Sheep Creek Aluminum TMDL

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Sheep Creek, near White Sulphur Springs, MT
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ACRONYMS AND ABBREVIATIONS

Acronym or Abbreviation	Definition
µg/L	Micrograms per liter
AAL	Acute Aquatic Life
BMP	Best Management Practice
CAL	Chronic Aquatic Life
CFR	Code of Federal Regulations (U.S.)
cfs	Cubic Feet Per Second
DEQ	Department of Environmental Quality (Montana)
e.g.	Example given
EPA	Environmental Protection Agency (U.S.)
FWP	Fish, Wildlife & Parks (Montana)
GIS	Geographic Information System
ID	Identification
i.e.	Id est (that is)
LA	Load Allocation
Lbs/day	Pounds per day
MBMG	Montana Bureau of Mines and Geology
MCA	Montana Code Annotated
mg/L	Milligrams per liter
MOS	Margin of Safety
MPDES	Montana Pollutant Discharge Elimination System
TMDL	Total Maximum Daily Load
su	Standard units
SWPP	Storm Water Pollution Prevention Plan
TSS	Total suspended solids
USFS	United States Forest Service
USGS	United States Geological Survey
WLA	Wasteload Allocation

DOCUMENT SUMMARY

This document presents an aluminum total maximum daily load (TMDL) for Sheep Creek in the Sheep Creek TMDL Project Area (Project Area). The Sheep Creek watershed is in central Montana in Meagher County, within the Little Belt Mountains, (**Figure 1-1**) and is a principal tributary to the Smith River.

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 streams and lakes can support their designated water quality uses. The Montana Department of Environmental Quality (DEQ) develops TMDLs, as required by the Montana Water Quality Act, and submits them to the U.S. Environmental Protection Agency for approval. All required TMDL development components are incorporated within this document.

Although DEQ recognizes there are other pollutant impairments in the Project Area such as the aluminum impairment of Moose Creek, this document only addresses aluminum as a cause of impairment in Sheep Creek.

Aluminum TMDL

Aluminum is a metal that can have toxic effects on aquatic life at elevated concentrations. Montana has a numeric water quality standard for aluminum that addresses the toxic effects and provides the basis for identifying concentration targets, expressing the TMDL as a daily load, and developing the TMDL allocations.

A source assessment of aluminum loading is included as a part of TMDL development. Aluminum occurs naturally in the environment, and the majority of aluminum loading to Sheep Creek is attributed to natural background. This consideration is integrated into the load allocation portion of the TMDL as well as future water quality planning. Aluminum loading from a proposed copper mine is identified and the TMDL provides wasteload allocations to address the future loads consistent with Tintina Montana Inc. final MPDES permit limits and requirements.

Document Organization

Sections 1.0 through 4.0 provide background information on the project area and TMDL development. Section 5.0 provides the detailed TMDL components of targets, source assessment, TMDL expression, and TMDL allocations. Section 6.0 provides information on next steps toward addressing the aluminum impairment in Sheep Creek, and Section 7.0 provides information on stakeholder involvement during TMDL development.

1.0 PROJECT OVERVIEW

This document presents an analysis of water quality information and establishes an aluminum total maximum daily load (TMDL) for Sheep Creek in the Sheep Creek TMDL Project Area (Project Area). An aluminum load is quantified for Sheep Creek accounting for all contributing sources of aluminum pollution. The Project Area is located in Meagher County in central Montana, and is a primary watershed of the Little Belt Mountains providing a significant portion of flow to its receiving water, the Smith River (hydrologic unit 10030103). **Figure 1-1** below shows the boundaries of the Project Area, Sheep Creek, and several of its significant tributaries.

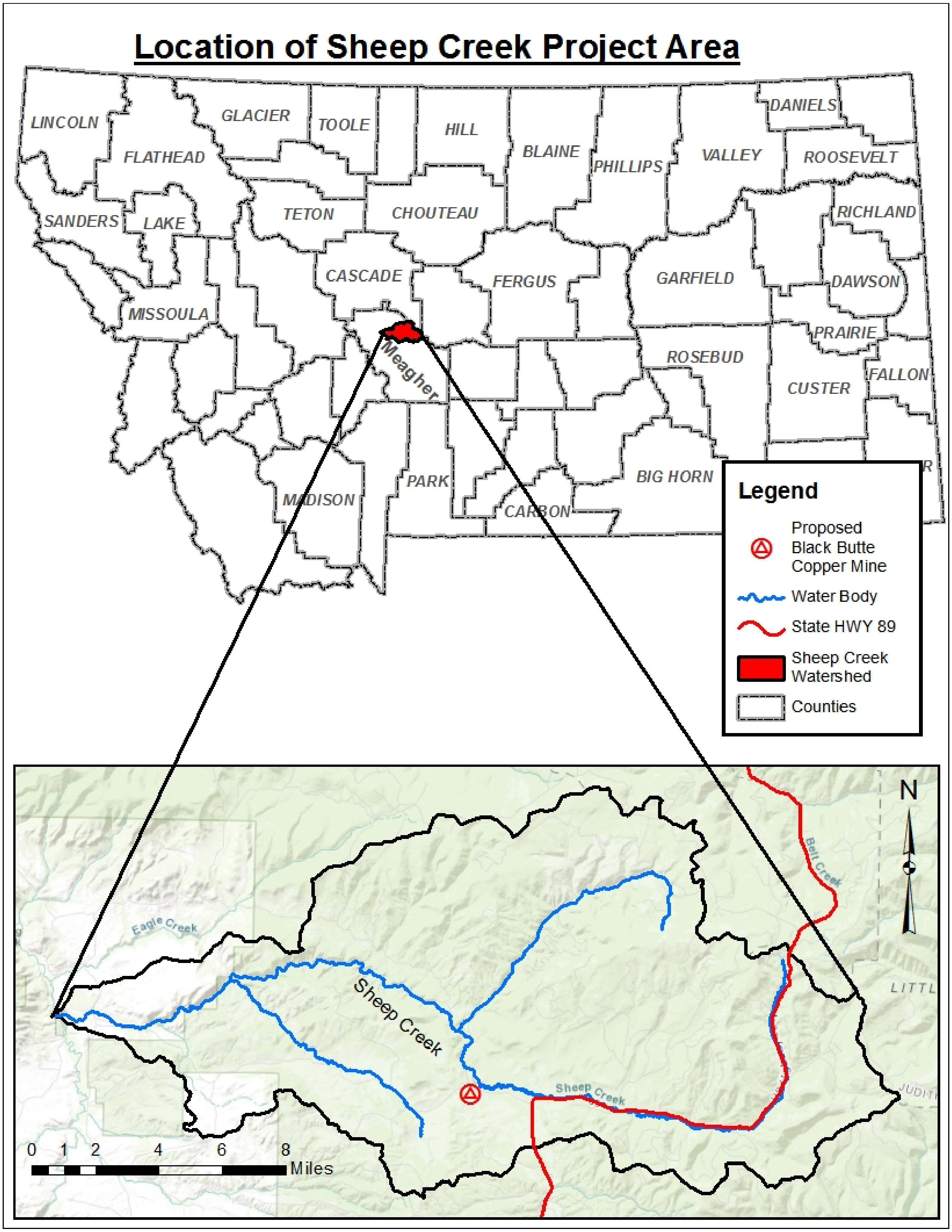

Figure 1-1. Location of the Sheep Creek TMDL Project Area

1.1 Why We Write TMDLs

The Montana Department of Environmental Quality (DEQ) is charged with protecting a clean and healthy environment. This includes actions that protect, maintain, and improve water quality, consistent with the Montana Water Quality Act and the federal Clean Water Act.

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

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

Each waterbody in Montana has a set of designated uses from the list above. Montana has established water quality standards to protect these uses, and a waterbody that does not meet one or more narrative or numeric water quality standards is called an impaired water. Each state must monitor their waters to track if they are supporting their designated uses, and every two years DEQ prepares a Water Quality Integrated Report (DEQ 2018) which lists all impaired waterbodies and their identified impairment causes. Impairment causes fall within two main categories: pollutant and non-pollutant.

Montana's biennial Water Quality Integrated Report identifies all the state's impaired waterbody segments. The 303(d) list-portion of the Integrated Report includes all of those waterbody segments impaired by a pollutant. Both Montana state law (Section 75-5-701, Montana Code Annotated (MCA) of the Montana Water Quality Act) and section 303(d) of the federal Clean Water Act require the development of TMDLs for impaired waterbodies when water quality is impaired by a pollutant. TMDLs are not required for non-pollutant causes of impairment.

Sheep Creek and Moose Creek are the only impaired waters in the Sheep Creek TMDL Project Area from Montana's 2018 303(d) List. The resulting TMDLs provide information to help ensure that surface water discharge permits are protective of water quality. A TMDL is the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. **Section 4.0** provides more detail on TMDL development and the required TMDL components. In Montana, the TMDLs also provide important information that stakeholders can use to help address pollutant sources not covered by surface water permits.

1.2 Water Quality Impairments and TMDL Addressed by this Document

This document includes one TMDL, which is an aluminum TMDL for Sheep Creek. DEQ has identified three impairment causes in the Sheep Creek watershed. These include aluminum and Escherichia coli (*E. coli*) impairments for Sheep Creek and an aluminum impairment for Moose Creek. In 2017, DEQ completed the "Sheep Creek *E. coli* TMDL and Water Quality Improvement Plan" (DEQ 2017) which addresses *E. coli* impairments in Sheep Creek.

For both aluminum impairment causes, DEQ has identified natural background as the likely reason for the elevated aluminum concentrations in Sheep and Moose creeks. Impairment conditions linked to natural background normally represent a low priority for TMDL development in Montana. However, Montana State Law (75-5-702 (9), MCA) places a priority on developing TMDLs for waterbodies where there is an application for a new individual permit that has a discharge that contains the pollutant for which the waterbody is impaired. DEQ has received a new individual permit application from Tintina Montana Inc. for a proposed copper mine. Because the permit addresses aluminum limits for discharges to Sheep Creek, the Sheep Creek aluminum TMDL was identified as high priority. The Moose Creek aluminum TMDL development remains a low priority since there is no linkage between the proposed copper mine discharges and the Moose Creek watershed.

1.3 Document Organization

This document addresses all the required components of a TMDL. 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 Sheep Creek TMDL Project Area Description:
Describes the physical characteristics and social profile of the watershed.

Section 3.0 Montana Water Quality Standards
Discusses the water quality standards that apply to Sheep Creek.

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

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

Section 6.0 Implementing the Sheep Creek Aluminum TMDL
Provides information on next steps toward addressing the aluminum impairment in Sheep Creek

Section 7.0 Public Participation and Public Comments
Describes other agencies and stakeholder groups who were involved with the development of this plan and the public participation process used to review the draft document. Addresses comments received during the public review period.

2.0 SHEEP CREEK TMDL PROJECT AREA DESCRIPTION

This section provides a general description of the physical, ecological, and social characteristics of the Sheep Creek TMDL Project Area, which equates to the boundary of the Sheep Creek watershed. This information thus provides context for the more detailed pollutant source assessment presented in **Section 5.0**.

2.1 PHYSICAL CHARACTERISTICS

The following information describes the physical characteristics of the Sheep Creek TMDL Project Area. This includes location, topography, climate, hydrology, and geology and soils.

2.1.1 Location

The Sheep Creek TMDL Project Area encompasses the Sheep Creek watershed with TMDL development focused on the mainstem of Sheep Creek, which flows approximately 41 miles from its headwaters to its confluence with the Smith River (hydrologic accounting unit 10030103). The Project Area encompasses approximately 195 square miles (124,500 acres) in central Montana and is located completely within Meagher County (**Figure 1-1**).

2.1.2 Topography

The topography is mapped in **Appendix A** in **Figure A-1**. Elevation ranges from 8,192 feet in the headwaters at the top of Porphyry peak to 4,376 feet at the confluence with the Smith River.

2.1.3 Climate

Average precipitation along the Sheep Creek corridor ranges from approximately 11.4 inches per year near the confluence with the Smith River to approximately 28.6 inches per year at Kings Hill near the northeastern edge of the watershed, according to climate summaries provided by the Western Regional Climate Center http://www.wrcc.dri.edu/summary/Climsmnidwmt.html. May and June are consistently the wettest months of the year and winter precipitation is dominated by snowfall. Average annual precipitation is mapped in **Appendix A** in **Figure A-2**. Precipitation is highest in the mountains to the north and east of Sheep Creek, along the borders of Cascade, Judith Basin, and Meagher counties.

The climate in Sheep Creek tends to be fairly consistent throughout the watershed. This is evident by the average minimum and maximum air temperatures in the headwaters and close to the mouth. Average maximum temperatures in the headwaters and at the mouth are 70°F and 77°F, respectively. Average minimum temperatures in the headwaters and at the mouth are 7°F and 10°F, respectively. The Sheep Creek watershed is a typical mid-elevation intermountain basin characterized by cold winters and mild summers, with lower elevations seeing slightly warmer and drier summers than the headwaters that tend to stay cooler and more humid.

2.1.4 Hydrology

The drainage in the Project Area is characterized by the mainstem of Sheep Creek and several smaller tributaries, mapped in **Appendix A** in **Figure A-3**. The watershed is broken into six subwatersheds: Sheep Creek Headwaters, Upper Sheep Creek, Moose Creek, Middle Sheep Creek, Big Butte Creek and Lower Sheep Creek. The watersheds of major tributaries (Moose Creek, Calf Creek, Big Butte Creek and Little Sheep Creek) that join Sheep Creek are important hydrologically, but are not covered in this document.

None of the tributary streams are monitored by U.S. Geological Survey (USGS) gaging stations. Their streamflow generally follows a hydrograph typical for the region, highest in May and June; 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. Streamflow begins to rebound in October and November when fall storms supplement the base-flow levels.

2.1.5 Geology and Soils

The Sheep Creek TMDL Project Area lies on the eastern edge of the Little Belt Mountains of central Montana. The Little Belts were formed in the Cretaceous period as an anticline cored by basement rocks (Baker, et. al, 1991). Laramide (Eocene) felsic igneous intrusions have resulted in numerous igneous rock intrusions such as sills, dikes, and diatremes. Some of the domal structures are capped by fairly flat-lying sedimentary rocks, primarily the Belt Series' basal Neihart quartzite but also Cambrian to Cretaceous sedimentary rocks. A portion of the Sheep Creek TMDL Project Area also lies within the sediments from the Precambrian Belt Sea; sediments were deposited in a trough known as the Helena embayment. The Project Area geology is mapped in **Appendix A** in **Figure A-4**. The Black Butte Iron Mine produces iron ore for cement production. This quarry is the only existing mining operation in the project area (**Figure 5-1**)

Soil erodibility is based on the Universal Soil Loss Equation (USLE) K-factor (Wischmeier and Smith, 1978). K-factor values range from 0 to 1, with a greater value corresponding to greater potential for erosion. Susceptibility to erosion is mapped in **Appendix A** in **Figure A-5**, with soil units assigned to the following ranges: low (0.0-0.2), moderate-low (0.2-0.29) and moderate-high (0.3-0.4). Values greater than 0.4 are considered highly susceptible to erosion. Despite the steep and rugged topography, the majority of the Project Area is mapped with soils rated as having low and moderate-low erodibility. Soils mapped with moderate-high erodibility are largely localized on the southern portion of the Sheep Creek watershed. No values greater than 0.4 are mapped in the Project Area.

2.2 Ecological Profile

This section describes the ecology of the Sheep Creek TMDL Project Area, including ecoregions, land cover, fire history, and species of concern.

2.2.1 Ecoregions

The U.S. Environmental Protection Agency defines ecoregions as areas where ecosystems (the type, quality, and quantity of environmental resources) are generally similar. Ecoregions serve as a spatial framework for research, assessment, management, and monitoring of ecosystems and their components. The Sheep Creek TMDL Project Area is predominately included in the Middle Rockies (17) ecoregion, with a small percentage, mostly near the mouth of Sheep Creek, located within the Northern Glaciated Plains Ecoregions (43) ecoregion (**Appendix A** in **Figure A-6**).

2.2.2 Land Cover

Land cover is mapped in **Appendix A** in **Figure A-7**, based on the USGS National Land Cover Dataset (Homer et al., 2004). As shown in this figure, the Project Area is dominated by evergreen forest (65.4%) in the uplands, and herbaceous and shrub/scrub cover in the lowlands (25.5% and 6.6%, respectively). Hay/pasture and cultivated crops are localized around the middle sections of Sheep Creek, as is most of the area around the mouth. Big Butte Creek and the headwaters of Moose Creek also have a significant area in upland grasses and shrub.

2.2.3 Fire History

Recent fire history (1985-2013) is mapped in **Appendix A** in **Figure A-8**. The largest fire in the Sheep Creek Project Area in recent history is the coyote fire (1996) which burned approximately 3,425 acres. Other significant fires include the 2011 Elk Park fire that burned approximately 600 acres and the 2003 Iron Butte fire which burned approximately 152 acres. There have also been a number of smaller fires since 2000 that have burned 35 acres or less; these include the McGuire Ranch, Sheep Creek, Allen Park and Moose Mountain fires.

2.2.4 Species of Concern

The Project Area provides habitat for a number of species of concern as noted by the Montana Department of Fish, Wildlife and Parks (FWP). The most noteworthy species is the Westslope Cutthroat Trout. Westslope Cutthroat exist in a number of tributaries to Sheep Creek and in the headwaters of Sheep Creek The mapped distribution of this and other species of concern is shown in **Appendix A** in **Figure A-9**, based on data provided by FWP (Multi-Resolution Land Characteristics Consortium, 2006).

2.3 Social Profile

The following section describes the social characteristics of the Sheep Creek TMDL Project Area. This includes population distribution, land ownership, and land management.

2.3.1 Population Density

The Sheep Creek TMDL Project Area does not contain any significant population centers. Therefore, there are no census geometries that exactly correspond to the Project Area. The closest major population center for the area is the town of White Sulphur Springs, MT, which is located outside of the Sheep Creek TMDL Project Area. The large area of U.S. Forest Service (USFS) land that comprises most of the watershed is relatively uninhabited. There are several homes and cabins along highway 89 in the upper portion of the watershed. Also, outside of the forest lands there are a few homes associated with ranching operation in the middle and lower portions of the watershed. Population density is mapped in **Appendix A** in **Figure A-10**.

2.3.2 Land Ownership

Federal lands managed by the USFS dominate the Project Area, and are found mostly in the upland areas. Federal Forest Service land comprises approximately 69% of the Project Area. Private lands dominate the river corridor, valley bottoms, and the area close to the mouth, comprising approximately 30% of the Project Area. Also, the Showdown Mountain Ski Area, located on leased U.S. National Forest land, is located at the headwaters of Sheep Creek along Highway 89. Land ownership is mapped in **Appendix A** in **Figure A-11**.

2.3.3 Agricultural Land Use

Agricultural land use in the Sheep Creek TMDL Project Area consists mostly of grazing on public and private land and some hay production. Grazing on public land is concentrated in the upland areas around Sheep Creek. There are small portions of land in the valley bottoms that are used as pasture or for hay production. U.S. Forest Service grazing allotments and major forms of agricultural land use are mapped in **Appendix A** in **Figure A-12**.

2.3.4 Road Networks

There are extensive road networks both in the valley bottoms and in the timbered uplands (**Appendix A** in **Figure A-13**). The main transportation corridor is the paved State Highway 89 that crosses the Project Area. However, there is also a well-established network of unpaved county and forest roads. Many of the forest roads were constructed for timber harvesting and may have been decommissioned. The ongoing USFS vegetation project has the potential for temporary road construction, reconstruction and associated maintenance.

3.0 Montana Water Quality Standards

The Montana Water Act provides for the restoration and maintenance of the chemical, physical, and biological integrity of the state'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 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

3.1 Stream Classifications and Designated Beneficial Uses

Stream classification is the designation of a single or group of uses to a waterbody based on the potential of the waterbody to support those uses. Designated uses, or beneficial uses, are simple narrative descriptions of water quality expectations or water quality goals. Montana waters are classified for multiple uses. Sheep Creek is classified as B-1, which specifies that the water must be maintained suitable for the following uses:

- Drinking, culinary, and food processing purposes, after conventional treatment (Drinking Water)
- Bathing, swimming, and recreation (Primary Contact Recreation)
- Growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers (Aquatic Life)
- Agricultural and industrial water supply

While a waterbody might not actually be used for a designated use (e.g., as a drinking water supply), its water quality still must be maintained suitable for that designated use. DEQ's water quality assessment methods are designed to evaluate the most sensitive uses for each pollutant, thus ensuring protection of all designated uses (DEQ 2012b). For Sheep Creek, the most sensitive use assessed for aluminum is Aquatic Life.

3.2 Numeric and Narrative Water Quality Standards

Montana's water quality standards include numeric and narrative criteria that protect the designated uses described above. Numeric standards define the allowable concentrations, frequency, and duration of specific pollutants so as not to impair designated uses. Numeric standards for aquatic life include chronic and acute values. Chronic aquatic life standards prevent long-term, low level exposure to pollutants. Acute aquatic life standards protect from short-term exposure to pollutants.

Narrative standards are developed when there is insufficient information to develop numeric standards and/or the natural variability makes it impractical to develop numeric standards. Narrative standards describe the allowable or desired condition and are also designed to protect the designated beneficial uses.

Through water quality sampling and data analysis (discussed further in **Section 5.4.2**) DEQ has determined that Sheep Creek, assessment unit MT41J002_030, does not meet the numeric water quality standard for aluminum.

3.3 NONDEGRADATION PROVISIONS

Nondegradation is addressed via the Nondegradation Policy within Montana state statute (75-5-303, MCA) and via Montana's nondegradation rules (17.30.7, Administrative Rules of Montana). The Nondegradation Policy states that existing uses of state waters and the level of water quality necessary to protect those uses must be maintained and protected. The nondegradation policy also addresses high-quality waters. Unless authorized by DEQ through a nondegradation review, or exempted from review under 75-5-317, the quality of high quality waters must be maintained. **Section 5.7** discusses how application of the Nondegradation Policy is applied toward TMDL allocations for a proposed new point source (Tintina Montana Inc.) discharge to waterbodies in the Sheep Creek watershed.

4.0 DEFINING TMDLS AND THEIR COMPONENTS

A total maximum daily load (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. The ultimate goal of the TMDL is to identify an approach to achieve and maintain water quality standards.

Pollutant sources are generally defined as two categories: point sources and nonpoint sources. Point sources are often linked to community wastewater treatment or industrial facilities with discernible, confined and discrete conveyances, such as pipes or ditches from which pollutants are being, or may be, discharged to a waterbody. Some sources such as return flows from irrigated agriculture are not included in this definition. Pollutant loading sources that do not meet the definition of a point source are considered nonpoint sources. Nonpoint sources are associated with diffuse pollutant loading to a waterbody and are often linked to runoff from agricultural, urban, or forestry activities, as well as streambank erosion and groundwater seepage that can occur from these activities. Natural background loading and atmospheric deposition are both considered types of nonpoint sources.

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 as: TMDL = ΣWLA + ΣLA + MOS, where:

ΣWLA is the sum of the wasteload allocation(s) (point sources)
ΣLA is the sum of the load allocation(s) (nonpoint sources)
MOS = margin of safety

TMDL development must include a margin of safety (MOS), which can be explicitly incorporated into the above equation as shown. Alternatively, the MOS can be implicit in the TMDL, meaning that the explicit MOS in the above equation is equal to zero and can therefore be removed from the above equation. An implicit MOS is used in the Sheep Creek TMDL (**Section 5.0**). 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.

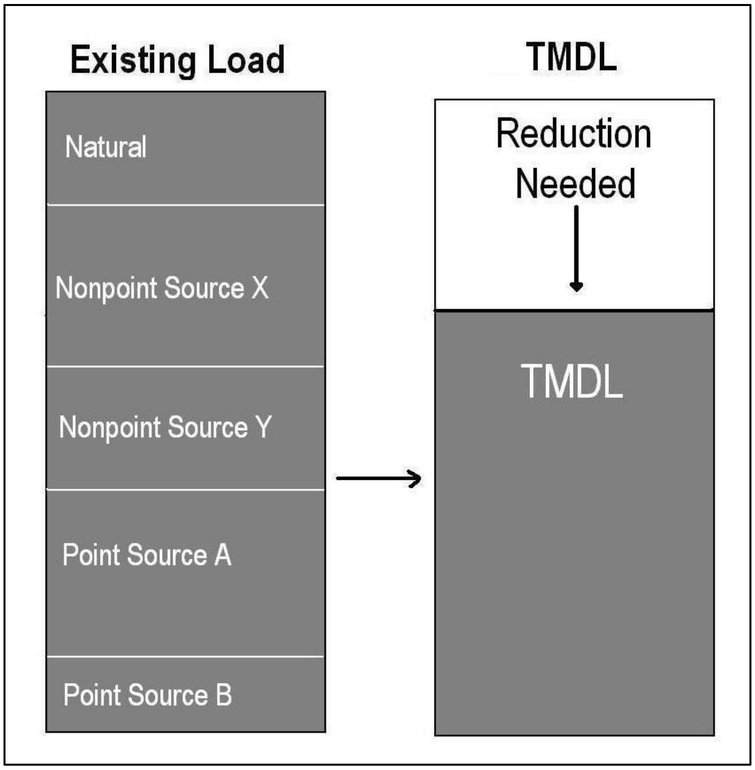

Figure 4-1: Schematic Example of TMDL Development

4.1 Developing Water Quality Targets

For each pollutant, TMDL water quality targets are applied to one or more parameters that link directly to the impaired beneficial use(s) and applicable water quality standard(s). For pollutants with established numeric water quality standards, the numeric value(s) are used as the TMDL targets. For pollutants with narrative water quality standard(s), the targets provide a translation of how the narrative standard(s) applies to the waterbody. The resulting targets provide a benchmark by which to evaluate attainment of water quality standards. Comparing existing stream conditions to target values allows for a better understanding of the extent and severity of the problem.

4.2 Quantifying Pollutant Sources

The goal of TMDL source assessment is to identify all significant pollutant loading sources, including natural background loading, and quantify them so that the relative pollutant contributions can be determined. Because the effects of pollutants on water quality can vary throughout the year, assessing pollutant sources includes an evaluation of the seasonal variability of the pollutant loading. The source assessment helps to define the extent of the problem by linking the pollutant load to specific sources in the watershed.

Source assessments are conducted on a watershed scale and can vary in level of detail resulting in reasonably accurate estimates or gross allotments, depending on the data availability and the techniques used for predicting the loading. Montana TMDL development often includes a combination of approaches, depending on the level of desired certainty for setting allocations and guiding implementation activities.

Nonpoint sources are quantified by source categories (e.g., septic systems) and/or by land uses (e.g., agricultural land use). These source categories and land uses can be divided further by ownership, such as federal, state, or private. Alternatively, most, or all, nonpoint pollutant sources in a sub-watershed or source area can be combined for quantification and TMDL load allocation purposes.

Point source pollutant loading is typically quantified for each individual surface water source permitted under the Montana Pollutant Discharge Elimination System (MPDES) program. Through MPDES permit requirements, point source dischargers provide discharge and other information that can be used for source assessment purposes.

4.3 Establishing the Total Allowable Load

TMDL development requires a determination of the total allowable load over the appropriate time period necessary to comply with the applicable water quality standard(s). TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure. Where a stream is impaired by a pollutant for which numeric water quality criteria exist, the TMDL, or allowable load, is typically calculated as a function of streamflow and the numeric criteria. This results in a loading rate per unit time TMDL expression such as pounds per day (lbs/day). This same approach can be applied when a numeric target is developed to interpret a narrative standard. For some narrative standards, DEQ applies other approaches for expressing the TMDL, such as a percent reduction in pollutant loading.

4.4 Determining Pollutant Allocations

Once the allowable load (the TMDL) is determined, that total must be divided among the contributing sources so that the sum of the allocations is equal to the TMDL, consistent with the above TMDL equation. Where a TMDL is variable based on streamflow, nonpoint source load allocations are often variable based on this same receiving streamflow. On the other hand, point source wasteload allocations are often based on conservative streamflow and discharge conditions and/or can be variable based on the point source discharge flow and a discharge concentration limit.

Figure 4-2 illustrates how, for a given streamflow condition, the TMDL is allocated to different sources using WLAs for point sources and load allocations (LA) for natural and nonpoint sources. Although some flexibility in allocations is possible, the sum of all allocations must meet the TMDL for all segments of the waterbody. **Figure 4-2** shows multiple point and nonpoint source allocations. In Montana, nonpoint source allocations are sometimes grouped into one composite allocation. This composite load allocation approach is applied in cases where data is limited, there is significant source assessment uncertainty, and/or DEQ has determined that the best approach is to provide stakeholders with flexibility in addressing sources, allowing them to choose where to focus on improved land management practices and other remediation or restoration efforts.

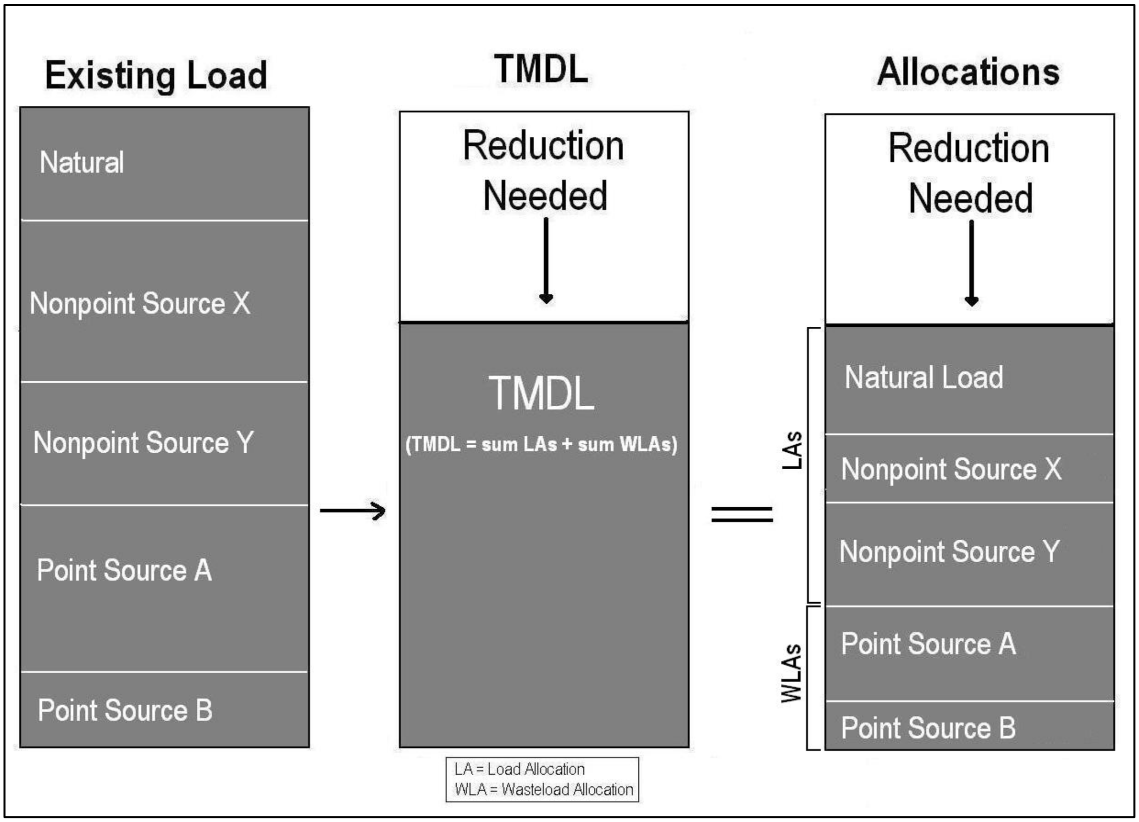

Figure 4-2: Schematic Diagram of a TMDL and its Allocations

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA 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. For the TMDL in this document where there is a combination of nonpoint sources and a point source, the permitted point source WLA is not dependent on implementation of the composite LA.

4.5 Implementing TMDL Allocations

Montana law (Section 75-5-703, MCA of the Montana Water Quality Act) requires that wasteload allocations are incorporated into appropriate discharge permits. Per federal regulation (40 CFR 122.44), the discharge permit effluent limits must be consistent with the assumptions and requirements of the available WLA developed within the TMDL.

Because of limited state and federal regulatory requirements, nonpoint source reductions linked to LAs are implemented primarily through voluntary measures, although the nonpoint sources of aluminum in this document are predominately linked to natural background conditions.

5.0 Aluminum TMDL Components

This portion of the document focuses on aluminum as a cause of water quality impairment in the Sheep Creek TMDL Project Area. It describes: (1) how excess aluminum impairs beneficial use, (2) the stream segment of concern, (3) information sources, (4) the water quality targets and comparison to existing conditions, (5) the sources of aluminum, (6) how the Sheep Creek aluminum TMDL is defined, (7) the aluminum TMDL, load allocations and the rationale supporting them and (8) the margin of safety and seasonality considerations accounting for uncertainties in TMDL development.

5.1 Effects of Excess Aluminum on Beneficial Uses

Elevated concentrations of aluminum can impair the support of aquatic life and fisheries beneficial uses. Within aquatic ecosystems, aluminum can have a toxic and bioconcentrating effect on biota. DEQ's numeric water quality standard is based on protection of aquatic life, representing the beneficial use of concern addressed in this TMDL document.

5.2 Stream Segment of Concern

Sheep Creek, from its headwaters to its mouth at the Smith River, is the stream segment of concern in the Sheep Creek Project Area for which an aluminum TMDL will be developed. Sheep Creek flows approximately 41.3 miles from its headwaters in the Little Belt Mountains to its confluence with the Smith River (**Figure 5-1**). Sheep Creek is listed as impaired for aluminum in the 2018 Montana Water Quality Integrated Report (**Table 5-1**), and TMDL development is based on this listing.

Table 5-1. Stream Segment of Concern for Aluminum Impairment (2018 Integrated Report)

Stream Segment (Assessment Unit)	Assessment Unit ID
Sheep Creek – Headwaters to mouth (Smith River)	MT41J002_030

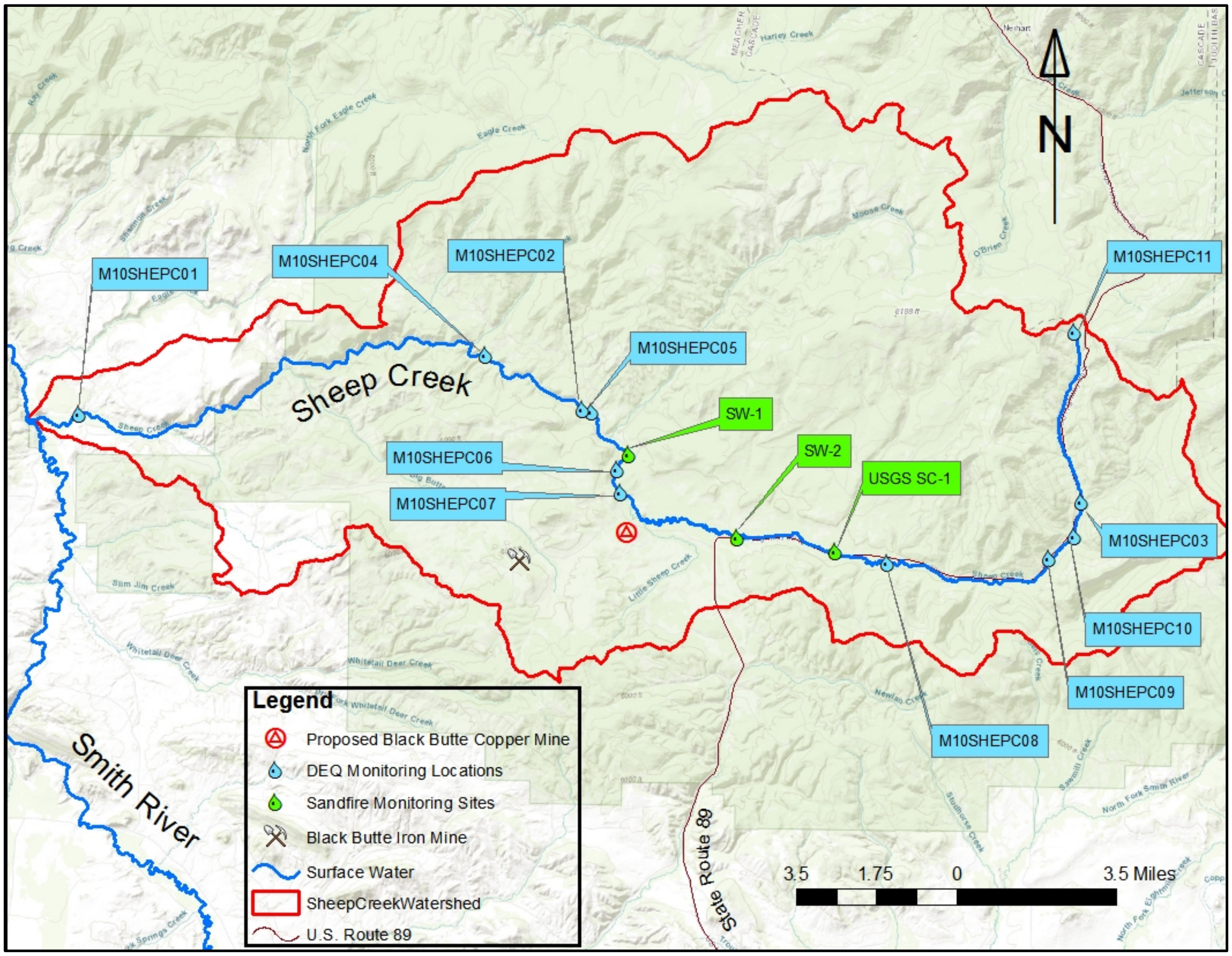

Figure 5-1. Sheep Creek Watershed and Aluminum Water Quality Sampling Locations

5.3 Information Sources

Data and information used for impairment determination, source assessment, and TMDL development consisted of:

- Water chemistry, and streamflow data collected by DEQ
- Water chemistry and streamflow data collected by Tintina Montana Inc.
- Geographic Information System (GIS) analysis including aerial imagery
- Literature reviews

The water chemistry data collected by DEQ are publicly available through EPA's Water Quality Portal database at: https://www.waterqualitydata.us/portal/. **Figure 5-1** includes monitoring locations and other locational information pertinent to the Sheep Creek Project Area.

5.4 Aluminum Water Quality Target and Comparison to Existing Conditions

Water quality targets are numeric indicators used to evaluate attainment of water quality standards. In this section, the aluminum water quality target is presented and compared to recently collected aluminum data.

5.4.1 Aluminum Target

Aluminum has numeric water quality criteria defined in Circular DEQ-7 (Montana Department of Environmental Quality, 2012a). These criteria include values for protecting aquatic life, and apply as water quality standards for Sheep Creek due to its B-1 classification (**Section 3.0**). Aquatic life criteria include values for both acute aquatic life (AAL) and chronic aquatic life (CAL) effects (**Table 5-2**). For aluminum, the most stringent of these criteria is the chronic criteria of 87µg/L (equivalent to 87 parts per billion). This criterion is adopted as the water quality target to protect all beneficial uses. Satisfying or meeting the target equates to aluminum concentration values of less than or equal to the 87 µg/L (i.e., values above 87 µg/L represent an undesirable condition).

DEQ's Monitoring and Assessment program guidance for metals assessment methods (DEQ, 2012c) was applied toward making the aluminum impairment determination. Below are the applicable conditions applied toward making the Sheep Creek impairment determination. These same conditions also apply toward evaluating TMDL target attainment.

- If more than 10% of the samples exceed (i.e., are more than) the AAL or CAL target, then the waterbody is considered impaired for that pollutant.
- If a single sample exceeds the AAL target by more than a factor of two, the waterbody is considered impaired.
- A minimum 8 samples are required, and samples must represent both high and low flow conditions.

Table 5-2. Aluminum Water Chemistry Targets Applicable to the Sheep Creek TMDL Project Area

Metal of Concern	Aquatic Life Criteria (µg/L)		Human Health Criteria (µg/L)
	Acute	Chronic	
Aluminum, Dissolved	750	87	Not Applicable

5.4.2 Existing Conditions and Target Comparison

Water quality data used in this document were collected by DEQ in September 2005 and May through September of 2015, and by Tintina Montana Inc. (Tintina) from 2011 to 2017. DEQ acknowledges that Tintina is a wholly owned subsidiary of Sandfire Resources America Inc. (Sandfire), and that in DEQ records Tintina is also referred to as Sandfire during data collection in the Sheep Creek watershed. The data used to evaluate attainment of the water quality standard (target) for impairment determination purposes consist of all the available and applicable DEQ and Tintina data from 2011 through 2015. This accounts for the majority of the aluminum samples collected, totaling 111, of which 28 were collected by DEQ at 11 different locations. The remainder were collected by Tintina at three locations. Additional data collected by Tintina (2016 -2017) are used in the sources assessment process. Monitoring locations used by DEQ and Tintina are identified in **Figure 5-1**. **Appendix B** provides a summary of aluminum data collected by both DEQ and Tintina.

A summary of aluminum data used for impairment determination is provided below in **Table 5-3**. The **Table 5-3** data show that individual aluminum values ranged from 3 µg/L to 390 µg/L, with 14 of 111 samples above the Chronic Aquatic Life (CAL) target. Because metals concentrations were found to be above the CAL target in greater than 10% of the samples (13%), the water quality standard is not met and aluminum is listed as a cause of impairment to Sheep Creek, justifying TMDL development.

Table 5-3. Sheep Creek Aluminum Target Evaluation Summary

Parameter	Aluminum
# Samples	111
Minimum values (µg/L)	3.0
Maximum Values (µg/L)	390
# Acute Exceedances	0
Acute Exceedance Rate	0.0%
# Chronic Exceedances	14
Chronic Exceedance Rate	13%
# Samples > 2X the Acute Standard	0

5.5 Source Assessment and Quantification

5.5.1 Data Analysis

Based on DEQ's impairment determination for the 303(d) list, the primary aluminum source(s) identified in the Sheep Creek watershed are those sources that are naturally occurring. Metals such as aluminum occur naturally in aquatic ecosystems due to weathering of local geology and soils. These processes break down aluminum minerals and provide a means to introduce aluminum into aquatic ecosystems. The fate of any metal suspended in the water column is highly dependent on the chemical characteristic (pH, alkalinity) of the water. This contributes to the difficulty in identifying clear sources of aluminum in a watershed. This section provides additional data analysis to further determine the most likely source(s) using the water quality data from locations in **Figure 5-1** and discussed in **Sections 5.3** and **5.4**.

Figure 5-2 plots aluminum concentrations from individual monitoring locations in the Sheep Creek watershed. This figure helps to illustrate the distribution and magnitude of aluminum concentrations and target exceedances (i.e., concentrations greater than the target) with respect to monitoring site location within the watershed. The highest observed aluminum concentrations were seen at Tintina monitoring sites SC-1, SW-2 and SW-1 (also the sites with the most data collected). These sites are part of the Tintina monitoring network used to characterize water quality in Sheep Creek adjacent to the proposed Black Butte Copper Mine. Additional values above the target also occur at the downstream locations. These results show that the higher aluminum values occur toward the middle and downstream locations along Sheep Creek, although there are a relatively low number of samples from the upstream portion of Sheep Creek.

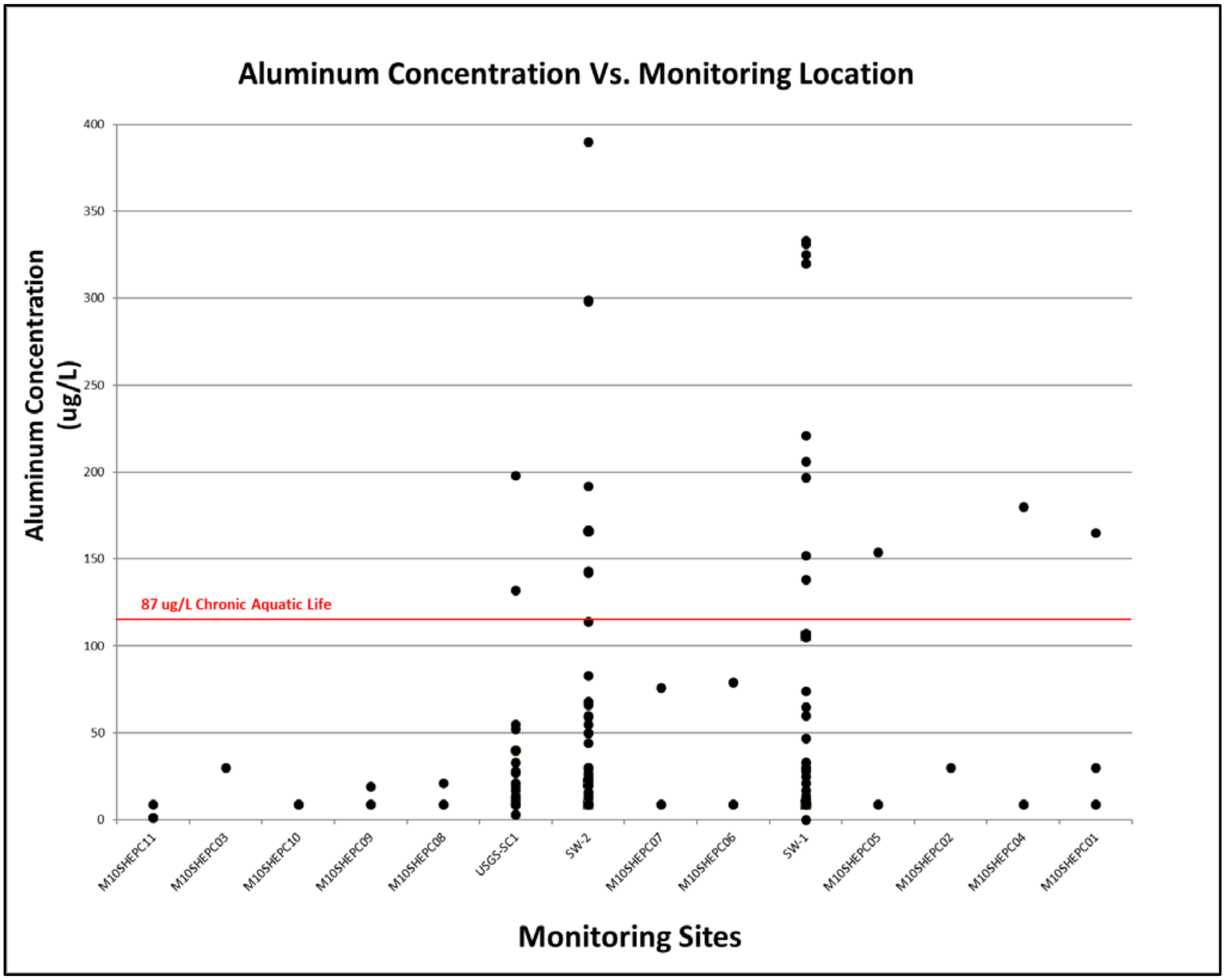

Figure 5-2. Aluminum Concentrations with Respect to Monitoring Location (left to right represents upstream to downstream locations)

Flow rate can be a major influence of metals concentrations in a waterbody because flow is related to saturation of soils, runoff and the amount of erosion from the watershed, but analyzing flow against aluminum concentration showed no relationship. To further evaluate potential flow and runoff impacts on aluminum, the potential linkage between flow conditions and total suspended solids (TSS) concentrations was evaluated to better understand Sheep Creek water quality parameter responses for subsequent analysis of TSS vs. aluminum concentrations. **Figure 5-3** shows the TSS concentrations plotted against flow. This figure shows that TSS concentrations are influenced by flow, with higher TSS concentrations often associated with increasing flow as would be expected, though there are several exceptions to this relationship.

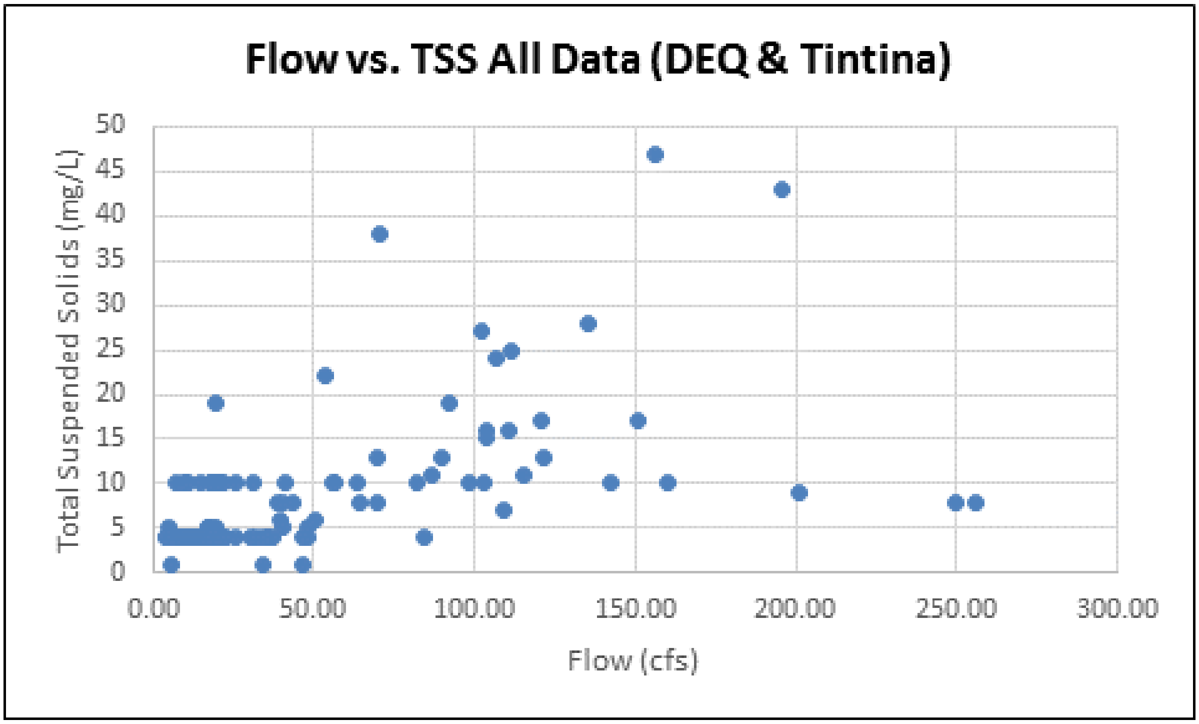

Figure 5-3. Flow vs. Total Suspended Solids

Figure 5-4 is a plot of dissolved aluminum concentrations and TSS. **Figure 5-4** shows a lack of a clear relationship between high aluminum concentrations and TSS. This figure shows that aluminum concentrations tended to fluctuate independent of TSS, with some of the highest concentrations occurring when lower TSS values were observed. If there was a concise relationship between aluminum and TSS one would expect that to see a true linear relationship between rising aluminum concentration and rising TSS concentrations. As shown in **Figure 5-4**, this is not the case.

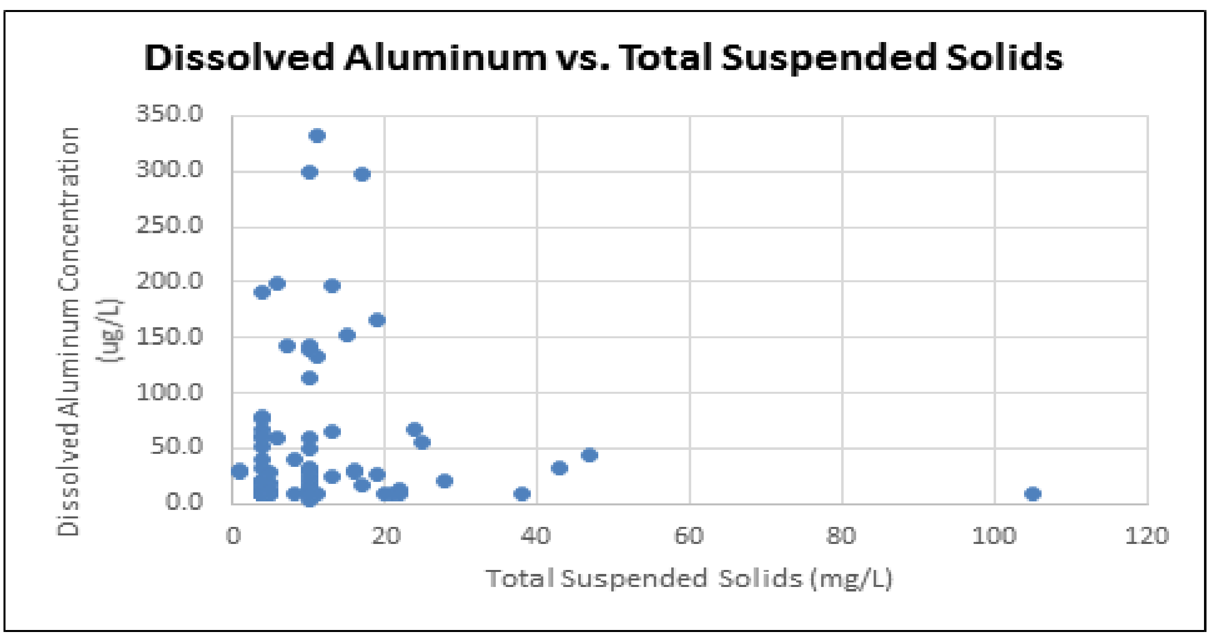

Figure 5-4. Dissolved Aluminum vs. Total Suspended Solids

One method to evaluate upstream to downstream effects more closely involves looking at data collected during the same flow conditions over the same time period (referred to as a synoptic sampling event). The synoptic event that was chosen occurred during a high runoff period in May of 2015. Over this 2-day period 9 samples were collected from monitoring locations throughout the watershed (**Figure 5-5**). This figure shows increasing aluminum concentrations from upstream to downstream, with low aluminum concentrations at upstream locations with lower flows (< 66 cfs) and high aluminum concentrations occurring at downstream locations with higher flows (> 66 cfs). The higher flow is a function of more catchment area in the downstream direction, thus it is difficult to determine whether the higher aluminum concentrations are resulting from an increase in flow, location in the watershed, or some a combination of both.

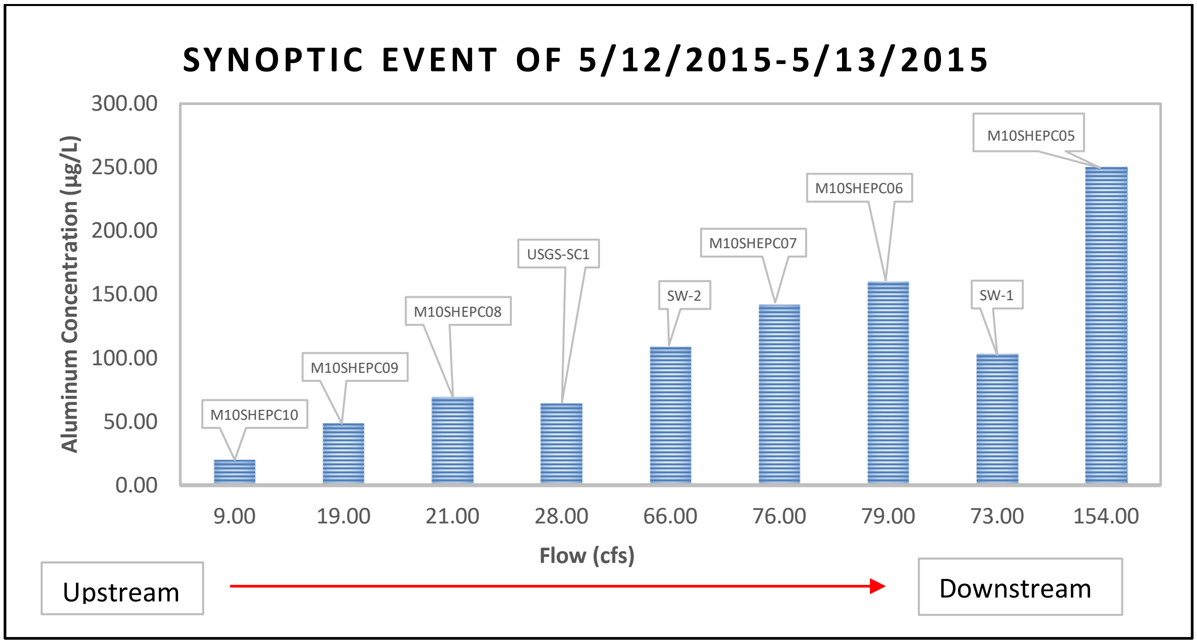

Figure 5-5. Synoptic Monitoring of Aluminum in Sheep Creek 5/12/15 - 5/13/15

A final analysis of the data is specific to timing. All the higher concentrations of aluminum fall with the March through June time period (prior to or during elevated spring runoff). These high aluminum concentrations don't always coincide with high flows. High aluminum concentrations occur at periods of low flow and high flows throughout this time period. The common thread in high aluminum concentrations in Sheep Creek is that they occur during the spring.

This may be attributable to the samples having been collected prior to high runoff events and there being some aluminum contributions associated with snow melt. Natural, unpolluted rain and snow are slightly acidic (Utah State University, 2005) and has a pH of between 5 and 6 standard units (su). When snow melts rapidly, it may not percolate through the soil before reaching the stream, as such soils can't buffer it. During these events streams may become slightly acidic. The solubility of aluminum in water increases as pH decreases (Smith and Haines, 1995), which is likely to increase the availability aluminum in the water column.

5.5.2 Potential Sources Contributing Aluminum to Sheep Creek

This section combines the **Section 5.5.1** data analysis and other information to help identify the probable sources of elevated aluminum loading to Sheep Creek. Three source types are discussed: historical and existing mining, human caused land disturbances (other than mines), and natural background.

5.5.2.1 Historical and Existing Mining

Historical mining in the Sheep Creek watershed has been limited. DEQs Abandoned Mines Lands program lists the Tenderfoot-Sheep Creek Mining District as having only one abandoned mine in the watershed. This is the Sheep Creek Iron Mine. The Montana Bureau of Mines and Geology Abandoned-Inactive Mines Program published an open-file report (MBMG, 2000) where they identified abandoned or inactive mines, mills and processing facilities related to mineral extraction. This report indicated the presence of one other mine, the Iron Cliff Mine, and reported this mine as likely a duplicate of the Sheep Creek Iron Mine. Reference to both mines in this report was limited. The Sheep Creek Iron mine was screened out of the report because of the small size of the workings. The Iron Cliff mine was screened out of the report due to no reference to it in the U.S. Bureau of Mines Mineral Industry Location System data base and the likelihood of it being a duplicate.

Not mentioned in the MBMG report is the Virginia Mine. This mine was active in the 1890s and consisted of a 70-foot shaft and a 30-foot drift (Weed 1990). This mine was located approximately 1500 feet to the west of the proposed Tintina Montana, Inc. copper mine site. There are no significant land disturbances associated with this site.

Active mining in the Sheep Creek watershed is also limited. There is one active mine in the watershed, the Black Butte Iron Mine. The Black Butte Iron Mine is located in the Big Butte Creek subbasin, approximately 2 miles to the southwest of the proposed Tintina Montana, Inc. copper mine (**Figure 5-1**). Big Butte Creek is a tributary to Sheep Creek and enters Sheep Creek about 6 miles upstream of the confluence of Sheep Creek and the Smith River. The Black Butte Iron Mine has an active DEQ Hard Rock operating permit (No. 00071) which encompasses a permit area of approximately 118 acres with 7 acres of actual surface disturbance. The Black Butte Iron Mine does not have a direct discharge to surface waters and is therefore not subject to MPDES discharge permit requirements. Operating permits require that there be no impact to any wetland, surface or groundwater. The mines annual report submitted to DEQ in 2019, the mine indicated approximately 0.5 acres of new surface disturbance. Active loading and hauling of mined material were taking place during 2015 water quality sampling efforts conducted by DEQ.

There is little evidence of the Black Butte Iron Mine affecting the water quality of Big Butte Creek or Sheep Creek. DEQ data collected in Big Butte Creek immediately downstream of the Iron Butte Mine (M10BBUTC01) one day after the 2015 synoptic event (5/14/2015). This data did not show aluminum concentrations above the detection limit. The lack of elevated aluminum concentrations downstream of the Iron Butte Mine is indicative of the minimal impacts this mine is having on water quality.

The confluence of Sheep Creek and Big Butte Creek is upstream of monitoring location (M10SHEPC01). This monitoring location does show elevated aluminum concentrations (**Figure 5-2**), though it is also below Calf and Moose Creeks, both tributary watersheds with elevated aluminum loads likely linked to natural background as discussed below in **Section 5.5.2.3**.

Based on the above discussion, historical (abandoned) mines and the one existing mine within the Sheep Creek watershed are not considered sources of elevated aluminum loading.

5.5.2.2 Human Caused Land Disturbances (Other than Mines)

There are several types of human land disturbances throughout the Sheep Creek watershed, including unpaved roads, a ski area and grazing related erosion. Elevated metals loading can be linked to land disturbances and increased erosion where the metals are attached to eroded soils that enter a stream. If this were occurring for dissolved aluminum in Sheep Creek, it is likely that there would be a positive relationship between high runoff and dissolved aluminum. The plot showing total dissolved solids (TSS) vs. dissolved aluminum (**Figure 5-4**) does not indicate a relationship, suggesting little to no linkage between aluminum and TSS loading and human related erosion activities in the watershed.

5.5.2.3 Natural Background

The available data and information all suggest that naturally occurring aluminum is the most prevalent source of aluminum in the Sheep Creek watershed. Aluminum occurs naturally in aquatic ecosystems due to weathering of local geology, particularly geologic material containing feldspars (such as orthoclase, anorthite, albite) as well as micas and bauxite). Geochemically, aluminum solubility is most often controlled by alunite or by gibbsite, depending on pH. Aluminum is one of the most common elements in rock forming minerals, such as feldspars, micas and clays, which are abundant in the watershed.

Aluminum data representative of natural background conditions can be found within the Sheep Creek watershed in Calf Creek. Calf Creek is considered a ‘reference’ site by DEQ because it is in an area of the Sheep Creek watershed that is mostly undisturbed by human activities. Reference data collected in Calf Creek in 2014 and 2015 (**Table 5-4**) show that one of four samples was above the aluminum standard of 87 µg/L at 282 µg/L.

Table 5-4. Aluminum Reference Site Data and Summary Statistics

Station ID	Site Name	Sample Collection Date and Concentration			
		8/31/2013	7/20/2014	5/13/2015	7/20/2015
REFCAC	Calf Creek	16 (µg/L)	55 (µg/L)	282 (µg/L)	20 (µg/L)

In addition to elevated aluminum values in Calf Creek, DEQ data for Moose Creek, a large tributary below the proposed Tintina copper mine site, also shows elevated values of aluminum linked to natural background based on analysis of likely sources of aluminum. Five monitoring locations (headwaters to mouth) on Moose Creek all resulted in values above the chronic aquatic life standard. All the exceedances in Moose Creek occurred during the 2015 synoptic event timeline used for **Figure 5-5**, showing that this watershed contributed significantly to the aluminum concentration increase from upstream (M10SHEPC06) to downstream (M10SHEPC05).

Between 2011 and 2015 a total (DEQ and Tintina) of 24 aluminum samples were collected in Big Butte Creek. Tintina data from 5/25/2011, 6/4/2013 and 3/25/2015 reported aluminum values in exceedance of the chronic aquatic life standard (120, 196, and 139 mg/L respectively). DEQ attributed these elevated aluminum values predominately to natural background loading consistent with observations within Calf Creek, Moose Creek and Sheep Creek areas upstream of the confluence with Big Butte Creek (**Section 5.5.2**).

5.6 Defining the Sheep Creek aluminum TMDL

The aluminum TMDL is developed for Sheep Creek from the headwaters to mouth. As such, the aluminum TMDL applies to any point along Sheep Creek and therefore is intended to protect uses along the entire stream. Because streamflow varies upstream to downstream, seasonally, and even day to day, defining the TMDL as a static value, based on one flow condition is not always practical. Instead, the Sheep Creek aluminum TMDL is defined as an equation of the appropriate target concentration multiplied by a flow and a conversion factor as shown in **Equation 1**.

Equation 1: TMDL = (X) (Y) (k)
TMDL= Total Maximum Daily Load in lbs/day
X= aluminum water quality target (= 87 µg/L)
Y= streamflow in cubic feet per second
k = conversion factor of 0.0054

Using **Equation 1**, the TMDL is expressed as a loading rate in units of pounds per day (lbs/day) and can be readily calculated for any flow at any location along Sheep Creek. It is protective of all uses because it is based on the lowest applicable aluminum water quality standard for developing the target as defined in **Section 5.4**.

Figure 5-6 shows the linear relationship between the aluminum TMDL calculated for any flow. While a 10% target exceedance rate is allowed for making impairment determinations, the TMDL is established with a goal of meeting the target 100% of the time. This provides an implicit margin of safety (MOS) by focusing water management actions toward satisfying the TMDL 100% percent of the time.

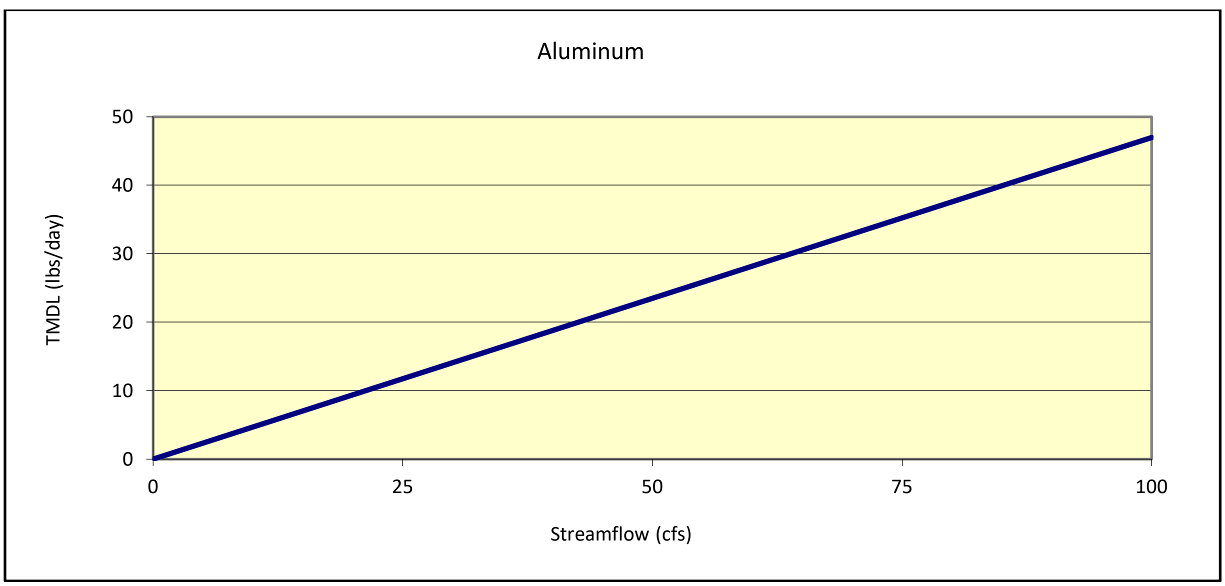

Figure 5-6. Aluminum TMDL as a Function of Flow

5.7 Aluminum TMDL Allocations

As discussed in **Section 4.0**, the TMDL is divided among all contributing point and nonpoint sources per **Equation 2** below. Because an implicit MOS is applied for the Sheep Creek aluminum TMDL, an MOS is not included within **Equation 2** since it is equal to zero in the TMDL equation.

Equation 2: TMDL = ΣLA + ΣWLA
ΣLA is the sum of the load allocation(s) (nonpoint sources)
ΣWLA is the sum of the wasteload allocation(s) (point sources)

Table 5-5 provides a summary of nonpoint sources and point sources for which load and wasteload allocations will be developed. Though there are currently no aluminum point sources in the Sheep Creek watershed. Tintina applied for and was issued a Montana Discharge Elimination System (MPDES) permit (permit number MT0031909) for an underground copper mine. Upon issuance, Tintina will be the owner and operator of the proposed Black Butte Copper Mine (**Figure 5-1**). Though covered under one MPDES permit, there are separate discharges (and outfalls) of mine wastewater and stormwater. Each will be addressed via separate wasteload allocations (WLAs) in the TMDL, as discussed further in **Section 5.7.2.**

Table 5-5. Aluminum Source Categories for the Sheep Creek TMDL

Source Category	Source Descriptions
Nonpoint Sources (addressed via load allocations):	• Natural Background: Local geology • Human Caused Sources with no MPDES surface discharge permit requirements: Any human caused land disturbances or other human activities that could lead to elevated aluminum loading
Point Sources (addressed via wasteload allocations):	• Existing point sources of aluminum: None • Future point source of aluminum: Tintina Montana, Inc. proposed copper mine: o Treated mine wastewater o Permitted stormwater runoff

The following sections describe the development of the load allocation and wasteload allocations.

5.7.1 Load Allocation Development

Load allocations (LAs) can apply to individual nonpoint sources or nonpoint source categories, including natural background (**Section 4.4**). Because natural background is the predominant source of aluminum loading, a separate load allocation is not provided for human caused nonpoint sources. However, because the TMDL should incorporate all potential existing loading sources, a composite load allocation is developed as the sum of natural background and human caused sources (**LA_{NB+H}**). The human caused sources, as identified in **Table 5-5**, include any human caused land disturbances or other human activities that could lead to elevated aluminum loading. As noted in the source assessment and data analysis, there is little evidence to suggest human sources are contributing to the elevated loading that is creating the impairment condition in Sheep Creek or any of its tributaries. It is therefore reasonable to apply a composite load allocation as described. **Section 5.7.3** provides information on the calculation of values for the **LA_{NB+H}** in the context of the Sheep Creek aluminum TMDL and all aluminum load and wasteload allocations.

5.7.2 Wasteload Allocation Development

There are two types of surface water discharges covered under the final MPDES Permit (Permit No: MT0031909). Each is provided a separate WLA for the aluminum TMDL. These are:

- Treated mine wastewater (**WLA_{TMW}**)
- Stormwater discharge (**WLA_{Storm}**)

The characteristics of each discharge, and the process used to develop MPDES permit limits are described in detail within the permit fact sheet (DEQ 2019a). This includes application of the Nondegradation Policy within Montana state statute and administrative rules. DEQ determined that the information and approaches used to develop the MPDES permit limits for these discharges are both protective of water quality in Sheep Creek and meet or exceed water quality protection requirements necessary for TMDL development. Therefore, each TMDL WLA in this document is developed in a manner consistent with the final MPDES permit (MT0031909) and are not intended to add any new permit limits or conditions.

5.7.2.1 Treated Mine Wastewater WLA Development

The MPDES discharge permit application Tintina Montana Inc. submitted to DEQ (DEQ 2019b), indicates that outfall 001 will discharge treated wastewater to groundwater under the alluvial plain adjacent to Sheep Creek via a subsurface infiltration system. Discharged mine wastewater and comingled groundwater from the alluvial aquifer are expected to reach Sheep Creek, and the adjacent tributary of Coon Creek. Because this is a new discharge, specific nondegradation requirements apply as defined within the MPDES permit fact sheet and summarized here. Sheep Creek is not considered a high-quality water for aluminum due to its existing impairment by aluminum. Protection of Sheep Creek is thus based on Tier 1 nondegradation requirements, which require any discharge does not exceed the applicable water quality standard. Coon Creek, on the other hand, is considered a high-quality water; therefore, Coon Creek is subject to Montana’s Tier -2 nondegradation requirements. Based on Coon Creeks’ existing water quality and flow conditions, and DEQ’s application of the nondegradation rules, 13 µg/L is the discharge concentration that will cause nonsignificant change to existing water quality and is used to define the permit limits for treated mine wastewater discharged to Outfall 001 (DEQ 2019a). This value is also the basis for the treated mine wastewater wasteload allocation (**WLA_{TMW}**) for the aluminum TMDL. It is defined for all discharge flows via **Equation 3**:

> **Equation 3: WLA_{TMW} = (Flow) x (Discharge Concentration Limit) x (Conversion Factor)**
> Where:
> Flow = Treated wastewater flow to Outfall 001 in cubic feet per second (cfs)
> Nondegradation criteria = 13 µg/L
> Conversion Factor = 0.0054 (converts to units of pounds per day)

The only variable in **Equation 3** is the treated wastewater flow. By applying **Equation 3**, the wasteload allocation can be calculated for any discharge flow. For example, an average continuous discharge flow to Outfall 001, as identified in the permit fact sheet, is estimated at 397 gallons per minute (0.88 cfs), which equates to an **WLA_{TMW}** of 0.062 lbs/day of aluminum for this specific discharge flow condition. If the discharge flow increases, then the **WLA_{TMW}** also increases proportional to the increase in discharge. If the discharge flow decreases, then the **WLA_{TMW}** decreases proportional to the decrease in flow. **Section 5.7.3** provides further information on the calculation of the **WLA_{TMW}** in the context of the Sheep Creek aluminum TMDL and all other aluminum load and wasteload allocations.

The discharge reaching Sheep Creek is protective because the treated wastewater will have concentrations significantly lower than the applicable aluminum standard for Sheep Creek. Furthermore, the concentration of aluminum in the treated wastewater discharged to outfall 001 is not expected to exceed 1.0 µg/L (DEQ 2019b), which is below the 13 µg/L that the $\mathbf{WLA_{TMW}}$ is based upon.

5.7.2.2 Stormwater Discharge Wasteload Allocation Development

Stormwater is discharged to surface waters from the proposed copper mine via Outfalls 002 – 014. These outfalls capture stormwater runoff from access roads, haul roads, topsoil stockpiles, berms constructed of non-waste rock materials, and runoff from undisturbed ground on slopes above the facility and associated structures. Discharges from these outfalls will not contain process wastewater or mine drainage.

Given that storm water discharges do not come directly in contact with the mine or mill process areas and should not contain contaminated sediment easily controlled by stormwater best management practices (BMPs), DEQ is establishing the use of BMPs for the control of pollutants discharged at Outfalls 002 - 014. As part of the Special Conditions Section 4.0 of the DEQ permit fact sheet (DEQ 2019a), the permittee must develop, implement, and maintain a Stormwater Pollution Prevention Plan (SWPPP) identifying all BMPs selected for stormwater control and submit the SWPPP for DEQ review and approval. BMPs represent the minimum level of control that must be implemented in MPDES permits to prevent or control the discharge of pollutants to state waters. The approximate acreage subject to stormwater BMPs as reported in the MPDES permit fact sheet (DEQ 2019a) is about 234 acres. However, EPA does require identification of a numerical stormwater WLA for TMDL development purposes at a minimum. This stormwater WLA can be met by following permit BMP conditions and is not intended to add concentration or load limits or additional conditions to stormwater aspects of the MPDES permit.

As part of the MPDES permit fact sheet, an estimate of aluminum concentration in stormwater was determined based on the difference between a tributary baseflow and stormwater runoff conditions, resulting in an aluminum concentration in stormwater of less than 69 µg/L (DEQ 2019a). This estimate is based on stormwater runoff from the mine site prior to any land disturbance and provides the basis for calculating a numeric stormwater wasteload allocation ($\mathbf{WLA_{STORM}}$) via **Equation 4**:

> **Equation 4: $\mathbf{WLA_{Storm}}$ = (Flow) x (Discharge Concentration) x Conversion Factor**
> Where:
> Flow = Sum of stormwater flows to Outfalls 002 through Outfalls 014 in cfs
> Discharge Concentration = estimated at 69 µg/L
> Conversion Factor = 0.0054 (converts to units of pounds per day)

The only variable in **Equation 4** is the stormwater flow, and by applying **Equation 4** the wasteload allocation can be readily calculated for any stormwater flow volume. As an example, a storm event of 0.18 inches of rainfall, which is consistent with the average maximum daily rainfall for the wettest months of the year (April-July) in the White Sulphur Springs area (NOAA, 2019) could yield an average daily flow of 0.9 cfs. This is based on 50% of the precipitation becoming stormwater runoff (versus infiltration), producing 77,754 cubic feet of stormwater runoff over the full day. At 0.9 cfs, the $\mathbf{WLA_{Storm}}$ would equate to 0.34 lbs/day of aluminum for this specific daily stormwater flow discharge. The $\mathbf{WLA_{Storm}}$ will often equate to zero on days where there is no stormwater runoff entering Sheep Creek or tributaries to Sheep Creek.

Though the numeric **WLA** $_{Storm}$ represents a reasonable estimate of the loading with application of best management practices (BMPs), the **WLA** $_{Storm}$ is not intended to add concentration or load limits or additional conditions to stormwater aspects of the MPDES permit. Consistent with EPA guidance (EPA, 2002), the WLA will be met by adhering to the permit requirements described in the permit fact sheet (DEQ, 2019a) and required in the MPDES permit (DEQ, 2019b). As long as all SWPP requirements are effectively implemented, the discharge will be consistent with background conditions and is not expected to add elevated aluminum loading to Sheep Creek. **Section 5.7.3** provides further information on calculating a numeric **WLA** $_{Storm}$ in the context of the Sheep Creek aluminum TMDL and all other aluminum load and wasteload allocations.

5.7.3 Calculating the Load and Wasteload Allocations

The aluminum TMDL for Sheep Creek is based on the following sum of load and wasteload allocations:

Equation 5: $TMDL = LA_{NB+H} + WLA_{TMW} + WLA_{Storm}$

Load and wasteload allocations can be computed for all Sheep Creek flow conditions at all Sheep Creek locations using the allocation development approaches defined in **Sections 5.7.1** and **5.7.2** coupled with the TMDL development approach defined in **Section 5.6.**

This section defines TMDL calculations for three different conditions at two general locations along Sheep Creek:

1. Sheep Creek above the proposed copper mine discharge locations
2. Sheep Creek below the copper mine discharge locations under non-stormwater runoff conditions
3. Sheep Creek below the copper mine discharge locations during stormwater flow conditions

The following sections illustrate how the TMDL and load allocations can be computed under variable flow conditions at different locations. These scenarios only apply at the example Sheep Creek flow and discharge flow combinations. These scenarios also take into consideration that the **WLA** $_{Storm}$ can be implemented via stormwater BMPs as defined in a DEQ approved SWPPP.

5.7.3.1 TMDL Calculations for Sheep Creek Above the Proposed Copper Mine

For all Sheep Creek flow conditions above the proposed copper mine, the wasteload allocations are not applicable and are effectively set to zero. Calculation of the composite load allocation (LA_{NB+H}), via **Equation 5**, simplifies to:

Equation 6: $TMDL = LA_{NB+H}$

At an example upstream Sheep Creek flow of 15 cfs, the TMDL (from **Equation 1, Section 4.0**) equates to:

$TMDL = (15cfs)(87\mu g/L)(0.0054) = 7.0\ lbs/day.$

Using **Equation 6**, the composite load allocation is also equal to 7.0 lbs/day at the Sheep Creek flow of 15 cfs. If flow doubles to 30 cfs, then both the TMDL and LA_{NB+H} each double to 14 lbs/day. Using **Equation 1** and **Equation 6**, a TMDL and composite load allocation for above the proposed mine can be calculated for all Sheep Creek flow conditions. **Table 5-6** summarizes the TMDL and allocation results for Sheep Creek.

Table 5-6. Upstream Sheep Creek Aluminum TMDL and Composite Load Allocation for an Example Sheep Creek Flow Condition

Sheep Creek Flow (cfs)	**TMDL* (lbs/day)**	**Composite Load Allocation to Natural Background and Human Sources (LA_{NB+H})* (lbs/day)**
15	7.0	7.0

* Values only apply when Sheep Creek is flowing at 15 cfs and at locations above permitted point sources

5.7.3.2 TMDL Calculations for Sheep Creek Below the Proposed Copper Mine; No Stormwater Discharge

Because storm events are sporadic, there will be periods of no stormwater discharge. Downstream of the proposed copper mine under conditions of no stormwater discharges from Outfalls 002 through 014, the **WLA_{Storm}** is equal to zero and **Equation 5** simplifies to:

Equation 7: $TMDL = LA_{NB+H} + WLA_{TMW}$

The flow within Sheep Creek downstream of the proposed copper mine discharge is the sum of the treated mine waste discharge flow and the remainder of flow in Sheep Creek from all other sources:

Sheep Creek Total Flow (**$flow_{SCTF}$**) = Treated Mine Waste Discharge Flow (**$flow_{TMW}$**) + All Other Sheep Creek Flow (**$flow_{SCOTHER}$**)

For example, if Sheep Creek is flowing at 50 cfs, and the treated mine waste discharge flow is 1 cfs (450 gallons/minute), then the flow from all other sources in Sheep Creek would equal 49 cfs. At a flow of 50 cfs in Sheep Creek, the TMDL (per **Equation 1**) would be:

TMDL = (50 cfs)(87 µg/L)(.0054) = 23.49 lbs/day

The **WLA_{TMW}** at a flow of 1 cfs can be calculated via **Equation 3:**

WLA_{TMW} = (1 cfs)(13 µg/L)(0.0054) = 0.07 lbs/day

Equation 7 can then be used to determine the composite load allocation as follows:

TMDL = 23.49 lbs/day = **LA_{NB+H}** + 0.07 lbs/day

LA_{NB+H} = 23.49 – 0.07 = 23.42 lbs/day

This above approach can be used to calculate the aluminum TMDL, composite load allocation, and treated mine wasteload allocation under non-stormwater conditions under any set of measured Sheep Creek and treated mine discharge flow conditions. **Table 5-7** summarizes the TMDL and allocation results for the above example flow and discharge conditions.

Table 5-7. Aluminum TMDL and Allocations for an Example Sheep Creek Flow Condition Below the Proposed Mine; no Stormwater Discharge

Example Sheep Creek Flow (cfs)	TMDL* (lbs/day)	Treated Mine Wasteload Allocation* (WLA_{TMW} in lbs/day)	Stormwater Wasteload Allocation* (WLA_{Storm} in lbs/day)	Composite Load Allocation to Natural Background and Human Sources* (LA_{NB+H} in lbs/day)
50	23.49	0.07	0.0	23.42

* Values only apply when Sheep Creek is flowing at 50 cfs, the treated mine discharge is 1 cfs, and there is no stormwater discharge

5.7.3.3 TMDL Calculations for Sheep Creek Below the Proposed Copper Mine with Stormwater Flows

Below the proposed copper mine under conditions with both stormwater and treated mine discharge flows, **Equation 5** applies. The TMDL, load and wasteload allocations can be calculated for any combination of flows for Sheep Creek, the treated mine waste discharge, and the stormwater discharge. The flow within Sheep Creek below the discharge is the sum of the treated mine waste discharge flow, the stormwater discharge, and the remainder of flow in Sheep Creek from all other sources:

Sheep Creek Total Flow ($\mathbf{flow_{SCTF}}$) = Treated Mine Waste Discharge Flow ($\mathbf{flow_{TMW}}$) + Stormwater Discharge Flow ($\mathbf{flow_{Storm}}$) + All Other Sheep Creek Flow ($\mathbf{flow_{SCOTHER}}$)

For example, if Sheep Creek is flowing at 80 cfs, the treated mine waste discharge flow is 0.9 cfs (404 gallons per minute), and the stormwater flow is 1.5 cfs (from a relatively large storm event), then the flow from all other sources in Sheep Creek would equal 77.6 cfs. At a flow of 80 cfs in Sheep Creek, the TMDL (per **Equation 1**) would be:

TMDL = (80 cfs)(87 µg/L)(0.0054) = 37.58 lbs/day

The $\mathbf{WLA_{TMW}}$ per **Equation 3** would be:

$\mathbf{WLA_{TMW}}$ = (0.9 cfs)(13 µg/L)(0.0054) = 0.06 lbs/day

The WLA_{Storm} per **Equation 4** would be:

$\mathbf{WLA_{Storm}}$ = (1.5 cfs)(69)(0.0054) = 0.56 lbs/day

Equation 5 can then be used to determine the composite load allocation as follows:
TMDL = 37.58 lbs/day = LA_{NB+H} + 0.06 lbs/day + 0.56 lbs/day

$\mathbf{LA_{NB+H}}$ = 37.58 – 0.06 – 0.56 = 36.96 lbs/day

This above approach can be used to calculate the aluminum TMDL, composite load allocation, treated mine wasteload allocation, and stormwater wasteload allocation under all conditions. **Table 5-8** summarizes the TMDL and allocation results for a Sheep Creek flow of 80 cfs below the treated mine waste discharge with a stormwater discharge flow described above.

Table 5-8. Aluminum TMDL and Allocations for an Example Sheep Creek Flow Condition Below the Proposed Mine During Stormwater Discharge

Example Sheep Creek Flow (cfs)	TMDL* (lbs/day)	Treated Mine Wasteload Allocation* (WLA_{TMW} in lbs/day)	Stormwater Wasteload Allocation* (WLA_{Storm} in lbs/day)	Composite Load Allocation to Natural Background and Human Sources* (LA_{NB+H} in lbs/day)
80	37.58	0.06	0.56	36.96

* Values only apply for the specified flow condition examples

As previously noted, the **WLA_{Storm}** can be implemented via stormwater BMPs as defined in a DEQ-approved SWPPP. The identification of how a numeric **WLA_{Storm}** is determined is not intended to add concentration or load limits or additional conditions to the stormwater aspects of the MPDES permit. This approach is protective of water quality in Sheep Creek since implementation of BMPs within the SWPPP is expected to result in conditions representative of existing (pre-mine) stormwater quality for aluminum.

5.8 Margin of Safety and Seasonality

5.8.1 Margin of Safety

A margin of safety (MOS) is a required component of TMDL development. The MOS accounts for the uncertainty about aspects of TMDL development such as target development, source assessment, and defining the TMDL and allocations. 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 (U.S. Environmental Protection Agency, 1999). This plan addresses MOS implicitly in the following ways:

- The TMDL is set so the lowest applicable target is met 100% of the time. This focuses toward 100% compliance with the target, thereby providing an MOS for the majority of conditions.
- The lowest or most stringent numeric water quality target for aluminum was used for TMDL calculations for Sheep Creek.
- The Coon Creek nonsignificance criteria used for the **WLA_{TMW}** is considerably more stringent than the Chronic Aquatic Life standard and target that could be applied to Sheep Creek (13 µg/L vs 87 µg/L) further ensuring protection of all designated beneficial uses.
- The MPDES permit does not provide for dilution of treated mine wastewater discharge in the alluvial aquifer. Dilution with the alluvial ground water would result in a lower concentration of aluminum reaching Sheep Creek or tributaries that might be impacted by the discharge (Coon Creek). Not accounting for dilution would more closely equate to a direct discharge to Sheep Creek or its tributaries. This approach has the effect of slightly overestimating the impacts resulting from discharges.
- The WLA for stormwater (**WLA_{Storm}**) is based on aluminum concentrations representative of existing background water quality, and implementation of a robust suite of stormwater best management practices as part of the MPDES permit requirements.
- Though the source assessment results point strongly toward natural background as the predominate source of aluminum loading, the TMDL load allocation is a composite approach that incorporates both natural background and any potential nonpoint sources of aluminum loading.

5.8.2 Seasonality

TMDL development must consider seasonality and 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). Seasonality is addressed in the following ways:

- DEQ's assessment process includes a mix of high and low flow sampling since metals sources may contribute to elevated metals loading during high and/or low flow stream conditions. The seasonality considerations help identify the flow conditions in which exceedances occur and guide the development of the TMDLs.
- The source assessment considered both high and low flow conditions.
- The water quality standard, TMDL target, and TMDL applies throughout the year.
- TMDL calculation described in **Section 5.7.3** considered seasonal variations while developing the TMDL.

6.0 Implementing the Sheep Creek Aluminum TMDL

The section addresses implementation of the Sheep Creek aluminum TMDL in the context of point source and nonpoint sources (including natural background) of aluminum. It also includes discussion of future consideration regarding the aluminum water quality standard.

6.1 Point Sources

Implementation of the Sheep Creek aluminum wasteload allocations is dependent on adherence by Tintina Montana Inc. to all MPDES permit requirements. This will ensure that all assumptions and requirements of the treated mine waste discharge waste load allocation (**WLA_{TMD}**) and storm water waste load allocation (**WLA_{Storm}**) are satisfied.

6.2 Nonpoint Sources and Natural Background Considerations

As discussed in **Section 5.5**, it is likely that aluminum target values are naturally exceeded during certain times or at certain locations in the watershed. Therefore, it appears that implementing water quality improvement practices for existing land uses may have no measurable effect on aluminum concentrations in Sheep Creek. However, Montana DEQ advocates and supports stakeholder activities to improve water quality throughout the Sheep Creek watershed for the following reasons:

- The recently completed Sheep Creek *E. coli* TMDL (DEQ 2017) identifies water quality improvement approaches and best management practices (BMPs) that can lead to reductions in *E. coli* loading to Sheep Creek or tributaries to Sheep Creek. Many of the BMPs or other land use activities that reduce *E. coli* loading can also reduce loading from other pollutants such as nutrients and sediment.
- As part of DEQ's water quality assessment activities for Sheep Creek, several pollutants were evaluated, including nutrients and sediment. Though DEQ concluded that Sheep Creek was not impaired for these pollutants, the data show some nutrient and sediment impacts to Sheep Creek water quality. There is potential for improved water quality via BMPs that reduce nutrient and or sediment loading to Sheep Creek or any of the tributaries to Sheep Creek. These BMPs can address grazing practices (particularly near streams), unpaved roads, and ski area management. Additional water quality sampling of Sheep Creek and its tributaries may aid in further identification of fluctuations in aluminum concentrations and assessment of sources.
- Sheep Creek is a major tributary to the Smith River, which is important for recreational and agricultural purposes. Protecting or improving water quality in Sheep Creek for any parameter can contribute to healthier water quality for the Smith River.

6.3 Aluminum Water quality standard consideration

Because of the natural conditions associated with aluminum impairment to Sheep Creek, Montana DEQ may eventually need to revise or update the numeric aluminum standard for Sheep Creek as a logical path forward for eventual removal of the aluminum impairment in Sheep Creek. This work could ultimately be part of a statewide process to address the numerous waterbodies in Montana with aluminum naturally elevated above the standard.

7.0 Public Participation and Public Comments

Stakeholder and public involvement is a component of total maximum daily load (TMDL) planning required by Montana state law which directs the Department of Environmental Quality (DEQ) to consult with a watershed advisory group and local conservation districts during the TMDL development process. Technical advisors, stakeholders, state and federal agencies, interest groups, and the public were solicited to participate in differing capacities throughout the TMDL development process for this project in the Sheep Creek TMDL Project Area.

7.1 Participants

Throughout completion of the aluminum TMDL in this document, DEQ worked to keep stakeholders apprised of project status and solicited input from a TMDL watershed advisory group. A description of the participants and their roles in the development of the TMDL in this document is contained below.

Montana Department of Environmental Quality
The Montana Water Quality Act (75-5-703, Montana Code Annotated (MCA)) directs DEQ to develop all necessary TMDLs. DEQ 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.

United States Environmental Protection Agency
EPA is the federal agency responsible for administering and coordinating requirements of the Clean Water Act. Section 303(d) of the Clean Water Act directs states to develop TMDLs 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 reviewing and evaluating TMDLs to see that they meet all federal requirements.

Conservation District
The Sheep Creek TMDL Project Area falls within Meagher County, and DEQ consulted with the Meagher County Conservation District during development of the TMDLs in this document, which included opportunities to provide comment during the various stages of TMDL development and an opportunity for participation in the watershed advisory group described below.

Sheep Creek TMDL Watershed Advisory Group
The Sheep Creek TMDL Watershed Advisory Group consisted of selected resource professionals who possess a familiarity with water quality issues and processes in the Sheep Creek watershed, and representatives of applicable interest groups. All members were solicited to participate and work with DEQ in an advisory capacity per Montana state law. DEQ requested participation from the interest groups defined in 75-5-704 MCA and included local city and county representatives, livestock-oriented and farming-oriented agriculture representatives, mining industry representatives, state and federal land management agencies, and representatives of fishing tourism interests. The advisory group also included additional stakeholders 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. Communication with advisory group members was typically conducted through e-mail, and draft documents and meeting presentations were made available via DEQ's wiki for water quality planning projects (http://mtwaterqualityprojects.pbworks.com). Members had the opportunity to review and provide comment on the draft TMDL document prior to the public comment period, and to attend meetings organized by DEQ for soliciting feedback on the document. Member's comments were incorporated into this version of the draft document. Final technical decisions regarding document modifications reside with DEQ.

7.2 Response to Public Comments

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

The public comment period for this document was initiated on August 24, 2020 and closed on September 22, 2020. A virtual public informational meeting was held September 10, 2020 at 5 p.m. via Zoom. At the meeting, DEQ provided an overview of the aluminum TMDL, answered questions, and solicited input and comment on the document. The public comment period and public meeting were announced in an August 24, 2020 press release from DEQ which was published on DEQ's website and was distributed to multiple media outlets across Montana. A public notice advertising the public comment period and public meeting was published in the following newspapers: Great Falls Tribune, Helena Independent Record, and Meagher County News. Additionally, the announcement was distributed to the project's TMDL watershed advisory group, the Statewide TMDL Advisory Group, and other additional contacts via e-mail.

Formal, written comments were received from Sandfire Resources America, Inc. and Trout Unlimited. DEQ evaluates all comments and related information to ensure no critical information was excluded from the TMDL document. Excerpts of the received comments are numbered and provided below, along with DEQ's response to each comment. The original comment letters are located in the project files at DEQ and may be reviewed upon request.

Comment 1: Because the aluminum is naturally occurring, Montana law prohibits the application of any standard more stringent than the natural condition. Mont. Code Ann. §§ 75-5-306; 75-5-222. Therefore, DEQ's determination that Sheep Creek is "failing to achieve compliance with applicable water quality standards" is erroneous. The "applicable water quality standard" in this case is the naturally-occurring level of aluminum in the stream.

> **Response 1**: The Department has been developing guidance for implementing Montana Code Annotated (MCA) 75-5-222(1), for situations like Sheep Creek. This guidance helps with identifying requirements for determining nonanthropogenic conditions, and defining how the nonanthropogenic condition will influence DEQ's method for assessing impairment, the TMDL development process and subsequent MPDES surface water discharge limits. Existing guidance is located at http://deq.mt.gov/water/Surfacewater/standards under "Supporting Technical Documents".
>
> Water quality standards development requires approval through the Board of Environmental Review, public and stakeholder involvement, and obtaining EPA approval on a final rule package for Clean Water Act purposes. Until there are modification(s) to the aluminum standard in Sheep Creek, the existing dissolved aluminum standard of 87 µg/L for chronic aquatic life

support, along with the existing assessment method of a 10% allowable exceedance rate, must be applied for both TMDL development and impairment assessment purposes.

Because the water quality standard is set for the protection of aquatic life, Sheep Creek is, by definition, impaired for not fully protecting the aquatic life beneficial use. An "impaired water body" is defined as a water body or stream segment for which sufficient credible data shows that the water body or stream segment is failing to achieve compliance with applicable water quality standards (Montana Water Quality Act; Section 75-5-103(14)).

Pursuant to 75-5-702(9), MCA, when DEQ receives an application for a new individual permit to discharge to a surface water body that is listed as impaired, the discharge would contain a pollutant for which the water body is impaired, and there is not a TMDL developed, the DEQ shall develop a TMDL. MCA (75-5-703) and Section 303 of the federal Clean Water Act also require the development of TMDLs for impaired water bodies.

Comment 2: The TMDL references no documented harms to aquatic life, so the alleged "impairment" appears to be a problem on paper, not in reality. Because the aluminum is naturally occurring, it makes little sense to impose a more stringent standard for the sake of protecting beneficial uses of Sheep Creek. The stream obviously cannot support any beneficial uses that require lower levels of aluminum than already occur naturally.

Response 2: As stated in DEQ's response to Comment 1, Sheep Creek is considered impaired for aluminum. Aluminum has numeric water quality criteria defined in Circular DEQ-7. These criteria include values for protecting aquatic life, and apply as water quality standards for Sheep Creek. For aluminum, the most stringent of these criteria is the chronic criteria of 87µg/L. This criterion is adopted as the water quality target to protect all beneficial uses. Satisfying or meeting the target equates to aluminum concentration values of less than or equal to the 87 µg/L in Sheep Creek.

Elevated concentrations of aluminum can impair the support of aquatic life and fisheries beneficial uses. Within aquatic ecosystems, aluminum can have a toxic and bioconcentrating effect on biota. DEQ's numeric water quality standard is based on protection of aquatic life, representing the beneficial use of concern addressed in the TMDL document. The detrimental effects of aluminum on aquatic animals is documented in EPA's Ambient Water Quality Criteria for Aluminum: https://www.epa.gov/sites/production/files/2019-02/documents/ambient-wqc-aluminum-1988.pdf. Table 6 of this document reports that Brook Trout exposed to the concentration of 169 µg/L aluminum experienced 24% weight reduction, and exposure to 88 µg/L experienced a 4% weight reduction. Both exposures were over a 60-day time interval.

Comment 3: DEQ and the Statewide TMDL Advisory Group could rely upon EPA's 2013 "A Long-term Vision for Assessment, Restoration, and Protection under the Clean Water Act Section 319 Program" and its promotion of TMDL alternatives to identify waterbodies with naturally elevated levels of pollutants, like aluminum in Sheep Creek, and designate those for site specific standard development (a TMDL alternative), rather than a traditional TMDL.

Response 3: DEQ recognizes that for situations like aluminum in Sheep Creek, there could be a need for a revision to the numeric standard and/or how the existing standard is applied within the context of an allowable exceedance rate for impairment determinations. See Responses 1 and 2 for additional information on application of the water quality standard to nonanthropogenic conditions.

Comment 4: The TMDL's waste load allocation for the treated mine wastewater (Section 5.7.2.1) is artificially low. There is no authority for DEQ to impose a load allocation for any point source discharge to Sheep Creek based on nondegradation limits for Coon Creek. Derivation of effluent limits based on nondegradation requirements for Coon Creek is a permitting function and should not change the waste load allocation in this TMDL. Waste load allocations must identify the portion of the loading capacity attributed to individual existing and future point sources, 40 C.F.R. § 130.2(h). Waste load allocations among points sources may be adjusted through the permitting process; so long as the "total WLA, as expressed in the TMDL, remains the same or decreases, and there is no reallocation between the total WLA and the total LA," a new TMDL is not required. EPA Guidelines for Reviewing TMDLs, p. 4 (May 20, 2002). In this case, it appears that DEQ is unnecessarily setting up a situation that could require additional TMDL development if Tintina's (or a new point source's) discharge changes with respect to Sheep Creek. A more appropriate WLA should be based on the nonanthropogenic concentration of aluminum (> 87 µg/L).

> **Response 4**: As discussed in Comment 1, when DEQ receives an application for a new individual MPDES permit to discharge to a surface water body that is listed as impaired, and there is not a TMDL developed, DEQ is required to develop a TMDL (MCA 75-5-702 (9)). As such, a new TMDL is required for the Black Butte Copper Mine. The Final MPDES permit authorizes a discharge to Coon Creek, as such the TMDL WLA was established based on potential aluminum loading to Coon Creek.
>
> The TMDL document was developed pursuant to 40 C.F.R. 122.44 d (1) vii B, which requires that any effluent limits developed to a narrative or numeric water quality criterion are consistent with the assumptions and requirements of a WLA for the discharge prepared by the state and approved by EPA. The TMDL document was developed to ensure that the WLAs are consistent with the final MPDES permit effluent limits.
>
> EPA regulations require a TMDL include WLAs, which identify the portion of the loading capacity allocated to individual existing and future point source(s) (40 C.F.R. §130.2(h), 40 C.F.R. §130.2(i)). While it is true that individual WLAs may be adjusted during the MPDES permitting process, if the WLAs are adjusted, the individual effluent limits in the MPDES permit must be consistent with the assumptions and requirements of the adjusted WLAs defined in the TMDL.

Comment 5: Two clerical errors were also noted, as follows: 1) Where the document refers to Tintina's draft MPDES permit, it should be updated to reflect the final MPDES permit issued in June 2020; and 2) Appendix B should likely refer to "dissolved aluminum" instead of "total dissolved aluminum" to be commensurate with Circular DEQ-7.

> **Response 5**: The TMDL document has been updated to indicate the MPDES permit is final and **Appendix B** has been updated to indicate aluminum is dissolved, not total dissolved aluminum.

Comment 6: In the draft TMDL, the DEQ assumes that the proposed copper mines MPDES permit will ensure that there are no discharges that will cause or contribute to an exceedance of the water quality standards. When asked in the public zoom meeting how they would ensure this, the response was that the DEQ’s enforcement division would be responsible of that. Looking at the history of hard rock mines in Montana, the pollution they cause to our rivers and streams, and the lack of enforcement by the DEQ at these mines, we have extreme concerns about the continued degradation to Sheep Creek from overly high concentrations of aluminum from the addition of this manmade source.

Additionally, the proposed mine would be discharging water that would have added metals in it like iron. Nowhere in the TMDL does it take into consideration the problems that could be caused by high concentrations of more than one metal in the stream and what co-toxicity that may cause.

> **Response 6**: Thank you for your comments on DEQ's enforcement response, but TMDLs cannot establish DEQ's enforcement response. TMDLs must be written to what is allowable without exceeding the water quality standard, not written to what is not allowed, such as violations of MPDES permits.
>
> This TMDL is solely for an aluminum impairment in Sheep Creek and establishes wasteload allocations for aluminum only. Sheep Creek is also considered impaired for *E. coli*. This impairment was addressed in a 2017 TMDL document.
>
> Water quality data used in this document were collected by DEQ in September 2005 and May through September of 2015. At that time a full suite of metals data was collected and analyzed. This data analysis indicated the only metal impairment in Sheep Creek was for aluminum. If future sampling indicates that other metals are causing impairment, then additional TMDLs can be developed that may potentially impact effluent limits. It is important to note that Montana's narrative water quality criteria also to apply (17.30.637(1)(d), MCA) and are capable of capturing impacts of combinations of pollutants that may be toxic or harmful to aquatic life. The narrative standards state that surface waters must be free from substances attributable to municipal, industrial, agricultural practices or other discharges that will "create concentrations or combinations of materials that are toxic or harmful to human, animal, plant or aquatic life".

Comment 7: Trout Unlimited has always been an active stakeholder in the Sheep Creek watershed and will continue to be through the entire process. We are more than willing to work with the other stakeholders, landowners, Forest Service, Conservation District etc. in order to make Sheep Creek as healthy as possible. Best management practices in the final TMDL should include:

1. Continued random sampling of Sheep Creek and its tributaries at peak and low flows.
    a. In the response to our comments the Montana DEQ stated that they" advocate and support stakeholder activities to improve water quality throughout the watershed this includes continued characterization of water quality for all potential pollutants including aluminum." And that "Additional water quality sampling of Sheep Creek and its tributaries may aid in further identification of fluctuations in aluminum concentrations and assessment of sources". We believe the DEQ needs to do more than advocate and support these activities and instead take a lead role in the continued sampling of Sheep Creek. Stakeholder groups do not have the time or resources to do the sampling and testing required, especially with the potential addition of a point source polluter in the proposed mine.

2. Ensure there is not an additional, manmade source of aluminum or any other heavy metal entering Sheep Creek.
    a. An obvious BMP to ensure the water quality of Sheep Creek.

Response 7: DEQ does not have the resources to simultaneously conduct continual sampling of Sheep Creek and the rest of Montana's waterbodies. Sampling conducted by DEQ in Sheep Creek for impairment determination and source assessment purposes establishes a baseline of water quality conditions that document water quality in Sheep Creek prior to discharge(s) associated with the Black Butte Copper Mine.

DEQ does support volunteer monitoring efforts. Volunteer monitoring programs are administered by watershed groups, conservation districts, water quality protection districts, non-profit organizations, schools, and other entities. Volunteers may collect chemical, physical, or biological parameters to evaluate water quality, aquatic habitat, and streamflow.

DEQ's Volunteer Monitoring Support Program supports volunteer monitoring in several ways:

- Financial support, such as our Volunteer Monitoring Lab Analysis Program;
- Technical support, such as trainings and guidance documents;
- Administering volunteer monitoring opportunities; and
- Forming partnerships with other entities in the state that also support volunteer monitoring.

Additional information pertaining to DEQ's volunteer monitoring assistance is available here: http://deq.mt.gov/water/surfacewater/monitoring

DEQ is required to periodically assess the waters for which TMDLs have been completed to determine whether compliance with water quality standards has been attained. This assessment uses the suite of objectives specified in the TMDL document to measure compliance with water quality standards and achievement of full support of all applicable beneficial uses. This assessment is accomplished through a TMDL Implementation Evaluation (TIE). Through the TIE process any significant changes in load contributions from human-caused or naturally occurring sources are evaluated. If significant changes to loading are identified, corrective actions are recommended.

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