	0.48 (15.3%)
Peterson Creek	-	-	-	-	129.9 (0.8%)	0.65 (0.2%)	-	-

Table 5-29. Comparison of Loads from Metals-Impaired Tributary Streams

Load Component	Cadmium (lbs/day)		Copper (lbs/day)		Iron (lbs/day)		Lead (lbs/day)	
	High Flow	Low Flow	High Flow	Low Flow	High Flow	Low Flow	High Flow	Low Flow
Remainder: CERCLA, point sources	2.68 (86.3%)	0.04 (23.8%)	803.9 (91.9%)	23.5 (81.1%)	15,369 (90.1%)	122.3 (30.3%)	121.5 (93.2%)	1.15 (36.7%)

Tributary loads are taken from the Upper Clark Fork Tributaries TMDL document

Silver Bow Creek

Silver Bow Creek (as discussed above in **Section 5.6.1**) is a source of metals to this AU of the Clark Fork River. However, much of the metals load is captured in the Warm Springs Ponds, approximately one-half mile above the start of the Clark Fork River, as shown above in **Figure 5-16**. Accordingly, Silver Bow Creek does not contribute significantly to metals impairment of this segment of the Clark Fork River.

Warm Springs Creek

Warm Springs Creek (MT76G002_012) has completed TMDLs for arsenic, cadmium, copper, iron, lead, and zinc. However, this AU of the Clark Fork River is not impaired by arsenic. As a C-2 classified stream, the HHS does not apply and arsenic levels do not exceed the aquatic life target (**Section 5.4.2**). **Table 5-29** shows that metals loading from Warm Springs Creek can represent a significant load to this segment of the Clark Fork River, somewhat because of the relatively significant flow associated with Warm Springs Creek. In fact, the data within **Table 5-30** show that at low flow conditions Warm Springs Creek does not contribute to target or TMDL exceedances within the Clark Fork River. The data within **Table 5-30** also show that the high flow load reductions needed to meet the Warm Springs metals TMDLs are relatively small when compared to the existing loads identified in **Table 5-29**. Nevertheless, these load reductions, if not attained, could contribute to exceedances of the TMDL for this segment of the Clark Fork River by more than 50% for copper, and approximately 10% for iron and lead at high flow conditions and for cadmium at low flow conditions (see **Table 5-20** in **Section 5.5**). Data in **Table 5-30** are based on the greatest target exceedances and therefore represent worst-case scenarios and highest loading conditions (Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, 2010, p. 175).

Table 5-30. Example Metals TMDLs and Load Reductions for Warm Springs Creek

Metal	Flow Conditions	TMDL (lbs/day)	Percent Reduction Needed	Load Reduction Needed (lbs/day)
Cadmium	Storm event	0.078	42%	0.56
	High flow	0.168	20%	0.042
	Low flow	0.080	0%	0
Copper	Storm event	2.689	87%	18
	High flow	5.924	89%	48
	Low flow	2.849	0%	0
Iron	Storm event	270.0	--	0
	High flow	507.6	41%	353
	Low flow	216.0	0%	0
Lead	Storm event	0.9480	63%	1.61
	High flow	2.254	57%	3.0
	Low flow	1.151	0%	0

Modified from Table 7-64 in the Upper Clark Fork Tributaries TMDL document

Lost Creek

Lost Creek (MT76G002_072) is impaired by arsenic, copper, and lead. However, this AU of the Clark Fork River is not impaired by arsenic. As a C-2 classified stream, the HHS does not apply and arsenic levels do not exceed the aquatic life target. Per **Table 5-31**, Lost Creek is a much less significant source of copper and lead than Warm Springs Creek, and meeting the TMDLs will result in relatively minor overall loading reductions to the Clark Fork River.

Table 5-31. Example Metals TMDLs and Load Reductions for Lost Creek

Metal	Flow Conditions	TMDL (lbs/day)	Percent Reduction Needed	Load Reductions Needed (lbs/day)
Copper	Storm event	0.033	85%	0.187
	High flow	0.651	57%	0.86
	Low flow	0.053	0%	0
Lead	Storm event	0.012	64%	0.021
	High flow	0.207	9%	0.02
	Low flow	0.019	0%	0

Modified from Table 7-53 from the Upper Clark Fork Tributaries TMDL document

Modesty Creek

Modesty Creek (MT76G002_080) has completed TMDLs for arsenic, cadmium, copper, and lead. However, this AU of the Clark Fork River is not impaired by arsenic. As a C-2 classified stream, the HHS does not apply and arsenic levels do not exceed the aquatic life target. Per **Table 5-32**, Modesty Creek is a relatively insignificant source of elevated metals loading and meeting the TMDLs will result in relatively minor overall loading reductions to the Clark Fork River.

Table 5-32. Example Metals TMDLs and Load Reductions for Modesty Creek

Metal	Flow Conditions	TMDL (lbs/day)	Percent Reduction Needed	Load Reductions Needed (lbs/day)
Arsenic	Storm event	0.081	57%	0.11
	High flow	0.199	23%	0.59
	Low flow	0.345	29%	0.14
Cadmium	Storm event	0.003	23%	0.0009
	High flow	0.014	0%	0
	Low flow	0.022	0%	0
Copper	Storm event	0.108	48%	0.10
	High flow	0.579	0%	0
	Low flow	0.866	0%	0
Lead	Storm event	0.044	45%	0.36
	High flow	0.345	0%	0
	Low flow	0.480	0%	0

Modified from Table 7-57 in the Upper Clark Fork Tributaries TMDL document

Peterson Creek

Peterson Creek (MT76G002_131) has a completed TMDL for iron. Per **Table 5-33**, Peterson Creek is a relatively insignificant source of elevated iron loading and meeting the iron TMDL will result in a very minor loading reduction to the Clark Fork River.

Table 5-33. Example Metals TMDLs and Load Reductions for Peterson Creek

Metal	Flow Conditions	TMDL (lbs/day)	Percent Reduction Needed	Load Reductions Needed (lbs/day)
Iron	High flow	62.370	52%	67.6
	Low flow	0.648	0%	0

Modified from Table 7-59 in the Upper Clark Fork Tributaries TMDL document

5.6.3 Clark Fork River, Cottonwood Creek to Little Blackfoot River (MT76G001_030) Source Assessment

This AU is included within the lower half of the Clark Fork River OU's Reach A. Sources of metals to this segment include tailings within the AU, and the AU immediately upstream. Average existing loads calculated at the USGS gage 12324400 above the Little Blackfoot, based on data from 2012, are provided below in **Table 5-34**.

Table 5-34. Existing Loads (lbs/day) and Associated Concentrations (µg/L)

	Arsenic*	Cadmium	Copper	Iron	Lead	Zinc
High Flow (994 cfs)	222.2 (41.4)	4.51, 0.84	1,192, 222	20,719, 3,860	173.4, 32.3	971.5, 181
Low Flow (189 cfs)	21.3 (20.9)	0.09, 0.09	17.5, 17.2	116.4, 114	1.12, 1.1	9.19, 9.0

*There is no arsenic impairment for this C-1 waterbody; loads are presented for comparison downstream

5.6.3.1 Superfund Sites Regulated Under CERCLA

The river corridor for the entire length of this AU is included within the Clark Fork River OU of the Milltown Reservoir / Clark Fork River Superfund Site. The streambank and streambed sediments within this segment are a source of metals to river in this segment. This segment is a lesser source of total metals loading than the upstream segment, however (Sando et al., 2014).

5.6.3.2 MPDES-Permitted Point Source Discharges Regulated Under CWA

The Deer Lodge WWTP (MPDES Permit No. MT0022616) is a domestic WWTF located at 198 North Frontage Road, Deer Lodge. The current permit for the Deer Lodge WWTP was issued in September 2006. The permit is expired and has been under administrative extension since 2009. The current permit does not provide effluent limits for metals, but sampling is required for: antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc.

Review of the last 3 years of effluent sampling data (**Table 5-35**) shows that the effluent from the Deer Lodge plant generally does not exceed targets (which are based on chronic aquatic life criteria, due to the C-1 classification of the receiving water).

Table 5-35. Deer Lodge WWTP Effluent Characteristics

Metal	Average Effluent Concentration	Target (at 164 mg/L hardness)	Average Load (at 4 cfs)
Cadmium	0.07 µg/L	0.39 µg/L	0.0015 lbs/day
Copper	5.78 µg/L	14.2 µg/L	0.0349 lbs/day
Lead	0.34 µg/L	5.9 µg/L	0.0073 lbs/day
Zinc	13.37 µg/L	182 µg/L	0.2887 lbs/day

Average based on five samples reported between January 2011 and January 2013

Effluent flows from the Deer Lodge plant vary seasonally, with winter flows generally under one million gallons per day (approximately 1.5 cfs) and summer flows of 2.5–3 million gallons per day (3.8–4.6 cfs). Overall, the loading from this facility is insignificant.

A new plant is planned and a new permit will be issued. DEQ anticipates that the planned facility will match or better the current metals treatment. However, Deer Lodge also intends to make infiltration and inflow improvements to the sewer system to reduce the influent (and effluent) volumes, which are high for a city of this size. Reviewing the influent water quality data, it appears as though the influent metals concentrations are relatively low (e.g., 7–14 µg/L for copper). It is conceivable that the existing low metals concentrations are partly due to dilution by these large volumes and concentrations could rise as a result of the improvements.

5.6.3.3 Upstream Sources

No metals-impaired tributary streams join the river in this segment. The segment of the Clark Fork River just upstream has high concentrations of metals, and therefore is a major source of metals to this segment. Loads and concentrations from this Clark Fork River segment (**Table 5-34**) can be roughly compared to loads and concentrations from the upstream segment (**Table 5-28**; **Section 5.6.2**). At high flow conditions the loads generally increase while concentrations remain similar for cadmium, copper, lead and iron. This suggests that high flow impacts from streambanks and stream sediment within this segment of the Clark Fork River may be consistent with the streambank and stream sediment water quality impacts in the upstream Clark Fork River segment. All low flow loading and associated concentrations are significantly lowered within this segment in comparison to the upstream segment.

5.6.4 Clark Fork River, Little Blackfoot River to Flint Creek (MT76G001_010) Source Assessment

This AU roughly corresponds to Reach B of the Clark Fork River OU. This reach of the river is characterized by a narrower valley, with fewer slickens and fewer evident tailings layers in streambanks (U.S. Environmental Protection Agency, 2004). The USGS (Sando et al., 2014) established that this reach "contributes proportionally much less than Reach 5 to copper loading in the Clark Fork." (Reach 5 in the USGS report extends from the gage at Galen to the gage at Deer Lodge, which corresponds roughly to the segment between Warm Springs Creek and Cottonwood Creek.) Existing loads at the USGS station 12324680 at Gold Creek are provided below in **Table 5-36**, based on data from 2012.

Table 5-36. Existing Loads (lbs/day) and Associated Concentrations (µg/L)

	Arsenic	Cadmium	Copper	Iron	Lead	Mercury
High Flow (1,730 cfs)	243.8 (26)	4.95 (0.53)	1,056 (113)	27,465 (2,940)	185.9 (20)	1.34* (0.15)
Low Flow (362 cfs)	24.0 (12)	0.09 (0.045)	18.0 (9.2)	145.0 (74)	0.78 (0.4)	<0.001* (<0.01)

*Flows of 1,660 and 179 cfs

Sources of metals to this AU include: tailings within the AU, metals from the AU directly upstream, and metals-impaired tributary streams including: the Little Blackfoot River, Gold Creek, and Dunkleberg Creek.

5.6.4.1 Superfund Sites Regulated Under CERCLA

The entire length of this AU is included within the Clark Fork River OU of the Milltown Reservoir / Clark Fork River Superfund Site. This segment corresponds to the Drummond Valley – Reach B of the OU.

Slickens are present in this segment, but in smaller and more discontinuous deposits than found in the Deer Lodge Valley (U.S. Environmental Protection Agency, 2004).

5.6.4.2 Upstream Sources

As mentioned above, the Clark Fork River immediately upstream is a major source of the metals loads to this AU, relaying suspended metals that largely originate in the first AU of the Clark Fork River (Sando et al., 2014). This is supported by comparing loads and concentrations from this Clark Fork River segment (**Table 5-36**) to loads and concentrations from the upstream segment (**Table 5-34**; **Section 5.6.3**). At high flow conditions the loads have relatively minor increases even with significant increases in flow, while concentrations significantly decrease.

5.6.4.3 Metals-Impaired Tributary Streams

Little Blackfoot River

The Little Blackfoot River (Dog Creek to the mouth; MT76G004_010) has completed TMDLs for arsenic and lead, presented below in **Table 5-37**. During high flow conditions, the flow in the Little Blackfoot is generally comparable to flow in the Clark Fork River (Sando et al., 2014; U.S. Environmental Protection Agency, 2004), although under low flow conditions flows in the Little Blackfoot are considerably lower than in the Clark Fork River.

Table 5-37. Example Metals TMDLs and Load Reductions for the Little Blackfoot River

Metal	Flow	TMDL (lbs/day)	Percent Reduction Needed	Load Reduction Need (lbs/day)
Arsenic	High flow	83.997	29%	33.6
	Low flow	3.143	0%	0
Lead	High flow	16.043	79%	61.2
	Low flow	1.505	0%	0

Modified from Table 7-31 in the Little Blackfoot River Watershed TMDL document

The above **Table 5-37** is modified from the Little Blackfoot River Watershed TMDLs and Framework Water Quality Improvement Plan (Montana Department of Environmental Quality and U.S. Environmental Protection Agency, Region 8, 2011). Although this water chemistry data was collected in 2008, the Little Blackfoot watershed has not been subject to intensive remediation, and DEQ assumes that the data in the Little Blackfoot River TMDL reflects current conditions.

Target exceedances in the Little Blackfoot River are generally limited to high flow conditions, and are linked to particulates originating in the headwater regions of the Little Blackfoot River watershed (Montana Department of Environmental Quality and U.S. Environmental Protection Agency, Region 8, 2011). Comparison of **Tables 5-36** and **5-37** demonstrates that the Little Blackfoot River can be a significant source of arsenic and lead to the Clark Fork River during high flow: over 40% of the total load for each impairment cause. This contribution drops to less than 10% during low flow. The **Table 5-37** results are based on the highest target and associated TMDL exceedance values and therefore represent worse case (highest) loading conditions (Montana Department of Environmental Quality and U.S. Environmental Protection Agency, Region 8, 2011, p. 7-29). Note, however, that comparison of instream arsenic and lead loads between Clark Fork River segments (**Tables 5-34** and **5-36**) suggest a lower average high flow influence from the Little Blackfoot River. Similarly, in the early 1990s, the USGS (Smith et al., 1998) concluded that the Little Blackfoot River was a minor (~10%) source of lead to the mainstem Clark Fork River on an annual basis. However, the metals loads in the Clark Fork River have declined in the last 15 years (Sando et al., 2014) whereas the loads in the Little Blackfoot River have probably remained more or less static, and may represent a relatively larger contribution. The arsenic and lead load reductions, if not attained, could contribute to exceedances of the TMDL for this segment of the Clark Fork River (see **Table 5-20** in **Section 5.5**) by more than 35% for arsenic and more than 150% for lead in some high flow conditions.

The Little Blackfoot River is not currently listed as impaired by mercury. Recent sampling by DEQ (2012–2013) did not find any target exceedances. Three of four samples did not contain detectable concentrations of mercury. The detected concentration was 0.04 µg/L, below the target of 0.05 µg/L. At the corresponding flow of 24 cfs, the estimated load is 0.0052 lbs/day.

Gold Creek

The lower segment of Gold Creek (MT76G005_091) has completed TMDLs for lead and iron. The loads and associated reductions represent relatively minor contributions to the Clark Fork River (**Table 5-38**).

Table 5-38. Example Metals TMDLs and Load Reductions for Gold Creek

Metal	Flow Conditions	TMDL (lbs/day)	Percent Reduction Needed	Load Reduction Needed (lbs/day)
Iron	High flow	470.718	29%	192
	Low flow	37.206	0%	0
Lead	High flow	1.478	0%	0
	Low flow	0.413	0%	0

Modified from Table 7-52 in the Upper Clark Fork Tributaries TMDL document

Dunkleberg Creek

The lower segment of Dunkleberg Creek (MT76G005_071) has completed TMDLs for arsenic, cadmium, copper, iron, lead and zinc. The loads and associated reductions are relatively minor (**Table 5-39**) due to the small flow in the creek.

Table 5-39. Example Metals TMDLs and Load Reductions for Dunkleberg Creek

Metal	Flow Conditions	TMDL (lbs/day)	Percent Reduction Needed	Load Reduction Needed (lbs/day)
Arsenic	High flow	0.432	33%	0.21
	Low flow	0.162	--	
Cadmium	High flow	0.013	0%	0
	Low flow	0.006	--	
Copper	High flow	0.467	55%	0.57
	Low flow	0.214	--	
Iron	High flow	43.200	28%	16.8
	Low flow	16.200	--	
Lead	High flow	0.172	32%	0.08
	Low flow	0.086	--	
Zinc	High flow	5.998	0%	0
	Low flow	2.737	--	

Modified from Table 7-47 in the Upper Clark Fork Tributaries TMDL document. “--“ indicates no data available

5.6.5 Clark Fork River, Flint Creek to Blackfoot River (MT76E001_010) Source Assessment

This segment of the Clark Fork River includes both Reach C of the Mainstem Clark Fork River OU as well as the Milltown Reservoir OU. Reach C occupies a narrow canyon with few if any streambank exposures of tailings (Sando et al., 2014; U.S. Environmental Protection Agency, 2004). The existing loads, estimated at USGS station 12334550 (Clark Fork at Turah Bridge) are provided below in **Table 5-40**, based on data from 2012.

Table 5-40. Existing Loads (lbs/day) and Associated Concentrations (µg/L)

	Arsenic	Cadmium	Copper	Iron	Lead	Mercury	Zinc
High Flow (4,820 cfs)	296.7 (11.4)	6.77 (0.26)	1,294 (49.7)	34,878 (1,340)	229.0 (8.8)	1.11* (0.12)	1,512 (58)
Low Flow (1,120 cfs)	32.0 (5.3)	0.30 (0.05)	22.9 (3.8)	290.3 (48)	1.21 (0.2)	<0.001* (<0.01)	22.9 (3.8)

*Flows of 1,720 and 275, at Clark Fork near Drummond

Loading increases from the upstream segment (**Table 5-36**, **Section 5.6.4**) are relatively minor compared to the significant increase in flow, and there are significant concentration decreases for arsenic, cadmium, copper, iron and lead.

Figure 5-18 is a plot of copper concentrations, aquatic life criteria, and flow recorded at the USGS gage near Drummond (12331800) over a 10-year period. This example illustrates the sediment source of metals impairment to water quality. The highest concentration each year tends to be detected just prior to the peak of the hydrograph, and the concentrations decline with the falling limb. This graph also illustrates that 2011 was a high flow year. This may have produced a flushing effect, possibly accounting for the lower metals concentrations detected in 2012 (more dramatically in downstream segments). The other metals follow a similar pattern.

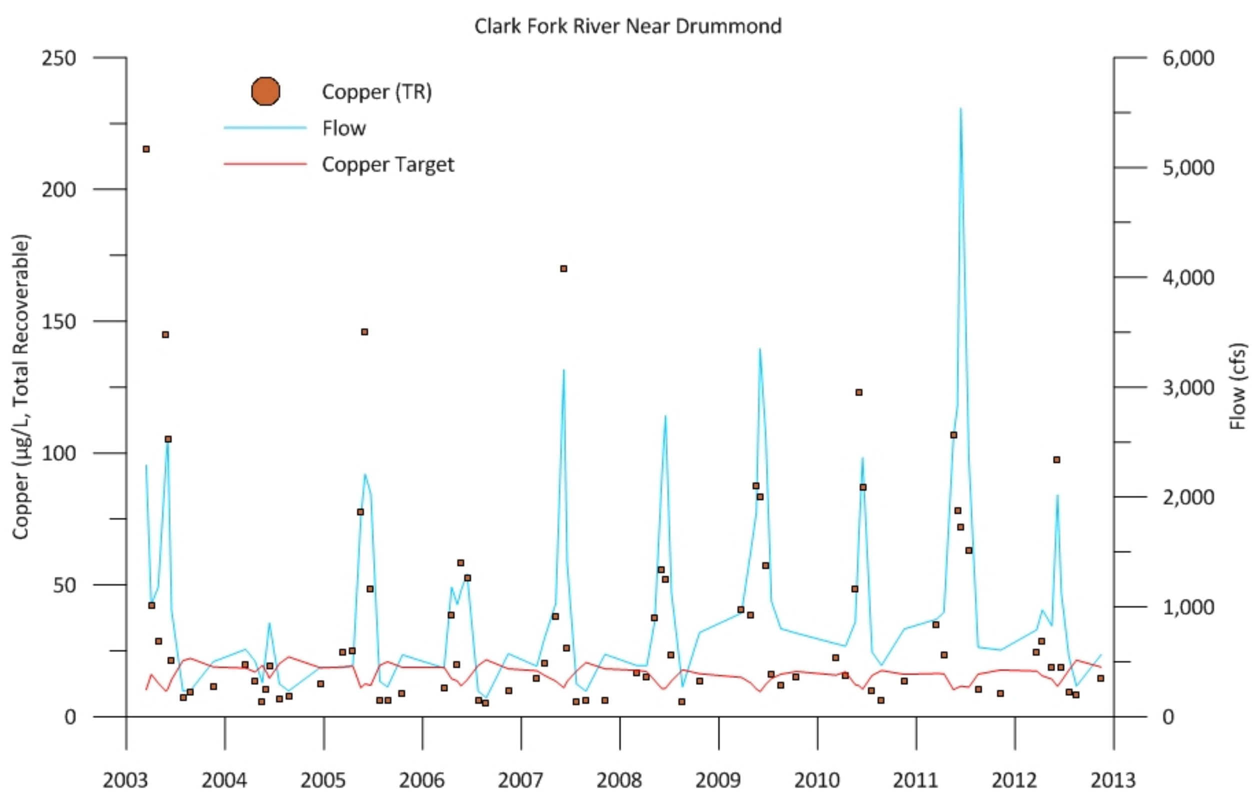

Figure 5-18. Copper Concentrations in the Clark Fork River near Drummond

5.6.5.1 Superfund Sites Regulated Under CERCLA

The entire length of this AU is included within the Clark Fork River OU of the Milltown Reservoir / Clark Fork River Superfund Site. This segment includes the Reach C – Bearmouth Canyon portion of the OU. Tailings deposits within this segment are relatively minor (Sando et al., 2014; U.S. Environmental Protection Agency, 2004). This AU also includes the Milltown Reservoir OU, which former included large volumes of metals-laden sediment that was deposited in the reservoir through the 20th Century. These sediments were excavated and removed following the breaching of Milltown Dam in 2008. During drawdown and subsequent excavation and stream channel construction, some contaminated sediments probably contributed to elevated metals concentrations in the water quality data used by DEQ for assessment. This is incorporated into the MOS (**Section 5.8.2**). The primary source of Superfund-related metals loading in this segment, therefore, comes from upstream AUs, primarily the first segment of the Clark Fork River (Sando et al., 2014).

5.6.5.2 MPDES-Permitted Point Sources Regulated Under CWA

Drummond Wastewater Treatment Plant

The town of Drummond operates a wastewater treatment system that discharges to a facultative lagoon. As the system has an average design flow less than one million gallons per day and does not have any significant industrial contributors, it operates under a general domestic sewage treatment lagoon permit (MTG580002) effective until December 31, 2017. No chemistry data are available to characterize the metals load in the discharge. The facility has an outlet to the Clark Fork River, but according to DEQ Technical and Financial Assistance Bureau engineering staff, the lagoon has not discharged in years (Jerry Paddock, personal communication 2014). KLJ Engineering performed a leakage study of the Drummond lagoon in fall 2013. The study determined that the lagoon loses 1,107,045 gallons annually to leakage (3,033 gallons per day or 0.005 cfs). This is lost to groundwater, but given the lagoon's proximity to the Clark Fork River, it is likely that this is hyporheic water and that the metals load in the effluent eventually makes it to the Clark Fork River.

However, estimates of copper and lead may be made by using average concentrations from a community of similar age, with providing similar treatment, with copper and lead concentrations likely derived from residential plumbing, as is the case in Drummond. Per consultation with DEQ Technical and Financial Assistance Bureau engineering staff, East Helena was used as a proxy (Paul Lavigne, personal communication 2014). Typical copper concentrations of 16.9 µg/L and lead concentrations of 1.36 µg/L were used (Robert Peccia & Associates, 2011), along with Drummond's estimated leakage rate of 0.005 cfs. This results in estimated groundwater loads of:

Copper: 16.9 µg/L x 0.005 cfs x 0.0054 = 0.0004 lbs/day
Lead: 1.36 µg/L x 0.005 cfs x 0.0054 = 0.00004 lbs/day

These estimated loads are insignificant compared to the instream loads.

Missoula MS4

Under EPA's Stormwater Phase II Rule, Missoula is regulated as a small MS4 under a DEQ general permit (MTR040000). The MS4 covers the urban limits, which includes Bonner. This portion is 0.45 square miles, or 1% of the total MS4 area. After a GIS analysis of the stormwater infrastructure, DEQ determined that all the stormwater in the Bonner portion of the MS4 drains northward into the Blackfoot River where no metals impairment conditions exist.

5.6.5.3 Metals-Impaired Tributaries

Metals impaired tributaries to this AU include: Flint Creek, Cramer Creek, and Wallace Creek. Flint Creek is an appreciable source of metals load, as shown below in **Table 5-41**.The other sources are minor compared to upstream mainstem metals sources.

Flint Creek

Flint Creek (Boulder Creek to the mouth: MT76E003_012) is impaired by arsenic, copper, iron, and lead.

Table 5-41. Example Metals TMDLs and Load Reductions for Flint Creek

Metal	Flow	TMDL (lbs/day)	Percent Reduction Needed	Load Reduction Needed (lbs/day)
Arsenic	High	26.0	64.3%	47
	Low	3.21	9.1%	0.32
Copper	High	15.7	36.5%	9.0
	Low	2.15	0%	0%
Iron	High	2,602	12.1%	358
	Low	321	0%	0%
Lead	High	4.32	93.8%	65
	Low	1.42	9.0%	0.14

Modified from Table 6-35 of the Flint Creek TMDL document

Table 5-41 above is taken from the Flint Creek Planning Area Sediment and Metals TMDLs and Framework Water Quality Improvement Plan (Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau, 2012). This table illustrates the loads contributed to the Clark Fork River by Flint Creek, and the percent reduction gives an idea of the magnitude of the target exceedances in Flint Creek. **Table 5-41** also demonstrates that Flint Creek is a considerable source of arsenic and lead to the Clark Fork River during high flow conditions. In fact, the existing high flow lead load from Flint Creek exceeds the example Clark Fork River high flow TMDL for lead (68.14 lbs/day) provided n **Table 5-20** (**Section 5.5**). The **Table 5-41** results are based on the highest target and associated TMDL exceedance values and therefore represent worse case (highest) loading conditions (Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau, 2012, p. 6-32). Note that comparison between **Tables 5-36** and **5-40** suggest a lower average high flow influence from Flint Creek.

The upper segment of Flint Creek (above Boulder Creek) is identified as impaired for mercury and a mercury TMDL was developed for this segment (Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau, 2012). Mercury has not been formally assessed in the lowest segment of Flint Creek and therefore a mercury TMDL has not been developed for this segment. Several studies (Staats, 2008; Langner et al., 2011) of mercury bioaccumulation identify Flint Creek as a major contributor of mercury-laden sediment to the Clark Fork River. **Table 5-42** provides DEQ remediation data (2012–2013) and demonstrates that the mercury load from Flint Creek is considerable.

Table 5-42. DEQ Remediation Flint Creek Mercury Results (2012–2013)

Date	Mercury (µg/L)	Flow (cfs)	Load (lbs/day)	Required Reduction (%)
4/9/2012	0.10	173	0.093	50%
6/5/2012	1.50	357	2.892	97%
9/11/2012	<0.01	35	0.002	0%

Table 5-42. DEQ Remediation Flint Creek Mercury Results (2012–2013)

Date	Mercury (µg/L)	Flow (cfs)	Load (lbs/day)	Required Reduction (%)
12/4/2012	<0.01	126	0.007	0%
3/19/2013	0.18	104	0.101	72%
5/14/2013	0.41	45	0.100	88%
6/11/2013	0.02	27	0.003	0%
6/25/2013	0.06	100	0.030	10%
9/17/2013	0.03	38	0.006	0%

Flow data are provided by the USGS for station 12331500 Flint Creek near Drummond, Montana

During high flow in June 2012, Flint Creek contributed nearly three pounds per day of mercury. For comparison, the Clark Fork River loads for the same period are provided below in **Table 5-43**. Flow data are provided by the USGS gage stations at these locations. The smaller load measured near Drummond (approximately at Bearmouth) on the same day suggests that a considerable portion of the mercury load settles out in river bed sediment near the mouth of Flint Creek.

Table 5-43. Clark Fork River Mercury Loads, June 2012

Location	Date	Mercury (µg/L)	Flow (cfs)	Load (lbs/day)
Clark Fork at Deer Lodge	6/6/2012	0.10	791	0.3
Clark Fork at Gold Creek	6/6/2012	0.15	1,660	1.34
Clark Fork near Drummond	6/5/2012	0.12	1,720	1.11

Cramer Creek

Cramer Creek is impaired by aluminum and lead. Cramer Creek is ungaged, but based on DEQ's metal sampling for the Bonita – Superior TMDL project (Montana Department of Environmental Quality, 2013), discharge ranges from 10 to 20 cfs in high flow, and is less than 1 cfs in low flow. This results in a relatively small load to the Clark Fork River (**Table 5-44**).

Table 5-44. Example Metals TMDLs and Load Reductions for Cramer Creek

Metal	Flow	TMDL (lbs/day)	Percent Reduction Needed	Load Reduction Needed (lbs/day)
Lead	High flow	0.578	34%	0.3
	Low flow	0.353	46%	0.3

Modified from Table 5-18 of the Bonita – Superior Metals TMDL document

Wallace Creek

Wallace Creek is impaired by copper. Copper concentrations in Wallace Creek exceed targets by a slim margin. The highest reported concentration was 6 µg/L (Montana Department of Environmental Quality, 2013). With the relatively small discharge of Wallace Creek, this is a very small contribution of copper to the Clark Fork River – less than one-tenth of a pound per day in either flow regime (**Table 5-45**).

Table 5-45. Example Metals TMDLs and Load Reductions for Wallace Creek

Metal	Flow	TMDL (lbs/day)	Percent Reduction Needed	Load Reduction Needed (lbs/day)
Copper	High flow	0.071	13%	0.01
	Low flow	0.016	0%	0

Modified from Table 5-19 of the Bonita – Superior Metals TMDL document

5.6.6 Clark Fork River, Blackfoot River to Rattlesnake Creek (MT76M001_030) Source Assessment

This segment of the Clark Fork River largely transports metals loads originating upstream in Butte and the Deer Lodge Valley. The existing loads, estimated at USGS station 12340500 (Clark Fork above Missoula) are provided below in **Table 5-46**, based on data from 2012.

Table 5-46. Existing Loads (lbs/day) and Associated Concentrations (µg/L)

	Arsenic	Cadmium	Copper	Iron	Lead	Zinc
High Flow (11,600 cfs)	338.3 (5.4)	6.26 (0.1)	1,209 (19.3)	59,759 (954)	231.8 (3.7)	1,516 (24.2)
Low Flow (2,520 cfs)	39.46 (2.9)	0.27 (0.02)	28.58 (2.1)	639.6 (47)	1.36 (0.1)	<40.8 (<3)

Loading increases from upstream (**Table 5-40**, **Section 5.6.5**) to downstream (above **Table 5-46**) are relatively minor compared to the significant increase in flow, and there are significant concentration decreases for arsenic, cadmium, copper, iron and lead. Much of this is due to the dilution provided by the Blackfoot River and Rock Creek.

5.6.6.1 MPDES-Permitted Point Sources Regulated under CWA

Missoula MS4

Under EPA's Stormwater Phase II Rule, Missoula is regulated as a small MS4 under a DEQ general permit (MTR040000). The MS4 covers the urban limits, which includes East Missoula and Hellgate. A minor portion (17%) of the Missoula MS4 permit area drains to this segment of the Clark Fork River. The MS4 area in this segment is 6.17 square miles (of a total of 36.34 square miles). DEQ analyzed the City of Missoula's GIS coverage of the stormwater infrastructure, and determined that 0.06 square miles (44 acres) of stormwater catchment discharge to this segment of the Clark Fork River. The annual discharge was estimated using the stormwater discharge area of 44 acres, average annual precipitation of 14 inches, and an estimated percentage of total annual precipitation draining to surface water of 8% provided by DEQ modeling staff (Erik Makus, personal communication 2014). This results in an estimated annual discharge of 180,000 cubic feet or 5,070,819 liters. All of this discharge is considered to be from suburban/residential areas, rather than urban.

The MS4 permit requires sampling of representative commercial/industrial and residential areas for copper, lead and zinc, but not arsenic, cadmium, or iron. The Missoula City-County Health Department conducted a study of chemical deicer effects in the 1990s (Missoula City-County Health Department and Missoula Valley Water Quality District, 1997). The study included sampling of both stormwater outfalls and dry wells, and the contributing areas were characterized as commercial or residential. Although the sampling locations are not identical, comparison of these data suggest that copper and lead concentrations in stormwater have declined considerably since the 1990s. Since the MS4 permit requires that the sample locations are representative, and since stormwater management practices have improved since the 1990s, DEQ used the permit sampling data (2009–2013) to estimate the existing copper and lead loads from the Missoula MS4. Based on the sample reporting for the MS4 permit, the average concentration of copper, lead, and zinc in stormwater runoff from commercial areas is 26 µg/L, 14 µg/L, and 0.178 µg/L, respectively. DEQ therefore estimates that this portion of the MS4 contributes annual loads of 0.29 lbs of copper, 0.16 lbs of lead, and 0.002 lbs of zinc.

To estimate an average "per-event" load, the annual load estimates are divided by the average number of times the MS4 discharges in a year. DEQ did not identify a threshold magnitude for precipitation events that result in stormwater discharge, and snowmelt complicates estimates by generally lagging behind the precipitation event. DEQ chose 0.25 inches of precipitation as a representative value. Between 1984 and 2013, there was an average of 16.1 precipitation events greater than 0.25 inches. By dividing the estimated annual loads by 16, DEQ estimates that the per-event loads (considered equivalent to daily loads given the short duration of rainfall and runoff events) are 0.02 lbs of copper, 0.01 lbs of lead, and 0.0001 lbs of zinc. Note that these estimated stormwater loads are not significant in comparison to existing instream loads (**Table 5-47**), particularly at the high flows when impairment conditions are of concern. Comparisons should be made to the high flow loads in **Table 5-47**, since that is when impairment conditions are of concern for this segment of the Clark Fork River. Under low flow conditions, these values can be compared to the example TMDL loads defined within **Table 5-20** of **Section 5.5**, which are 149.4 lbs/day for copper, 55.2 lbs/day for lead, and 1,916 lbs/day for zinc. Based on the existing low flow Clark Fork River loads for both metals (**Table 5-47**) and the example allowable loads (TMDLs) in **Table 5-20**, it is apparent that copper, lead, and zinc loading from the Missoula MS4 will not cause or contribute to impairment. Arsenic, cadmium, and iron loading is expected to be similarly small.

5.6.6.2 Upstream Sources

Mainstem and tributary sources above this segment are the major contributors of metals to this segment of the Clark Fork River (Sando et al., 2014). The contributions from the MS4 are not significant.

5.6.6.3 Natural Background Metals

DEQ estimates the load due to natural background metals sources ($LA_{Natural}$) in this segment using a concentration equal to one-half the method detection limits, except for iron, which is estimated to be 50 µg/L. DEQ believes this estimate to be reasonable due to the occasional non-detect results for metals samples. The LA is set equal to these respective concentrations times the increase in flow (Δ flow) along the length of the segment.

5.6.7 Clark Fork River, Rattlesnake Creek to Fish Creek (MT76M001_020) Source Assessment

This segment of the Clark Fork River largely transports metals loads originating upstream in the Deer Lodge Valley, although there are point sources that discharge to this AU, in addition to the Bitterroot River. The existing loads, estimated at the Petty Creek fishing access site, are provided below in **Table 5-47** using 2012 data. The 2012 data represent non-impaired conditions

Table 5-47. Existing Loads (lbs/day) and Associated Concentrations (µg/L)

	Copper	Iron	Lead
High Flow (24,000 cfs)	1,296 (10.0)	99,792 (770)	233.3 (1.8)
Low Flow (5,725 cfs)	61.8 (2.0)	2,782 (90)	<15.5 (<0.5)

No direct flow measurement available; estimated from bracketing gage stations

Loading increases from upstream (**Table 5-46**, **Section 5.6.6**) to downstream (**Table 5-47** above) are proportionally low compared to the significant increase in flow, and there are significant concentration decreases for all three metals. Some of this is likely due to dilution from tributaries that do not have metals impairment concerns.

5.6.7.1 MPDES-Permitted Point Sources Regulated Under CWA

Missoula Wastewater Treatment Plant
The Missoula WWTP (MPDES ID MT0022594) is a domestic WWTF located at 1100 Clark Fork Lane, and permitted to discharge to the Clark Fork River in this AU. The permit is currently under an administrative extension. The plant samples semi-annually for total recoverable metals: antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc, but has no effluent limits for metals.

Effluent concentrations are compared to targets calculated using a hardness value of 86 mg/L, the 25th percentile value at the USGS gage Clark Fork River above Missoula (12340500). Although this gage is located in the segment upstream, it characterizes the Clark Fork River in Missoula better than downstream gages. The 25th percentile is chosen to be consistent with DEQ's current permitting methods. Copper and lead targets at this hardness are 8.2 µg/L and 2.6 µg/L, respectively.

Copper concentrations have varied between 5 µg/L and 11 µg/L since January 2010. The copper concentrations are close to meeting the water quality target; the higher results (10–11 µg/L) are reported during January, which corresponds to low-flow and higher hardness in the Clark Fork River. Lead concentrations varied between 0.9 µg/L and 1.3 µg/L, below the water quality target. Using the average value of the maximum daily discharges reported between 2011 and 2013 (8.2 million gallons per day, or 12.7 cfs), the greatest expected loads for copper and lead are:

Copper: 11 µg/L x 12.7 cfs x 0.0054 =0.75 lbs/day
Lead: 1.3 µg/L x 12.7 cfs x 0.0054 = 0.09 lbs/day

Note that these loads are very small in comparison to existing loads (**Table 5-47**), particularly during high flows when impairment conditions are of concern. No data are currently available to characterize the iron load from the Missoula facility.

Missoula MS4
Under EPA's Stormwater Phase II Rule, Missoula is regulated as a small MS4 under a DEQ general permit (MTR040000). The MS4 permit area corresponds to the Missoula urban area, and includes areas under the responsibility of the City of Missoula, Missoula County, the University of Missoula, and Montana Department of Transportation. The City of Missoula has primary responsibility for the permit, but the other entities are all co-permittees. Approximately 55% (19.81 square miles of 36.34) of the Missoula stormwater permit area would drain to this segment of the Clark Fork River. Much of the stormwater generated within Missoula is managed by dry wells or sumps, which capture stormwater and drain it into the vadose zone, the unsaturated area below the ground surface and above the groundwater table. Areas such as the heart of downtown Missoula collect stormwater in storm sewers which discharge to surface water. Estimates of the percentage of Missoula's MS4 that discharges to surface water rather than to the subsurface vary from 15 to 30% (Missoula City-County Health Department and Missoula Valley Water Quality District, 1997; Alban, 2012). DEQ analyzed the City of Missoula's GIS coverage of the stormwater infrastructure, and determined that 4.4 square miles (2,836 acres) of stormwater catchment discharge to this segment of the Clark Fork River. This area was then subdivided to classify portions as urban (19%) or as suburban/residential (81%) to distinguish between varying degrees of impervious surface.

The annual discharge was estimated using the stormwater discharge area of 2,836 acres and average annual precipitation of 14 inches. Based on consultation with DEQ modeling staff, the percentage of total annual precipitation that runs off to surface water was estimated as 8% for suburban/residential areas and 40% for urban areas, such as the heart of downtown (Erik Makus, personal communication 2014). This results in an estimated annual discharge of 20,160,172 cubic feet or 570,872,580 liters.

The MS4 permit requires sampling for copper, lead and zinc, but not iron. The Missoula City-County Health Department conducted a study of chemical deicer effects in the 1990s (Missoula City-County Health Department and Missoula Valley Water Quality District, 1997). The study included sampling of both stormwater outfalls and dry wells, and the contributing areas were characterized as commercial or residential. Although the sampling locations are not identical, comparison of these data suggest that copper and lead concentrations in stormwater have declined considerably since the 1990s. Since the MS4 permit requires that the sample locations are representative, and since stormwater management practices have improved since the 1990s, DEQ used the permit sampling data (2009–2013) to estimate the existing copper and lead loads from the Missoula MS4. Based on the sample reporting for the MS4 permit, the average concentration of copper and lead in stormwater runoff from commercial areas is 26 µg/L and 14 µg/L, respectively. Stormwater runoff from residential areas has average copper and lead concentrations of 14 µg/L and 3 µg/L, respectively. DEQ therefore estimates that this portion of the MS4 contributes annual loads of 28.1 lbs of copper and 13.7 lbs of lead.

DEQ did not find any information on the precipitation threshold required to initiate flow in the storm sewer outfalls. DEQ chose 0.25 inches of precipitation as a representative value. Between 1984 and 2013, there was an average of 16.1 precipitation events greater than 0.25 inches. By dividing the estimated annual loads by 16, DEQ estimates that the per-event loads (considered equivalent to daily loads given the short duration of storm and runoff events) are of 1.8 lbs/day of copper and 0.85 lbs/day of lead. Note that these estimated stormwater loads are not significant in comparison to existing instream loads (**Table 5-47**), particularly at the high flows when impairment conditions are of concern. Comparisons should be made to the high flow loads in **Table 5-47**, since that is when impairment conditions are of concern for this segment of the Clark Fork River. Under low flow conditions, these values can be compared to the example TMDL loads defined within **Table 5-20** of **Section 5.5**, which are 219.94 lbs/day for copper and 65.7 lbs/day for lead. Based on the existing low flow Clark Fork River loads for both metals (**Table 5-47**) and the example allowable loads (TMDLs) in **Table 5-20**, it is apparent that copper and lead loading from the Missoula MS4 will not cause or contribute to impairment.

Seaboard Foods, LLC

Seaboard Foods, LLC has a MPDES permit (MT0000094) to discharge from Daily's Premium Meats, located at 2900 Mullan Road in Missoula. The permit does not provide effluent limits for metals, but requires sampling for arsenic, cadmium, copper and lead. Effluent concentrations are compared to targets calculated using a hardness value of 86 mg/L, the 25th percentile value at the USGS gage Clark Fork River above Missoula (12340500). Although this gage is located in the segment upstream, it characterizes the Clark Fork River in Missoula better than downstream gages. The 25th percentile is chosen to be consistent with DEQ's current permitting methods. Copper and lead targets at this hardness are 8.2 µg/L and 2.6 µg/L, respectively. According to the permit, average discharge flow is 0.092 cfs. The highest reported copper concentration is 1 µg/L, well below the water quality target. Lead results were not identified in EPA's ICIS database.

M2Green Redevelopment (formerly Stone Container Corporation)

This permit (MT0000035) was originally issued to a discharge of process wastewater from a pulp and paper plant. Stone Container Corporation operated the plant until 2010, and sold the property to M2Green Redevelopment in 2011. The MPDES permit was also transferred to M2Green in 2011. The majority of the former plant has been demolished, and M2Green is currently in the planning phase of a redevelopment project to create an industrial park. M2Green plans a WWTF to treat domestic wastewater from employee restroom and shower facilities, and modified the permit renewal application to allow discharge of domestic wastewater rather than industrial wastewater. The renewed permit was issued on March 14, 2014. The planned WWTP has a projected average discharge of 26,000 gallons per day (0.04 cfs) and a projected maximum discharge of 96,000 gallons per day (0.15 cfs). The permit includes five outfalls. Outfalls 001, 002, and 003 are direct discharges of domestic wastewater to the Clark Fork River. Outfall 004 is for uncontaminated non-contact cooling water, or unaltered groundwater. Outfall 005 is for discharge of domestic wastewater to groundwater via discharge to a pond. Due to the contaminated groundwater underlying the site, the permit does not allow for discharge to groundwater until the site has been assessed, and remediated if determined to be contaminated. According to the permit:

> *Authority to discharge to the south polishing pond (SPP) or alternate pond sites is stayed until the site(s) have been assessed under the appropriate clean-up statute(s) and remediated if found to be contaminated. Following such assessments, the permittee must receive written approval from EPA and/or DEQ as appropriate regarding pond location, design, and remedial status prior to discharging to the SPP and/or construction of an alternate pond site(s).*

For this reason, discharge to Outfalls 001, 002, and 003 may not begin until DEQ provides written approval of the conveyance mechanism; unlined ditches are not allowed.

The load contributed by the planned facility may be estimated using the example residential concentrations from East Helena. These were: copper concentrations of 16.9 µg/L and lead concentrations of 1.36 µg/L. Assuming a maximum discharge scenario in which the facility is operating at maximum output and the metals load is transmitted directly to the Clark Fork River, the estimated loads are:

Copper: 16.9 µg/L x 0.15 cfs x 0.0054 = 0.014 lbs/day
Lead: 1.36 µg/L x 0.15 cfs x 0.0054 = 0.001 lbs/day

These copper and lead concentrations are likely to be overestimates, as the new development would likely use polyethylene plumbing, rather than copper and lead. Note that these loads are not significant in comparison to existing loads (**Table 5-47**), particularly at the high flows when impairment conditions are of concern.

Alberton Wastewater Treatment Plant

The Town of Alberton's WWTP is a WWTF currently operating on an administratively extended permit (MT0021555) to discharge to the Clark Fork River. The facility is located at 117 Parkway Drive, Alberton. The discharge was sampled semi-annually for arsenic, cadmium and copper in 2009 and 2010. The permit does not provide effluent limits for metals. Only one copper result was identified in EPA's ICIS database, and was below water quality targets at the laboratory detection limit. No data are available for lead. However, an estimate may be made by using average concentrations from a community of similar age, with similar treatment technology, with copper and lead concentrations likely derived from residential plumbing, as is the case in Alberton. Per consultation with DEQ Technical and Financial

Assistance Bureau engineering staff, East Helena was used as a proxy (Paul Lavigne, personal communication 2014). Typical copper concentrations of 16.9 µg/L and lead concentrations of 1.36 µg/L (Robert Peccia & Associates, 2011) were used, along with Alberton's maximum reported discharge rate of 0.14 cfs. This results in estimated loads of:

Copper: 16.9 µg/L x 0.14 cfs x 0.0054 = 0.013 lbs/day
Lead: 1.36 µg/L x 0.14 cfs x 0.0054 = 0.001 lbs/day

Note that these loads are not significant in comparison to existing loads (**Table 5-47**), particularly at the high flows when impairment conditions are of concern.

5.6.7.2 Metals-Impaired Tributaries

Bitterroot River
The lower segment of the Bitterroot River has a lead TMDL currently under development. Recent assessments confirmed lead impairment and also confirm that the Bitterroot River is not impaired by copper or iron. Water quality data from near the mouth of the Bitterroot River are available from June 6, 2012 and August 24, 2012 (**Table 5-48**). Although the 2012 samples are not synchronous with the samples in the Clark Fork River, they do characterize a typical high flow and low flow condition in the Bitterroot River in 2012.

Table 5-48. Example Bitterroot River Metals Concentrations

Date	Flow (cfs)	Hardness (mg/L)	Copper (µg/L)	Iron (µg/L)	Lead (µg/L)
6/6/2012	11,800	25	1.0	520	0.5
8/24/2012	610	76	1.0	50	<0.5
Highest Reported Concentrations					
3/16/2004	1,060	48	13.7	-	-
5/19/2009	9,260	25	-	2310	2.37

The data used to determine lead impairment for the Bitterroot River included a 16% target exceedance rate for lead. The greatest concentration of 2.37 µg/L was reported in 2009 at a flow of 9,260 cfs, corresponding to a load of 118 lbs/day, which is 91 lbs/day above the lead TMDL for the Bitterroot River on that date. It is worth noting, however, that the Bitterroot River is lower in hardness than the Clark Fork River, which results in lower lead targets and a correspondingly lower TMDL in that stream. To be consistent with the worst-case approach used in example TMDLs from other impaired tributary streams, the highest reported concentrations are also included in **Table 5-48**. The highest reported lead concentration equates to a load of 118 lbs/day, or approximately one-half of the high flow lead TMDL (**Table 5-20**). These data suggest that the Bitterroot River is a minor source of metals to the Clark Fork River under typical recent flows, but can be a significant source of lead loads under some high flow conditions.

5.6.7.3 Upstream Sources

The Clark Fork River immediately upstream is the major contributors of metals to this AU of the Clark Fork River.

5.6.7.4 Natural Background Metals

DEQ estimates the load due to natural background metals sources ($LA_{Natural}$) in this segment using a concentration equal to one-half the method detection limits, except for iron, which is estimated to be 50 µg/L. DEQ believes this estimate to be reasonable due to the occasional non-detect results for metals samples. The LA is set equal to these respective concentrations times the increase in flow (Δ flow) along the length of the segment.

5.6.8 Clark Fork River, Fish Creek to Flathead River (MT76M001_010) Source Assessment

This segment of the Clark Fork River largely transports metals loads originating upstream in Butte and the Deer Lodge Valley, although there is a point source and an impaired tributary that discharge to this AU. The existing loads, calculated from data collected above the mouth of the Flathead River, are provided below in **Table 5-49** using 2012 data. The 2012 data represent non-impaired conditions.

Table 5-49. Existing Loads (lbs/day) and Associated Concentrations (µg/L)

	Copper	Iron	Lead
High Flow (25,400 cfs)	1,234 (9.0)	97,384 (710)	219.4 (1.6)
Low Flow (6,600 cfs)	71.3 (2.0)	1,782 (50)	<17.8 (<0.5)

No direct discharge measurement available; estimated from bracketing gage stations

Metals loads from upstream (**Table 5-47**, **Section 5.6.7**) to downstream (**Table 5-49** above) are similar under high and low flow conditions.

5.6.8.1 MPDES-Permitted Point Sources Regulated Under CWA

This AU largely transports metals loads originating upstream in the Deer Lodge Valley, although there are point sources that discharge to this AU.

Superior Wastewater Treatment Plant

The town of Superior's WWTF (MT0020664) is permitted to discharge to the Clark Fork River. The facility is located at Riverside Avenue, Superior. The permit does not provide effluent limits for metals, nor require any metals sampling. Therefore no data are available to characterize the effluent's effect on metals in the Clark Fork River. However, an estimate may be made by using average concentrations from a community of similar age, with similar treatment technology, and copper and lead concentrations likely derived from residential plumbing, as is the case in Superior. Per consultation with DEQ Technical and Financial Assistance Bureau engineering staff, East Helena was used as a proxy (Paul Lavigne, personal communication 2014). Typical copper concentrations of 16.9 µg/L and lead concentrations of 1.36 µg/L (Robert Peccia & Associates, 2011) were used, along with Superior's maximum reported discharge rate of 0.18 cfs. This results in estimated loads of:

Copper: 16.9 µg/L x 0.18 cfs x 0.0054 = 0.016 lbs/day
Lead: 1.36 µg/L x 0.18 cfs x 0.0054 = 0.001 lbs/day

Note that these loads are not significant in comparison to existing loads (**Table 5-49**), particularly at the high flows when impairment conditions are of concern.

5.6.8.2 Metals-Impaired Tributaries

Flat Creek
A Superfund site (Flat Creek Iron Mountain Mine) OU is located in Flat Creek. There are historic mine tailings in the streambanks and streambed. As a result, Flat Creek is impaired by metals including: antimony, arsenic, cadmium, lead, mercury, and zinc. Of these, only lead is a cause of impairment to this segment of the Clark Fork River. **Table 5-50** below presents the lead TMDL and required load reductions. The data in **Table 5-50** are based on the highest target and associated TMDL exceedance values and therefore represent worse case (highest) loading conditions (Montana Department of Environmental Quality, 2013, p. 5-21). The highest reported concentration of lead in Flat Creek is two orders of magnitude greater than in the Clark Fork River, although the high flow discharge is three orders of magnitude smaller. The high flow lead load from Flat Creek represents a considerable load to the Clark Fork River. The load reduction, if not attained, could contribute to exceedances of the TMDL for this segment of the Clark Fork River (see **Table 5-51** in **Section 5.7**) by close to 50% under worst case high flow conditions in Flat Creek.

Table 5-50. Example Metals TMDLs and Load Reductions for Flat Creek

Metal	Flow	TMDL	Percent Reduction Needed	Load Reduction Needed (lbs/day)
Lead	High flow	1.023	99%	96.9
	Low flow	0.077	55%	0.95

Modified from Table 5-20 in the Bonita – Superior Metals TMDL document

5.6.8.3 Upstream Sources
The Clark Fork River mainstem upstream is the major contributor of metals to this segment of the Clark Fork River.

5.6.8.4 Natural Background Metals
DEQ estimates the load due to natural background metals sources ($LA_{Natural}$) in this segment using a concentration equal to one-half the method detection limits, except for iron, which is estimated to be 50 µg/L. DEQ believes this estimate to be reasonable due to the occasional non-detect results for metals samples. The LA is set equal to these respective concentrations times the increase in flow (Δ flow) along the length of the segment.

5.6.9 Source Assessment Summary
Although many metals sources are identified in the source assessments, a subset of them constitutes the most significant contributors. This includes:

- Butte stormwater (cadmium, copper, lead, mercury, zinc)
- Butte-Silver Bow WWTP (copper, zinc, possibly others)
- Warm Springs Ponds (arsenic)
- Clark Fork River sediments and streambanks upstream of Deer Lodge (arsenic, cadmium, copper, lead, zinc, possibly mercury)
- Mill-Willow Bypass (arsenic, copper, lead)
- Warm Springs Creek (cadmium, iron, lead)
- Little Blackfoot River (arsenic, lead)
- Flint Creek (arsenic, lead, mercury)
- Bitterroot River (lead)
- Flat Creek (lead)

Butte and the tailings deposits alongside Silver Bow Creek and the Clark Fork River are the dominant metals sources. However, there are also significant contributions from certain tributaries, at least under the worst-case scenarios used for the source assessments. The work underway in the Milltown Reservoir/Clark Fork River and Silver Bow Creek/Butte Area Superfund Sites is likely to meet the performance goals and attain the TMDLs within these sites (i.e., above the Blackfoot River) under most conditions. However, reducing the instream metals concentrations enough to create assimilative capacity in all segments of the Clark Fork River will probably require remediation in the tributary watersheds listed above. Meeting the TMDLs in these tributary streams will result in considerable improvement of Clark Fork River water quality. Downstream of the former Milltown Reservoir and the Superfund sites, water quality improvement is evident. The improved water quality combined with the diluting influence of the Blackfoot River is already resulting in TMDL attainment and creating assimilative capacity in the Clark Fork River below the mouth of the Blackfoot River.

5.7 Metals Allocations

As discussed in **Section 4.0**, a TMDL equals the sum of all the WLAs, LAs, and an MOS. WLAs are allowable pollutant loads that are assigned to permitted and non-permitted point sources. Mining-related waste sources (e.g., 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 natural background sources, as well as human-caused nonpoint loading. Where practical, LAs to human sources are provided separately from natural background sources. In addition to metals LAs, 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 natural background
MOS = Margin of Safety or an accounting of uncertainty about the relationship between metals loads and receiving water quality.

As constituents of the TMDL, allocations are also functions of concentration times flow. Flow (and therefore the allocated load) may increase, provided the concentration does not exceed the target. Put another way, a point source which discharges at the target concentration does not contribute to impairment (nor improve conditions), regardless of the flow component. Therefore, the WLAs in this document are concentration-based. This is appropriate given the wide range of discharge rates for point sources, some of which have no discharge under most circumstances. This allocation strategy also provides the TMDL with built-in capacity for future load components (such as treated Berkeley Pit water) which do not presently exist.

In the absence of synoptic data, it is not always feasible to present load-based example allocations that sum precisely to calculated instream loads. However, since the allocations are concentration-based, examples may be provided individually, using average flow rates for each discharge.

In the sections that follow, LAs and WLAs are provided for each pollutant-waterbody combination for which a TMDL is prepared (see **Table 5-19**). Metals allocations in the Silver Bow Creek and Clark Fork River TMDL project are provided for the following source categories:

- Superfund sites (WLA_{NPL})
- MPDES-permitted wastewater treatment discharges (WLA_{WWTP})
- MPDES-permitted Municipal separate stormwater sewer systems or MS4s (WLA_{MS4})
- Natural background metals sources ($LA_{Natural}$)
- Metals-impaired tributary streams ($LA_{Tributaries}$)
- Upstream AUs ($LA_{Upstream}$)

DEQ provides an implicit MOS by using assumptions known to be conservative, discussed further in **Section 5.8.2**. In most cases, the MOS in the TMDL equation above equals zero and is not included in the specific TMDLs for each segment because of reliance on this implicit MOS. However, in some segments below the Blackfoot River, the sums of the allocations are smaller than the TMDLs. This is due to the dilution provided by unimpaired flows from large tributaries and the conservative WLAs provided due to currently impaired conditions (i.e., the anticipated future available load is not made available to point sources or other potential sources throughout the watershed). In these cases, the remaining unallocated load is equivalent to an explicit MOS.

5.7.1 Types of Allocations

The WLAs and LAs provided in this document fall into several broad categories. These vary according to the source type. Examples include: Superfund sites, MPDES-permitted discharges, impaired tributaries, and natural background levels. These are briefly introduced below.

5.7.1.1 Superfund Site Wasteload Allocations

Superfund sites are operated under CERCLA, and are not subject to regulation under CWA via MPDES permitting. However, CERCLA §121(d) requires that Superfund projects meet (or waive) all applicable or relevant and appropriate requirements (ARARs) at their completion (U.S. Environmental Protection Agency, 2011a). ARARs are based on federal or more stringent state standards, and therefore are effectively the same as the water quality targets discussed above in **Section 5.3**. Also, these facilities are metals sources that must be accounted for in the TMDLs. Therefore, DEQ provides WLAs to the Superfund sites. The specific allocations and how they relate to the TMDLs for each AU are discussed in detail below for the following stream segments:

- MT76G003_020 Silver Bow Creek
- MT76G001_040 Clark Fork River (Warm Springs Creek to Cottonwood Creek)
- MT76G001_030 Clark Fork River (Cottonwood Creek to Little Blackfoot River)
- MT76G001_010 Clark Fork River (Little Blackfoot River to Flint Creek)
- MT76E001_010 Clark Fork River (Flint Creek to Blackfoot River)

5.7.1.2 MPDES-Permitted Point Source Wasteload Allocations

WLAs are provided for each MPDES-permitted point-source discharge to Silver Bow Creek and the Clark Fork River (refer back to **Table 5-22** for a summary).

For impaired waters with no assimilative capacity, DEQ normally sets WLAs to meet the target concentration within the discharge (i.e., “end-of-pipe”) to ensure that the permitted point source does not cause or contribute to impairment. There are exceptions in which the WLA discharge concentration within a TMDL (and subsequently in the corresponding MPDES permit) may be set higher than the target concentration, based on reasonable assurance that upstream actions, when combined with unimpaired or less impaired tributaries or flows, will create assimilative capacity. This reasonable assurance must be consistent with EPA TMDL approval requirements (U.S. Environmental Protection Agency, 2000). Generally, unregulated nonpoint sources cannot be relied upon to provide reasonable assurance in the form of upstream assimilative capacity due to inherent implementation certainty. However, in the Upper Clark Fork River basin three Superfund sites are operating under approved RODs and creating measurable improvements in water quality (Sando et al., 2014). These remediation programs are still in progress, and the removal of contamination along the mainstem Clark Fork River has only recently started. DEQ believes that these Superfund programs constitute reasonable assurance that water quality targets will generally be met in the Superfund areas. With the addition of unimpaired or less impaired flows, assimilative capacity for at least some metals will be created downstream, particularly in the segments below the Blackfoot River.

DEQ expects that the Superfund sites will achieve the goals established in the RODs, meeting the water quality standards established as ARARs. The majority of the metals loading is to the upstream segments (primarily Silver Bow Creek and the uppermost segment of the Clark Fork River (Sando et al., 2014)) where the instream flows are smaller. Therefore, by controlling the metals loading in these segments to the degree required by the RODs, the metals loads will be proportionally smaller in downstream segments that receive dilution from unimpaired tributaries. Since these segments are sequential, it is possible to identify where meeting the TMDL in one segment will result in meeting the TMDL or even creating assimilative capacity in a downstream segment. For this reason, DEQ anticipates assimilative capacity in some segments of the Clark Fork River. This is presented graphically in **Figure 5-19**.

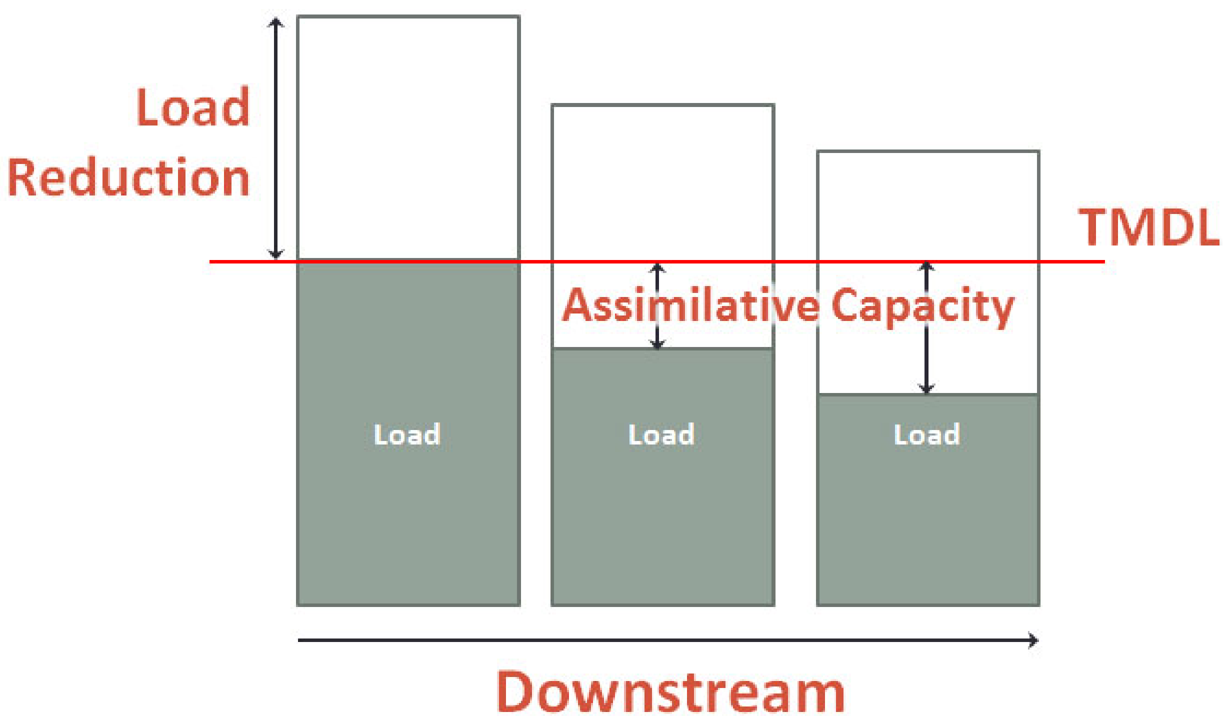

Figure 5-19. Anticipated Effects of Upstream Superfund Remediation

To demonstrate the anticipated effects of Superfund remediation, **Table 5-51** presents the reductions in existing loads (based on 2012 data) that are required to meet the example TMDLs presented above in **Table 5-20** (**Section 5-5**). Impairment conditions are strongly associated with high flow, so **Table 5-51** includes only the high flow load reductions. Note that these load reductions are not additive, since the loads are largely passed downstream. Silver Bow Creek is not shown due to the load-reducing influence of the Warm Springs Ponds. DEQ notes that remediation will have a higher degree of success with some metals than others (e.g., copper concentrations are consistently higher than zinc concentrations in **Figures 5-1** through **5-5**.), and that some metals are influenced by different sources, e.g., impaired tributaries. Therefore, the river segment in which assimilative capacity is anticipated varies by metal.

Table 5-51. Load Reductions Required to Meet TMDLs during High Flow Conditions

Waterbody Segment	Impairment	Load Reduction (lbs/day)
Clark Fork River, Warm Springs Creek to Cottonwood Creek (CFR MT76G001_040)	Arsenic*	131.95
	Cadmium	1.98
	Copper	835.40
	Iron	13,076
	Lead	116.74
Clark Fork River, Cottonwood Creek to Little Blackfoot River (CFR MT76G001_030)	Arsenic*	168.54
	Cadmium	**2.83** (assimilative capacity present below this point)
	Copper	**1,132.26** (assimilative capacity present below this point)
	Iron	15,351
	Lead	151.38
	Zinc	**210.39** (assimilative capacity present below this point)
Clark Fork River, Little Blackfoot River to Flint Creek (CFR MT76G001_010)	Arsenic	150.41
	Cadmium	2.11
	Copper	955.98
	Iron	**18,123** (assimilative capacity present below this point)
	Lead	149.61
	Mercury	**0.90** (assimilative capacity present below this point)
Clark Fork River, Flint Creek to Blackfoot River (CFR MT76E001_010)	Arsenic	**36.44** (assimilative capacity present below this point)
	Cadmium	0.48
	Copper	1,080.56
	Iron	8,850
	Lead	**160.90** (assimilative capacity present below this point)
	Mercury	0.65
	Zinc	(1,226.83)
Clark Fork River, Blackfoot River to Rattlesnake Creek (CFR MT76M001_030)	Arsenic	(288.14)
	Cadmium	(8.21)
	Copper	721.91
	Iron	(2,881)
	Lead	79.84
	Zinc	(4,749.06)
Clark Fork River, Rattlesnake Creek to Fish Creek (MT76M001_020)	Copper	548.12
	Iron	(29,808)
	Lead	31.69

Table 5-51. Load Reductions Required to Meet TMDLs during High Flow Conditions

Waterbody Segment	Impairment	Load Reduction (lbs/day)
Clark Fork River, Fish Creek to Flathead River (MT76M001_010)	Copper	466.73
	Iron	(39,776)
	Lead	15.59

Load reductions in parenthesis represent assimilate capacity present during 2012 high flow
*No arsenic impairment. Load reductions are calculated with the HHS, which does not apply to these segments. The load reductions are presented to allow tracking the arsenic load in downstream segments since meeting the arsenic TMDLs in the downstream segments requires upstream load reductions.

For example, under 2012 high flow conditions, the Clark Fork River between Cottonwood Creek and the Little Blackfoot River requires a load reduction of 1,132 lbs/day in order to meet the copper TMDL. However, the segment below that only requires a reduction of 956 lbs/day in order to meet the high flow copper TMDL. Due to the influence of Flint Creek, the assimilative capacity declines in the segment between Flint Creek and the Blackfoot River, where a high flow load reduction of 1,080 lbs/day is required. Below the Blackfoot River, the required load reduction falls to 722 lbs/day, and continues to decline further in the next two segments downstream. Because the required load reduction in all downstream segments is less than 1,132 lbs/day, remediation actions adequate to meet the TMDL in the Clark Fork River between Cottonwood Creek and the Little Blackfoot River would apparently remove enough copper to also meet TMDL requirements in all downstream segments. This same analysis applies to cadmium and zinc.

Table 5-51 demonstrates that if the combined efforts of the Superfund remedies are successful at achieving water quality targets within the Deer Lodge valley (above the mouth of the Little Blackfoot River), it will likely result in assimilative capacity for some metals (arsenic, cadmium, copper, and zinc) downstream of that point. However, due to inputs from the Little Blackfoot River and other tributaries, iron, lead, and mercury loads will continue to exceed the TMDLs downstream of the Little Blackfoot River within at least one or more segments. For example, lead loads will be at or near the TMDL in the segment between the Little Blackfoot River and Flint Creek, and generally above the lead TMDL from Flint Creek to the Blackfoot River, although it is possible that Rock Creek adds adequate dilution to meet the lead TMDL within the lower portion of this segment. Below the Blackfoot River, lead removal from the upstream superfund actions would be adequate to provide assimilative capacity since removal of 151.38 lbs/day will exceed load reduction requirements for all Clark Fork River segments below the Blackfoot River. For iron, the Superfund remedies will provide assimilative capacity for all Clark Fork River segments below Flint Creek. Mercury data is not yet adequate to determine the extent to which mercury load reductions from Superfund remedies would address the required mercury load reductions for the impaired segments of the Clark Fork River.

Because of the TI waiver for arsenic in Mill and Willow creeks, significant reduction of the arsenic load from Mill-Willow Bypass cannot be assumed. This tributary is a major source of arsenic to the Upper Clark Fork River. The high flow arsenic load from Mill-Willow Bypass was estimated at nearly 40 lbs/day in the Upper Clark Fork Tributaries TMDL document (Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, 2010); this represents nearly half of the high flow TMDL for the Clark Fork River between the Little Blackfoot River and Flint Creek (**Table 5-20**). The beginning of this segment is where the target changes from the chronic aquatic life standard of 150 µg/L to the human health standard of 10 µg/L. This suggests that the arsenic TMDL may not be met in this segment unless the load from Mill and Willow creeks can be compensated for elsewhere. The TMDL will likely be met in the next segment downstream, however, due to the addition of unimpaired flows.

Note that this assimilative capacity analysis does not consider remediation of the mainstem Clark Fork River below the Little Blackfoot River (Reaches B and C), as the tailings deposits in these reaches are isolated and discontinuous (U.S. Environmental Protection Agency, 2004), and the extent of potential loading reductions are not well defined. Note also that below the Blackfoot River, metals impairments are declining even as of 2012, due to the unimpaired large tributary and the removal of Milltown reservoir sediments. **Table 5-51** demonstrates that meeting water quality targets for lead, arsenic and iron in specific segments of the Clark Fork River above the Blackfoot River requires either overperformance of the Superfund remedies, remediation in the major impaired tributaries of the Little Blackfoot River and Flint Creek, or both.

5.7.1.3 Natural Background Metals Load Allocations

Natural background concentrations are not separated from the WLAs to the Streamside Tailings, Mainstem Clark Fork River or Milltown Reservoir Sediments Superfund site OUs, and therefore do not appear as discrete LAs above the Blackfoot River. Natural background loads within tributaries are inherently included within the composite LAs as defined within each specific TMDL document where the tributary TMDLs and more detailed allocations were developed.

Due to the mineralized geology of the surrounding mountains, Silver Bow Creek likely had natural background concentrations of trace metals that were higher than method detection limits. These are summarized below in **Table 5-52**, based on the discussion in **Section 5.6.1.5**. The Clark Fork River, however, receives considerable flow from tributaries that were not productively mined, and natural background metal concentrations are presumed to be diluted to the point that one-half the method detection levels are a reasonable approximation for all but iron. Samples with non-detectable concentrations are not unusual, supporting this approach. Iron is not a trace element and can be found at measurable levels in pristine watersheds, so the detection limit of 50 µg/L is used.

Table 5-52. Metals Detection Limits and Estimated Natural Background Concentrations

Metal	Method Detection Limit	Clark Fork River Estimated Natural Background	Silver Bow Creek Estimated Natural Background
Arsenic	3	1.5	5
Cadmium	0.08	0.04	0.1
Copper	1	0.5	4
Iron	50	50	345
Lead	0.5	0.25	2
Mercury	0.0001	0.0025	0.0005
Zinc	10	5	10

Units are µg/L

5.7.1.4 Metals-Impaired Tributary Load Allocations

A LA is provided to all metals-impaired tributaries joining each AU. The allocation is a composite allocation equal to the sum of all discrete allocations developed for each TMDL for those tributaries. These TMDLs are provided in TMDL documents published by DEQ and approved by EPA. All approved TMDL documents are available on DEQ's website (http://deq.mt.gov/wqinfo/TMDL/finalReports.mcpx). Since tributary streams have differing impairment causes, these composite allocations are pollutant specific.

5.7.1.5 Upstream Assessment Unit Load Allocations
Each AU of the Clark Fork River is given an LA for all upstream sources. This allocation is equivalent to the TMDL for the AU immediately upstream.

5.7.2 Allocations by Waterbody Segment
The specific allocations for each waterbody segment are presented below in **Sections 5.7.2.1** through **5.7.2.8**.

5.7.2.1 Silver Bow Creek (MT76G003_020) Allocations
Allocations for Silver Bow Creek include:

- WLA_{Butte}: Composite wasteload allocations applicable to all Butte area OUs of the Silver Bow Creek/Butte Area Superfund Site combined with the area covered by the Butte-Silver Bow MS4 stormwater MPDES permit.
- $WLA_{Streamside\ Tailings\ OU}$: Wasteload allocations for the Streamside Tailings OU of the Butte Area Superfund Site.
- $WLA_{Warm\ Springs\ Ponds\ OU}$: Wasteload allocations for the Warm Springs Pond OUs
- Multiple MPDES-permitted point source wasteload allocations including:
  - $WLA_{Butte\text{-}Silver\ Bow\ WWTP}$: Butte-Silver Bow WWTP
  - $WLA_{Rocker\ WWTP}$: Rocker WWTP
  - WLA_{MR}: Montana Resources, Inc.
  - $WLA_{REC\ Adv\ Si}$: REC Advanced Silicon Materials, Inc.
- $LA_{Tributaries}$: Composite load allocations to metals-impaired tributaries.

Because Superfund actions have the goal of meeting water quality targets in Silver Bow Creek, the natural background load component is inherently included within the above LAs and WLAs. Therefore $LA_{Natural}$ is not specifically identified for Silver Bow Creek.

Butte Area Superfund and MS4 Composite Wasteload Allocations
This composite WLA (WLA_{Butte}) is applicable to all Butte area OUs of the Silver Bow Creek / Butte Area Superfund Site combined with the area covered by the Butte-Silver Bow MS4 stormwater MPDES permit. The Butte area OUs of the Silver Bow Creek/Butte Area Superfund Site together constitute a considerable source of metals to Silver Bow Creek. The Superfund site is operated under CERCLA and is therefore not subject to CWA regulation via MPDES permitting. However, to account for all metals loading to Silver Bow Creek, the TMDL must include a WLA for this load component.

OUs are created in order to address specific contaminant sources and pathways, but the entire Superfund site has the goal of meeting water quality targets in Silver Bow Creek. Allocation to specific OUs would be inappropriate. CERCLA programs will retain discretion over how best to achieve the instream water quality targets identified as ARARs. Therefore, all metals loading from these OUs are combined to ensure that remedial programs retain the flexibility to best attain the remedial goals.

Per EPA guidance (U.S. Environmental Protection Agency, 2002), the Butte MS4 (MTR040006) must be addressed via a WLA. Stormwater runoff is a major source of metals load to Silver Bow Creek, and is recognized as such in the BPSOU ROD. Isolating stormwater from metals sources and preventing stormwater impacted by mine waste it from discharging into Silver Bow Creek are major components of the selected remedy. As a result, much of the stormwater draining from Butte is managed under CERCLA, sharing some, but not all, of the same methods and goals as the MS4 program under the CWA.

(For instance, there is no CERCLA responsibility for common industrial activities unrelated to historic mining and milling activities.) The MS4 area and the Superfund area overlap, but not completely. The MS4 area includes portions of Butte upstream of the BPSOU, including part of the Blacktail Creek drainage. Up to 15% of the base flow copper load within the BPSOU originates in the Blacktail Creek drainage upstream of Harrison Avenue (U.S. Environmental Protection Agency, 2008), and runoff events from the Blacktail Creek drainage occasionally result in elevated metals concentrations. Part of the Blacktail Creek drainage is within the Westside Soils OU, another part of the Butte Area Superfund Site.

Butte-Silver Bow is named as one of the potentially responsible parties in the ROD and works to address stormwater issues throughout Butte, both within and outside the delineated Superfund OUs. Additionally, the goal of Superfund remediation is achieving water quality targets throughout and at the downstream end of the BPSOU for impacts caused by mining, and this goal cannot be achieved without addressing all upstream metals sources. For these reasons, the Butte MS4 and the Butte Area Superfund Site are presently addressed via a composite WLA (WLA_{Butte}).

The WLA_{Butte} for each metals impairment cause is set equal to the water quality target multiplied by flow. The flow measurement is provided by the USGS gage station 12323250 at the I-90 bridge (alternately known as SS-07), minus the Butte-Silver Bow WWTP discharge flow, since this WWTP discharge is provided a separate WLA below. Using an example instream hardness of 134 mg/L (the 25th percentile value) and a flow of 44 cfs (50 cfs on 7/17/12, minus the average WWTP discharge of 5.97 cfs), example WLA may be calculated in pounds per day using the following equations:

WLA_{Butte}

Arsenic: 10 µg/L x 44 cfs x 0.0054 = 2.38 lbs/day
Cadmium: 0.34 µg/L x 44 cfs x 0.0054 = 0.07 lbs/day
Copper: 12 µg/L x 44 cfs) x 0.0054 = 2.85 lbs/day
Lead: 4.6 µg/L x 44 cfs) x 0.0054 = 1.09 lbs/day
Mercury: 0.05 µg/L x 44 cfs x 0.0054 = 0.01 lbs/day
Zinc: 154 µg/L x 44 cfs x 0.0054 = 36.6 lbs/day

Streamside Tailings OU Superfund Wasteload Allocations

The Streamside Tailings OU of the Butte Area Superfund Site is provided a WLA (WLA_{SSTOU}). This allocation is set equal to the water quality target multiplied by the increase in flow (Δ flow) along the OU, minus any allocations provided between. The USGS operates a gage on either end of the OU, facilitating this calculation. The upstream end is monitored by USGS gage 12323250 (aka SS-07) and the downstream end by USGS gage 12323600 at Opportunity. An example for copper is presented below. To facilitate the calculations, the target is calculated using an instream hardness of 134 mg/L (the 25th percentile calculated at SS-07), the allocation may be calculated in pounds per day using the following equations:

WLA_{SSTOU} =

Arsenic: 10 µg/L x (Δ flow) x 0.0054 – ($LA_{German\ Gulch}$ + $WLA_{REC\ Adv\ Si}$ + WLA_{Rocker})
Cadmium: 0.34 µg/L x (Δ flow) x 0.0054 – ($WLA_{REC\ Adv\ Si}$ + WLA_{Rocker})
Copper: 12 µg/L x (Δ flow) x 0.0054 – ($WLA_{REC\ Adv\ Si}$ + WLA_{Rocker})
Lead: 4.6 µg/L x (Δ flow) x 0.0054 – ($WLA_{REC\ Adv\ Si}$ + WLA_{Rocker})
Mercury: 0.05 µg/L x (Δ flow) x 0.0054 – ($WLA_{REC\ Adv\ Si}$ + WLA_{Rocker})
Zinc: 154 µg/L x (Δ flow) x 0.0054 – ($WLA_{REC\ Adv\ Si}$ + WLA_{Rocker})

An example WLA_{SSTOU} for copper could be calculated according to the following formula, using example WLAs to Rocker and REC Advanced Silicon Materials, Inc., which are provided below:

Δ flow (7/17/12: 95 cfs – 50 cfs) = 45 cfs

$WLA_{REC\ Adv\ Si}$ (target (12 µg/L) x average discharge (1.7 cfs)) = 0.11 lbs/day

WLA_{Rocker} (target (12 µg/L) x average discharge (0.035 cfs)) = 0.002 lbs/day

WLA_{SSTOU} = 12 µg/L x 45 cfs x 0.0054 – (0.11 lbs/day + 0.002 lbs/day) = 2.80 lbs/day

As demonstrated by the equations above, there are allocations addressing three flows entering this reach of Silver Bow Creek: the German Gulch tributary and the Rocker WWTP and REC Advanced Silicon Materials, Inc., discharges. As discussed below, the only impairment to German Gulch shared by Silver Bow Creek is arsenic, and therefore the corresponding arsenic LA to German Gulch is separate from the Streamside Tailings OU arsenic WLA.

Also, as discussed above, the Streamside Tailings OU incorporates all natural background loading. It also incorporates all metals loading from tributaries that are not impaired for the metal of concern (e.g., Browns Gulch). These tributaries are likely providing flows at or near natural background concentrations and therefore provide dilution during both high and low flow events.

Warm Springs Ponds OUs Superfund Wasteload Allocations

The Warm Springs Ponds OUs are collectively assigned a WLA ($WLA_{Warm\ Springs\ Ponds}$). This allocation is set to the water quality target multiplied by discharge flow from the ponds (as measured at the outlet station SS-05). The goal is to ensure that water leaving the ponds is eventually achieving all target concentrations, even though DEQ understands that meeting these allocations depends heavily on loading reductions already addressed within all other allocations. Using an example instream hardness of 144 mg/L (the 25^{th} percentile calculated at Warm Springs), the allocation may be calculated in pounds per day using the following equations:

$WLA_{Warm\ Springs\ Ponds\ OU}$ =

Arsenic: 10 µg/L x (flow) x 0.0054

Cadmium: 0.35 µg/L x (flow) x 0.0054

Copper: 12.7 µg/L x (flow) x 0.0054

Lead: 5.1 µg/L x (flow) x 0.0054

Mercury: 0.05 µg/L x (flow) x 0.0054

Zinc: 163.2 µg/L x (flow) x 0.0054

Note that since TMDLs for Silver Bow Creek are developed to support all potential uses (as discussed above in **Section 5.4.2**), the arsenic target of 10 µg/L applies to this WLA.

Butte-Silver Bow Wastewater Treatment Plant (MT0022012) Wasteload Allocations

WLAs ($WLA_{Butte\text{-}Silver\ Bow\ WWTP}$) for arsenic, cadmium, copper, lead, mercury, and zinc are provided to the Butte-Silver Bow WWTP, located at 800 Centennial Drive in Butte. The current permit for the Butte-Silver Bow WWTP was written in November 2011 and includes four metals with reasonable potential to exceed instream water quality standards (cadmium, copper, mercury and zinc). Due to upstream impairments, the receiving water has no assimilative capacity and the effluent limits in the permit are based on meeting water quality standards at the point of discharge. The permit specifies that the plant is to meet the current limits by January 1, 2016. To ensure the Butte-Silver Bow treatment plant does not cause or contribute to a violation of water quality standards, the WLA ($WLA_{Butte\text{-}Silver\ Bow\ WWTP}$) is based on a discharge concentration equal to the target concentration for each impairment cause multiplied by the discharge flow. Therefore, example WLAs may be calculated in lbs/day according to the equations below, using on the 25th percentile hardness at SS-07 (134 mg/L) established in the permit and the average discharge flow of 5.97 cfs:

WLA $_{\text{Butte-Silver Bow WWTP}}$ =

Arsenic: 10 µg/L x 5.97 cfs x 0.0054 = 0.32 lbs/day
Cadmium: 0.3 µg/L x 5.97 cfs x 0.0054 = 0.01 lbs/day
Copper: 12 µg/L x 5.97 cfs x 0.0054 = 0.39 lbs/day
Lead: 4.6 µg/L x 5.97 cfs x 0.0054 =0.15 lbs/day
Mercury: 0.05 µg/L x 5.97 cfs x 0.0054 = 0.002 lbs/day
Zinc: 154 µg/L x 5.97 cfs x 0.0054 = 4.96 lbs/day

Example WLAs (WLA $_{\text{Butte-Silver Bow WWTP}}$) are illustrated (as loads in pounds per day) as a function of the Butte-Silver Bow facility discharge flow in **Figure 5-20** below. Note that the WLA for each metal increases with increasing discharge flow.

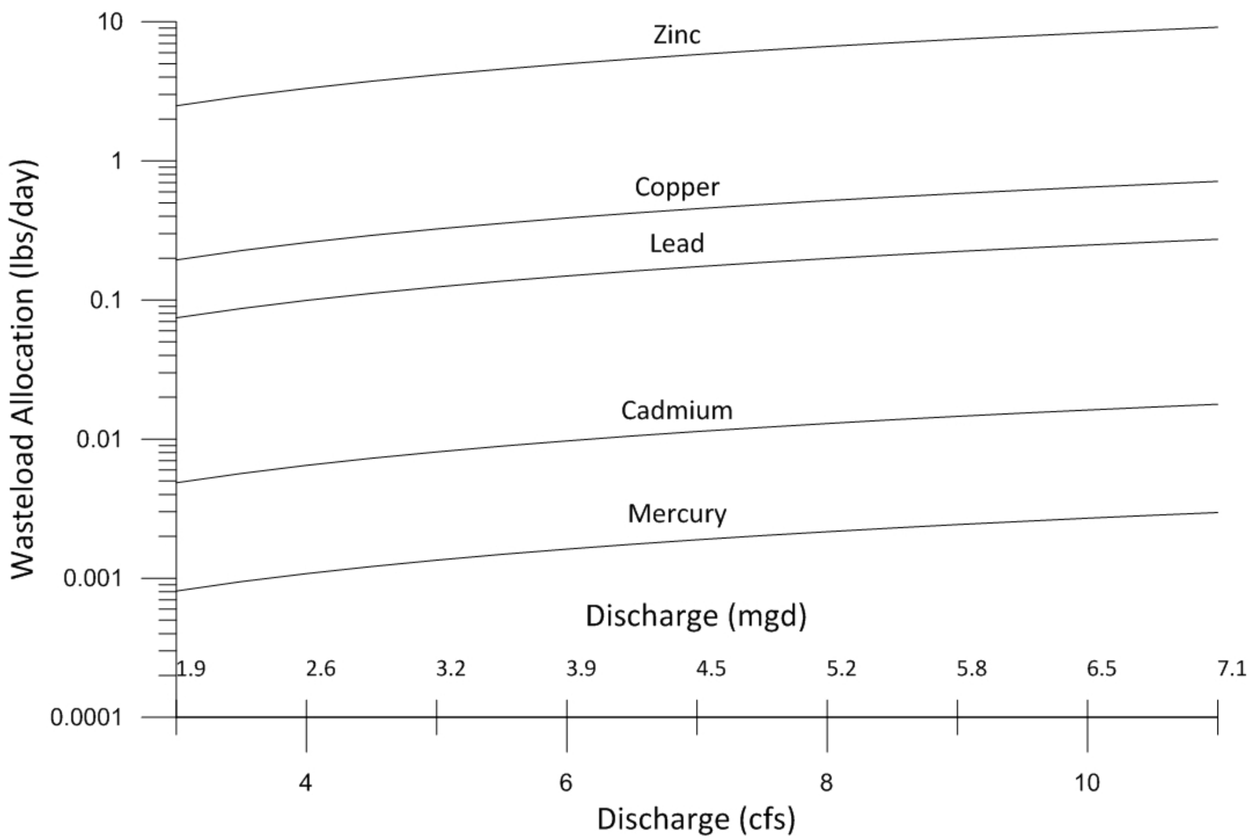

Figure 5-20. Example Wasteload Allocations for Butte-Silver Bow Wastewater Treatment Plant

Rocker Wastewater Treatment Plant (MT0027430) Wasteload Allocations

WLAs (WLA $_{\text{Rocker}}$) are provided for arsenic, cadmium, copper, lead, mercury, and zinc to the Rocker WWTP, located at 122030 Nissler Road in Rocker. The facility has a permit to discharge to Silver Bow Creek, with effluent limits for two metals: copper and zinc. The effluent limits were based on a WLA of the chronic aquatic life standard, and become effective January 1, 2017. The receiving water has no assimilative capacity due to upstream impairments. To ensure the Rocker treatment plant does not cause or contribute to a violation of water quality standards, the WLA (WLA $_{\text{Rocker WWTP}}$) is based on a discharge concentration equal to the target concentration for each impairment cause multiplied by the discharge flow. Therefore, example WLAs may be calculated in lbs/day according to the equations below, using the 25th percentile hardness at SS-07 (134 mg/L) and the average discharge flow (0.035 cfs) established in the permit:

$WLA_{Rocker\ WWTP}$ =

Arsenic: 10 x 0.035 cfs x 0.0054 = 0.002 lbs/day
Cadmium: 0.34 x 0.035 cfs x 0.0054 = 0.0001 lbs/day
Copper: 12 µg/L x 0.035 cfs x 0.0054 = 0.002 lbs/day
Lead: 4.62 x 0.035 cfs x 0.0054 = 0.001 lbs/day
Mercury: 0.05 x 0.035 cfs x 0.0054 = 0.00001 lbs/day
Zinc: 154 µg/L x 0.035 cfs x 0.0054 = 0.029 lbs/day

Example WLAs (WLA_{Rocker}) for copper and zinc are illustrated (as loads in pounds per day as a function of the Rocker facility discharge flow in **Figure 5-21** below. Note that the WLA for each metal increases with increasing discharge flow.

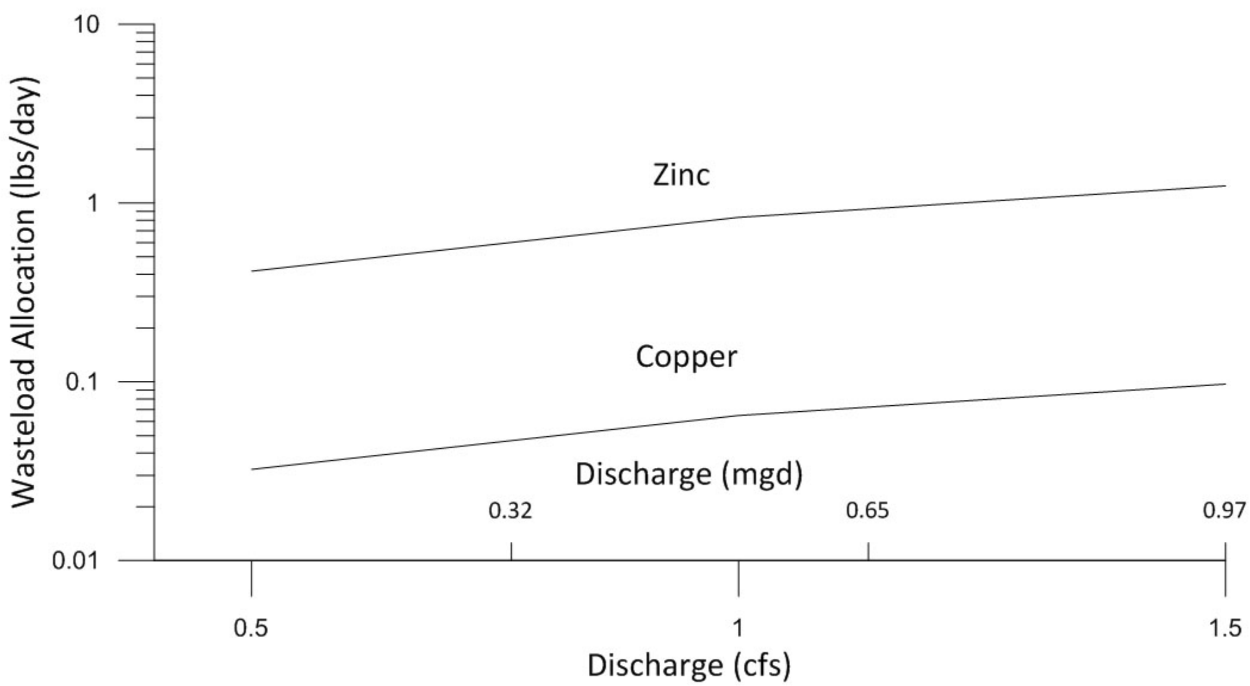

Figure 5-21. Example Wasteload Allocations for Rocker Wastewater Treatment Plant

Montana Resources, Inc. (MT0000191) Wasteload Allocations

WLAs (WLA_{MR}) for arsenic, cadmium, copper, lead, mercury, and zinc are provided to MR. This facility, located at 600 Shields Avenue in Butte, has a MPDES permit (MT0000191) for a single major industrial outfall, discharging to Silver Bow Creek via MSD. DEQ understands that the facility does not discharge under normal operation. To ensure the MR facility does not cause or contribute to a violation of water quality standards, the WLA is based on a discharge concentration equal to the target concentration for each impairment cause multiplied by the discharge flow. The metals WLAs may be calculated in lbs/day using the following equations, based on the 25th percentile hardness (101 mg/L) established in the permit:

WLA_{MR} =

Arsenic: 10 µg/L x (discharge flow) x 0.0054
Cadmium: 0.27 µg/L x (discharge flow) x 0.0054
Copper: 9.41 µg/L x (discharge flow) x 0.0054
Lead: 3.22 µg/L x (discharge flow) x 0.0054
Mercury: 0.05 µg/L x (discharge flow) x 0.0054
Zinc: 120.8 µg/L x (discharge flow) x 0.0054

According to the permit fact sheet, the discharge flow term is expected to be equal to zero under normal operations (i.e., there is no discharge).

REC Advanced Silicon Materials, Inc. (MT0030352) Wasteload Allocations

WLAs ($WLA_{REC\ Adv\ Si}$) for arsenic, cadmium, copper, lead, mercury, and zinc are provided to the REC Advanced Silicon Materials, Inc., facility located at 119140 Rick Jones Way outside of Butte. The facility discharges to Sheep Gulch, an ephemeral stream, but the effluent discharge of roughly 1.5 cfs creates perennial flow that joins Silver Bow Creek. The permit specifies that there is no mixing zone and the effluent limits (copper, nickel and zinc) are set to end-of-pipe. However, the hardness of the effluent (and therefore the receiving water in Sheep Gulch) is high enough that the effluent limits are calculated using 400 mg/L hardness. The resulting effluent limits are considerably higher than the target concentrations in Silver Bow Creek, which has no assimilative capacity due to upstream impairments. The current copper loads represent roughly 3% of the high flow TMDL and 10% of the low flow TMDL. Therefore, the WLAs for all discharge locations, whether Sheep Gulch or Silver Bow Creek, are set to match the effluent limits the permit provides to an alternate outfall (003) on Silver Bow Creek. These limits are set using hardness values representative of Silver Bow Creek water quality. Therefore, example WLAs may be calculated in lbs/day according to the equations below, using the 25th percentile hardness at SS-07 / USGS 12323250 that was established in the permit (134 mg/L) and average discharge flow of 1.71 cfs:

$WLA_{REC\ Adv\ Si}$ =

Arsenic: 10 x 1.71 cfs x 0.0054 = 0.09 lbs/day
Cadmium: 0.34 x 1.71 cfs x 0.0054 = 0.003 lbs/day
Copper: 12 µg/L x 1.71 cfs x 0.0054 = 0.11 lbs/day
Lead: 4.62 x 1.71 cfs x 0.0054 = 0.04 lbs/day
Mercury: 0.05 x 1.71 cfs x 0.0054 = 0.0005 lbs/day
Zinc: 154 µg/L x 1.71 cfs x 0.0054 = 1.42 lbs/day

Based on very low levels in prior sampling history, cadmium and lead discharge concentrations are below the target, demonstrating that these specific metals WLAs are being met. There is a possibility that Superfund remediation upstream may create assimilative capacity for one or more metals of concern at this point of Silver Bow Creek. Therefore, a staged WLA implementation approach is acceptable whereby the WLAs are applicable the permit cycle after construction of the Streamside Tailings OU remedy is completed. During this staged implementation, monitoring is required to ensure adequate characterization of metals discharge concentrations. This monitoring does not need to include cadmium and lead unless there are operational changes that could affect the discharge concentrations of these two metals. If Silver Bow Creek in this area improves to the point that it has assimilative capacity for one or more metals of concern, then the corresponding $WLA_{REC\ Adv\ Si}$ could be increased based on a standard mixing zone analysis, taking into account the appropriate hardness levels in Silver Bow Creek.

Example WLAs ($WLA_{REC\ Adv\ Si}$) for copper and zinc are illustrated (as loads in pounds per day as a function of the REC Advanced Silicon Materials, Inc., facility discharge flow in **Figure 5-22** below. Note that the WLA for each metal increases with increasing discharge flow.

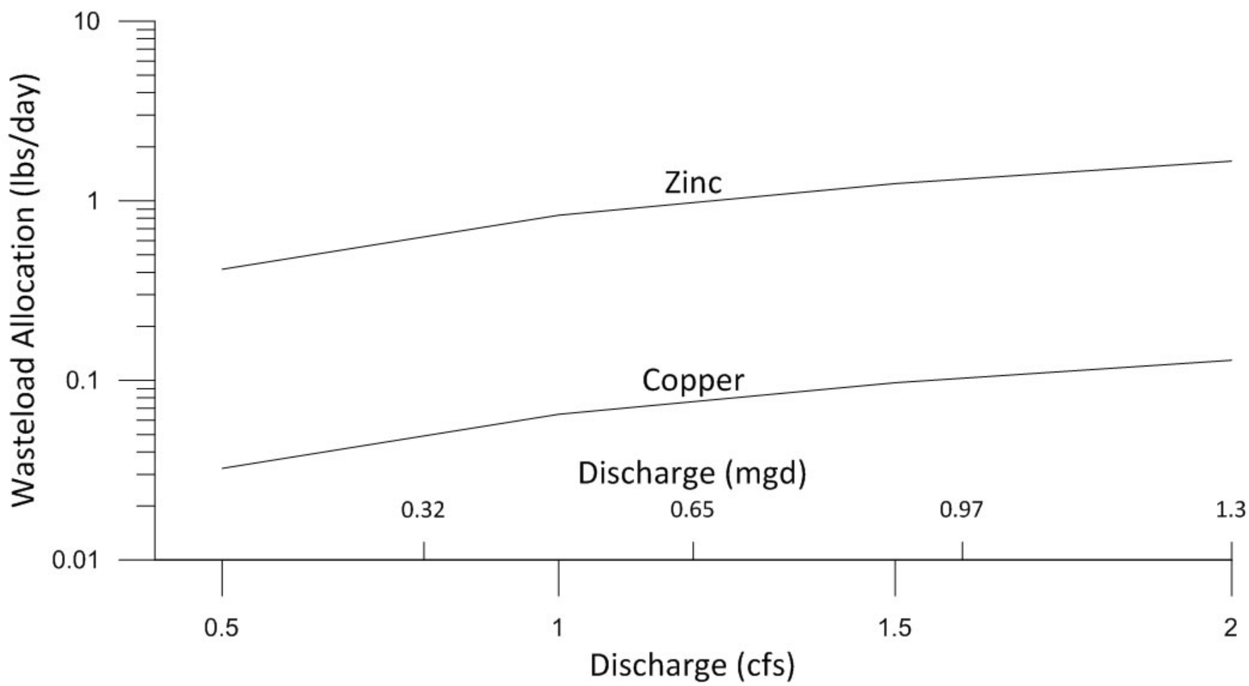

Figure 5-22. Example Wasteload Allocations for REC Advanced Silicon Materials, Inc.

Metals-Impaired Tributary Load Allocations

LAs are provided to metals-impaired tributaries: German Gulch and Mill-Willow Bypass. The allocation to German Gulch only includes arsenic, since that is the only metal impairment to German Gulch shared by Silver Bow Creek. The allocations are equal to the TMDLs for these waterbody-pollutant combinations. As in this document, these TMDLs are based on the target concentration times flow (times a conversion factor to express in lbs/day). The targets are identical to those established above in **Section 5.3**.

For arsenic, this LA can be combined as follows:

$$LA_{Tributaries} = LA_{German\ Gulch} + LA_{Mill\text{-}Willow\ Bypass}$$

For cadmium, copper, lead, and zinc, this LA is:

$$LA_{Tributaries} = LA_{Mill\text{-}Willow\ Bypass}$$

Sum of Allocations

Metals TMDLs for Silver Bow Creek are the sum of the allocations provided above, and at the gage at Opportunity, may be expressed by the following formula:

$$TMDL_{SBC} = WLA_{Butte} + WLA_{Streamside\ Tailings} + WLA_{Butte\ WWTP} + WLA_{Rocker\ WWTP} + WLA_{MR} + WLA_{REC\ Adv\ Si} + LA_{Tributaries}$$

An example TMDL for copper at Opportunity is presented below. For the purpose of calculating this example, the copper TMDL under high flow conditions is calculated using the same target (12 µg/L) as the WLAs provided above, which is based on the 25^{th} percentile hardness value at SS-07.

Example TMDL $_{SBC}$ = [2.85 lbs/day (WLA $_{Butte}$) + 2.80 lbs/day (WLA $_{SSTOU}$) + 0.39 lbs/day (WLA $_{Butte\ WWTP}$) + 0.002 lbs/day (WLA $_{Rocker\ WWTP}$) + 0 lbs/day (WLA $_{MR}$) + 0.11 lbs/day (WLA $_{REC\ Adv\ Si}$)] = 6.15 lbs/day
As previously discussed (**Section 5.6.1.1**), the Warm Springs Ponds generally act as a sink for most metals, while acting as a source of arsenic to the lowest reach of Silver Bow Creek. Therefore, the allocations above the Warm Springs Ponds will all add up to 100% of the TMDL load as measured at the gaging station at Opportunity (upstream of the ponds), whereas the allocations are generally "reset" below the Warm Springs Ponds. Therefore, the TMDL at the mouth of Silver Bow Creek would equate to:

TMDL $_{SBC}$ = WLA $_{Warm\ Springs\ Ponds\ OUs}$ + LA $_{Tributaries}$ (LA $_{Mill\text{-}Willow\ Bypass}$).

5.7.2.2 Clark Fork River: Warm Springs Creek to Cottonwood Creek (MT76G001_040) Allocations

Allocations for this segment of the Clark Fork River include:

- WLA $_{Mainstem\ OU}$: Wasteload allocation applicable to the Mainstem OU of the Milltown Reservoir/Clark Fork River Superfund Site.
- Multiple MPDES-permitted point source wasteload allocations, including:
  - WLA $_{MT\ Behavioral\ Health}$: Montana Behavioral Health, Inc.
  - WLA $_{MT\ State\ Hospital}$: Montana State Hospital in Warm Springs
- LA $_{Tributaries}$: Composite load allocations to metals-impaired tributaries
- LA $_{Upstream}$: Composite load allocations to upstream segments, in this case Silver Bow Creek and Warm Springs Creek

Mainstem Clark Fork River Superfund Wasteload Allocations

The Mainstem Clark Fork River OU of the Milltown Reservoir / Clark Fork River Superfund Site is provided a WLA (WLA $_{Mainstem\ OU}$). This allocation is equal to the water quality target multiplied by the increase in flow (Δ flow) along this segment of the river, minus any allocations provided between. This allocation therefore includes any natural background or diffuse metals loads (such as metals in groundwater related to Anaconda smelter fallout). This is appropriate given the remedial goals expressed in the ROD. The USGS operates a gage on either end of the OU, facilitating this calculation. The upstream end is monitored by USGS gage at Galen (12323800) and the downstream end by the USGS gage at Deer Lodge (12324200). The allocation under high flow conditions may be calculated in pounds per day using the following equations and the instream hardness (106 mg/L) provided in **Table 5-28**:

WLA $_{Mainstem\ OU}$ =
Cadmium: 0.28 µg/L x (Δ flow) x 0.0054 – (WLA $_{MT\ Behavioral\ Health}$ + WLA $_{MT\ State\ Hospital}$ + LA $_{Tributaries\ (Modesty)}$)
Copper: 9.8 µg/L x (Δ flow) x 0.0054 – (WLA $_{MT\ Behavioral\ Health}$ + WLA $_{MT\ State\ Hospital}$ + LA $_{Tributaries\ (Lost\ \&\ Modesty)}$)
Lead: 3.43 µg/L x (Δ flow) x 0.0054 – (WLA $_{MT\ Behavioral\ Health}$ + WLA $_{MT\ State\ Hospital}$ + LA $_{Tributaries\ (Lost\ \&\ Modesty)}$)
Iron: 1,000 µg/L x (Δ flow) x 0.0054 – (WLA $_{MT\ Behavioral\ Health}$ + WLA $_{MT\ State\ Hospital}$ + LA $_{Tributaries\ (Peterson)}$)

An example WLA $_{Mainstem\ OU}$ for copper is calculated below, using the following:

- Δ flow (on June 6, 2012) = [Deer Lodge flow (736 cfs) – Galen flow (572 cfs)] = 164 cfs
- WLA $_{MT\ Behavioral\ Health}$ = 0.00054 lbs/day (**Section 5.6.2.2**)

- WLA $_{\text{MT State Hospital}}$ = 0.003 lbs/day (**Section 5.6.2.2**)
- Lost Creek high flow copper TMDL = 0.651 lbs/day (from Upper Clark Fork Tributaries Document)
- Modesty Creek high flow copper TMDL = 0.579 lbs/day (from Upper Clark Fork Tributaries Document)

[164 cfs x 9.8 µg/L x 0.0054] – [0.00054 lbs/day + 0.003 lbs/day + 0.65 lbs/day + 0.58 lbs/day]
8.69 lbs/day – 1.24 lbs/day = 7.45 lbs/day

This method of calculating the WLA to streambank/streambed tailings could be repeated for all AUs above the Blackfoot River. As discussed above for Silver Bow Creek streamside tailings WLA, this streamside tailings OU incorporates all natural background loading. It also incorporates all metals loading from tributaries that are not impaired for the metal of concern. These tributaries are likely providing flows at or near natural background concentrations and therefore provide dilution during both high and low flow events.

Montana Behavioral Health, Inc. (MT0021431) Wasteload Allocations

WLAs (WLA $_{\text{MT Behavioral Health}}$) for cadmium, copper, iron, and lead are provided to the Montana Behavioral Health WWTP (MT0020664), located at 5824 Yellowstone Trail in Galen. The WLAs are set to the current average cadmium, copper, iron, and lead concentrations in the effluent. Because these values are not available and the WLA cannot be quantified at this time using average discharge data, the WLA $_{\text{MT Behavioral Health}}$ for copper may be estimated using the copper value (16.9 µg/L) from East Helena. Because of the high hardness in the Clark Fork River (118 mg/L is the 25th percentile value from the USGS gage at Galen), the cadmium and lead targets are higher than would be expected from an average treatment facility. Therefore the WLAs for these two metals are estimated using the instream targets:

Cadmium: 0.28 µg/L x (discharge flow) x 0.0054
Copper: 16.9 µg/L x (discharge flow) x 0.0054
Iron: 1,000 µg/L x (discharge flow) x 0.0054
Lead: 3.43 µg/L x (discharge flow) x 0.0054

Although the copper values might be slightly above the target concentrations, the overall loading from this discharge is minor and represents a negligible loading contribution. For example, at low flow, the copper load is approximately 0.003% of the TMDL. As discussed above in **Section 5.7** and shown in **Table 5-51**, DEQ anticipates that in the future there may be assimilative capacity for some metals in this segment of the Clark Fork River so that a standard mixing zone may be available to this discharge. As the current permit does not require any metals sampling, the next permit renewal must require semi-annual effluent sampling for cadmium, copper, iron and lead in order to better understand loading from this facility. This data can then be used to refine the above estimated WLAs to match existing discharge concentrations.

If assimilative capacity has not been created after completion of CERCLA remediation activities and the Montana Behavioral Health WWTP is found to cause or contribute to impairment, revised WLAs may be provided at that time. DEQ will evaluate the facility's percent contribution toward metals impairment in this segment of the Clark Fork River and determine whether a new suite of WLAs is necessary for this facility prior to subsequent permit renewals.

Montana State Hospital (MTG580004) Wasteload Allocations
WLAs ($WLA_{MT\ State\ Hospital}$) for cadmium, copper, iron, and lead are provided to the Montana State Hospital WWTP (MTG580004), located in Warm Springs. The WLAs are set to the current average cadmium, copper, iron, and lead concentrations in the effluent. Because these values are not available and the WLA cannot be quantified at this time using average discharge data, the $WLA_{MT\ State\ Hospital}$ for copper may be estimated using the copper value (16.9 µg/L) from East Helena. As the high hardness in the Clark Fork River (118 mg/L is the 25th percentile value from the USGS gage at Galen), the cadmium and lead targets are higher than would be expected from an average treatment facility. Therefore the WLAs for these two metals are estimated using the instream targets:

Cadmium: 0.28 µg/L x (discharge flow) x 0.0054
Copper: 16.9 µg/L x (discharge flow) x 0.0054
Iron: 1,000 µg/L x (discharge flow) x 0.0054
Lead: 3.43 µg/L x (discharge flow) x 0.0054

Although the copper values might be slightly above the target concentrations at high flows, the overall loading from this discharge is minor and represents a negligible loading contribution. For example, at high flow, the copper load is approximately 0.5% of the TMDL. As discussed above in **Section 5.7** and shown in **Table 5-51**, DEQ anticipates that in the future there may be assimilative capacity for some metals in this segment of the Clark Fork River so that a standard mixing zone may be available to this discharge. As the current permit does not require any metals sampling, the next permit renewal must require semi-annual effluent sampling for cadmium, copper, iron and lead in order to better understand loading from this facility. This data can then be used to refine the above estimated WLAs to match existing discharge concentrations.

If assimilative capacity has not been created after completion of CERCLA remediation activities and the Montana State Hospital WWTP is found to cause or contribute to impairment, revised WLAs may be provided at that time. DEQ will evaluate the facility's percent contribution toward metals impairment in this segment of the Clark Fork River and determine a new suite of WLAs is necessary for this facility prior to subsequent permit renewals.

Metals-Impaired Tributaries Load Allocations
The $LA_{Tributaries}$ term is equal to the sum of TMDLs for Lost Creek, Modesty Creek, and Peterson Creek (refer back to **Tables 5-30** through **5-33** in **Section 5.6.2.3**). The tributary streams included in this term vary by pollutant cause (identified below), as not each of these tributaries has TMDLs for all four metals impairment causes.

- Cadmium: Modesty Creek
- Copper: Lost Creek and Modesty Creek
- Lead: Lost Creek and Modesty Creek
- Iron: Peterson Creek

Therefore, the copper $LA_{Tributaries}$ load allocation is equal to $LA_{Lost\ Creek}$ + $LA_{Modesty\ Creek}$ whereas the cadmium $LA_{Tributaries}$ load allocation is equal to $LA_{Modesty\ Creek}$.

Upstream Load Allocations
The LAs to upstream sources ($LA_{Upstream}$) are similar in concept to the metals-impaired tributary LAs. They are a composite of all allocations for each specific metal equal to the applicable TMDL for Silver Bow Creek and Warm Springs Creek.

$LA_{Upstream}$ =

Cadmium: $LA_{Silver\ Bow\ Creek} + LA_{Warm\ Springs\ Creek}$
Copper: $LA_{Silver\ Bow\ Creek} + LA_{Warm\ Springs\ Creek}$
Lead: $LA_{Silver\ Bow\ Creek} + LA_{Warm\ Springs\ Creek}$
Iron: $LA_{Silver\ Bow\ Creek} + LA_{Warm\ Springs\ Creek}$

Warm Springs Creek has TMDLs developed for cadmium, copper, lead and iron, whereas Silver Bow Creek has TMDLs developed for cadmium, copper and lead but not iron. Therefore, the upstream LA to Silver Bow Creek for iron is not represented by an existing TMDL within Silver Bow Creek but instead is separately defined as the flow at the mouth of Silver Bow Creek multiplied by the iron target of 1,000 µg/L (times the 0.0054 conversion factor to yield a load in lbs/day). This flow can be measured at the USGS gage station on Silver Bow Creek at Warm Springs.

Sum of Allocations

The metals TMDLs for Clark Fork River between Warm Springs Creek and Cottonwood Creek (CFR01) are expressed by the following formula:

$$TMDL_{CFR01} = WLA_{Mainstem\ OU} + WLA_{MT\ Behavior\ Health} + WLA_{MT\ State\ Hospital} + LA_{Tributaries} + LA_{Upstream}$$

An example TMDL for copper is presented below using the June 6, 2012 flow of 736 cfs at Deer Lodge. For the purpose of calculating this example, the copper TMDL is calculated using the same target (9.8 µg/L). The MPDES-permitted discharge WLAs are calculated using the estimated concentration of 16.9 µg/L (**Section 5.6.2.2**). To precisely calculate the $LA_{Tributaries}$ and $LA_{Upstream}$ terms, the instantaneous flow and hardness are required at the mouths of these streams. For this example, the $LA_{Tributaries}$ is based on the same example TMDLs used above to calculate the WLA Mainstem OU and the $LA_{Upstream}$ is the difference between the TMDL and the sum of the other allocations.

$TMDL_{CFR01}$ = 9.8 µg/L x 736 cfs x 0.0054 = 38.95 lbs/day

38.95 lbs/day = [7.45 lbs/day ($WLA_{Mainstem\ OU}$) + 0.00054 lbs/day ($WLA_{MT\ Behavioral\ Health}$) + 0.03 lbs/day ($WLA_{MT\ State\ Hospital}$) + 0.654 lbs/day ($LA_{Tributaries}$) + 30.24 lbs/day ($LA_{Upstream}$)]

5.7.2.3 Clark Fork River: Cottonwood Creek to Little Blackfoot River (MT76G001_030) Allocations

Allocations for this segment of the Clark Fork River include:

- $WLA_{Mainstem\ OU}$: Wasteload allocation applicable to the Mainstem OU of the Milltown Reservoir/Clark Fork River Superfund Site.
- $WLA_{Deer\ Lodge}$: Deer Lodge WWTP.
- $LA_{Upstream}$: Load allocations to the upstream segment of the Clark Fork River

Mainstem Clark Fork River Superfund Wasteload Allocations

The Mainstem Clark Fork River OU of the Milltown Reservoir / Clark Fork River Superfund Site is provided a WLA ($WLA_{Mainstem\ OU}$). As is the case for the AU immediately upstream, this allocation is set equal to the water quality target multiplied by the increase in flow (Δ flow) along this segment of the river, minus any allocations provided between. This allocation therefore includes any natural background or diffuse metals loads, including that from groundwater. This is appropriate in light of the cleanup goals established in the ROD. The USGS operates a gage on either end of the OU, facilitating this calculation. The upstream end is monitored by USGS gage at Deer Lodge (12324200) and the downstream end by the USGS gage above the Little Blackfoot near Garrison (12324400). The allocation may be calculated in pounds per day using the following equations:

$WLA_{\text{Mainstem OU}}$ in lbs/day =

Cadmium: 0.3 µg/L x (Δ flow) x 0.0054 – ($WLA_{\text{Deer Lodge WWTP}}$)
Copper: 12 µg/L x (Δ flow) x 0.0054 – ($WLA_{\text{Deer Lodge WWTP}}$)
Lead: 4.6 µg/L x (Δ flow) x 0.0054 – ($WLA_{\text{Deer Lodge WWTP}}$)
Iron: 1,000 µg/L x (Δ flow) x 0.0054 – ($WLA_{\text{Deer Lodge WWTP}}$)
Zinc: 154 µg/L x (Δ flow) x 0.0054 – ($WLA_{\text{Deer Lodge WWTP}}$)

The hardness-dependent target concentrations are calculated using a hardness of 134 mg/L, which is the 25^{th} percentile value for the USGS gage at Deer Lodge.

Deer Lodge Wastewater Treatment Plant (MT0022616) Wasteload Allocations

WLAs ($WLA_{\text{Deer Lodge WWTP}}$) for cadmium, copper, iron, lead, and zinc are provided to the Deer Lodge WWTP (MT0022616), located at 198 N Frontage Road in Deer Lodge. These allocations are set to meeting the instream targets at “end of pipe.” That is, the concentration of the effluent is based on the target concentration for each impairment cause, multiplied by the discharge flow. The examples below are calculated using a hardness of 134 mg/L, the 25^{th} percentile value for the USGS gage at Deer Lodge. This is based on the assumption that DEQ will use this value when calculating effluent limits for future permits. The metals WLAs may be calculated in units of pounds/day according to the following equations:

$WLA_{\text{Deer Lodge WWTP}}$ in lbs/day =

Cadmium: 0.3 µg/L x (discharge flow) x 0.0054
Copper: 12 µg/L x (discharge flow) x 0.0054
Iron: 1,000 µg/L x (discharge flow) x 0.0054
Lead: 4.6 µg/L x (discharge flow) x 0.0054
Zinc: 154 µg/L x (discharge flow) x 0.0054

Because the existing treatment plant currently meets these targets in the discharge, DEQ expects that the new plant will perform at least as well. However, as discussed above, it is possible that the influent (and therefore the effluent) metals concentrations may rise slightly in response to inflow and infiltration improvements. Under these circumstances, it is possible that one or more metals concentrations in the discharge could slightly exceed one or more metals target concentrations used as the basis for each $WLA_{\text{Deer Lodge WWTP}}$. Any such target concentration exceedances in the discharge would presumably be minor, consistent with the discharge concentration assumptions provided for the Montana State Hospital (**Section 5.7.2.2**) and other small dischargers discussed above. As discussed above in **Section 5.7** and shown in **Table 5-51**, DEQ anticipates that in the future there may be assimilative capacity for some metals in this segment of the Clark Fork River. Therefore, until such time that mainstem Clark Fork River Superfund remediation activities are completed, the $WLA_{\text{Deer Lodge WWTP}}$ for each metal can alternatively be based on the eventual discharge concentration rather than the instream targets if the discharge concentration is greater than the instream target.

If the expected assimilative capacity has not been created after completion of CERCLA remediation activities and the Deer Lodge WWTP is found to cause or contribute to impairment, revised WLAs may be provided at that time. DEQ will evaluate the facility’s percent contribution toward metals impairment in this segment of the Clark Fork River and determine whether a new suite of WLAs is necessary for this facility prior to subsequent permit renewals. This and other adaptive management strategies are discussed below in **Section 5.8**.

Upstream Load Allocations
The LAs to upstream sources ($LA_{Upstream}$) are a composite of all allocations for each specific metal equal to the applicable TMDL for the segment of the Clark Fork River immediately upstream. The upstream segment has TMDLs developed for cadmium, copper, lead and iron, but not zinc. Therefore, the upstream LA to the Clark Fork River to Cottonwood Creek for zinc is not represented by a TMDL but instead is separately defined as the flow in the Clark Fork River at the segment boundary (mouth of Cottonwood Creek) multiplied by the zinc target. This flow can be estimated from the USGS gage station Clark Fork River at Deer Lodge (12324200).

Sum of Allocations
All the metals TMDLs for the Clark Fork River between Cottonwood Creek and the Little Blackfoot River are expressed by the following formula:

$$TMDL_{CFR02} = WLA_{Mainstem\ OU} + WLA_{DeerLodge\ WWTP} + LA_{Upstream}$$

The TMDL for each metal could be calculated according to the same methods outline in the example provided above in **Section 5.7.2.2**.

5.7.2.4 Clark Fork River: Little Blackfoot River to Flint Creek (MT76G001_010) Allocations

Allocations for this segment of the Clark Fork River include:

- $WLA_{Mainstem\ OU}$: Wasteload allocation applicable to the Mainstem OU of the Milltown Reservoir/Clark Fork River Superfund Site.
- $LA_{Tributaries}$: Composite load allocation to metals-impaired tributaries
- $LA_{Upstream}$: Load allocations to the upstream segment of the Clark Fork River

Mainstem Clark Fork River Superfund Wasteload Allocations
The Mainstem Clark Fork River OU of the Milltown Reservoir / Clark Fork River Superfund Site is provided a WLA ($WLA_{Mainstem\ OU}$). As is the case for the AU immediately upstream, this allocation is set equal to the water quality target multiplied by the increase in flow (Δ flow) along this segment of the river, minus any allocations provided between. This allocation therefore includes any natural background or diffuse metals loads. Calculating this Δ flow is difficult, but the upstream end may be roughly estimated by adding flow at the USGS gage on the Clark Fork River above the Little Blackfoot River (12324400) to flow at the gage on the Little Blackfoot River (12324590). The downstream end may be roughly estimated by subtracting the flow from Flint Creek (12331500) from the flow at the USGS gage near Drummond (12331800). Alternately, this WLA may be calculated by subtracting all other allocations from the TMDL. Using an example instream hardness of 125 mg/L (the 25th percentile calculated at Gold Creek), the allocation may be calculated in pounds per day using the following equations:

$WLA_{Mainstem\ OU}$ in lbs/day =

Arsenic: 10 µg/L x (Δ flow) x 0.0054 – ($LA_{Little\ Blackfoot\ River} + LA_{Dunkleberg\ Creek}$)
Cadmium: 0.32 µg/L x (Δ flow) x 0.0054 – ($LA_{Dunkleberg\ Creek}$)
Copper: 11.3 µg/L x (Δ flow) x 0.0054 – ($LA_{Dunkleberg\ Creek}$)
Iron: 1,000 µg/L x (Δ flow) x 0.0054 – ($LA_{Gold\ Creek} + LA_{Dunkleberg\ Creek}$)

Lead: 4.2 µg/L x (Δ flow) x 0.0054 – ($LA_{\text{Little Blackfoot River}}$ + $LA_{\text{Gold Creek}}$ + $LA_{\text{Dunkleberg Creek}}$)
Mercury: 0.05 µg/L (Δ flow) x 0.0054

Metals-Impaired Tributaries Load Allocations
The $LA_{\text{Tributaries}}$ term is equal to the sum of TMDLs for the Little Blackfoot River, Gold Creek, and Dunkleberg Creek. The tributary streams included in this term vary by pollutant cause (identified below), as not each of these tributaries has TMDLs for all four metals impairment causes.

- Arsenic: Little Blackfoot River and Dunkleberg Creek
- Cadmium: Dunkleberg Creek
- Copper: Dunkleberg Creek
- Iron: Gold Creek and Dunkleberg Creek
- Lead: Little Blackfoot River, Gold Creek, and Dunkleberg Creek

Therefore, the copper $LA_{\text{Tributaries}}$ load allocation includes the only $LA_{\text{Dunkleberg}}$, whereas the $LA_{\text{Tributaries}}$ for iron is $LA_{\text{Gold Creek}}$ + $LA_{\text{Dunkleberg Creek}}$.

Upstream Load Allocations
The LAs to upstream sources (LA_{Upstream}) for cadmium, copper, iron, and lead are equal to the applicable TMDL for the segment immediately upstream. The upstream segment does not have arsenic or mercury impairments (or TMDLs) because the C-1 classification has no drinking water use or HHS. The LA_{Upstream} for these impairment causes are set to the target times flow in the Clark Fork River above the mouth of the Little Blackfoot River.

LA_{Upstream} in lbs/day =
Arsenic: 10 µg/L x (flow at upstream end of segment) x 0.0054
Mercury: 0.05 µg/L x (flow at upstream end of segment) x 0.0054

The implication of this LA is that the Mainstem OU actions and other remedial activities will have to control arsenic and mercury loads in the upstream segments in order to meet the targets in this segment. As identified in **Table 5-51**, this would require significant upstream source load reductions for arsenic. For mercury, there are insufficient data to quantify loads from the upstream source area and identify any reductions necessary to meet the upstream LA.

Sum of Allocations
TMDLs for arsenic, cadmium, copper, iron, lead, and mercury are expressed by the following formula:

$$TMDL_{\text{CFR03}} = WLA_{\text{Mainstem OU}} + LA_{\text{Upstream}} + LA_{\text{Tributaries}}$$

The TMDL could be calculated according to the same methods outline in the example provided above in **Section 5.7.2.2**.

5.7.2.5 Clark Fork River: Flint Creek to Blackfoot River (MT76E001_010) Allocations

Allocations for this segment of the Clark Fork River include:

- $WLA_{\text{Mainstem OU}}$: Wasteload allocation applicable to the Mainstem and Milltown Reservoir OUs of the Milltown Reservoir/Clark Fork River Superfund Site.
- WLA_{Drummond}: Town of Drummond WWTP
- $LA_{\text{Tributaries}}$: Composite load allocation to metals-impaired tributaries
- LA_{Upstream}: Load allocations to the upstream segment of the Clark Fork River

Milltown Reservoir Sediments / Clark Fork River Superfund Wasteload Allocations
The Mainstem Clark Fork River and Milltown Reservoir Sediments OUs of the Milltown Reservoir / Clark Fork River Superfund Site are provided a WLA ($WLA_{Milltown}$). As is the case for the AU immediately upstream, this allocation is set equal to the water quality target multiplied by the increase in flow (Δ flow) along this segment of the river, minus any allocations provided between. This allocation therefore includes any natural background or diffuse metals loads, including contaminated groundwater. This segment is not well-bracketed by the USGS gages, as the Clark Fork near Drummond (12331800) gage is some distance downstream from the top of the segment. However, due to the narrow bedrock canyon and lack of significant tributaries, the Δ flow may still be roughly estimated by the difference between this gage and the gage at Turah Bridge (12334550). Alternately, this WLA may be calculated by subtracting all other allocations from the TMDL. Using an example instream hardness of 85.6 mg/L (the 25^{th} percentile calculated at Turah Bridge), the allocation may be calculated in pounds per day using the following equations:

$WLA_{Milltown}$ =

Arsenic: 10 µg/L x (Δ flow) x 0.0054 – ($WLA_{Drummond}$ + LA_{Flint})
Cadmium: 0.24 µg/L x (Δ flow) x 0.0054 – $WLA_{Drummond}$
Copper: 8.2 µg/L x (Δ flow) x 0.0054 – ($WLA_{Drummond}$ + LA_{Flint} + $LA_{Wallace}$)
Iron: 1,000 µg/L x (Δ flow) x 0.0054 – ($WLA_{Drummond}$ + LA_{Flint})
Lead: 2.63 µg/L x (Δ flow) x 0.0054 – ($WLA_{Drummond}$ +LA_{Flint} + LA_{Cramer})
Mercury: 0.05 µg/L x (Δ flow) x 0.0054 – ($WLA_{Drummond}$ + LA_{Flint})
Zinc: 105.4 µg/L x (Δ flow) x 0.0054 – $WLA_{Drummond}$

Town of Drummond (MTG580002) Wasteload Allocations
WLAs ($WLA_{Drummond}$) for arsenic, cadmium, copper, iron, lead, mercury, and zinc are provided to the Town of Drummond's facultative wastewater lagoon facility, which operates under a general permit (MTG580002). The facility has an outlet to the Clark Fork River, but according to DEQ engineering staff, the lagoon has not discharged in over 10 years (Jerry Paddock, personal communication 2014). KLJ Engineering performed a leakage study of the Drummond lagoon in fall 2013. The study determined that the lagoon loses 1,107,045 gallons annually to leakage (3,033 gallons per day or 0.005 cfs). This is lost to groundwater, but given the lagoon's proximity to the Clark Fork River, it is likely that this is hyporheic water and that much of the metals load in the lagoon seepage water eventually makes it to the Clark Fork River.

The WLAs are applicable to the permitted surface water discharge outlet, which would equate to higher allowable loading than the above potential groundwater seepage. These allocations are set to the current average copper in the effluent, if discharge were to occur, and the instream targets for arsenic, cadmium, iron, lead, and mercury since it is assumed that the targets for these metals are higher than would be expected from and average treatment facility for all metals of concern other than copper. Because the copper values are not available and the WLA cannot be quantified at this time using average discharge data, the WLA Drummond for copper may be estimated using the copper and concentrations from East Helena, as with the small treatment plants upstream (**Section 5.7.2.2**). The WLAs may be calculated in lbs/day according to the following:

Arsenic: 10 µg/L x (discharge flow) x 0.0054
Cadmium: 0.24 µg/L x (discharge flow) x 0.0054
Copper: 16.9 µg/L x (discharge flow) x 0.0054
Iron: 1,000 µg/L x (discharge flow) x 0.0054

Lead: 4.27 µg/L x (discharge flow) x 0.0054
Mercury: 0.05 µg/L x (discharge flow) x 0.0054
Zinc: 145 µg/L x (discharge flow) x 0.0054

Although the copper values might be slightly above the target concentrations, the overall loading from the town of Drummond WWTP discharge is minor and represents an extremely low loading contribution, particularly given the fact that metals impairment conditions are linked to high flow events within the Clark Fork River.

As discussed above in **Section 5.7** and shown in **Table 5-51**, DEQ believes there is reasonable assurance that in the future there will be assimilative capacity in this segment of the Clark Fork River for all metals impairments with the possible exceptions of lead and mercury.

If the expected assimilative capacity has not been created after completion of CERCLA remediation activities and there is potential for the Drummond WWTP to cause or contribute to impairment, revised WLAs may be provided at that time. DEQ will evaluate the facility's percent contribution toward metals impairment in this segment of the Clark Fork River and determine whether a new suite of WLAs is necessary for this facility prior to subsequent permit renewals.

Metals-Impaired Tributaries Load Allocations

The $LA_{Tributaries}$ term is equal to the sum of TMDLs for Flint Creek, Cramer Creek, and Wallace Creek. The tributary streams included in this term vary by pollutant cause (identified below), as not each of these tributaries has TMDLs for all four metals impairment causes. TMDLs for cadmium and zinc do not have a $LA_{Tributaries}$ allocation.

- Arsenic: Flint Creek
- Copper: Flint Creek and Wallace Creek
- Lead: Flint Creek and Cramer Creek
- Iron: Flint Creek

Therefore, the copper $LA_{Tributaries}$ load allocation includes the following: $LA_{Flint\ Creek}$ + $LA_{Wallace\ Creek}$.

As mentioned above in **Section 5.6.5**, Flint Creek is a significant source of arsenic, lead, and mercury, and considerable reductions are required. As noted above, a mercury TMDL has not been developed for the lower segment of Flint Creek. Therefore, the LA to Flint Creek for mercury is set to the target (0.05 µg/L) times the flow in Flint Creek (best estimated at the USGS gage Flint Creek near Drummond: 12331500). Reductions of up to 97% are required (**Table 5-42**). Although a mercury TMDL has not been developed for the lower segment of Flint Creek, this LA effectively means that the Flint Creek watershed loading must be at or below the equivalent of what would be required if a mercury TMDL was in place for the lowest segment of Flint Creek.

Upstream Load Allocations

The LAs to upstream sources ($LA_{Upstream}$) are a composite of all allocations for each specific metal equal to the applicable TMDL for the segment of the Clark Fork River immediately upstream. The upstream segment has TMDLs developed for arsenic, cadmium, copper, lead, iron, and mercury, but not zinc. Therefore, the zinc LA to the upstream segment of the Clark Fork River is not represented by a TMDL but instead is separately defined as the flow in the Clark Fork River at the mouth of Flint Creek multiplied by the zinc target. This flow can be estimated from the USGS gage station Clark Fork River at Deer Lodge (12324200).

Sum of Allocations

TMDLs for arsenic, copper, iron, lead, and mercury are expressed by the following formula:

$$TMDL_{CFR04} = WLA_{Milltown} + WLA_{Drummond} + LA_{Upstream} + LA_{Tributaries}$$

TMDLs for cadmium and zinc are expressed by the following formula:

$$TMDL_{CFR04} = WLA_{Milltown} + WLA_{Drummond} + LA_{Upstream}$$

The TMDL could be calculated for each metal according to the same methods outline in the example provided above in **Section 5.7.2.2**.

5.7.2.6 Clark Fork River: Blackfoot River to Rattlesnake Creek (MT76M001_030) Allocations

Allocations for this segment of the Clark Fork River include:

- $WLA_{Missoula\ MS4}$: Missoula's stormwater sewer system
- $LA_{Natural}$: Load allocation to natural background metals loads
- $LA_{Upstream}$: Load allocations to the upstream segment of the Clark Fork River

Note that natural background LAs are separately identified for this and all further downstream segments. This is because there are no Superfund OUs along the mainstem where natural background loading is inherently incorporated within this and all downstream segments. Tributary and other flow contributions to the Clark Fork River presumably have metals concentrations consistent with natural background loading unless specifically provided a LA or WLA.

Missoula MS4 (MTR040007) Wasteload Allocations

Per EPA guidance (U.S. Environmental Protection Agency, 2002), MS4 permits must be addressed by WLAs, and the WLAs must be expressed in numeric form (see 40 C.F.R. §130.2(h) and (i)). At the state level, ARM 17.30.1111(5)(a) requires MS4 permittees to develop, implement, and enforce a stormwater management program (SWMP) to reduce the discharge of pollutants to the maximum extent practicable. ARM 17.30.1111(5)(a) also states, "For the purposes of this rule, narrative effluent limitations requiring the implementation of BMPs are the most appropriate form of effluent limitations when designed to satisfy technology requirements (including reductions of pollutants to the maximum extent practicable) and to protect water quality. Implementation of BMPs consistent with the provisions of the SWMP required pursuant to this rule and the provisions of the permit shall constitute compliance with the standard of reducing pollutants to the "maximum extent practicable." The SWMP must include six minimum control measures:

1. Public education and outreach
2. Public involvement/participation
3. Detection and elimination of illicit discharges
4. Control of stormwater runoff from construction sites
5. Management of post-construction stormwater in new development or redevelopment
6. Pollution prevention/good housekeeping

Additionally, the permit requires semiannual sampling in two locations, one that represents a residential area, and the other that represents a commercial/industrial area. Neither of these sample locations is located within the portion of the MS4 considered in relation to this segment of the Clark Fork River, but the data from them is assumed to be representative of the MS4 as a whole. The portion of the MS4 evaluated here is considered to be commercial, rather than residential.

The Missoula MS4 (MTR040007) is assigned WLAs ($WLA_{Missoula\ MS4}$) for arsenic, cadmium, copper, iron, lead, and zinc. As discussed in **Section 5.6.6.1**, DEQ estimates that this portion of the Missoula MS4 may contribute annual loads of 0.29 lbs of copper, 0.16 lbs of lead, and 0.002 lbs of zinc, and average daily loads of 0.02 lbs/day of copper, 0.01 lbs/day of lead, and 0.0001 lbs/day of zinc. These loads represent significant reductions (35% for copper and 95% for lead) from estimated loads based on the 1990s data (Missoula City-County Health Department and Missoula Valley Water Quality District, 1997). DEQ believes this demonstrates reduction in stormwater-related metals loading to the Clark Fork River due to stormwater controls, and that further reductions are possible via full implementation of stormwater BMPs consistent with the MS4 general permit requirements.

BMP effectiveness values reported from the International Storm Water BMP Database (Geosyntec Consultants, Inc. and Wright Water Engineers, Inc., 2012) are used as the basis for the $WLA_{Missoula\ MS4}$. The database provides summary statistics for metals concentration reduction efficiencies from a variety of BMPs. Metals studied include arsenic, cadmium, chromium, copper, iron, lead, nickel, and zinc, both dissolved and total fractions. Studied BMPs include: grass strips, bioretention, bioswales, detention basins, manufactured devices, media filters, porous pavement, and retention ponds, among others. The International Storm Water BMP Database summarizes BMP effectiveness studies by evaluating the 25th, median, and 75th percentile concentrations of influent and effluent. To set this allocation, DEQ used the median influent and effluent concentrations from the BMP Database, and established an average percent reduction in metals concentrations of 55%. Since concentrations from the commercial sampling site are consistently higher than the residential site and this portion of the MS4 is considered a commercial source category, percent reduction is not weighted. Therefore, the WLA to this portion of the Missoula MS4 is a 55% reduction in metals loads, applicable to arsenic, cadmium, copper, iron, lead, and zinc. This equates to 0.009 lbs/day of copper, 0.0045 lbs/day of lead, and 0.00004 lbs/day of zinc, based on the existing load estimates provided above. Data are not available for arsenic, cadmium, or iron to provide numeric load estimates.

The WLAs are not intended to add concentration or load limits to the permit. Consistent with EPA guidance and the CWA (U.S. Environmental Protection Agency, 2002) DEQ assumes the WLAs will be met by adhering to the permit requirements and reducing either the metals concentrations or the discharge volumes, or both. As identified in the permit, monitoring data should continue to be collected and evaluated to assess BMP performance and help identify whether and where additional BMP implementation may be necessary. A sampling location should be added to this portion of the MS4 area to characterize stormwater metals loads (arsenic, cadmium, copper, iron, lead, and zinc) to this segment of the Clark Fork River

Natural Background Load Allocations

The load due to natural background metals sources ($LA_{Natural}$) is estimated using a concentration equal to one-half the method detection limits, except for iron, which is estimated to be 50 µg/L. DEQ believes this estimate to be reasonable due to the occasional non-detect results for metals samples. The LA is set equal to these respective concentrations times the increase in flow (Δ flow) along the length of the segment since the upstream LAs already inherently include natural background loading. The LAs may be calculated in lbs/day according to the following equations:

Arsenic: 1.5 µg/L x (Δ flow) x 0.0054
Cadmium 0.04 µg/L x (Δ flow) x 0.0054
Copper: 0.5 µg/L x (Δ flow) x 0.0054
Iron: 50 µg/L x (Δ flow) x 0.0054

Lead: 0.25 µg/L x (Δ flow) x 0.0054
Zinc: 5 µg/L x (Δ flow) x 0.0054

Upstream Load Allocations
The LAs to upstream sources ($LA_{Upstream}$) are a composite of all allocations for each specific metal equal to the applicable TMDL for the segment immediately upstream. These LAs are therefore defined as the instream target multiplied by flow (and a conversion factor of 0.0054 to yield a load in lbs/day) at the upstream segment boundary (mouth of the Blackfoot River). There is no gage at this location, but flow could be roughly estimated at the USGS gage located roughly 3 river miles downstream: Clark Fork River above Missoula (12340500), due to the lack of any significant tributaries in that distance.

Sum of Allocations
TMDLs for arsenic, cadmium, copper, iron, lead, and zinc are expressed by the following formula:

$$TMDL_{CFR05} = WLA_{Missoula\ MS4} + LA_{Upstream} + LA_{Natural}$$

Note that the $WLA_{Missoula\ MS4}$ term is only nonzero during runoff events. The TMDL could be calculated for each metal according to the same methods outline in the example provided above in **Section 5.7.2.2**.

5.7.2.7 Clark Fork River: Rattlesnake Creek to Fish Creek (MT76M001_020) Allocations
Allocations for this segment of the Clark Fork River include:

- Multiple MPDES-permitted point sources, including:
  - $WLA_{Missoula\ WWTP}$: Missoula's WWTP
  - $WLA_{Missoula\ MS4}$: Missoula's stormwater sewer system
  - $WLA_{Seaboard}$: Seaboard Foods, LLC
  - $WLA_{M2Green}$: M2Green Redevelopment (former Stone site)
  - $WLA_{Alberton}$: Town of Alberton WWTP
- $LA_{Bitterroot}$: Load allocation to the Bitterroot River
- $LA_{Natural}$: Load allocation to natural background metals loads
- $LA_{Upstream}$: Load allocations to the upstream segment of the Clark Fork River

Missoula Wastewater Treatment Plant (MT0022594) Wasteload Allocations
WLAs ($WLA_{Missoula\ WWTP}$) for copper, iron and lead are provided to the Missoula WWTP (MT0022594), located at 1100 Clark Fork Lane in Missoula. The WLAs are set to the highest observed copper concentration (11 µg/L), and the water quality target for iron and lead. The WLAs may be calculated in lbs/day according to the following:

Copper: 11 µg/L x (discharge flow) x 0.0054
Iron: 1,000 µg/L x (discharge flow) x 0.0054
Lead: 2.6 µg/L x (discharge flow) x 0.0054

Effluent concentrations are compared to targets calculated using a hardness value of 86 mg/L, the 25th percentile value at the USGS gage Clark Fork River above Missoula (12340500). Although this gage is located in the segment upstream, it characterizes the Clark Fork River in Missoula better than downstream gages. The 25th percentile is chosen to be consistent with the methods currently used by DEQ's Discharge Permitting Section. Copper and lead targets at this hardness are 8.2 µg/L and 2.6 µg/L, respectively. As calculated above in **Section 5.6.7.1**, the highest expected loads from the Missoula WWTP are small: 0.75 lbs/day for copper and 0.09 lbs/day for lead. The overall copper loading from the

City of Missoula WWTP discharge represents an extremely low loading contribution, particularly given the fact that impairment conditions for copper are linked to high flow events within the Clark Fork River. For copper, this represents 0.3% of the low flow TMDL and 0.1% of the high flow TMDL. At typical high flow impairment conditions, a 571 lbs/day copper load reduction is needed in the Clark Fork River to meet the TMDL (**Table 5-51**). Reducing the $WLA_{Missoula\ WWTP}$ so that it is consistent with the example 5.8 µg/L high flow Clark Fork River target (**Table 5-20**) would only result in about a 0.2 lbs/day load reduction in the Clark Fork River. Although the copper WLA is slightly above the example target concentration, it is below the acute chronic life criterion (12.54) at this example hardness. The copper WLA is provided in anticipation of assimilative capacity and in consideration of Missoula's small (~0.05%) contribution to the existing load under impaired conditions.

As discussed above in **Section 5.7** and shown in **Table 5-51**, DEQ believes Superfund remediation provides reasonable assurance that in the future there will be assimilative capacity in this segment of the Clark Fork River for all metals impairments, and a mixing zone will be available to this discharge. The next permit renewal must retain copper and lead and add iron to the list of metals for semi-annual effluent sampling to continue to monitor loading from this facility.

If the expected assimilative capacity has not been created after completion of CERCLA remediation activities and the City of Missoula WWTP is found to cause or contribute to impairment, revised WLAs may be provided at that time. DEQ will evaluate the facility's percent contribution toward metals impairment in this segment of the Clark Fork River and determine whether a new suite of WLAs is necessary for this facility prior to subsequent permit renewals.

Missoula MS4 (MTR040007) Wasteload Allocations

Per EPA guidance (U.S. Environmental Protection Agency, 2002), MS4 permits must be addressed by WLAs, and the WLAs must be expressed in numeric form (see 40 C.F.R. §130.2(h) and (i)). At the state level, ARM 17.30.1111(5)(a) requires MS4 permittees to develop, implement, and enforce a SWMP to reduce the discharge of pollutants to the maximum extent practicable. ARM 17.30.1111(5)(a) also states, "For the purposes of this rule, narrative effluent limitations requiring the implementation of BMPs are the most appropriate form of effluent limitations when designed to satisfy technology requirements (including reductions of pollutants to the maximum extent practicable) and to protect water quality. Implementation of BMPs consistent with the provisions of the SWMP required pursuant to this rule and the provisions of the permit shall constitute compliance with the standard of reducing pollutants to the "maximum extent practicable." The SWMP must include six minimum control measures:

1. Public education and outreach
2. Public involvement/participation
3. Detection and elimination of illicit discharges
4. Control of stormwater runoff from construction sites
5. Management of post-construction stormwater in new development or redevelopment
6. Pollution prevention/good housekeeping

Additionally, the permit requires semiannual sampling in two locations, one that represents a residential area, and the other that represents a commercial/industrial area.

The Missoula MS4 (MTR040007) is assigned WLAs ($WLA_{Missoula\ MS4}$) for copper, iron, and lead. As discussed in **Section 5.6.7.1**, DEQ estimates that this portion of the Missoula MS4 contributes annual loads of 28.1 lbs of copper and 13.7 lbs of lead, and average daily loads (during runoff events) of 1.76

lbs/day copper and 0.85 lbs/day of lead. These loads represent significant reductions (44% and 92%) from estimated loads based on the 1990s data (Missoula City-County Health Department and Missoula Valley Water Quality District, 1997). DEQ believes this demonstrates reductions in stormwater-related metals loading to the Clark Fork River due to stormwater controls, and that further reductions are possible via full implementation of stormwater BMPs consistent with the MS4 general permit requirements.

BMP effectiveness values reported from the International Storm Water BMP Database (Geosyntec Consultants, Inc. and Wright Water Engineers, Inc., 2012) are used as the basis for the $WLA_{Missoula\ MS4}$. The database provides summary statistics for metals concentration reduction efficiencies from a variety of BMPs. Metals studied include arsenic, cadmium, chromium, copper, iron, lead, nickel, and zinc, both dissolved and total fractions. Studied BMPs include: grass strips, bioretention, bioswales, detention basins, manufactured devices, media filters, porous pavement, and retention ponds, among others. The International Storm Water BMP Database summarizes BMP effectiveness studies by evaluating the 25th, median, and 75th percentile concentrations of influent and effluent. To set this allocation, DEQ used the median influent and effluent concentrations from the BMP Database, and established an average percent reduction in metals concentrations of 55%. Samples from the representative residential location are generally close to the instream copper and lead targets, therefore the required percent reduction is estimated by focusing on the commercial source type. Commercial source areas contribute an average of 75% of the annual metals load. Multiplying this percentage by the 55% average reduction results in a 40% reduction. Therefore, the WLA to the Missoula MS4 is a 40% reduction in metals loads, applicable to copper, iron and lead. This equates to 1.1 lbs/day for copper and 0.51 lbs/day for lead, based on the daily load estimates provided above. Data are not available for iron to provide a numeric load estimate.

The WLAs are not intended to add concentration or load limits to the permit. Consistent with EPA guidance and the CWA (U.S. Environmental Protection Agency, 2002), DEQ assumes the WLAs will be met by adhering to the permit requirements and reducing either the metals concentrations or the discharge volumes, or both. As identified in the permit, monitoring data should continue to be collected and evaluated to assess BMP performance and help identify whether and where additional BMP implementation may be necessary. Iron should be added to the list of sample analytes in order to understand iron loads in stormwater and quantify the WLAs. In addition to the current representative sampling locations, a storm sewer outfall draining the urban core of Missoula should be added to the sampling locations in order to characterize this source area.

Seaboard Foods, LLC (MT0000094) Wasteload Allocations

WLAs ($WLA_{Seaboard}$) for copper, iron and lead are provided to Seaboard Foods, LLC, which discharges from Daily's Premium Meats, located at 2900 Mullan Road in Missoula. The WLAs are based on meeting the water quality targets in the discharge ("end of pipe"). The WLAs may be calculated in lbs/day according to the following:

Copper: 8.2 µg/L x (discharge flow) x 0.0054
Iron: 1,000 µg/L x (discharge flow) x 0.0054
Lead: 2.6 µg/L x (discharge flow) x 0.0054

Effluent concentrations are compared to targets calculated using a hardness value of 86 mg/L, the 25th percentile value at the USGS gage Clark Fork River above Missoula (12340500). Although this gage is located in the segment upstream, it characterizes the Clark Fork River in Missoula better than downstream gages. The 25th percentile is chosen to be consistent with DEQ's current permitting methods. Copper and lead targets at this hardness are 8.2 µg/L and 2.6 µg/L, respectively. Based on the low concentration of copper in the effluent samples, DEQ believes that these targets are likely already being met in the discharge. Even if that is not the case, as discussed above in **Section 5.7** and shown in **Table 5-51**, DEQ believes there is reasonable assurance that in the future there will be assimilative capacity in this segment of the Clark Fork River for all metals impairments, and a standard mixing zone will be available to this discharge. In addition to fulfilling its semi-annual effluent requirements sampling for copper and lead, iron should be added in order to quantify the WLAs. If the sampling results show that one or more of the above WLAs are not being met, then DEQ will evaluate the facility's percent contribution toward metals impairment in this segment of the Clark Fork River and determine whether a new suite of WLAs is necessary for this facility prior to subsequent permit renewals.

M2Green Redevelopment (MT0000035) Wasteload Allocations

A renewed permit (MPDES ID MT0000035) was issued on March 13, 2014, to M2Green Redevelopment, located at 14377 Pulp Mill Road, Missoula, Montana, 59808. The permit was formerly associated with the Stone Container Corporation pulp and paper mill. WLAs ($WLA_{M2Green}$) are provided for copper, iron and lead. The WLAs are set to meeting the targets at the point of discharge, and may be calculated in lbs/day using the following:

Copper: 8.4 µg/L x (discharge flow) x 0.0054
Iron: 1,000 µg/L x (discharge flow) x 0.0054
Lead: 2.7 µg/L x (discharge flow) x 0.0054

The example target concentrations are based on the 25th percentile value of hardness data available for this segment of the Clark Fork River (89 µg/L), to be consistent with DEQ's current permitting procedure. DEQ anticipated that a new treatment plant serving new plumbing should achieve these concentrations. Even if that is not the case, as discussed above in **Section 5.7** and shown in **Table 5-51**, DEQ believes there is reasonable assurance that in the future there will be assimilative capacity in this segment of the Clark Fork River for all metals impairments, and a standard mixing zone may be available to this discharge. As this would be a new facility, constructed on a former industrial site, the effluent should be sampled semi-annually not just for the current instream impairment causes, but for a full suite of metals in order to characterize the effluent. The analyte suite should include: antimony, arsenic, beryllium, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, silver, thallium, and zinc. If the sampling results show that one or more of the above WLAs are not being met, then DEQ will evaluate the facility's percent contribution toward metals impairment in this segment of the Clark Fork River and determine whether a new suite of WLAs is necessary for this facility prior to subsequent permit renewals.

Alberton Wastewater Treatment Plant (MT0021555) Wasteload Allocations

WLAs ($WLA_{Alberton}$) are provided to the Town of Alberton's WWTP, which is located at 117 Parkway Drive, Alberton. The facility is currently operating on an administratively extended permit. The WLAs are set to the current average copper, iron, and lead concentrations in the effluent. Because these values are not available and the WLA cannot be quantified at this time using average discharge data, the $WLA_{Alberton}$ for copper and lead may be estimated using the copper and lead concentrations from East Helena, and iron is estimated using the instream target. The WLAs may be calculated in lbs/day according to the following:

Copper: 16.9 µg/L x (discharge flow) x 0.0054
Iron: 1,000 µg/L x (discharge flow) x 0.0054
Lead: 1.36 µg/L x (discharge flow) x 0.0054

Although the copper and lead values might be slightly above the target concentrations, the overall loading from the town of Alberton WWTP discharge is minor and represents an extremely low loading contribution, particularly given the fact that impairment conditions for copper and lead are linked to high flow events within the Clark Fork River. For example, the estimated daily copper load of 0.013 lbs/day (**Section 5.6.7.1**) represents 0.006% of the low flow TMDL and 0.002% of the high flow TMDL.

As discussed above in **Section 5.7** and shown in **Table 5-51**, DEQ believes there is reasonable assurance that in the future there will be assimilative capacity in this segment of the Clark Fork River for all metals impairments, and a standard mixing zone will be available to this discharge. As the current permit does not require any metals sampling, the next permit renewal must require semi-annual effluent sampling for copper, iron and lead in order to better understand loading from this facility and quantify the WLAs.

If the expected assimilative capacity has not been created after completion of CERCLA remediation activities and the Alberton WWTP is found to cause or contribute to impairment, revised WLAs may be provided at that time. DEQ will evaluate the facility's percent contribution toward metals impairment in this segment of the Clark Fork River and determine whether a new suite of WLAs is necessary for this facility prior to subsequent permit renewals.

Bitterroot River Load Allocation

The lower segment of the Bitterroot River is impaired by lead, and a TMDL is currently being developed for lead. A LA for lead ($LA_{Bitterroot}$) equal to the TMDL is assigned to the Bitterroot River. The allocation is equal to the target concentration for lead times flow in in the Bitterroot River. Since the Bitterroot River tends to have lower water hardness than the Clark Fork River, this LA represents a reduction in lead concentrations in the Clark Fork River.

Natural Background Load Allocations

The load due to natural background metals sources ($LA_{Natural}$) is estimated using a concentration equal to one-half the method detection limits, except for iron, which is estimated to be 50 µg/L. DEQ believes these estimates to be reasonable due to the occasional non-detect results for metals samples. The LA is set equal to these respective concentrations times the increase in flow (Δ flow) along the length of the segment since the upstream LAs already inherently include natural background loading. The LAs may be calculated in lbs/day according to the following equations:

Copper: 0.5 µg/L x (Δ flow) x 0.0054
Iron: 50 µg/L x (Δ flow) x 0.0054
Lead: 0.25 µg/L x (Δ flow) x 0.0054

Upstream Load Allocations

The LAs to upstream sources ($LA_{Upstream}$) are a composite of all allocations for each specific metal equal to the applicable TMDL for the segment immediately upstream. These LAs are therefore defined as the instream target multiplied by the flow (and a conversion factor of 0.0054 to yield a load in lbs/day) at the upstream segment boundary (the mouth of Rattlesnake Creek). This flow is difficult to estimate, but corresponds generally to the flow at the USGS gage Clark Fork River above Missoula (12340500) plus the flow in Rattlesnake Creek (which is ungaged).

Sum of Allocations

TMDLs for copper and iron are expressed by the following formula:

$$TMDL_{CFR06} = WLA_{Missoula\ WWTP} + WLA_{Missoula\ MS4} + WLA_{Seaboard} + WLA_{M2Green} + WLA_{Alberton\ WWTP} + LA_{Upstream} + LA_{Natural}$$

The lead TMDL is expressed by the following formula:

$$TMDL_{CFR06} = WLA_{Missoula\ WWTP} + WLA_{Missoula\ MS4} + WLA_{Seaboard} + WLA_{M2Green} + WLA_{Alberton\ WWTP} + LA_{Upstream} + LA_{Bitterroot} + LA_{Natural}$$

Note that the $WLA_{Missoula\ MS4}$ term is only nonzero during runoff events. The TMDL could be calculated for each metal according to the same methods outline in the example provided above in **Section 5.7.2.2**.

5.7.2.8 Clark Fork River: Fish Creek to Flathead River (MT76M001_010) Allocations

Allocations for this segment of the Clark Fork River include:

- $WLA_{Superior}$: Town of Superior WWTP
- $LA_{Flat\ Creek}$: Load allocation to Flat Creek
- $LA_{Natural}$: Load allocation to natural background metals loads
- $LA_{Upstream}$: Load allocations to the upstream segment of the Clark Fork River

Superior Wastewater Treatment Plant (MT0020664) Wasteload Allocations

WLAs ($WLA_{Superior}$) for copper, iron, and lead are provided to the town of Superior's WWTF, which is located at Riverside Avenue, Superior. The WLAs are set to the current average copper, iron, and lead concentrations in the effluent. Because these values are not available and the WLA cannot be quantified at this time using average discharge data, the $WLA_{Superior}$ in lbs/day for copper and lead may be estimated using the copper and lead concentrations from East Helena, and iron is estimated using the instream target:

Copper: 16.9 µg/L x (effluent flow) x 0.0054
Iron: 1,000 µg/L x (discharge flow) x 0.0054
Lead: 1.36 µg/L x (discharge flow) x 0.0054

Although the copper and lead values might be slightly above the target concentrations, the overall loading from the town of Superior WWTP discharge is minor and represents an extremely low loading contribution, particularly given the fact that impairment conditions for copper and lead are linked to high flow events within the Clark Fork River.

As discussed above in **Section 5.7** and shown in **Table 5-51**, DEQ believes there is reasonable assurance that in the future there will be assimilative capacity in this segment of the Clark Fork River for all metals impairments, and a standard mixing zone will be available to this discharge. As the current permit does not require any metals sampling, the next permit renewal must require semi-annual effluent sampling for copper, iron and lead in order to better understand loading from this facility and quantify the WLAs.

If the expected assimilative capacity has not been created after completion of CERCLA remediation activities and the Superior WWTP is found to cause or contribute to impairment, revised WLAs may be provided at that time. DEQ will evaluate the facility's percent contribution toward metals impairment in this segment of the Clark Fork River and determine whether a new suite of WLAs is necessary for this facility prior to subsequent permit renewals.

Flat Creek Load Allocation
The LA to Flat Creek is equal to the lead TMDL for Flat Creek. The allocation is expressed the same way as the TMDL: target concentration times flow (times a conversion factor to calculate lbs/day). Using the example data provided in the Bonita-Superior Metals TMDL document (Montana Department of Environmental Quality, 2013), this is estimated to be 1.023 lbs/day during high flow and 0.077 lbs/day during low flow.

Natural Background Metals Load Allocations
The load due to natural background metals sources ($LA_{Natural}$) is estimated using a concentration equal to one-half the method detection limits, except for iron, which is estimated to be 50 µg/L. DEQ believes these estimates to be reasonable due to the occasional non-detect results for metals samples. The LA is set equal to these respective concentrations times the increase in flow (Δ flow) along the length of the segment since the upstream LAs already inherently include natural background loading. The LAs may be calculated in lbs/day according to the following equations:

Copper: 0.5 µg/L x (Δ flow) x 0.0054
Iron: 50 µg/L x (Δ flow) x 0.0054
Lead: 0.25 µg/L x (Δ flow) x 0.0054

Upstream Load Allocations
The LAs to upstream sources ($LA_{Upstream}$) are a composite of all allocations for each specific metal equal to the applicable TMDL for the segment immediately upstream These LAs are therefore defined as the instream targets for these metals multiplied by the flow (and a conversion factor of 0.0054 to yield a load in lbs/day) at the upstream segment boundary (the mouth of Fish Creek). Determining the flow at this point in the Clark Fork River is difficult, due to many tributary inputs between USGS gages on the Clark Fork below Missoula (12353000) and the Clark Fork at St. Regis (12354500).

Sum of Allocations
TMDLs for copper and iron are expressed by the following formula:

$$TMDL_{CFR07} = WLA_{Superior\ WWTF} + LA_{Upstream} + LA_{Natural}$$

The lead TMDL is expressed by the following formula:

$$TMDL_{CFR07} = WLA_{Superior\ WWTF} + LA_{Upstream} + LA_{Flat\ Creek} + LA_{Natural}$$

The TMDL could be calculated for each metal according to the same methods outline in the example provided above in **Section 5.7.2.2**.

5.8 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 LAs. TMDL development must also incorporate an MOS into the LA 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 an MOS in the Silver Bow Creek and Clark Fork River metal TMDL development process.

5.8.1 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 both metals loading pathways and water hardness change from high to low flow conditions. In Silver Bow Creek and in the Clark Fork River, the sediment-linked metals are mobilized and suspended during high flow, leading to high total recoverable 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 different metals source categories commonly have different pathways to the stream that vary according to the season or hydrograph. This may 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.
- 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.

5.8.2 Margin of Safety

The MOS 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 variable metals sources and pathways 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 LAs, 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 an MOS for the majority of conditions where the most protective (lowest) target value is linked to the numeric aquatic life standard.
- 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 an MOS since a 4-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.

- The TMDLs are based on numeric water quality standards developed at the national level via EPA and incorporate an MOS necessary for the protection of human health and aquatic life.
- 10 years of data were reviewed, including water quality data that predates remedial projects. The impairment assessments are therefore conservative and may overstate the current magnitude of the metals impairments to these waterbodies.

Furthermore, some segments downstream of the Blackfoot River incorporate an explicit MOS that is not easily quantified. WLAs in these segments are either end-of-pipe or close to it, based on existing discharge characteristics. These WLAs, plus the upstream, tributary and background LAs, sum to values less than the TMDLs. The remaining unallocated load capacity will be created by upstream Superfund remediation in combination with the diluting effects of tributaries such as Rock Creek and the Blackfoot River. This unallocated load equates to more of an explicit versus an implicit MOS. It could be calculated by subtracting the sum of all WLAs and LAs from the TMDL.

5.9 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 DQO process. The DQOs process ensures that the data are 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 assessments can improve the ability to measure and achieve 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 Silver Bow Creek and the Clark Fork River project are based on future attainment of water quality standards. In order to achieve this, all significant sources of metals loading must be addressed via remediation projects and discharge permits. 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 four categories identified below:

- Remediation 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.
- A use attainment analysis changes the water classification, resulting in different targets.

- Targets are not attained after all reasonable source controls and applicable remediation activities are applied. Under these circumstances, site-specific standards may be necessary.

DEQ anticipates that Superfund remediation on the Clark Fork River upstream of the Blackfoot River, together with the addition of unimpaired or less impaired flows, will create assimilative capacity in the Clark Fork River below its confluence with the Blackfoot River, and possibly above it. DEQ believes that the approved RODs and ongoing remediation of these Superfund sites, when combined with unimpaired tributaries and flows provide reasonable assurance that the cumulative loading reductions upstream will be sufficient for the WLAs to MPDES permits below the Blackfoot River, and mixing zones may be available to these discharges in future permit cycles. If the expected assimilative capacity has not been created and these discharges are found to cause or contribute to impairment, revised WLAs may be provided at that time. DEQ will evaluate the facilities' contribution toward metals impairment in the receiving segment of the Clark Fork River and determine whether the target concentration must be met at the point of discharge or whether a new suite of WLAs will be provided based on additional metals remediation activities upstream.

6.0 RESTORATION STRATEGY

Resource extraction (historical mining, milling, and smelting) is the primary source of metals impairment to Silver Bow Creek and the Clark Fork River. This chapter describes the overall strategy for attaining metals water quality standards. In short, success depends on the combined Superfund efforts, and to a lesser extent on abandoned mine remediation in two major tributary watersheds: the Little Blackfoot River and Flint Creek. While the remedial strategy for Silver Bow Creek and the Clark Fork River are already established under the RODs for the Superfund sites, there are opportunities for watershed groups or other interested parties to make meaningful contributions toward improving water quality in metals-impaired tributary streams (refer to **Section 5.6** for a summary).

The details that comprise the overall strategy are established in both the Records of Decision for the Butte Area/Silver Bow Creek, the Clark Fork River/Milltown Reservoir, and the Anaconda Company Smelter Superfund Sites, and in the TMDL documents for tributary watersheds.

6.1 WATER QUALITY RESTORATION OBJECTIVES

The general goal of this TMDL document is to provide an overall plan for recovery and support of aquatic life and drinking water uses (where applicable) within Silver Bow Creek and the Clark Fork River. 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 of the river corridor and impaired tributary watersheds requires collaboration among private landowners, government land managing agencies, and other interested stakeholders. Stakeholders may include:

- Montana Region 8 EPA
- DEQ Federal Superfund Bureau
- DEQ Abandoned Mines Bureau
- Atlantic Richfield Company
- Montana Resources, Inc.
- Butte-Silver Bow City-County Government
- City of Missoula
- City of Deer Lodge
- City of Anaconda
- Town of Drummond
- Town of Philipsburg
- Town of Alberton
- Town of Superior
- Watershed Restoration Council
- Mile High Conservation District
- Deer Lodge Valley Conservation District
- Granite County Conservation District

- Missoula County Conservation District
- Mineral County Conservation District
- Montana Fish, Wildlife & Parks
- Clark Fork Coalition
- Trout Unlimited
- The Nature Conservancy
- Private landowners
- United States Forest Service (USFS)
- United States Bureau of Land Management (BLM)

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 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 Silver Bow Creek and Clark Fork River 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.

6.3.1 Superfund Authority in Silver Bow Creek, the Clark Fork River, and Flat Creek

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: short-term removals that require a prompt response, and 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 Clark Fork Basin sites were added to the NPL of CERCLA sites in 1983. These included the Silver Bow Creek Site, the Milltown Reservoir Site, and Anaconda Smelter Site. The Silver Bow Creek Site was redesignated the Silver Bow Creek / Butte Area Site in 1987, and the Milltown Reservoir Site was redesignated the Milltown Reservoir / Clark Fork River site in 1992. Each of these sites is subdivided into several OUs (OUs) in order to focus on the particular sources, contaminants and challenges specific to each OU.

The Silver Bow Creek / Butte Area Site includes seven active OUs:

- Streamside Tailings OU01
- Butte Mine Flooding OU03
- Warm Springs Ponds Active Area OU04
- Rocker Timber Framing and Treating OU07
- Butte Priority Soils OU08
- Warm Springs Ponds Inactive Area OU12
- West Side Soils OU13

Several other former OUs have been merged into the BPSOU. Also, the Clark Fork River / Downstream OU was transferred to the Milltown Reservoir / Clark Fork River Site.

The Milltown Reservoir / Clark Fork River Site includes three OUs:

- Milltown Drinking Water Supply OU01
- Milltown Reservoir Sediments OU02
- Mainstem Clark Fork River OU03

While neither Silver Bow Creek nor the Clark Fork River flows through the Anaconda Smelter Site, it borders the Clark Fork River and includes several major tributaries, such as Warm Springs Creek.

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.

The Iron Mountain Mill Superfund Site includes a portion of the Flat Creek watershed (OU02). Several agencies (EPA, USFS, and DEQ) are coordinating removal of streambank tailings.

6.3.2. 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 tributary watersheds that drain to the Clark Fork River or Silver Bow Creek. The extent that these programs may be necessary will depend in part on the success of ongoing

Superfund work in Silver Bow Creek and the Clark Fork River and the level of stakeholder involvement and initiative throughout the watersheds with metals impairment causes.

6.4 Temporary Disturbances and Water Quality Impacts

DEQ acknowledges that construction or maintenance activities related to restoration, 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.

The objectives for future monitoring in Silver Bow Creek and the Clark Fork River include:

- tracking remediation activities and evaluating the effectiveness of individual and cumulative remediation activities
- impairment status monitoring to assess attainment of water quality targets and identify long-term trends in water quality.

Each of these objectives is discussed below.

7.1 REMEDIATION EFFECTIVENESS MONITORING

Effectiveness monitoring is a major component of the Superfund efforts, and future data collection in the Clark Fork River and Silver Bow Creek is established under the RODs for these Superfund sites.

DEQ recommends additional monitoring of mercury concentrations in the Clark Fork River. The impairment determinations were based on single exceedances of the human health target in segments with designated drinking water uses. More data in the Deer Lodge valley reach of the river may identify aquatic life impairments.

DEQ will conduct a TMDL Implementation Evaluation (TIE) to determine whether water quality is improving as expected. 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 demonstrate the TMDL is being achieved, then the waterbody is recommended for a formal reassessment of its use-support status. If TMDLs are not being met, then 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 IMPAIRMENT STATUS MONITORING

In addition to tracking remediation effectiveness, metals sampling in the Clark Fork River below the mouth of the Blackfoot River would help to track the status of use impairment in these segments. 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.

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 Silver Bow Creek and Clark Fork River metals TMDL project.

8.1 Participants and Roles

Throughout completion of the Silver Bow Creek and Clark Fork River metals TMDLs, DEQ maintained contact 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 metals TMDLs in Silver Bow Creek and the Clark Fork River and their roles is contained below.

8.1.1 Montana Department of Environmental Quality

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

8.1.2 U.S. Environmental Protection Agency

EPA is the federal agency responsible for administering and coordinating requirements of the CWA. Section 303(d) of the CWA directs states to develop TMDLs (see **Section 1.1**), and EPA has developed guidance and programs to assist states in that regard. EPA has provided funding and technical assistance to Montana’s overall TMDL program and is responsible for final TMDL approval. EPA is the federal agency overseeing remediation and restoration activities in Butte, Silver Bow Creek, Anaconda, and the Clark Fork River, in conjunction with DEQ. Additionally, EPA is the federal agency overseeing remediation and restoration activities in the Flat Creek drainage, in conjunction with DEQ and USFS.

8.1.3 TMDL Advisory Group

The Silver Bow Creek and Clark Fork River metals 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 email 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.

8.1.4 Montana Conservation Districts

Silver Bow Creek and the Clark Fork River flow through multiple counties: Silver Bow, Deer Lodge, Powell, Granite, Missoula, and Mineral Counties. Therefore, DEQ provided the Watershed Restoration Council, as well as Mile High, Deer Lodge Valley, 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 TMDL advisory group.

8.1.5 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, and is of prime importance for the Mainstem OU remediation. The DEQ sincerely thanks the project area landowners for their support of these efforts.

8.2 Response to Public Comments

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

The public review period began on February 27, 2014, and ended on March 24, 2014. DEQ made the draft document available to the public, solicited public input and comments, and announced public meetings at which the TMDLs were presented to the public. These outreach efforts were conducted via emails to watershed advisory group members and other interested parties, posts on the DEQ website, and announcements in the following newspapers: the Montana Standard (Butte), the Anaconda Leader, the Silver State Post (Deer Lodge), the Missoulian, and the Mineral Independent (Superior). DEQ provided an overview of these metals TMDLs at public presentations in Butte and Deer Lodge on March 11, and in Missoula on March 12.

During the public comment period, DEQ received 2 comments. The comments and accompanying responses are provided below. The original comments are held on file at DEQ and are available upon request.

Comment #1

Assessing remediation efforts and when to require more cleanup efforts I realize that the Upper Clark Fork remediation/restoration work will take 15 years. And that a few years of recovery is needed after the work on the ground is completed. However, I do not think we should wait 20 years to decide whether what has been done is enough. Once work on the most upstream reach is done, then an assessment should be made within 5 years as to whether that reach is meeting standards – and if it is not, adaptive management, more restoration should be called for. This assessment should occur with each reach as the restoration work moves down stream. When the most downstream reach is done 15 years from now, then that should be assessed within 5 years of its completion. But we should not wait 20 years before assessing how well the upstream restoration worked.

Response to Comment #1

DEQ agrees that assessment of the Superfund cleanup should not wait until completion of the construction phase. A TMDL implementation evaluation will follow within 5–10 years, and represents only one of several water quality evaluations to come. The EPA and USGS are jointly engaged in the Clark Fork River Long-Term Monitoring Project. More details are available here: http://wy-mt.water.usgs.gov/projects/clarkfork/. As part of this project, the USGS samples 20 locations in the Clark Fork River basin (including Silver Bow Creek) 8 times per year. This will allow the EPA (and other interested parties) to track the progress and degree of success of the Superfund remediation of the Mainstem OU. Additionally, DEQ Remediation Division will collect additional samples on a remediation-reach scale to assess the success of individual reach cleanup. In short, the water quality conditions in the Clark Fork River will be tracked both on the scale of individual cleanup reaches and at the scale of the upper river basin. Additionally, it is likely that DEQ may conduct an additional metals water quality assessment of the Clark Fork River within the next 10 years.

Comment #2

I think citizens would get more out of big complex TMDLs if there was an executive summary that provided an overview similar to the PowerPoint offered at the public meetings. I also think it would be much easier to browse long documents if they were available with clickable tables of contents – as they once were. I can remember when documents were first provided on the Internet – they usually had clickable tables of contents – now they are just big unwieldy hard-to-navigate pdfs.

Response to Comment #2

DEQ agrees that TMDL documents are large and complex documents. This is unavoidable to some degree, but in future documents DEQ will strive to expand the Document Summary into a more comprehensive summary of the document and its conclusions, with more explanatory figures and maps. The PDF version document does include a clickable 'bookmarks' pane, although it does not open by default.

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APPENDIX A – WATER BODY IMPAIRMENT STATUS OF SILVER BOW CREEK AND THE CLARK FORK RIVER BASED ON THE 2012 INTEGRATED REPORT

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Table A-1. Waterbody Impairment Status of Silver Bow Creek and the Clark Fork River based on the 2012 Integrated Report

Waterbody and Location Description	Waterbody ID	Impairment Cause	TMDL Pollutant Category	Impairment Cause Status
Silver Bow Creek, headwaters to mouth (Clark Fork River)	MT76G003_020	Aluminum	Metals	Not impaired based on updated assessment
		Arsenic	Metals	Arsenic TMDL contained in this document
		Copper	Metals	Copper TMDL contained in this document
		Iron	Metals	Not impaired based on updated assessment
		Lead	Metals	Lead TMDL contained in this document
		Manganese	Metals	Not impaired based on updated assessment
		Silver	Metals	Not impaired based on updated assessment
		Zinc	Metals	Zinc TMDL contained in this document
		Nitrates	Nutrients	Nitrate TMDL contained in a separate, concurrent document
		Physical substrate habitat alterations	Not applicable: non-pollutant	Addressed by sediment TMDL in a separate, concurrent document
		Sedimentation/Siltation	Sediment	Sediment TMDL contained in a separate, concurrent document
Clark Fork River, Warm Springs Creek to Cottonwood Creek	MT76G001_040	Arsenic	Metals	Not impaired based on updated assessment
		Cadmium	Metals	Cadmium TMDL contained in this document
		Copper	Metals	Copper TMDL contained in this document
		Lead	Metals	Lead TMDL contained in this document
		Nitrogen (Total)	Nutrients	Nitrogen TMDL completed in 1998
		Phosphorus (Total)	Nutrients	Phosphorus TMDL completed in 1998
		Sedimentation/Siltation	Sediment	Sediment TMDL contained in a separate, concurrent document
		Alteration in stream-side or littoral vegetative covers	Not applicable: non-pollutant	Addressed by sediment TMDL in a separate, concurrent document
		Low flow alterations	Not applicable: non-pollutant	Addressed by sediment TMDL in a separate, concurrent document

Table A-1. Waterbody Impairment Status of Silver Bow Creek and the Clark Fork River based on the 2012 Integrated Report

Waterbody and Location Description	Waterbody ID	Impairment Cause	TMDL Pollutant Category	Impairment Cause Status
Clark Fork River, Cottonwood Creek to Little Blackfoot River	MT76G001_030	Copper	Metals	Copper TMDL contained in this document
		Lead	Metals	Lead TMDL contained in this document
		Zinc	Metals	Zinc TMDL contained in this document
		Nitrogen (Total)	Nutrients	Nitrogen TMDL completed in 1998
		Phosphorus (Total)	Nutrients	Phosphorus TMDL completed in 1998
		Sedimentation/Siltation	Sediment	Sediment TMDL contained in a separate, concurrent document
		Physical substrate habitat alterations	Not applicable: non-pollutant	Addressed by sediment TMDL in a separate, concurrent document
		Alteration in stream-side or littoral vegetative covers	Not applicable: non-pollutant	Addressed by sediment TMDL in a separate, concurrent document
		Low flow alterations	Not applicable: non-pollutant	Addressed by sediment TMDL in a separate, concurrent document
Clark Fork River, Little Blackfoot River to Flint Creek	MT76G001_010	Arsenic	Metals	Arsenic TMDL contained in this document
		Copper	Metals	Copper TMDL contained in this document
		Lead	Metals	Lead TMDL contained in this document
		Zinc	Metals	Not impaired based on updated assessment
		Nitrogen (Total)	Nutrients	Nitrogen TMDL completed in 1998
		Phosphorus (Total)	Nutrients	Phosphorus TMDL completed in 1998
		Sedimentation/Siltation	Sediment	Sediment TMDL contained in a separate, concurrent document
		Physical substrate habitat alterations	Not applicable: non-pollutant	Addressed by sediment TMDL in a separate, concurrent document
		Alteration in stream-side or littoral vegetative covers	Not applicable: non-pollutant	Addressed by sediment TMDL in a separate, concurrent document
		Low flow alterations	Not applicable: non-pollutant	Addressed by sediment TMDL in a separate, concurrent document

Table A-1. Waterbody Impairment Status of Silver Bow Creek and the Clark Fork River based on the 2012 Integrated Report

Waterbody and Location Description	Waterbody ID	Impairment Cause	TMDL Pollutant Category	Impairment Cause Status
Clark Fork River, Flint Creek to Blackfoot River	MT76E001_010	Arsenic	Metals	Arsenic TMDL contained in this document
		Cadmium	Metals	Cadmium TMDL contained in this document
		Copper	Metals	Copper TMDL contained in this document
		Iron	Metals	Iron TMDL contained in this document
		Lead	Metals	Lead TMDL contained in this document
		Zinc	Metals	Zinc TMDL contained in this document
		Nitrogen (Total)	Nutrients	Nitrogen TMDL completed in 1998
		Phosphorus (Total)	Nutrients	Phosphorus TMDL completed in 1998
		Chlorophyll-a	Not applicable: non-pollutant	Addressed via nutrient TMDLs completed in 1998
		Alteration in stream-side or littoral vegetative covers	Not applicable: non-pollutant	To be addressed in a future project
Clark Fork River, Blackfoot River to Rattlesnake Creek	MT76M001_030	Copper	Metals	Copper TMDL contained in this document
		Lead	Metals	Lead TMDL contained in this document
		Nutrient/Eutrophication Biological Indicators	Nutrients	Nutrient TMDL completed in 1998
Clark Fork River, Rattlesnake Creek to Fish Creek	MT76M001_020	Arsenic	Metals	Not impaired based on updated assessment
		Cadmium	Metals	Not impaired based on updated assessment
		Copper	Metals	Copper TMDL contained in this document
		Nitrogen (Total)	Nutrients	Nitrogen TMDL completed in 1998
		Phosphorus (Total)	Nutrients	Phosphorus TMDL completed in 1998
		Chlorophyll-a	Not applicable: non-pollutant	Addressed via nutrient TMDLs completed in 1998
		Organic Enrichment (Sewage) Biological Indicators	Nutrients	Nutrient TMDL completed in 1998
Clark Fork River, Fish Creek to Flathead River	MT76M001_010	Copper	Metals	Copper TMDL contained in this document
		Lead	Metals	Lead TMDL contained in this document
		Nitrogen (Total)	Nutrients	Nitrogen TMDL completed in 1998
		Phosphorus (Total)	Nutrients	Phosphorus TMDL completed in 1998

Table A-1. Waterbody Impairment Status of Silver Bow Creek and the Clark Fork River based on the 2012 Integrated Report

Waterbody and Location Description	Waterbody ID	Impairment Cause	TMDL Pollutant Category	Impairment Cause Status
Clark Fork River, Flathead River to Noxon Reservoir	MT76N001_010	Cadmium	Metals	Not impaired based on updated assessment
		Fish-Passage Barrier	Not applicable: non-pollutant	To be addressed in a future project
Clark Fork River, aka Cabinet Gorge Reservoir, Noxon Dam to Idaho Border	MT76N001_020	Alteration in stream-side or littoral vegetative covers	Not applicable: non-pollutant	To be addressed in a future project
		Dissolved Gas Supersaturation	Dissolved Gas	TMDL to be completed in a future project
		Other flow regime alterations	Not applicable: non-pollutant	To be addressed in a future project
		Temperature, water	Temperature	TMDL to be completed in a future project

APPENDIX B – METALS DATA

Appendix B (metals data) is available upon request.

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. Although the major sources of metals contamination directly affecting Silver Bow Creek and the Clark Fork River are already addressed in Superfund Sites with approved RODs, there are opportunities in tributary drainages for interested parties to contribute to water quality improvement within the Clark Fork River.

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(2013)). 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 cleanup 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. 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.

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.

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 currently exist within the project area.

C9.0 References

Montana Department of Environmental Quality. 2011a. Comprehensive Environmental Compensation Responsibility Act (CECRA) Priority List. http://deq.mt.gov/StateSuperfund/cecralistformats.mcpx. Accessed 2/21/2014a.

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