Montana Department of Environmental Quality

Beaverhead Sediment Total Maximum Daily Loads and Framework Water Quality Protection Plan

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ACRONYM LIST

Acronym	Definition
AFO	Animal Feeding Operation
AGI	Applied Geomorphology Inc.
AML	Abandoned Mine Lands
ARM	Administrative Rules of Montana
BDNF	Beaverhead Deerlodge National Forest
BEHI	Bank Erosion Hazard Index
BFW	Bankfull Width
BLM	Bureau of Land Management (federal)
BMP	Best Management Practices
BOR	Bureau of Reclamation
BWC	Beaverhead Watershed Committee
CAFO	Concentrated (or Confined) Animal Feed Operations
CFR	Code of Federal Regulations
CWA	Clean Water Act
DEQ	Department of Environmental Quality (Montana)
DNRC	Department of Natural Resources & Conservation
EPA	Environmental Protection Agency (US)
EQIP	Environmental Quality Initiatives Program
FWP	Fish, Wildlife, and Parks (Montana)
GIS	Geographic Information System
HSI	Hydro Solutions Inc.
INFISH	Inland Native Fish Strategy
IR	Integrated Report
LA	Load Allocation
LAI	Luzenac America, Inc.
LFSC	Left Fork Stone Creek
LWD	Large Woody Debris
MARS	Montana Aquatic Resources Services
MCA	Montana Code Annotated
MDT	Montana Department of Transportation
MGD	Million Gallons per Day
MOS	Margin of Safety
MPDES	Montana Pollutant Discharge Elimination System
MSU	Montana State University
NBS	Near Bank Stress
NHD	National Hydrography Dataset
NPS	Nonpoint Source
NRCS	National Resources Conservation Service
NRDP	Natural Resource Damage Program
NTU	Nephelometric Turbidity Unit
PIBO	PACFISH/INFISH Biological Opinion
PWS	Public Water System (or Supply)
RIT/RDG	Resource Indemnity Trust/Reclamation and Development Grants Program
RSI	Riffle Stability Index

Acronym	Definition
SAP	Sampling and Analysis Plan
SMZ	Streamside Management Zone
SSC	Suspended Sediment Concentrations
SSURGO	Soil Survey Geographic database
SWAT	Soil & Water Assessment Tool
SWPPP	Storm Water Pollution Prevention Plan
TIE	TMDL Implementation Evaluation
TMDL	Total Maximum Daily Load
TPA	TMDL Planning Area
TSS	Total Suspended Solids
USDA	United States Department of Agriculture
USFS	United States Forest Service
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation
VFS	Vegetated Filter Strips
WARD	Water quality Assessment, Reporting, and Documentation system
WEPP:Road	Water Erosion Prediction Project Methodology
WLA	Wasteload Allocation
WMS	Watershed Management Section
WRP	Watershed Restoration Plan
WWTF	Wastewater Treatment Facility

DOCUMENT SUMMARY

This document presents a Total Maximum Daily Load (TMDL) and framework water quality improvement plan for 18 stream segments, including the Beaverhead River (lower), Blacktail Deer Creek, Clark Canyon Creek, Dyce Creek, Farlin Creek, French Creek, Grasshopper Creek, Rattlesnake Creek (upper and lower), Reservoir Creek, Scudder Creek, Spring Creek, Steel Creek, Stone Creek (upper and lower), Taylor Creek, West Fork Blacktail Deer Creek, and West Fork Dyce Creek. (see **Map A-1** found in **Appendix A**).

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

The Beaverhead TMDL planning area is located in Beaverhead County, with a small portion in Madison County and includes the towns of Dillon and Twin Bridges. The Beaverhead TPA encompasses the Beaverhead River watershed (fourth-code hydrologic unit code 10020002), which begins at the outlet of the Clark Canyon Reservoir and flows northeast 79.5 miles before joining the Big Hole River to form the Jefferson River. The TPA is bounded by the Pioneer Mountains on the west, the Ruby Range to the east, and the Snowcrest Range and Blacktail Mountains to the south.

Sediment was identified as impairing aquatic life and coldwater fishes in 18 stream segments. The scope of the TMDLs in this document addresses problems with sediment (see **Table DS-1**). Although DEQ recognizes that there are other pollutant listings for this TPA, this document addresses only sediment.

Sediment is affecting beneficial uses in these streams by altering aquatic insect communities, reducing fish spawning success, and increasing turbidity. Water quality restoration goals for sediment were established on the basis of fine sediment levels in trout spawning areas and the stability of streambanks. DEQ believes that once these water quality goals are met, all water uses currently affected by sediment will be restored.

Sediment loads are quantified for natural background conditions and for the following sources: bank erosion, hillslope erosion, and roads. The most significant sources include: bank and hillslope erosion from current and historic rangeland grazing and hay production within the riparian (streamside) area. The Beaverhead TPA watershed sediment TMDLs indicate that reductions in sediment loads ranging from 55% to 74% will satisfy the water quality restoration goals.

Recommended strategies for achieving the sediment reduction goals are also presented in this plan. They include best management practices (BMPs) for grazing, small acreages, cropland, and irrigation. In addition, they include BMPs for expanding riparian buffer areas and using other land, soil, and water conservation practices that improve stream channel conditions and associated riparian and wetland vegetation.

Implementation of most water quality improvement measures described in this plan, with the exception of permitted facilities, is based on voluntary actions of watershed stakeholders. For permitted facilities, water quality improvement measures will be met by adherence to permit requirements.

Ideally, local watershed groups and/or other watershed stakeholders will use this TMDL, and associated information, as a tool to guide local water quality improvement activities. Such activities can be documented within a watershed restoration plan consistent with DEQ and EPA recommendations.

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

Table DS-1. List of Impaired Waterbodies and their Impaired Uses in the Beaverhead TPA with Completed Sediment TMDLs Contained in this Document

Waterbody & Location Description	TMDL Prepared	TMDL Pollutant Category	Impaired Use(s)
Beaverhead River (lower), Grasshopper Creek to mouth (Jefferson River)	Sediment	Sedimentation/ Siltation	Aquatic Life
Blacktail Deer Creek, headwaters to mouth (Beaverhead River)	Sediment	Sedimentation/ Siltation	Aquatic Life
Clark Canyon Creek, headwaters to mouth (Beaverhead River)	Sediment	Sedimentation/ Siltation	Aquatic Life
Dyce Creek, confluence of East and West Forks to Grasshopper Creek	Sediment	Sedimentation/ Siltation	Aquatic Life
Farlin Creek, headwaters to mouth (Grasshopper Creek)	Sediment	Sedimentation/ Siltation	Aquatic Life
French Creek, headwaters to mouth (Rattlesnake Creek)	Sediment	Sedimentation/ Siltation	Aquatic Life
Grasshopper Creek*, headwaters to mouth (Beaverhead River)	Sediment	No Listing in the 2012 Water Quality Integrated Report	
Rattlesnake Creek (upper), headwaters to Dillon PWS off-channel well T7S R10W S11	Sediment	Sedimentation/ Siltation	Aquatic Life
Rattlesnake Creek (lower), from the Dillon PWS off-channel well T7S R10W S11 to the mouth (Van Camp Slough)	Sediment	Sedimentation/ Siltation & Solids (Suspended/ Bedload)	Aquatic Life
Reservoir Creek, headwaters to mouth (Grasshopper Creek)	Sediment	Sedimentation/ Siltation	Aquatic Life
Scudder Creek, headwaters to mouth (Grasshopper Creek)	Sediment	Sedimentation/ Siltation	Aquatic Life
Spring Creek, headwaters to mouth (Beaverhead River)	Sediment	Sedimentation/ Siltation	Aquatic Life
Steel Creek, headwaters to mouth (Driscol Creek)	Sediment	Sedimentation/ Siltation & Solids (Suspended/Bedload)	Aquatic Life & Primary Contact Recreation
Stone Creek (upper), Left Fork and Middle Fork to confluence of un-named tributary, T6S R7W S34	Sediment	Sedimentation/ Siltation & Turbidity	Aquatic Life & Primary Contact Recreation
Stone Creek (lower), confluence with unnamed creek in T6S R7W S34 near Beaverhead/Madison county border	Sediment	Sedimentation/ Siltation	Aquatic Life
Taylor Creek, headwaters to mouth (Grasshopper Creek)	Sediment	Sedimentation/ Siltation	Aquatic Life
West Fork Blacktail Deer Creek, headwaters to mouth (Blacktail Deer Creek)	Sediment	Sedimentation/ Siltation	Aquatic Life
West Fork Dyce Creek, headwaters to mouth (Dyce Creek)	Sediment	Sedimentation/ Siltation	Aquatic Life

1.0 INTRODUCTION

This document presents an analysis of water quality information and establishes total maximum daily loads (TMDLs) for sediment problems in the Beaverhead TMDL Planning Area (TPA). This document also presents a general framework for resolving these problems. **Map A-1,** found in **Appendix A,** shows a map of waterbodies in the Beaverhead TPA with sediment pollutant listings.

1.1 BACKGROUND

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

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

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

Each waterbody has a set of designated uses. Montana has established water quality standards to protect these uses. Waterbodies that do not meet one or more standards are called impaired waters. Every two years DEQ must file a Water Quality Integrated Report (IR), which lists all impaired waterbodies and their identified impairment causes. Impairment causes fall within two main categories: pollutant and non-pollutant.

Montana's biennial IR identifies all the state's impaired waterbody segments. All waterbody segments within the IR are indexed to the National Hydrography Dataset (NHD). The 303(d) list portion of the IR includes all of those waterbody segments impaired by a pollutant, which require a TMDL. TMDLs are not required for non-pollutant impairments. **Table A-1** in **Appendix A** identifies impaired waters for the Beaverhead TPA from Montana's 2012 303(d) List, as well as non-pollutant impairment causes included in Montana's "2012 Water Quality Integrated Report." **Table A-1** provides the current status of each impairment cause, identifying whether it has been addressed by TMDL development.

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

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

- Determining measurable target values to help evaluate the waterbody's condition in relation to the applicable water quality standards
- Quantifying the magnitude of pollutant contribution from their sources

- Determining the TMDL for each pollutant based on the allowable loading limits for each waterbody-pollutant combination
- Allocating the total allowable load (TMDL) into individual loads for each source

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

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

1.2 Water Quality Impairments and TMDLs Addressed by this Document

Table 1-1 below lists all of the impairment causes from the “2012 Water Quality Integrated Report” that are addressed in this document (also see **Map A-1** in **Appendix A**). This document contains pollutant impairments within the sediment TMDL pollutant category.

New data assessed during this project identified new sediment impairment causes for 1 waterbody. This impairment cause is identified in **Table 1-1** as not being on the 2012 303(d) List (within the integrated report): Grasshopper Creek.

TMDLs are completed for each waterbody – pollutant combination, and this document contains 18 TMDLs (**Table 1-1**). There are several non-pollutant types of impairment that are also addressed in this document. As noted above, TMDLs are not required for non-pollutants, although in many situations the solution to one or more pollutant problems will be consistent with, or equivalent to, the solution for one or more non-pollutant problems. The overlap between the pollutant TMDLs and non-pollutant impairment causes is discussed in **Section 6.1**. **Section 6.1** also provides some basic water quality solutions to address those non-pollutant causes not specifically addressed by TMDLs in this document.

Although DEQ recognizes that there are other pollutant listings for this Beaverhead TPA without completed TMDLs (**Table A-1** in **Appendix A**), this document only addresses those identified in **Table 1-1**. This is because DEQ sometimes develops TMDLs in a watershed at varying phases, with a focus on one or a couple of specific pollutant types. **Table A-1** in **Appendix A** includes impairment causes with completed TMDLs, as well as non-pollutant impairment causes that were addressed by those TMDLs.

Table 1-1. Water Quality Impairment Causes for the Beaverhead TPA Addressed within this Document

Waterbody & Location Description	Waterbody ID	Impairment Cause	Pollutant Category	Impairment Cause Status	Included in IR 2012 Integrated Report*
BEAVERHEAD RIVER, Clark Canyon Dam to Grasshopper Creek	MT41B001_010	Low flow alterations	Not Applicable; Non-Pollutant	Partially addressed	Yes
		Alteration in streamside or littoral vegetative covers	Not Applicable; Non-Pollutant	Addressed via restoration plan (see **Sections 6** and **7**)	Yes
BEAVERHEAD RIVER, Grasshopper Creek to mouth (Jefferson River)	MT41B001_020	Sedimentation/Siltation	Sediment	Sediment TMDL completed	Yes
		Physical substrate habitat alterations	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes
		Low flow alterations	Not Applicable; Non-Pollutant	Partially addressed	Yes
		Alteration in streamside or littoral vegetative covers	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes
BLACKTAIL DEER CREEK, headwaters to mouth (Beaverhead River)	MT41B002_030	Sedimentation/Siltation	Sediment	Sediment TMDL completed	Yes
		Low flow alterations	Not Applicable; Non-Pollutant	Not yet addressed by a TMDL or restoration plan	Yes
		Alteration in streamside or littoral vegetative covers	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes
CLARK CANYON CREEK, headwaters to mouth (Beaverhead River), T9S R10W S28	MT41B002_110	Sedimentation/Siltation	Sediment	Sediment TMDL completed	Yes
		Alteration in streamside or littoral vegetative covers	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes
DYCE CREEK, confluence of East and West Forks to Grasshopper Creek	MT41B002_140	Sedimentation/Siltation	Sediment	Sediment TMDL completed	Yes
		Low flow alterations	Not Applicable; Non-Pollutant	Not yet addressed by a TMDL or restoration plan	Yes
		Alteration in streamside or littoral vegetative covers	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes
EAST FORK BLACKTAIL DEER CREEK, headwaters to mouth (Blacktail Deer Creek)	MT41B002_040	Alteration in streamside or littoral vegetative covers	Sediment	Addressed via restoration plan (see **Sections 6** and **7**)	Yes
FARLIN CREEK, headwaters to mouth (Grasshopper Creek), T6S R12W S7	MT41B002_020	Sedimentation/Siltation	Sediment	Sediment TMDL completed	Yes
		Alteration in streamside or littoral vegetative covers	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes
FRENCH CREEK, headwaters to mouth	MT41B002_100	Sedimentation/Siltation	Sediment	Sediment TMDL completed	Yes
		Alteration in streamside or	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes

Table 1-1. Water Quality Impairment Causes for the Beaverhead TPA Addressed within this Document

Waterbody & Location Description	Waterbody ID	Impairment Cause	Pollutant Category	Impairment Cause Status	Included in IR 2012 Integrated Report*
(Rattlesnake Creek)		littoral vegetative covers			
GRASSHOPPER CREEK, headwaters to mouth (Beaverhead River)	MT41B002_010	Sedimentation/Siltation	Sediment	Sediment TMDL completed	No
		Low flow alterations	Not Applicable; Non-Pollutant	Not yet addressed by a TMDL or restoration plan	Yes
		Alteration in streamside or littoral vegetative covers	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes
RATTLESNAKE CREEK, from the Dillon PWS off-channel well T7S R10W S11 to the mouth (Van Camp Slough)	MT41B002_090	Solids (Suspended/Bedload)	Sediment	Addressed by sediment TMDL	Yes
		Sedimentation/Siltation	Sediment	Sediment TMDL completed	Yes
		Low flow alterations	Not Applicable; Non-Pollutant	Not yet addressed by a TMDL or restoration plan	Yes
		Alteration in streamside or littoral vegetative covers	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes
RATTLESNAKE CREEK, headwaters to Dillon PWS off-channel well, T7S R10W S11	MT41B002_091	Sedimentation/Siltation	Sediment	Sediment TMDL completed	Yes
		Alteration in streamside or littoral vegetative covers	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes
RESERVOIR CREEK, headwaters to mouth (Grasshopper Creek)	MT41B002_120	Sedimentation/Siltation	Sediment	Sediment TMDL completed	Yes
		Alteration in streamside or littoral vegetative covers	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes
SCUDDER CREEK, headwaters to mouth (Grasshopper Creek), T6S R12W S19	MT41B002_180	Sedimentation/Siltation	Sediment	Sediment TMDL completed	Yes
		Alteration in streamside or littoral vegetative covers	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes
SPRING CREEK, headwaters to mouth (Beaverhead River)	MT41B002_080	Sedimentation/Siltation	Sediment	Sediment TMDL completed	Yes
		Low flow alterations	Not Applicable; Non-Pollutant	Not yet addressed by a TMDL or restoration plan	Yes
		Alteration in streamside or littoral vegetative covers	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes
STEEL CREEK, headwaters to mouth (Driscol Creek), T6S R12W S18	MT41B002_160	Solids (Suspended/Bedload)	Sediment	Addressed by sediment TMDL	Yes
		Sedimentation/Siltation	Sediment	Sediment TMDL completed	Yes
		Alteration in streamside or littoral vegetative covers	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes

Table 1-1. Water Quality Impairment Causes for the Beaverhead TPA Addressed within this Document

Waterbody & Location Description	Waterbody ID	Impairment Cause	Pollutant Category	Impairment Cause Status	Included in IR 2012 Integrated Report*
STONE CREEK, confluence with unnamed creek in T6S R7W S34 near Beaverhead/Madison county border	MT41B002_131	Sedimentation/Siltation	Sediment	Sediment TMDL completed	Yes
		Alteration in streamside or littoral vegetative covers	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes
STONE CREEK, Left Fork and Middle Fork to confluence of un-named tributary, T6S R7W S34	MT41B002_132	Turbidity	Sediment	Addressed by sediment TMDL	Yes
		Sedimentation/Siltation	Sediment	Sediment TMDL completed	Yes
		Low flow alterations	Not Applicable; Non-Pollutant	Not yet addressed by a TMDL or restoration plan	Yes
		Alteration in streamside or littoral vegetative covers	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes
TAYLOR CREEK, headwaters to mouth (Grasshopper Creek)	MT41B002_170	Sedimentation/Siltation	Sediment	Sediment TMDL completed	Yes
		Alteration in streamside or littoral vegetative covers	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes
WEST FORK BLACKTAIL DEER CREEK, headwaters to mouth (Blacktail Deer Creek)	MT41B002_060	Sedimentation/Siltation	Sediment	Sediment TMDL completed	Yes
		Alteration in streamside or littoral vegetative covers	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes
WEST FORK DYCE CREEK, headwaters to mouth (Dyce Creek)	MT41B002_070	Sedimentation/Siltation	Sediment	Sediment TMDL completed	Yes
		Alteration in streamside or littoral vegetative covers	Not Applicable; Non-Pollutant	Addressed by sediment TMDL	Yes

*Impairment causes not in the "2012 Water Quality Integrated Report" were recently identified and will be included in the 2014 Integrated Report.

1.3 Document Layout

This document addresses all of the required components of a TMDL and includes an implementation and monitoring strategy, as well as a strategy to address impairment causes other than sediment. 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 Beaverhead Watershed 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 the Beaverhead watershed.

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

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

Section 6.0 Other Identified Issues or Concerns:
Describes other problems that could potentially be contributing to water quality impairment and how the TMDLs in the plan might address some of these concerns. This section also provides recommendations for combating these problems.

Section 7.0 Restoration Objectives and Implementation Plan:
Discusses water quality restoration objectives and presents a framework for implementing a strategy to meet the identified objectives and TMDLs.

Section 8.0 Monitoring for Effectiveness:
Describes a water quality monitoring plan for evaluating the long-term effectiveness of the Beaverhead Sediment Total Maximum Daily Loads and Framework Water Quality Protection Plan

Section 9.0 Public Participation & Public Comments:
Describes other agencies and stakeholder groups who were involved with the development of the plan and the public participation process used to review the draft document. Addresses comments received during the public review period.

2.0 BEAVERHEAD WATERSHED DESCRIPTION

This section includes a summary of the physical characteristics and social profile of the Beaverhead watershed. An extended watershed description is contained in the DEQ Library (2003).

2.1 PHYSICAL CHARACTERISTICS

The following information describes the physical characteristics of the Beaverhead watershed.

2.1.1 Location

The Beaverhead TMDL planning area is located in Beaverhead County, with a small portion in Madison County and includes the towns of Dillon and Twin Bridges (**Appendix A, Map A-2**). The Beaverhead TPA encompasses the Beaverhead River watershed (fourth-code hydrologic unit code 10020002), which begins at the outlet of the Clark Canyon Reservoir and flows northeast 79.5 miles before joining the Big Hole River to form the Jefferson River. The TPA is bounded by the Pioneer Mountains on the west, the Ruby Range to the east, and the Snowcrest Range and Blacktail Mountains to the south.

The TPA is located in the Middle Rockies Level III Ecoregion. Eight Level IV Ecoregions are mapped within the TPA (Woods, et al., 2002), as shown on **Map A-3 (Appendix A)**. These include: Barren Mountains (17e), Alpine Zone (17h), Dry Intermontane Sagebrush Valleys (17aa), Dry Gneissic-Schistose-Volcanic Hills (17ab), Big Hole (17ac), Forested Beaverhead Mountains (17ae), Pioneer-Anaconda Ranges (17ag), and Eastern Pioneer Sedimentary Mountains (17ah).

2.1.2 Topography

Elevations in the planning area range from 4,600 feet above mean sea level at the confluence of the Beaverhead and Jefferson Rivers, to nearly 10,600 feet at the summit of Baldy Peak in the Pioneer Range. The majority of the planning area is between 5,000 and 7,000 feet, as shown on **Map A-4 (Appendix A)**.

2.1.3 Climate

Average precipitation in the watershed varies with elevation, from 9 inches/year in the valley to 39 inches/year at the highest elevations (**Appendix A, Map A-5**). Average snowfall ranges from 9 inches/year in the valley to 85.8 inches/year at higher elevations. May and June are consistently the wettest months of the year and winter precipitation is dominated by snowfall. Temperature patterns reveal that July is the hottest month and January is the coldest throughout the watershed (**Table 2-1**). Summertime highs are typically in the high seventies to low eighties F, and winter lows average 11 degrees F.

Table 2-1. Monthly Climate Summary: Dillon Airport

Dillon, Montana (242404) Period of Record: 1/1/1940 to 10/31/2011

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Ave. Max. Temp (F)	32.1	37.6	44.2	54.5	63.9	72.2	83.1	81.4	70.3	58.3	42.5	33.2	56.1
Ave. Min. Temp. (F)	10.9	15.0	20.2	28.4	36.4	43.4	49.1	47.4	39.4	30.9	20.2	12.6	29.5
Ave Tot. Precip. (in.)	0.26	0.24	0.50	0.93	1.71	1.93	0.98	0.94	1.01	0.62	0.38	0.26	9.76

Table 2-1. Monthly Climate Summary: Dillon Airport
Dillon, Montana (242404) Period of Record: 1/1/1940 to 10/31/2011

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Ave. Snowfall (in.)	4.9	3.8	7.1	6.2	2.3	0.1	0.0	0.0	1.3	2.5	4.1	4.1	36.4
Ave Snow Depth (in.)	1	1	1	0	0	0	0	0	0	0	1	1	0

2.1.3 Hydrology

The Beaverhead River begins at the confluence of Horse Prairie Creek and the Red Rock River, since 1964 inundated by the Clark Canyon Reservoir. The Bureau of Reclamation built the dam and associated irrigation infrastructure in order to irrigate the bench east of Dillon. Below the dam, the Beaverhead River flows about 15 miles through a canyon before entering the Beaverhead Valley. Major tributary streams are Grasshopper Creek, Blacktail Deer Creek, and Rattlesnake Creek. The Ruby River drains into the Beaverhead River slightly over a mile south of Twin Bridges. The Big Hole River meets the Beaverhead River just north Twin Bridges. The confluence of the Beaverhead and Big Hole Rivers marks the start of the Jefferson River.

The Bureau of Reclamation's East Bench Unit irrigates 49,800 acres via the diversion dam at Barretts (Rogers, 2008). Minimum discharges usually occur during late summer and often result in late-season shortages of irrigation water (Kendy and Tresch, 1996).

Operation of the Clark Canyon Reservoir influences the flow regime in the Beaverhead River. This is demonstrated graphically in a hydrograph of Beaverhead River discharge, measured at USGS gaging station 06016000 (Beaverhead River at Barretts). The peak of the hydrograph is shifted later in the year, reflecting controlled release of stored water. The low flow regime is fairly stable, reflecting average low-flow discharge from the reservoir. Diversion of river water to the East Bench Unit irrigation system is reflected at gaging stations further downstream, such as 0601700 (Beaverhead River at Dillon). Reduced flows are distinct between April and November, resulting in an inverted hydrograph.

The State of Montana Fish, Wildlife and Parks (MT FWP) maintains a list of Montana streams that support important fisheries or contribute to important fisheries (i.e. provide spawning and rearing habitats) that are significantly dewatered. Dewatering refers to a reduction in streamflow below the point where stream habitat is adequate for fish. The list was initially prepared by MT FWP in 1991 from field observations and revised in December 1997. The revised list includes a total of 207 streams and 2,614 stream miles which are chronically dewatered and 87 streams and 1,242 stream miles which are periodically dewatered. The 2 categories of dewatering are "chronic" – streams where dewatering is a significant problem in virtually all years and "periodic" – streams where dewatering is a significant problem only in drought or water-short years.

Most man-made dewatering occurs during the irrigation season (July-September) and although most dewatering is the result of irrigation withdrawals, a few of the streams listed are dewatered through dam regulation for agriculture or power production, or by natural causes. The number of miles of a given stream may vary from year to year depending on the amount of water available in the stream system. Dewatered streams identified in the Beaverhead planning area include: the Beaverhead River (62.5 miles), Blacktail Deer Creek (38.6 miles), Rattlesnake Creek (7.9 miles) and Grasshopper Creek (28.3 miles). A total of 137.3 miles of stream are reported dewatered in the planning area. This includes both chronic and periodic dewatering. Chronic dewatering is limited to the lower reaches of Rattlesnake and Blacktail Deer Creeks and the Beaverhead River below Dillon. Dewatered streams are shown on **Map A-6 (Appendix A)**.

2.1.4 Geology, Soils, and Stream Morphology

The planning area includes a diverse assemblage of geologic units, and is representative of the geology of southwestern Montana in general. The planning area's physiography includes high alpine mountains, broad pediments or terraces, and wide alluvial valleys. Detailed discussion of the bedrock geology exposed in the mountains is beyond the scope of this report. Tertiary valley fill deposits and Quaternary alluvium dominate the planning area, as shown on the simplified geologic map (**Appendix A, Map A-7**).

The USGS Water Resources Division created a dataset of hydrology-relevant soil attributes (Schwarz and Alexander, 1995), based on the USDA Natural Resources Conservation Service (NRCS) STATSGO soil database. The STATSGO data is intended for small-scale (watershed or larger) mapping, and is too general to be used at scales larger than 1:250,000. It is important to realize, therefore, that each soil unit in the STATSGO data may include up to 21 soil components. Soil analysis at a larger scale should use NRCS SSURGO data. The soil attributes considered in this characterization are erodibility and slope. 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 on **Map A-8 (Appendix A)**, 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 of >0.4 are considered highly susceptible to erosion. No values greater than 0.4 are mapped in the TPA.

Low susceptibility soils compose 10% of the TPA; moderate-low susceptibility soils comprise 73% of the TPA, and the remaining 17% is mapped with moderate-high susceptibility soils. No high susceptibility soils are mapped in the TPA. Low susceptibility soils are associated with the Pioneer Range and the Tertiary sediments on the pediment flanking the Ruby Range.

2.2 Ecological Parameters

2.2.1 Vegetation and Fire History

The majority of the planning area is mapped with shrub/scrub and grassland landcover. The lowland areas are dominated by hay/pasture and small grain cultivation, and the upland areas are covered with evergreen forest. The National Land Cover Dataset (2001) is shown on **Map A-9 (Appendix A)**.

The planning area experienced a relatively large fire in 2006, the Clark Canyon fire, which burned 15,345 acres in the Blacktail Mountains. The Sweetwater fire burned 7,566 acres of the Ruby Mountains in 1988. These and other fires of greater than 400 acres are shown on **Map A-10 (Appendix A)**.

2.2.2 Aquatic Life

Montana Fish, Wildlife and Parks report Westslope cutthroat trout in the planning area, generally in upland tributary streams. The sediment-listed streams with western cutthroat trout reported include Stone, Spring, French, Farlin, Dry, Taylor and Reservoir creeks. Fish distribution is shown on **Map A-11 (Appendix A)**.

2.3 Social Profile

The following describes the cultural profile of the Beaverhead planning area.

2.3.1 Land Use
Historic land uses included mining, fur trapping and agriculture, primarily ranching. Current land use in the watershed is dominated by agricultural cattle production, with less significant grain cropping and potato production. A large portion of the upper watershed is used for rangeland. The floodplains of the major tributaries are irrigated for hay and alfalfa production and pasture. Irrigation canals installed in the mid to late twentieth century provide water for irrigation from the Beaverhead River, much of which is derived from Clark Canyon Reservoir **(Appendix A, Map A-12).**

Other land uses in the basin are recreation, logging, and mining. The most intensive recreation use is fall big game hunting, especially in the upper Blacktail Deer Creek drainage. Mining has been and is still an important land use in the basin and a potential source of impairment to water quality. A large operating talc mine is located in the Stone Creek watershed.

Major transportation corridors in the planning area include Interstate 15 and Highway 41. The network of paved and unpaved roads is discussed in detail in the source assessment (**Section 5.6.3**).

2.3.2 Land Ownership
Roughly 39% of the planning area is under federal management (24% BLM; 15% USFS), 15% is state lands (including FWP managed lands and surface waters), and about 46% is in private ownership (**Appendix A, Map A-13**). In general, USFS lands occupy the higher, timbered areas, and the lower elevations are mostly private lands with some BLM and State Trust Lands. The US Bureau of Reclamation owns and manages the Clark Canyon Reservoir.

2.3.3 Population
As of the 2010 census, 9,246 people resided in Beaverhead County (**Appendix A, Map A-14**). Dillon is the largest municipality in the Beaverhead Watershed. As of the 2010 census, the population of Dillon was 4,134, a modest increase from the 2000 census. Other towns in the watershed include Bannack, Polaris, Argenta, Grant, and Twin Bridges. Twin Bridges is the second largest population center, with 400 residents.

2.3.4 Point Sources
As of January 19, 2012, there were seventeen Montana Pollutant Discharge Elimination System (MPDES) permitted point sources within the Beaverhead TPA (**Appendix A, Map A-15**):
- City of Dillon WWTF (MT0021458),
- Beaverhead Talc Mine (MT0027821)
- Barretts Minerals Inc (MT0029891)
- Two Concentrated Animal Feeding Operations (MTG010165 and MTG010212)
- Three Storm Water Mining Permits (MTR300135, MTR300136, and MTR300160), and
- Nine general permits for construction stormwater

2.3.5 Wastewater
The city of Dillon is sewered. The City of Dillon wastewater treatment plant discharges to the Beaverhead River under a MPDES permit. The town of Twin Bridges is also sewered, but its treatment plant discharges to the Jefferson River. Outside of these communities, wastewater treatment and disposal is provided by individual onsite septic systems.

3.0 MONTANA WATER QUALITY STANDARDS

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

Montana's water quality standards include four main parts:

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

Those components that apply to this document are reviewed briefly below. More detailed descriptions of Montana's water quality standards that apply to the Beaverhead TPA streams can be found **Appendix B.**

3.1 BEAVERHEAD TPA STREAM CLASSIFICATIONS AND DESIGNATED BENEFICIAL USES

Waterbodies are classified based on their designated uses. All Montana waters are classified for multiple uses. With the exception of the upper segment of Rattlesnake Creek which is an A-1, all streams within the Beaverhead TPA are classified as B-1, which specifies that the water must be maintained suitable to support all of the following uses: growth and propagation of fish and associated aquatic life; drinking water; agriculture; industrial supply; and recreation and wildlife. While some of the waterbodies might not actually be used for a designated use (e.g., drinking water supply), their water quality still must be maintained suitable for that designated use. More detailed descriptions of Montana's surface water classifications and designated uses are provided in **Appendix B.**

Nineteen waterbody segments in the Beaverhead TPA are listed in the "2012 Water Quality Integrated Report" as not supporting or partially supporting one or more designated uses (**Table 3-1**). Waterbodies that are "not supporting" or "partially supporting" a designated use are impaired and require a TMDL. TMDLs are written to protect all designated uses for a waterbody and not just those identified as being non or partially supported. DEQ describes impairment as either partially supporting or not supporting, based on assessment results. Not supporting is applied to not meeting a drinking water standard, and is also applied to conditions where the assessment results indicate a severe level of impairment of aquatic life or coldwater fishery. A non-supporting level of impairment does not equate to complete elimination of the use. Detailed information about Montana's use support categories can be found in DEQ's water quality assessment methods (Montana Department of Environmental Quality, Water Quality Planning Bureau, 2011).

Table 3-1. Impaired Waterbodies and their Designated Use Support Status on the "2012 Water Quality Integrated Report" in the Beaverhead TPA

Waterbody & Location Description	Waterbody ID	Use Class	Agriculture	Aquatic Life	Drinking Water	Primary Contact Recreation
BEAVERHEAD RIVER, Clark Canyon Dam to Grasshopper Creek	MT41B001_010	B-1	F	N	N	P
BEAVERHEAD RIVER, Grasshopper Creek to mouth (Jefferson River)	MT41B001_020	B-1	F	N	F	N
BLACKTAIL DEER CREEK, headwaters to mouth (Beaverhead River)	MT41B002_030	B-1	F	N	F	N
CLARK CANYON CREEK, headwaters to mouth (Beaverhead River), T9S R10W S28	MT41B002_110	B-1	F	P	F	F
DYCE CREEK, confluence of East and West Forks to Grasshopper Creek	MT41B002_140	B-1	F	P	F	P
EAST FORK BLACKTAIL DEER CREEK, headwaters to mouth (Blacktail Deer Creek)	MT41B002_040	B-1	F	P	F	F
FARLIN CREEK, headwaters to mouth (Grasshopper Creek), T6S R12W S7	MT41B002_020	B-1	F	P	F	F
FRENCH CREEK, headwaters to mouth (Rattlesnake Creek)	MT41B002_100	B-1	F	P	F	F
GRASSHOPPER CREEK, headwaters to mouth (Beaverhead River)	MT41B002_010	B-1	F	P	F	P
RATTLESNAKE CREEK, from the Dillon PWS off-channel well T7S R10W S11 to the mouth (Van Camp Slough)	MT41B002_090	B-1	F	P	N	P
RATTLESNAKE CREEK, headwaters to Dillon PWS off-channel well, T7S R10W S11	MT41B002_091	A-1	F	P	N	F
RESERVOIR CREEK, headwaters to mouth (Grasshopper Creek)	MT41B002_120	B-1	F	P	F	F
SCUDDER CREEK, headwaters to mouth (Grasshopper Creek), T6S R12W S19	MT41B002_180	B-1	F	P	F	F
SPRING CREEK, headwaters to mouth (Beaverhead River)	MT41B002_080	B-1	P	P	N	P
STEEL CREEK, headwaters to mouth (Driscol Creek), T6S R12W S18	MT41B002_160	B-1	P	N	N	N
STONE CREEK, confluence with unnamed creek in T6S R7W S34 near Beaverhead/Madison county border	MT41B002_131	B-1	P	P	N	P
STONE CREEK, Left Fork and Middle Fork to confluence of un-named tributary, T6S R7W S34	MT41B002_132	B-1	F	P	F	N
TAYLOR CREEK, headwaters to mouth (Grasshopper Creek)	MT41B002_170	B-1	F	P	F	F
WEST FORK BLACKTAIL DEER CREEK, headwaters to mouth (Blacktail Deer Creek)	MT41B002_060	B-1	N	P	N	P
WEST FORK DYCE CREEK, headwaters to mouth (Dyce Creek)	MT41B002_070	B-1	F	P	F	F

3.2 Beaverhead TPA Water Quality Standards

In addition to the use classifications described above, Montana's water quality standards include numeric and narrative criteria that protect the designated uses. Numeric criteria define the allowable concentrations of specific pollutants so as not to impair designated uses. Narrative criteria are more “free form” descriptions, or statements, of unacceptable conditions. **Appendix B** defines the narrative water quality criteria for the Beaverhead TPA, as only the narrative standards are applicable for sediment TMDL development.

Narrative standards are developed when there is insufficient information to develop specific numeric standards. Narrative standards describe either the allowable condition or an allowable increase of a pollutant above “naturally occurring” conditions. DEQ uses the naturally occurring condition, called a “reference condition,” to determine whether or not narrative standards are being met (see **Appendix B**).

Reference defines the condition a waterbody could attain if all reasonable land, soil, and water conservation practices were put in place. Reasonable land, soil, and water conservation practices usually include, but are not limited to, best management practices (BMPs).

The specific sediment narrative water quality standards that apply to the Beaverhead TPA are summarized in **Appendix B**.

4.0 Defining TMDLs and Their Components

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

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

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

A TMDL is expressed by the equation: TMDL = ΣWLA + ΣLA, where:

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

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

Development of each TMDL has four major components:

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

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

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

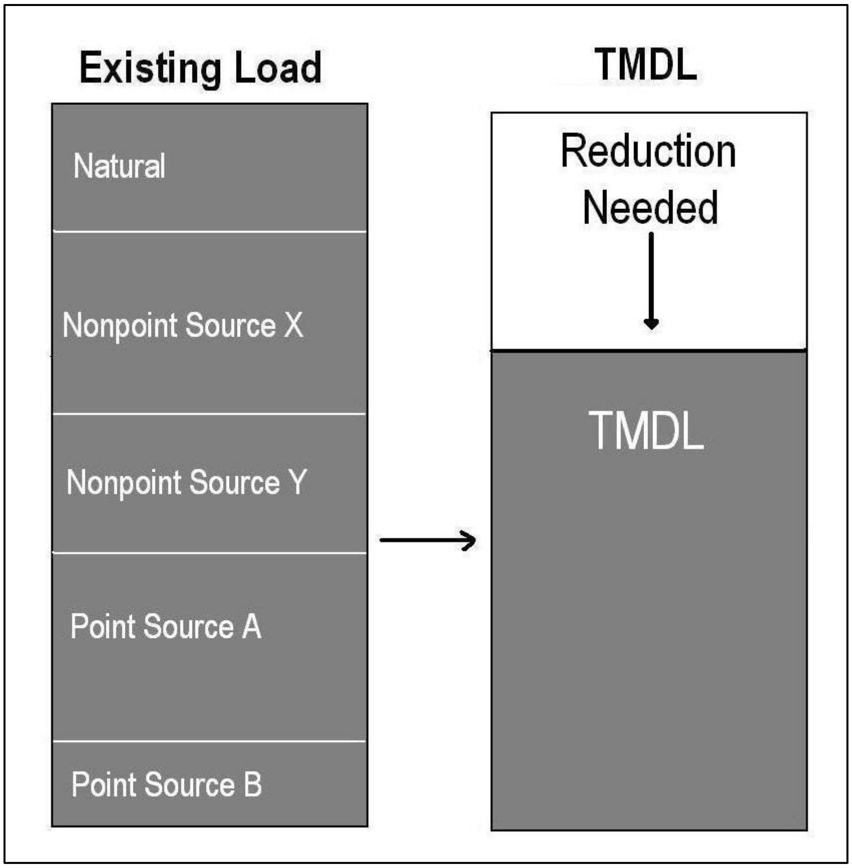

Figure 4-1. Schematic Example of TMDL Development

4.1 Developing Water Quality Targets

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

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

4.2 Quantifying Pollutant Sources

All significant pollutant sources, including natural background loading, are quantified 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 must include 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.

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

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

4.3 Establishing the Total Allowable Load

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

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

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

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

4.4 Determining Pollutant Allocations

Once the allowable load (the TMDL) is determined, that total must be divided among the contributing sources. In addition to basic technical and environmental analysis, DEQ also considers economic and social costs and benefits when developing allocations. The allocations are often determined by quantifying feasible and achievable load reductions through application of a variety of best management practices and other reasonable conservation practices.

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

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

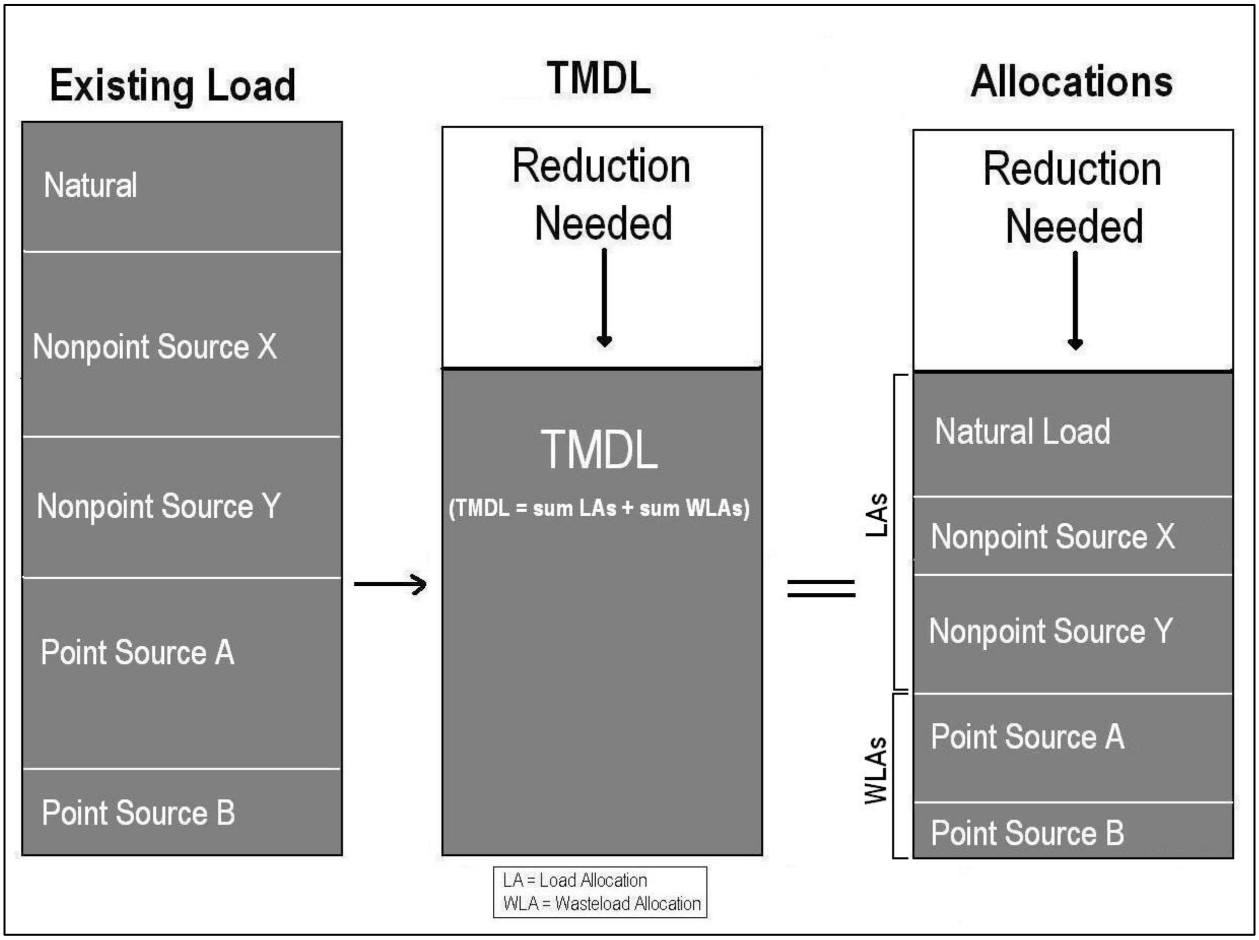

Figure 4-2. Schematic Diagram of a TMDL and its Allocations

Incorporating an MOS is required when developing TMDLs. The MOS accounts for the uncertainty between pollutant loading and water quality and is intended to ensure that load reductions and allocations are sufficient to support beneficial uses. 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).

5.0 Sediment TMDL Development

This portion of the document focuses on sediment as an identified cause of water quality impairments in the Beaverhead TMDL Planning Area (TPA). It includes: 1) the mechanisms by which sediment can impair beneficial uses, 2) the specific stream segments of concern, 3) the presently available data pertaining to sediment impairment characterization in the watershed, including target development and a comparison of existing water quality to targets, 4) quantification of the various contributing sources of sediment based on recent studies, and 5) identification of and justification for the sediment TMDLs and the TMDL allocations.

5.1 Mechanism of Effects of Excess Sediment on Beneficial Uses

Sediment is a naturally occurring component of healthy and stable stream and lake ecosystems. Regular flooding allows sediment deposition to build floodplain soils and point bars, and it prevents excess scour of the stream channel. Riparian and wetland vegetation and natural instream barriers such as large woody debris, beaver dams, or overhanging vegetation help trap sediment and build channel and floodplain features. When these barriers are absent or excessive sediment loading enters the system from increased bank erosion or other sources, it may alter channel form and function and affect fish and other aquatic life by increasing turbidity and causing excess sediment to accumulate in critical aquatic habitat areas not naturally characterized by high levels of fine sediment.

More specifically, sediment may block light and cause a decline in primary production, and it may also interfere with fish and macroinvertebrate survival and reproduction. Fine sediment deposition reduces availability of suitable spawning habitat for salmonid fishes and can smother eggs or hatchlings. Effects from excess sediment are not limited to suspended or fine sediment; an accumulation of larger sediment (e.g., cobbles) can fill pools, reduce the percentage of desirable particle sizes for fish spawning, and cause channel overwidening (which may lead to additional sediment loading and/or increased temperatures). This larger sediment can also reduce or eliminate flow in some stream reaches where sediment aggrades within the channel, causing flow to go subsurface (May and Lee, 2004). Although fish and aquatic life are typically the most sensitive beneficial uses regarding sediment, excess sediment may also affect other uses. For instance, high concentrations of suspended sediment in streams can also cause water to appear murky and discolored, negatively impacting recreational use, and excessive sediment can increase filtration costs for water treatment facilities that provide safe drinking water.

5.2 Stream Segments of Concern

A total of 17 waterbody segments in the Beaverhead TPA appeared on the 2012 Montana 303(d) List due to sediment impairments (**Table 5-1**). These include: Beaverhead River (lower), Blacktail Deer Creek, Clark Canyon Creek, Dyce Creek, Farlin Creek, French Creek, Rattlesnake Creek (upper and lower), Reservoir Creek, Scudder Creek, Spring Creek, Steel Creek, Stone Creek (upper and lower), Taylor Creek, West Fork Blacktail Deer Creek, and West Fork Dyce Creek. As shown in **Table 5-1**, many of the waterbodies with sediment impairments are also listed for habitat and flow alterations, which are non-pollutant forms of pollution frequently associated with sediment impairment. TMDLs are limited to pollutants, but implementation of land, soil, and water conservation practices to reduce pollutant loading will inherently address some non-pollutant impairments.

Grasshopper Creek, (MT41B002_010), a tributary to the Beaverhead River and the upper segment of the Beaverhead River (MT41B001_010), were not on the 303(d) list for sediment, but do have habitat alterations that are potentially linked to sediment and therefore were also evaluated as part of TMDL development.

Table 5-1. Waterbody Segments in the Beaverhead TPA with Sediment Listings and Possible Sediment-related Listings on the 2012 303(d) List

Stream Segment	Waterbody ID	Sediment Pollutant Listing	Non-Pollutant Causes of Impairment Potentially Linked to Sediment Impairment
Beaverhead River (upper), Clark Canyon Dam to Grasshopper Creek	MT41B001_010		Alteration in streamside or littoral vegetative covers & low flow alterations
Beaverhead River (lower), Grasshopper Creek to mouth (Jefferson River)	MT41B001_020	Sedimentation/ Siltation	Alteration in streamside or littoral vegetative covers, low flow alterations, and physical substrate habitat alterations
Blacktail Deer Creek, headwaters to mouth (Beaverhead River)	MT41B002_030	Sedimentation/ Siltation	Alteration in streamside or littoral vegetative covers & low flow alterations
Clark Canyon Creek, headwaters to mouth (Beaverhead River)	MT41B002_110	Sedimentation/ Siltation	Alteration in streamside or littoral vegetative covers
Dyce Creek, confluence of East and West Forks to Grasshopper Creek	MT41B002_140	Sedimentation/ Siltation	Alteration in streamside or littoral vegetative covers & low flow alterations
Farlin Creek, headwaters to mouth (Grasshopper Creek)	MT41B002_020	Sedimentation/ Siltation	Alteration in streamside or littoral vegetative covers
French Creek, headwaters to mouth (Rattlesnake Creek)	MT41B002_100	Sedimentation/ Siltation	Alteration in streamside or littoral vegetative covers
Grasshopper Creek, headwaters to mouth (Beaverhead River)	MT41B002_010		Alteration in streamside or littoral vegetative covers & low flow alterations
Rattlesnake Creek (upper), headwaters to Dillon PWS off-channel well T7S R10W S11	MT41B002_091	Sedimentation/ Siltation	Alteration in streamside or littoral vegetative covers
Rattlesnake Creek (lower), from the Dillon PWS off-channel well T7S R10W S11 to the mouth (Van Camp Slough)	MT41B002_090	Sedimentation/ Siltation & Solids (Suspended/ Bedload)	Alteration in streamside or littoral vegetative covers & low flow alterations
Reservoir Creek, headwaters to mouth (Grasshopper Creek)	MT41B002_120	Sedimentation/ Siltation	Alteration in streamside or littoral vegetative covers
Scudder Creek, headwaters to mouth (Grasshopper Creek)	MT41B002_180	Sedimentation/ Siltation	Alteration in streamside or littoral vegetative covers
Spring Creek, headwaters to mouth (Beaverhead River)	MT41B002_080	Sedimentation/ Siltation	Alteration in streamside or littoral vegetative covers & low flow alterations
Steel Creek, headwaters to mouth (Driscoll Creek)	MT41B002_160	Sedimentation/ Siltation & Solids (Suspended/ Bedload)	Alteration in streamside or littoral vegetative covers

Table 5-1. Waterbody Segments in the Beaverhead TPA with Sediment Listings and Possible Sediment-related Listings on the 2012 303(d) List

Stream Segment	Waterbody ID	Sediment Pollutant Listing	Non-Pollutant Causes of Impairment Potentially Linked to Sediment Impairment
Stone Creek (upper), Left Fork and Middle Fork to confluence of un-named tributary, T6S R7W S34	MT41B002_132	Sedimentation/ Siltation & Turbidity	Alteration in streamside or littoral vegetative covers & low flow alterations
Stone Creek (lower), confluence with unnamed creek in T6S R7W S34 near Beaverhead/Madison county border	MT41B002_131	Sedimentation/ Siltation	Alteration in streamside or littoral vegetative covers
Taylor Creek, headwaters to mouth (Grasshopper Creek)	MT41B002_170	Sedimentation/ Siltation	Alteration in streamside or littoral vegetative covers
West Fork Blacktail Deer Creek, headwaters to mouth (Blacktail Deer Creek)	MT41B002_060	Sedimentation/ Siltation	Alteration in streamside or littoral vegetative covers
West Fork Dyce Creek, headwaters to mouth (Dyce Creek)	MT41B002_070	Sedimentation/ Siltation	Alteration in streamside or littoral vegetative covers

5.3 Information Sources and Assessment Methods to Characterize Sediment Conditions

For TMDL development, information sources and assessment methods fall within two general categories. The first category, discussed within this section, is focused on characterizing overall stream health with focus on sediment and related water quality conditions. The second category, discussed within **Section 5.6**, is focused on quantifying sources of sediment loading within the watershed.

5.3.1 Summary of Information Sources

To characterize sediment conditions for TMDL development purposes, a sediment and habitat assessment was completed during 2010 and 2011. The below listed data sources represent the primary information used to characterize water quality and/or develop TMDL targets (**Figure 5-1**).

- DEQ assessment files and 2004/2005 reference sites
- 2010-2011 DEQ sediment and habitat assessment
- 2010 Beaverhead Deerlodge NF sediment and habitat assessment
- 2009-2011 suspended sediment and turbidity data collected by the USGS for the DEQ
- 2008-2009 turbidity and TSS data from collected by HSI for the DEQ
- 2003 stream morphology data collected by Kirk Environmental for the DEQ
- Relevant Local and Regional Reference Data
- BLM Watershed Assessments
- GIS data layers and publications regarding historical land usage, channel stability, and sediment conditions

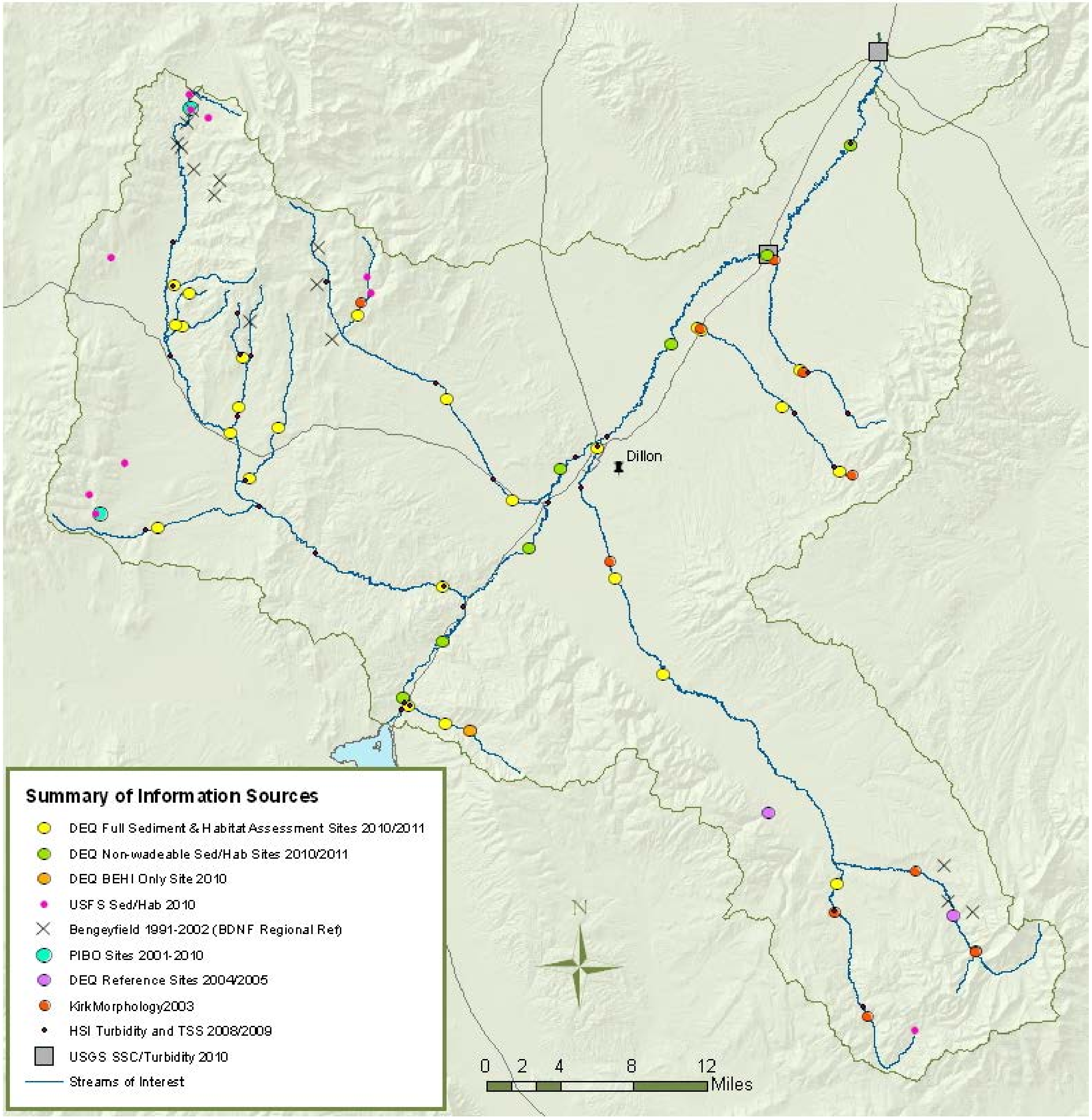

Figure 5-1. Reaches Assessed by DEQ in 2010/2011 and Other Sources of Information

5.3.2 DEQ Assessment Files and Reference Sites

The DEQ assessment files contain information used to make the existing sediment impairment determinations. The files include a summary of physical, biological, and habitat data collected by DEQ on most waterbodies between 1992 and 2004 as well as other historical information collected or obtained by DEQ. The most common quantitative data that will be incorporated from the assessment files are pebble counts and macroinvertebrate index scores. The files also include information on sediment water quality characterization and potentially significant sources of sediment, as well as information on non-pollutant impairment determinations and associated rationale. Files are available electronically on DEQ's Clean Water Act Information Center website: http://cwaic.mt.gov/.

In addition to the assessment files, the DEQ collected sediment and habitat data on two reference sites in the Beaverhead TPA in 2004/2005. Photos, TSS, Rosgen level II parameters, NRCS Habitat Assessment, macroinvertebrates, and periphyton were collected at both Cottonwood Creek and East Fork Blacktail Deer Creek (See **Appendix D** for relevant data).

5.3.3 DEQ's 2010-2011 Sediment and Habitat Assessments

Field measurements of channel morphology and riparian and instream habitat parameters (Montana Department of Environmental Quality, 2010) were collected in September 2010 and April 2011 from 31 reaches on 19 waterbody segments to aid in TMDL development (**Figure 5-1**). Field measurement methods were modified for several reaches on the Beaverhead River where high flows prevented wading during the assessment period **(Appendix C)**. To aid in the characterization of bank erosion in Clark Canyon Creek, an additional reach was assessed for bank erosion severity and source identification. In total, sediment and habitat data were collected from 32 reaches.

Initially, all streams of interest underwent an aerial assessment procedure by which reaches were characterized by four main attributes not affected by human activity: stream order, valley gradient, valley confinement, and ecoregion. These four attributes represent main factors influencing stream morphology, which in turn influences sediment transport and deposition. The next step in the aerial assessment involved identification of near-stream land uses since land management practices can have a significant influence on stream morphology and sediment characteristics. The resulting product was a stratification of streams into reaches that allow for comparisons among those reaches of the same natural morphological characteristics, while also indicating stream reaches where land management practices may further influence stream morphology. The stream stratification, along with field reconnaissance, provided the basis for selecting the above-referenced monitoring reaches.

Monitoring reaches were chosen with the goal of being representative of various reach characteristics, land use category, and anthropogenic influence. There was a preference toward sampling those reaches where anthropogenic influences would most likely lead to impairment conditions since it is a primary goal of sediment TMDL development to further characterize sediment impairment conditions. Thus, it is not a random sampling design intended to sample stream reaches representing all potential impairment and non-impairment conditions. Instead, it is a targeted sampling design that aims to assess a representative subset of reach types while ensuring that reaches within each [sediment] 303(d) listed waterbody with potential impairment conditions are incorporated into the overall evaluation. Typically, the effects of excess sediment are most apparent in low gradient, unconfined streams larger than 1st order (i.e., having at least one tributary); therefore, this stream type was the focus of the field effort (**Table 5-2**). Although the TMDL development process necessitates this targeted sampling design, it is acknowledged that this approach results in less certainty regarding conditions in 1st order streams and higher gradient reaches, and that conditions within sampled reaches are not necessarily representative of conditions throughout the entire stream. Additionally, reach selection on the Beaverhead River was limited by access and wadeability.

The field parameters assessed in 2010 and 2011 include standard measures of stream channel morphology, fine sediment, stream habitat, riparian vegetation, and streambank erosion. Although the sampling areas are frequently referred to as "sites" within this document, to help increase sample sizes and capture variability within assessed streams, sites were actually sampling reaches ranging from 500 to 2000 feet (depending on the channel bankfull width) that were broken into five individual and equally-sized cells. With the exception of the non-wadeable and BEHI only sites; channel morphology, stream habitat, riparian, and bank erosion measures were performed in all cells, while fine sediment measures were performed in four of the cells. Field parameters are briefly described in **Section 5.4**, and summaries of all field data are contained in the 2011 monitoring summary report (**Appendix C**).

Table 5-2. Stratified Reach Types and Sampling Site Representativeness within the Beaverhead TPA

Reach Type*	Number of Reaches	Sites Monitored	Methods Used
MR_2_1_U	14	SCUD 11-01	All Sed/Hab Methods
MR_4_1_U	48	STEL 05-01	All Sed/Hab Methods
		WFDY 17-01	All Sed/Hab Methods
MR_0_2_U	53	CLKC 32-01	All Sed/Hab Methods
		DYCE 02-02	All Sed/Hab Methods
		SPRG 31-01	All Sed/Hab Methods
		STON 20-02	All Sed/Hab Methods
		STON 22-02	All Sed/Hab Methods
		STON 22-02B	All Sed/Hab Methods
		TAYL 32-01	All Sed/Hab Methods
MR_2_2_C	29	FREN 23-01	All Sed/Hab Methods
MR_2_2_U	51	CLKC 19-02	All Sed/Hab Methods
		FARL 28-01	All Sed/Hab Methods
		RESR 11-01	All Sed/Hab Methods
		STON 05-01	All Sed/Hab Methods
		TAYL 27-01	All Sed/Hab Methods
MR_4_2_U	26	CLKC 18-02	BEHI Only
MR_0_3_U	62	RATT 54-04	All Sed/Hab Methods
		RATT 60-04	All Sed/Hab Methods
		WFBK 08-04	All Sed/Hab Methods
MR_0_4_U	34	GRAS 12-01	All Sed/Hab Methods
		GRAS 20-11	All Sed/Hab Methods
MR_0_5_U	30	BLKD 02-08	All Sed/Hab Methods
		BLKD 02-14	All Sed/Hab Methods
		BLKD 02-30	All Sed/Hab Methods
MR_0_7_U	32	BEAV 04-02	Cross-sections only
		BEAV 04-05	Cross-sections only
		BEAV 09-04	Non-wadeable reach methods
		BEAV 09-06	Non-wadeable reach methods with std. cross-sections
		BEAV 09-11	Non-wadeable reach methods
		BEAV 09-14	Non-wadeable reach methods
		BEAV 09-15	Non-wadeable reach methods

* Per DEQ's stratification methodology: MR= Middle Rockies; the first number in the series refers to stream gradient: 0=0-2%, 2=2-4%, 4=4-10%, and 10=>10%; the next number in the series refers to Strahler stream order, 1 through 7; and finally U = Unconfined & C = Confined

5.3.4 Beaverhead Deerlodge NF Sediment and Habitat Assessment 2010

In 2010, the Beaverhead Deerlodge National Forest (BDNF) surveyed ten streams in the Beaverhead Watershed for their Integrated Riparian Monitoring Hydrology Report. Two of the streams surveyed by BDNF, Grasshopper Creek and French Creek, are also streams that were surveyed by the DEQ during the DEQ's 2010-2011 sediment and habitat assessment for TMDL development. The primary objectives associated with the BDNF sites were to document riparian/stream condition and to evaluate trend based on future management at the allotment level. Sites were distributed across the Forest and were most commonly located where livestock directly influenced channel and/or riparian conditions. Three cross section measurements, bank erosion hazard index (BEHI) ratings, particle size distribution, sinuosity, slope, channel width/depth measurements, discharge, pictures and field notes were collected at each monitoring location.

5.3.5 USGS Suspended Sediment and Turbidity Data 2010

The U.S. Geological Survey (USGS) monitored suspended sediment and turbidity for the DEQ at two sites on the Beaverhead River in 2010/2011. At site 06018500, monthly suspended sediment concentrations (SSC) and sand fractions were collected from May through October in 2009 and 2010; June 1, 2010 to October 31, 2010; and two low flow samples in December 2010 and February 2011. At site 06023100, bi-monthly SSC and sand fractions were collected from June 1, 2010 to October 31, 2010; with two winter low flow samples in December 2010 and February 2010. Continuous turbidity was collected at both sites from June 2, 2010 to October 31, 2010. Data is available online at http://waterdata.usgs.gov/mt/nwis.

5.3.6 HSI Turbidity and TSS 2008-2009

Instantaneous turbidity and TSS was collected for the DEQ by HSI in 2008 and 2009 on Blacktail Deer Creek (3 sites), the Beaverhead River (8 sites), Clark Canyon Creek, Dyce Creek, East Fork Blacktail Deer Creek , East Fork Dyce Creek, Farlin Creek, French Creek, Grasshopper Creek (5 sites), Rattlesnake Creek (3 sites), Reservoir Creek (2 sites), Scudder Creek (2 sites), Spring Creek (4 sites), Stone Creek (4 sites), Taylor Creek (2 sites), West Fork Blacktail Deer Creek (2 sites), and West Fork Dyce Creek (2 sites).

5.3.7 KirK Environmental Stream Morphology Data 2003

KirK Environmental collected basic cross-section data in 2003 on Blacktail Deer Creek, East Fork Blacktail Deer Creek, French Creek, Indian Creek, Spring Creek, Stone Creek, and West Fork Blacktail Deer Creek. Relevant parameters assessed include bankfull width, W/D ratio, entrenchment ratio, sinuosity, pool count and depth, and an estimated d50 of the substrate. In addition to cross section data, KirK performed a visual habitat assessment on the creeks mentioned above and on the Beaverhead River, Dyce Creek, East Fork Dyce Creek, Farlin Creek, Grasshopper Creek, Rattlesnake Creek, Reservoir Creek, Scudder Creek, Steel Creek, Taylor Creek, and West Fork Dyce Creek.

5.3.8 PIBO Data

The PACFISH/INFISH Biological Opinion Effectiveness (PIBO) monitoring program collects data from reference and managed (i.e., non-reference) stream sites on USFS and BLM land within the Beaverhead watershed. Reference sites are defined as having catchment road densities less than 0.5 km/km^2, riparian road densities less than 0.25 km/km^2, no grazing within 30 years, and no known in-channel mining upstream of the site. Within the Beaverhead TPA, data were collected in 2006, 2008, and 2009 at three non-reference sites on Buffalo, Grasshopper and East Fork Blacktail Deer creeks (**Figure 5-1**). There are 18 reference sites within the Beaverhead Deerlodge National Forest (BDNF) in the Middle Rockies Level IV ecoregion, but because that is a small dataset for target development, and ecoregion is a primary stratification category, all PIBO reference data from the Middle Rockies ecoregion were used for target development. This consists of all sites within the BDNF as well as data from 55 other sites collected between 2001 and 2010. Data was collected following protocols described in *"Effectiveness Monitoring for Streams and Riparian Areas within the Pacific Northwest: Stream Channel Methods for Core Attributes" (U.S. Department of Agriculture, Forest Service, 2006).* Relevant data collected during these assessments include width/depth ratios, residual pool depths, pool frequency, large woody debris frequency, pebble counts, and the percentage of fine sediment in pool tails <6mm via grid toss.

5.3.9 Beaverhead Deerlodge Regional Reference Data

Regional reference data are available from the Beaverhead Deerlodge National Forest (BDNF). BDNF data were collected between 1991 and 2002 from approximately two hundred reference sites: seventy of the sites are located in the Greater Yellowstone Area and the remaining sites are in the BDNF, which is also located in southwestern Montana (Bengeyfield, 2004). Applicable reference data are width/depth ratios, entrenchment ratios, and fine sediment <6mm from pebble counts.

5.3.10 BLM Watershed Assessments

Watershed Assessments are available from the Bureau of Land Management and include Beaverhead West, Blacktail, East Bench, and East Grasshopper assessment areas. Relevant data collected during these assessments includes rangeland, riparian, and biodiversity health.

5.4 Water Quality Targets and Comparison to Existing Conditions

The concept of water quality targets was presented in **Section 4.1**, but this section provides the rationale for each sediment-related target parameter, discusses the basis of the target values, and then presents a comparison of those values to available data for the stream segments of concern in the Beaverhead River TPA (**Table 5-1**). Although placement onto the 303(d) list indicates impaired water quality, a comparison of water quality targets to existing data helps define the level of impairment and establishes a benchmark to help evaluate the effectiveness of restoration efforts.

In developing targets, natural variation throughout the river continuum must be considered. As discussed in more detail in **Section 3** and **Appendix B**, DEQ uses the reference condition to gage natural variability and assess the effects of pollutants with narrative standards, such as sediment. The preferred approach to establishing the reference condition is utilizing reference site data, but modeling, professional judgment, and literature values may also be used. The DEQ defines "reference" as the condition of a waterbody capable of supporting its present and future beneficial uses when all reasonable land, soil, and water conservation practices have been applied. In other words, the reference condition reflects a waterbody's greatest potential for water quality given historic and current land use activities. Although sediment water quality targets typically relate most directly to the aquatic life use, the targets are protective of all designated beneficial uses because they are based on the reference approach, which strives for the highest achievable condition. Waterbodies used to determine reference conditions are not necessarily pristine. The reference condition approach is intended to accommodate natural variations due to climate, bedrock, soils, hydrology and other natural physiochemical differences yet allow differentiation between natural conditions and widespread or significant alterations of biology, chemistry or hydrogeomorphology due to human activity.

The basis for the value for each water quality target varies depending on the availability of reference data and sampling method comparability to the 2010/11 DEQ data. As discussed in **Appendix B**, there are several statistical approaches DEQ uses for target development; they include using percentiles of reference data or of the entire sample dataset, if reference data are limited. For example, if low values are desired, the sampled streams are assumed to be severely degraded, and there is a high degree of confidence in the reference data, the 75th percentile of the reference dataset or the 25th percentile of the sample dataset (if reference data are not available) is typically used. However, percentiles may be used differently depending on whether a high or low value is desirable, the representativeness and range of variability of the data, the severity of human disturbance to streams within the watershed, and size of the dataset. For each target, descriptive statistics were generated relative to any available reference data (e.g., BDNF or PIBO) as well as for the entire sample dataset. The preferred approach for setting target values is to use reference data, where preference is given towards the most protective reference dataset. Additionally, the target value for some parameters may apply to all streams in the Beaverhead TPA, whereas others may be stratified by bankfull width, reach type characteristics (i.e., ecoregion, gradient, stream order, and/or confinement), or by Rosgen stream type if those factors are determined to be important drivers for certain target parameters. Although the basis for target values may differ by parameter, the goal is to develop values that incorporate an implicit margin of safety (MOS) and are achievable. The MOS is discussed in additional detail in **Section 5.8.2**.

5.4.1 Water Quality Targets

The sediment water quality targets for the Beaverhead TPA are summarized in **Table 5-3** and described in detail in the sections that follow. Sediment-related targets for the Beaverhead TPA are based on a combination of reference data from the BDNF, from the Middle Rockies portion of the PIBO dataset, and sample data from the DEQ 2010/2011 sampling effort. **Attachment C** provides a summary of the DEQ 2010/2011 sample data and a description of associated field protocols.

Consistent with EPA guidance for sediment TMDLs (U.S. Environmental Protection Agency, 1999), water quality targets for the Beaverhead TPA are comprised of a combination of measurements of instream siltation, channel form, biological health, and habitat characteristics that contribute to loading, storage, and transport of sediment, or that demonstrate those effects. Water quality targets most closely linked to sediment accumulation or sediment-related effects to aquatic life habitat are given the most weight (i.e., fine sediment and biological indices).

Target parameters and values are based on the current best available information, but they will be assessed during future TMDL reviews for their applicability and may be modified if new information provides a better understanding of reference conditions or if assessment metrics or field protocols are modified. For all water quality targets, future surveys should document stable (if meeting criterion) or improving trends. The exceedance of one or more target values does not necessarily equate to a determination that the information supports impairment; the degree to which one or more targets are exceeded are taken into account (as well as the current 303(d) listing status), and the combination of target analysis, qualitative observations, and sound, scientific professional judgment is crucial when assessing stream condition. Site-specific conditions such as recent wildfires, natural conditions, and flow alterations within a watershed may warrant the selection of unique indicator values that differ slightly from those presented below, or special interpretation of the data relative to the sediment target values.

Table 5-3. Sediment Targets for the Beaverhead TPA

Parameter Type	Target Description	Criterion
Fine Sediment	Percentage of fine surface sediment in riffles via pebble count (reach average)	Channel slope ≤ 2% for 6mm ≤ 17% Channel slope > 2% for 6mm ≤ 10% E channels for 6mm ≤ 30% Channel slope ≤ 2% for 2mm ≤ 11% Channel slope > 2% for 2mm ≤ 7% E channels for 2mm ≤ 25%
	Percentage of fine surface sediment < 6mm in pool tails via grid toss (reach average)	B & C channels ≤ 9% E channel: No target value Beaverhead River: No target value

Table 5-3. Sediment Targets for the Beaverhead TPA

Parameter Type	Target Description	Criterion
Channel Form and Stability	Bankfull width/depth ratio (reach average)	B stream type: > 12 and < 16 C stream type: > 12 and < 23 E & A stream types: < 12 Beaverhead River: No target value
	Entrenchment ratio (reach median)	A stream type: > 1.4
		B stream type: > 1.4-2.2
		C and E stream types: > 2.2
Instream Habitat	Residual pool depth (reach average)	< 15' bankfull width : > 0.9 (ft)
		> 15' bankfull width : > 1.4 (ft)
		Beaverhead River: No target value
	Pools/mile	< 15' bankfull width : ≥ 90
		15' - 30' bankfull width: ≥ 52
		> 30' bankfull width : ≥ 15
		Beaverhead River: No target value
Riparian Health	Percent of streambank with understory shrub cover (reach average)	≥ 56% understory shrub cover (where potential exists)
	Percent of streambank with bare ground	< 1% (recent ground disturbance)
Sediment Supply	Riffle stability index	<70 for B stream types >45 and <75 for C stream types
Biological Index	Macroinvertebrate bioassessment threshold	O/E ≥ 0.80

5.4.1.1 Fine Sediment

The percent of surface fines less than 6 mm and 2 mm is a measurement of the fine sediment on the surface of a streambed and is directly linked to the support of the coldwater fish and aquatic life beneficial uses. Increasing concentrations of surficial fine sediment can negatively affect salmonid growth and survival, clog spawning redds, and smother fish eggs by limiting oxygen availability (Irving and Bjorn, 1984; Weaver and Fraley, 1991; Shepard, et al., 1984; Suttle, et al., 2004). Excess fine sediment can also decrease macroinvertebrate abundance and taxa richness (Mebane, 2001; Zweig and Rabeni, 2001). Because similar concentrations of sediment can cause different degrees of impairment to different species, and even age classes within a species, and because the particle size defined as "fine" is variable and some assessment methods measure surficial sediment while others measure subsurface fine sediment, literature values for harmful fine sediment thresholds are highly variable. Some studies of salmonid and macroinvertebrate survival found an inverse relationship between fine sediment and survival (Suttle, et al., 2004) whereas other studies have concluded the most harmful percentage falls within 10 to 40 percent fine sediment (Bjorn and Reiser, 1991; Mebane, 2001; Relyea, et al., 2000). Bryce, et al. (2010) evaluated the effect of surficial fine sediment (via reach transect pebble counts) on fish and macroinvertebrates and found that the minimum effect level for sediment < 2mm is 13% for fish and 10% for macroinvertebrates. Literature values are taken into consideration during fine sediment target development, but because increasing concentrations of fine sediment are known to be harmful to aquatic life, targets are developed using a conservative statistical approach consistent with **Appendix B**, and consistent with Montana's water quality standard for sediment as described in **Section 3.2**.

5.4.1.1.1 Percent Fine Sediment < 6mm and < 2mm in Riffles via Pebble Count

Surface fine sediment measured in riffles by the modified (Wolman, 1954) pebble count indicates the particle size distribution across the channel width is an indicator of aquatic habitat condition that can point to excessive sediment loading. Pebble counts in 2010/2011 were performed in four riffles per sampling reach for a total of at least 400 particles.

BDNF reference data and Middle Rockies PIBO reference data were examined for fine sediment < 6 mm during the development of these targets. The BDNF reference data for pebble count was collected using the "zigzag" method, which includes both riffles and pools. The PIBO pebble count data are also a composite of riffle and pool particles. Both of these methods of collection likely result in a higher percentage of fines than a riffle pebble count, which was the method used for TMDL related data collection in the Beaverhead TPA, and because of this difference in methodology, the median statistic is applied (as discussed in **Section 5.4**) to reflect the desired condition. Targets for fine sediment < 6 mm are set at less than or equal to the median of the BDNF reference dataset **(bold** in **Table 5-4)**. The BDNF dataset is derived from regional sites and best represents target conditions.

In order to derive targets for fine sediment < 2 mm from the BDNF dataset, a ratio was determined through review of the proportionality of the 2010/2011 DEQ data. It is assumed in this watershed that the proportion of < 2 mm particles to < 6 mm particles will be relatively consistent, regardless of sediment volume. Therefore, the DEQ data, despite being taken from predominantly impaired segments, provides a resource to review this proportionality. That ratio (dividing the < 2mm median value by the <6 mm median value for both high and low gradient slopes) was then used with the BDNF reference data to develop targets for percent fines < 2mm **(bold** in **Table 5-5)**.

Values are based on slope, as high gradient reaches are typically "transport" reaches, or those reaches where slope and velocity are conducive to the movement of sediment through a system, rather than low gradient reaches, which tend to deposit sediment on the stream bottom. As a result, it is expected that transport reaches will have less percent surface fines than low gradient reaches. Due to an inherently high percentage of fines typical in Rosgen Type E channels, E channel values were examined separately. Because of the large amount of data available for E channels from the BDNF dataset, E channel targets for percent fines < 6mm are set at ≤ 30 and percent fines < 2mm are set at ≤25 based on the ratio taken from the DEQ dataset. Target values should be compared to the reach average value from pebble counts.

Table 5-4. 2010/2011 DEQ Data Summary and BDNF Reference Dataset Median Percent Fine Sediment < 6 mm. Target values are indicated in bold.

Data Source	Sample Size (n)	Parameter	Summary
BDNF reference – Channel Slope ≤ 2% (excludes E channels)	30	Median	**17**
BDNF reference - Channel Slope > 2%	49	Median	**10**
BDNF reference (E channels only)	64	Median	**30**
DEQ Sample Data – Channel Slope ≤ 2% (excludes E channels)	21	Median	32
		25th	25
DEQ Sample Data - Channel Slope > 2%	8	Median	39
		25th	29
Sample Data (E channels only)	1	Median and 25th	48

Table 5-5. 2010/2011 DEQ Data Summary and BDNF Reference Dataset Median Percent Fine Sediment < 2 mm. Target values are indicated in bold.

Data Source	Sample Size (n)	Parameter	Summary
BDNF reference – Channel Slope ≤ 2% (excludes E channels)	Extrapolated from DEQ ratio	Median	**11**
BDNF reference - Channel Slope > 2%	Extrapolated from DEQ ratio	Median	**7**
BDNF reference (E channels only)	Extrapolated from DEQ ratio	Median	**25**
DEQ Sample Data – Channel Slope ≤ 2% (excludes E channels)	21	Median	21
		25th	17
DEQ Sample Data - Channel Slope > 2%	8	Median	28
		25th	22
Sample Data (E channels only)	1	Median and 25th	24

5.4.1.1.2 Percent Fine Sediment < 6mm in Pool Tails via Grid Toss

Grid toss measurements in pool tails assess the level of fine sediment accumulation in macroinvertebrate habitat and potential fish spawning sites. A 49-point grid toss (Kramer, et al., 1993) was used to estimate the percent surface fine sediment < 6mm in pool tails in the Beaverhead TPA, and three tosses, or 147 points, were performed and then averaged for each assessed pool.

Grid toss reference data for pool tails are available from the PIBO dataset. The 75th percentile of the PIBO reference data for pool tails is 18% and the median is 9% (**Table 5-6**). PIBO performs three grid tosses at every pool encountered, and DEQ performs three grid tosses in each scour pool encountered where appropriate sized spawning gravels have been identified and the potential for spawning exists. Given that the DEQ performs a grid toss only in pools where spawning gravels exist, the resulting fines may be higher in pools found in the PIBO reference dataset, and because of this difference, the median statistic of the PIBO reference data is applied (as discussed in **Section 5.4**) to reflect the desired condition. The pool grid toss target for fine sediment less than 6 mm is set at 9%, using the median of the reference dataset. Due to an inherently high percentage of fines in Rosgen Type E channels, E channels will be evaluated independently.

Table 5-6. PIBO Reference and 2010/2011 DEQ Data Percentiles for Percent Fine Sediment < 6 mm via Grid Toss in Pool Tails. Target values are indicated in bold.

Data Source	Sample Size (n)	Parameter	Summary
PIBO Pool Tail	70	Median	**9**
		75th	18
DEQ 2010/2011 Sample Data Pool Tail	134	Median	19
		25th	11

*Each grid toss was counted as a sample

5.4.1.2 Channel Form and Stability

5.4.1.2.1 Width/Depth Ratio and Entrenchment Ratio

The width/depth ratio and the entrenchment ratio are dimensionless values representing fundamental aspects of channel morphology. Each provides a measure of channel stability, as well as an indication of the ability of a stream to transport and naturally sort sediment into a heterogeneous composition of fish habitat features (i.e., riffles, pools, and near bank zones). Changes in both the width/depth ratio and entrenchment ratio can be used as indicators of change in the relative balance between the sediment load and the transport capacity of the stream channel. As the width/depth ratio increases, streams become wider and shallower, suggesting an excess coarse sediment load (MacDonald, et al., 1991). As sediment accumulates, the depth of the stream channel decreases, which is compensated for by an increase in-channel width as the stream attempts to regain a balance between sediment load and transport capacity. Conversely, a decrease in the entrenchment ratio signifies a loss of access to the floodplain. Low entrenchment ratios signify that stream energy is concentrated in-channel during flood events versus having energy dissipation on the floodplain. Accelerated bank erosion and an increased sediment supply often accompany an increase in the width/depth ratio and/or a decrease in the entrenchment ratio (Rosgen, 1996; Knighton, 1998; Rowe, et al., 2003). Width/depth and entrenchment ratios were calculated for each 2010/2011 assessment reach based on 5 riffle cross section measurements.

Width/Depth Ratio Target Development

There is reference riffle width/depth ratio data for both the BDNF and PIBO datasets. The 2010/2011 Beaverhead dataset is primarily comprised of B and C channels and on average B channels tend to have a smaller width/depth ratio than C channels (Rosgen, 1996). The target value for width/depth ratio is based on the BDNF reference dataset, which is stratified by Rosgen channel type. The width/depth ratio target for the Beaverhead TPA for B & C channel types is set at greater than 12 and less than or equal to the 75th percentile of the reference value; and for A & E channels is set at less than 12 based on Rosgen stream type classification (**Table 5-7**).

Table 5-7. The 75th Percentiles of Reference Data used for Width/Depth Ratio Target Development

Data Source	Category	Sample Size	75th Percentile W/D
BDNF Reference	B channel type	30	**16**
BDNF Reference	C channel type	40	**23**

Entrenchment Ratio Target Development

Delineative criteria based on Rosgen stream type classification for entrenchment gives guidance of <1.4 for A, F and G streams, 1.4-2.2 for B streams, and >2.2 for C, E streams. These literature values will serve as the target ranges for entrenchment in the Beaverhead TPA **(Table 5-8)**.

Table 5-8. Entrenchment Targets for the Beaverhead TPA Based on the 25th Percentile of BDNF Reference Data

Rosgen Stream Type	Target Value
A, F, G	<1.4
B	1.4-2.2
C,E	>2.2

5.4.1.3 Instream Habitat Measures

For all instream habitat measures (i.e., residual pool depth and pool frequency), there is available reference data from PIBO. All of the instream habitat measures are important indicators of sediment input and movement as well as fish and aquatic life support, but they may be given less weight in the target evaluation if they do not seem to be directly related to sediment impacts. The use of instream habitat measures in evaluating or characterizing impairment needs to be considered from the perspective of whether these measures are linked to fine, coarse, or total sediment loading.

Residual Pool Depth

Residual pool depth, defined as the difference between the pool maximum depth and the pool tail crest depth, is a discharge-independent measure of pool depth and an indicator of the quality of pool habitat. Deep pools are important resting and hiding habitat for fish, and provide refugia during temperature extremes and high flow periods (Nielson, et al., 1994; Bonneau and Scarnecchia, 1998; Baigun, 2003). Similar to channel morphology measurements, residual pool depth integrates the effects of several stressors; pool depth can be decreased as a result of filling with excess sediment (fine or coarse), a reduction in-channel obstructions (such as large woody debris), and changes in-channel form and stability (Bauer and Ralph, 1999). A reduction in pool depth from channel aggradation may not only alter surface flow during the critical low flow periods, but may also impair fish condition by altering habitat, food availability, and productivity (May and Lee, 2004; Sullivan and Watzin, 2010). Residual pool depth is typically greater in larger systems.

The definition of pools for the PIBO protocol is fairly similar to the definition used for the 2010/2011 Beaverhead sample dataset; both define a pool as having its maximum depth greater than or equal to 1.5 times the pool tail crest depth. However, the DEQ dataset could potentially have a greater pool frequency and more pools with a smaller residual pool depth because the DEQ protocol records all pools encountered, whereas the PIBO protocol only counts pools greater than half the wetted channel.

Because of the variance between the PIBO and DEQ methods of counting pools, the residual pool depth target is equal to or greater than the PIBO median value (**bold** in **Table 5-9**). Target comparisons should be based on the reach average residual pool depth value. Because residual pool depths may indicate if excess sediment is limiting pool habitat, this parameter will be particularly valuable for future trend analysis using the data collected in 2010/2011 as a baseline. Future monitoring should document an improving trend (i.e. deeper pools) at sites which fail to meet the target criteria, while a stable trend should be documented at established monitoring sites that are currently meeting the target criteria.

Table 5-9. PIBO Reference and 2010/2011 DEQ Sample Data Percentiles for Residual Pool Depth (ft). Targets are shown in bold.

Category	PIBO Reference			DEQ Sample Data		
	n	Median	25th	n	Median	75th
< 15 ft bankfull width	9	**0.9**	0.7	18	0.6	0.8
15 - 30 ft bankfull width	40	**1.4**	1.2	5	1.3	1.6
> 30 ft bankfull width	17	**1.4**	1.2	2	0.8	0.9

Pool Frequency

Pool frequency is another indicator of sediment loading that relates to changes in-channel geometry and is an important component of a stream's ability to support the fishery beneficial use for many of the same reasons associated with the residual pool depth discussed above and also because it can be a major driver of fish density (Muhlfeld and Bennett, 2001; Muhlfeld, et al., 2001). Sediment may limit pool habitat by filling in pools with fines. Alternatively, aggradation of larger particles may exceed the stream's capacity to scour pools, thereby reducing the prevalence of this critical habitat feature. Pool frequency generally decreases as stream size (i.e., watershed area) increases.

Again, because of the difference between the PIBO and DEQ pool identification, the median statistic of the PIBO reference data is applied (as discussed in **Section 5.4**) to reflect the desired condition. The pool frequency target is equal to or greater than the PIBO median value (**bold** in **Table 5-10).** Pools per mile should be calculated based on the number of measured pools per reach and then scaled up to give a frequency per mile.

Table 5-10. PIBO Reference and 2010/2011 DEQ Sample Data Percentiles for Pool Frequency (pools/mile) and INFISH Riparian Management Objective Values. Targets are shown in bold.

Category	PIBO Reference			DEQ Sample Data		
	N	Median	25th	n	Median	75th
< 15 ft bankfull width	9	**108**	90	18	79	127
15 - 30 ft bankfull width	40	**62**	52	5	48	53
> 30 ft bankfull width	17	**17**	15	2	34	49

5.4.1.4 Riparian Health

Riparian Understory Shrub Cover

Interactions between the stream channel and the riparian vegetation along the streambanks are a vital component in the support of the beneficial uses of coldwater fish and aquatic life. Riparian vegetation provides organic material used as food by aquatic organisms and supplies LWD that influences sediment storage and channel morphology. Riparian vegetation helps filter sediment from upland runoff, stabilize streambanks, and it can provide shading, cover, and habitat for fish. During DEQ assessments conducted in 2010/2011, ground cover, understory shrub cover and overstory vegetation were cataloged at 10 to 20 foot intervals along the greenline at the bankfull channel margin along both sides of the stream channel for each monitoring reach. The percent of understory shrub cover is of particular interest in valley bottom streams historically dominated by willows and other riparian shrubs. While shrub cover is important for stream health, not all reaches have the potential for dense shrub cover or they may have the potential for a dense riparian community of a different composition, such as wetland vegetation or mature pine forest.

At the 2010/2011 assessment sites, the 75th percentile of understory shrub cover was 56%. Based on the 75th percentile, a target value of ≥ 56% is established for understory shrub cover in the Beaverhead TPA. This target value should be assessed based on the reach average greenline understory shrub cover value. Because not all reaches have the potential for dense shrub cover, for any reaches that do not meet the target value, the greenline assessment results will be more closely examined to evaluate the potential for dense riparian shrub cover.

Bare ground along Green Line

Percent bare ground is an important indicator of erosion potential, as well as an indicator of land management influences on riparian habitat. Bare ground was noted in the greenline inventory in cases where recent ground disturbance was observed, leaving bare soil exposed. Bare ground is often caused by trampling from livestock or wildlife, fallen trees, recent bank failure, new sediment deposits from overland or overbank flow, or severe disturbance in the riparian area, such as from past mining, road-building, or fire. Ground cover on streambanks is important to prevent sediment recruitment to stream channels. Sediment can wash in from unprotected areas due to snowmelt, storm runoff, or flooding. Bare areas are also much more susceptible to erosion from hoof shear. Most stream reaches have a small amount of naturally-occurring bare ground. As conditions are highly variable, this measurement is most useful when compared to reference values from best available conditions within the study area or literature values.

At the 2010/2011 assessment sites, the 25th percentile of bare ground throughout all reaches was one percent. Based on the 25th percentile, a target value of $\leq$1% is established for bare ground along the greenline for streams in the Beaverhead TPA.

5.4.1.5 Sediment Supply

Riffle Stability Index

The Riffle Stability Index (RSI) is an estimate of sediment supply in a watershed. RSI target values are established based on values calculated by Kappesser (Kappesser, 2002), who found that RSI values between 40 and 70 in B channels indicate that a stream's sediment transport capacity is in dynamic equilibrium with its sediment supply. Values between 70 and 85 indicate that sediment supplies are moderately high, while values greater than 85 suggest that a stream has excessive sediment loads. The scoring concept applies to any streams with riffles and depositional bars. Additional research on RSI values in C streams types was conducted in the St. Regis River watershed and applied in the St. Regis TMDL, for which a water quality target of greater than 45 and less than 75 was established based on Kappesser's research and local reference conditions for least-impacted stream segments. For the Beaverhead TPA an RSI target value of < 70 is established for B streams, while values of > 45 and < 75 are established for C streams. The target should be compared with the mean of measurements within a sample reach. Streams types other than B and C will need to be reviewed on a case-by-case basis.

5.4.1.6 Biological Indices

Macroinvertebrates

Siltation exerts a direct influence on benthic macroinvertebrates assemblages by filling in spaces between gravel and by limiting attachment sites. Macroinvertebrate assemblages respond predictably to siltation with a shift in natural or expected taxa to a prevalence of sediment tolerant taxa over those that require clean gravel substrates. Macroinvertebrate bioassessment scores are an assessment of the macroinvertebrate assemblage at a site, and DEQ uses one bioassessment methodology to evaluate stream condition and aquatic life beneficial-use support. Aquatic insect assemblages may be altered as a result of different stressors such as nutrients, metals, flow, and temperature, and the biological index values must be considered along with other parameters that are more closely linked to sediment.

The macroinvertebrate assessment tool used by DEQ is the Observed/Expected model (O/E). The rationale and methodology for the index is presented in the DEQ Benthic Macroinvertebrate Standard Operating Procedure (Montana Department of Environmental Quality, Water Quality Planning Bureau, 2006). The O/E model compares the taxa that are expected at a site under a variety of environmental conditions with the actual taxa that were found when the site was sampled and is expressed as a ratio of the Observed/Expected taxa (O/E value). However, scores in excess of 1.2 may not reflect the effects of sediment in the stream if there is an abundance of nutrients or a condition beyond the experience of the model, such as a large river system or a reference site not used to build the model. An O/E score of > 0.80 is established as a sediment target in the Beaverhead TPA, keeping in mind that scores over 1.2 may indicate excess nutrients or a condition beyond the experience of the model.

An index score greater than the threshold value is desirable, and the result of each sampling event is evaluated separately. Because index scores may be affected by other pollutants or forms of pollution such as habitat disturbance, they will be evaluated in consideration of more direct indicators of excess sediment. In other words, not meeting the biological target does not automatically equate to sediment impairment. Additionally, because the macroinvertebrate sample frequency and spatial coverage is typically low for each watershed and because of the extent of research showing the harm of excess sediment to aquatic life, meeting the biological target does not necessarily indicate a waterbody is fully supporting its aquatic life beneficial use. For this reason, measures that indicate an imbalance in sediment supply and/or transport capacity will also be used for TMDL development determinations.

5.4.1.7 Suspended Sediment Concentration (SSC) and Turbidity

Suspended solids consist of organic and inorganic materials that are transported to surface waters by overland flow or introduced into a system from streambank erosion. SSC is often used as an indicator of the amount of fine sediment moving through the system. Suspended sediment monitoring provides a direct measure of sediment transport dynamics, while turbidity (which is highly correlated with suspended sediment levels) provides an indirect, but more easily conducted measure of sediment. Suspended sediment and turbidity are seasonally variable and strongly correlated to stream discharge. Turbidity and suspended sediment concentrations tend to be hysteretic, with higher values on the rising limb of the hydrograph relative to the falling limb. In supply limited, high-energy stream environments, increased concentrations of suspended sediment during peak flows do not necessarily correspond to impairment of biological function.

The inherent seasonal variability of suspended sediment concentrations, and indirect link to biological impacts makes this a challenging variable to use for sediment targets. Additionally, insufficient data for turbidity and SSC exist to determine natural conditions. Therefore, sediment targets will not be expressed in terms of SSC or turbidity. This approach is taken based on the assumption that addressing other indicators of sediment will reduce SSC inputs to levels expected with reasonable land, water, and soil conservation practices in place. However, both SSC and turbidity data collected on the Beaverhead River by the USGS in 2010 will be used to support the TMDL development determination on the lower segment.

5.4.2 Existing Condition and Comparison to Water Quality Targets

This section presents summaries and evaluations of relevant water quality data for Beaverhead TPA waterbodies appearing on the Montana 2012 303(d) list. The weight-of-evidence approach described earlier in **Section 4.1**, using a suite of water quality targets, has been applied to each of the listed water quality impairments. Data presented in the section comes primarily from sediment and habitat assessments performed by DEQ during summer 2010/2011. Results of the 2010/2011 assessment are supported by additional data collected by DEQ in the DEQ Assessment Files, the Bureau of Reclamation, the USGS, KirK Engineering and Natural Resources, Hydro Solutions Inc. (HSI), and by data supplied by the Beaverhead National Forest. However, this section is not intended to provide an exhaustive review of all available data.

5.4.2.1 Beaverhead River (upper) MT41B001_010

The upper segment of the Beaverhead River is not listed for sedimentation/siltation on the 2012 303(d) List; however, it is listed for alterations in streamside or littoral vegetative covers and low flow; which are non-pollutant forms of pollution commonly linked to sediment impairment. The upper segment of the Beaverhead River flows 11.5 miles from the Clark Canyon Dam to Grasshopper Creek.

Physical Condition and Sediment Sources

In 2011, DEQ performed two cross sections at two monitoring sites on the upper segment of the Beaverhead River. The upstream site (BEAV 04-02) was located on the Clark Canyon Ranch just downstream of the HWY 15 overpass. Stream channel conditions at the reach included landform confinement and subsequent braiding when the channel opened, with several oxbows and back sloughs observed. There was some embedded cobble and few fines. Stream channel measurements at the reach resembled Rosgen type C4. Bank erosion at the reach was minimal, because of heavily vegetated riparian areas. A good portion of the riparian area was fenced-in and included water gaps, with evidence of heavy livestock grazing just outside of the riparian area adjacent to the fencing (**Figure 5-2**). The fencing has allowed the riparian area to develop quality vegetation dominated by sandbar willow, sedge along the water's edge, wetland grasses, rose, and currant.

Figure 5-2. Heavy willow browse outside of fenced riparian area

The downstream site of the upper segment of the Beaverhead River (04-05) was located at the Pipe Organ Fishing Access site just off of HWY 15, downstream of the bridge. Stream channel conditions at this reach included an abundance of sand and silt, with some embedded substrate. The reach was channelized and rip-rapped in areas. Stream channel measurements at the reach resembled Rosgen type C4. Bank erosion at the reach was minimal, with spotty erosion from recreational access to the river. The reach had several depositional bars consisting of fines along the sides of the channel. The reach had good riparian cover with sandbar willow, rose, and prickly currant in the areas that were not rip-rapped.

Comparison to Water Quality Targets
The existing data in comparison to the targets for the upper segment of the Beaverhead River are summarized in **Table 5-11** (See **Figure 5-3** for map). All bolded cells represent conditions where target values are not met.

Table 5-11. Existing Sediment-Related Data for the Upper Beaverhead River Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Riparian Health	
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm (mean)	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline % Bare Ground
BEAV 04-02	2011	98	C4	C3	8	6		40	3.4				
BEAV 04-05	2011	102	C4	C3	**21**	**20**		39	4.2				

Values that do not meet the target are in **bold**. Some parameters were not considered for targets on the Beaverhead River mainstem (parameter and values italicized).

Figure 5-3. Upper Beaverhead River DEQ Assessment Sites

See **Appendix D** for additional data collected by HSI.

Summary and TMDL Development Determination

Site BEAV 04-02 on Clark Canyon Ranch did not show signs of impairment at the time of sampling and the reach itself had abundant native wetland vegetation and the streambanks were in good condition. However, located just above the site, Clark Canyon Creek has been known to deliver large loads of fine sediment into the Beaverhead River during heavy spring precipitation events. The reservoir releases from Clark Canyon Dam have not been timed to correlate with tributary sediment discharges into the Beaverhead River, and in certain years, limited releases in the spring have resulted in large depositions of fine sediment in the upper segment of the Beaverhead River (**See Figure 5-4**). The Montana DEQ funded the Bureau of Reclamation (BOR) to perform a flushing flow analysis to determine the flows that would activate the sediment deposited from Clark Canyon Creek into the Beaverhead River (See **Attachment A** for the complete report). The result of the analysis indicates that a flow of 350 cfs may mobilize the sediment in the upper reach near the dam. The DEQ recommends that the release of 350 cfs be timed in conjunction with spring runoff events to be in accordance with reasonable water impoundment operations (ARM §17.30.636) and to meet the definition of all reasonable land, soil, and water conservation practices. It is noted however, that Montana's water quality law cannot divest, impair, or diminish legally obtained water rights, (MCA §75-5-705) and therefore meeting water rights may override managing reservoir releases to provide flushing flows for sediment mobility.

The site at Pipe Organ (BEAV 04-05) exceeded the riffle pebble count target values for fine sediment. Because of the limited amount of targets for the Beaverhead River mainstem, it is important to focus on the contribution and possible reduction from tributaries to the Beaverhead River. Excess fines in the upper segment of the Beaverhead River are related to the deposition of sediment that makes its way down from the outlet of Clark Canyon Creek. Because of the contribution of fine sediment from Clark Canyon Creek, it is important that dam releases coincide with spring runoff events, as mentioned above. Since a TMDL has been written for Clark Canyon Creek, and Clark Canyon Creek serves as the most significant source of sediment to the upper segment of the Beaverhead River, and the management and control of sediment deposition in the upper segment of the Beaverhead River is directly related to reservoir operations, no TMDL will be developed at this time for the upper segment of the Beaverhead River. It is assumed that if flushing flows are instituted to mobilize sediment in the Beaverhead River and the Clark Canyon Creek TMDL is met, sediment will not be an issue for the upper segment of the Beaverhead River.

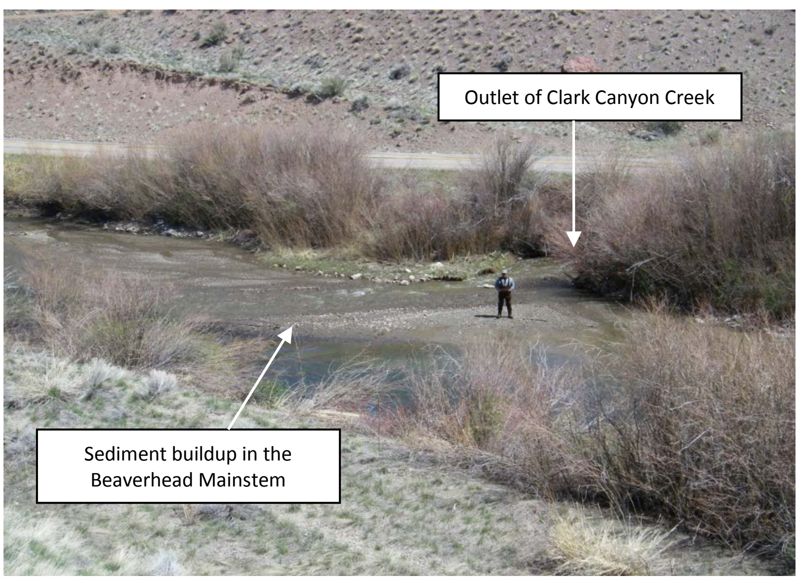

Figure 5-4. Sediment buildup in the Beaverhead River from Clark Canyon Creek (Oswald, FWP, 2009)

5.4.2.2 Beaverhead River (lower) MT41B001_020

The lower segment of the Beaverhead River is listed for sedimentation/siltation on the 2012 303(d) List. In addition, the lower segment of the Beaverhead River is also listed for alterations in streamside or littoral vegetative covers, flow alterations, and physical substrate habitat alterations; which are non-pollutant forms of pollution commonly linked to sediment impairment. The lower segment of the Beaverhead River flows 62.8 miles from Grasshopper Creek to the mouth (Jefferson River).

Physical Condition and Sediment Sources

In 2010, DEQ performed modified sediment and habitat assessments at five monitoring sites on the lower segment of the Beaverhead River. The uppermost site (BEAV 09-04) was located just below the

East Bench Canal Diversion off of Old Stage Rd. Stream channel conditions at the reach included a berm on river right from past channel manipulation and recent deposition of fill at the water's edge, with additional channel and flow manipulation for field irrigation. Stream channel measurements at the reach resembled Rosgen type C4. Within the sample reach, a layer of fines covered the gravel and cobble substrate and the reach had minimal pool habitat. Bank erosion at the site was minimal, where sandbar willow held the banks together. However, the lower quarter of the reach had some localized erosion where there was no fencing to keep grazing out of riparian area. The vegetation on river right, located next to cropland, was composed of mostly reed canary grass. Whereas the vegetation on river left, which had the riparian area fenced off from grazing and included a water gap, had high willow cover, sedge on the water's edge, grass ground cover, and decadent cottonwoods (**Figure 5-5**).

Figure 5-5. Difference in riparian cover on river right and left (BEAV 09-04)

The next site downstream (BEAV 09-06) was located on private property just above Dillon on Wheat Lane. Stream channel conditions at the reach included very thick growth of green algae and aquatic plants, which covered about 90% of the gravel and cobble substrate; with significant fines trapped by the algae and vegetation. Most of the substrate under the algae was embedded with fines and a white mineral crust. Stream channel measurements at the reach resembled Rosgen type C4. There were two types of eroding banks located at the reach; one caused by historical grazing, which was revegetating because of riparian fencing. The other type was a high bank located on outer meander bends, where the river was naturally cutting into the bank. The riparian vegetation was mostly pasture grass (including reed canary) and weeds (thistle and hounds-tongue), with some sedge and bulrush at the water's edge. There was some willow, mostly mature, with signs of historic overgrazing.

The middle site on the lower segment (BEAV 09-11) was located just north of the bridge on Anderson Lane. Stream channel conditions at the reach included a substrate dominated by sand and gravels, covered by aquatic vegetation. Any cobble present was not providing additional habitat as fines had filled in interstitial spaces. Stream channel measurements at the reach resembled Rosgen type E5. The majority of the banks were not eroding as tall grass, sedge, and willow dominated the riparian area. The meandering channel caused some erosion at outside bends. Historic grazing, resulting in a lack of established vegetation in places at outside bends, may have contributed to erosion at these locations.

There was evidence of heavy grazing historically on both river left and right; however, the riparian area was recovering with wetland vegetation cover and willows.

The fourth site on the lower segment (BEAV 09-14) was located at Beaverhead Rock, just upstream of the bridge on MT-41. Stream channel conditions at the reach included deep pools (5' to 6') and some smaller scour pools. The substrate was mostly gravel in riffles with sand interspersed, and heavy fines in slower water. Stream channel measurements at the reach resembled Rosgen type C4. River left was armored with riprap in places and eroding to fence-line in some locations. Bank erosion occurred mostly around the bridge and on river left due to grazing and riparian shrub removal. The reach was dominated by reed canary grass with some sedge, bulrush, and spike sedge at the water's edge.

The most downstream site on the lower segment of the Beaverhead River (BEAV 09-15) was located off of Silver Bow Lane, with the reach boundaries both up and downstream of the bridge. Stream channel conditions included an abundance of fine sediment, ranging from sand to clay, with some gravels and cobble. Pools were shallow throughout the reach. Stream channel measurements at the reach resembled Rosgen type C4/C5. Bank erosion occurred on outside meander bends where the stream naturally cut into the side of the bank; however, historic and current riparian grazing have left the banks with minimal vegetation and minimal deep binding root mass, increasing the vulnerability of banks to erosion. Banks were pugged throughout the reach and livestock browse was suppressing willow regeneration and reducing shrub cover. Sedges and meadow foxtail were found at the water's edge with some skunk bush, rose, snowberry, and birch in higher areas.

Comparison to Water Quality Targets

The existing data in comparison to the targets for the lower segment of the Beaverhead River are summarized in **Table 5-12**. The macroinvertebrate bioassessment data for the lower segment of the Beaverhead River is located in **Table 5-13** (See **Figure 5-6** for map). All bolded cells represent conditions where target values are not met.

Table 5-12. Existing Sediment-Related Data for the Lower Beaverhead Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Riparian Health	
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm (mean)	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline % Bare Ground
BEAV 09-04	2010	73	C4	C4	**52**	**37**		32	3.5			**51**	**2**
BEAV 09-06	2010	90	C4	C4	**43**	**36**		44	2.7			**15**	**5**
BEAV 09-11	2010	74	E5	E4				29	5.1			**39**	**9**
BEAV 09-14	2010	105	C4	C4	**43**	**38**		*46*	**3.1**			**39**	**8**
BEAV 09-15	2010	86	C4/C5	C4				38	3.2			**3**	**3**

Values that do not meet the target are in **bold**. Some parameters were not considered for targets on the Beaverhead River mainstem (parameter and values *italicized*).

Table 5-13. Macroinvertebrate Bioassessment Data for Lower Beaverhead River

Station ID	Location		Site Class	Collection Date	Collection Method	O/E
M02BVHDR01	45.183383	-112.689983	Low Valley	26-Jul-02	HESS	1.1
M08BEAVR01	45.545278	-112.335556	Low Valley	26-Jul-02	HESS	1.3
M02BVHDR01	45.183383	-112.689983	Low Valley	30-Jul-03	KICK	1.3
M08BEAVR01	45.545278	-112.335556	Low Valley	31-Jul-03	KICK	1.1
M08BEAVR01	45.545278	-112.335556	Low Valley	29-Jul-04	KICK	1.1
M02BVHDR01	45.183383	-112.689983	Low Valley	28-Jul-04	HESS	1.0
M02BVHDR01	45.183383	-112.689983	Low Valley	28-Jul-04	HESS	1.1

Values that do not meet the target are in **bold**.

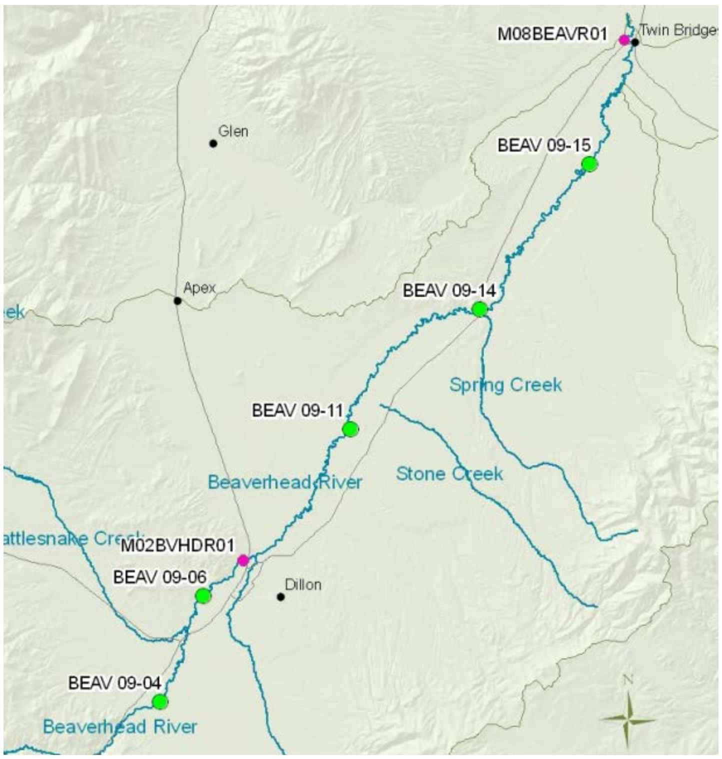

Figure 5-6. Lower Beaverhead River DEQ Assessment Sites and Macro Sites

Assessment methods were revised for some measurement variables to allow sampling in non-wadeable reaches (**see Appendix C**). Categorical data for channel substrate collected on non-wadeable reaches of the Beaverhead River are summarized in **Table 5-14**. These data provide a general picture of the size class of substrate in assessed non-wadeable reaches, but are not directly comparable to percent fine sediment data collected by Wolman pebble count.

Table 5-14. Percent of Substrate by Reach for each Cross-section per Substrate Type

Reach Id	Substrate	% of Substrate			Reach Average
		XS1	XS2	XS3	
BEAV_09_04	Silt / Clay	5	23	1	10
	Sand	60	33	44	45
	Gravel	32	35	31	32
	Cobble	3	9	25	12

Table 5-14. Percent of Substrate by Reach for each Cross-section per Substrate Type

Reach Id	Substrate	% of Substrate			Reach Average
		XS1	XS2	XS3	
BEAV_09_11	Silt / Clay	12	-	-	12
	Sand	60	-	-	60
	Gravel	28	-	-	28
	Cobble	0	-	-	0
BEAV_09_14	Silt / Clay	9	1	20	10
	Sand	42	53	43	46
	Gravel	47	39	29	38
	Cobble	2	7	8	6
BEAV_09_15	Silt / Clay	26	19	15	20
	Sand	45	31	33	36
	Gravel	28	46	46	40
	Cobble	1	4	6	4

Additional data and data summaries for longitudinal profiles and channel cross-sections from non-wadeable reaches are included in **Appendix C**. Few trends are evident from the data, but review of the cross-section plots reveals a high proportion of fine sediment in the downstream Beaverhead River reaches, and in some cross-sections of reaches further upstream.

See **Appendix D** for additional data collected by USGS and HSI.

Summary and TMDL Development Determination

All reaches sampled in 2010/2011 failed to meet fine sediment and riparian health targets. Because of the limited amount of targets for the Beaverhead River mainstem, the focus on sediment reduction will be on the tributaries to the Beaverhead River. Several tributaries including Clark Canyon Creek and Grasshopper Creek have contributed excess fines to the Beaverhead River. As discussed in **Section 5.4.2.1**, the DEQ recommends that the BOR coordinate dam releases that coincide with spring runoff events in order to flush excess sediment, coming in from tributaries, through the Beaverhead River (see **Attachment A**). The dam needs to be operated in a reasonable manner, in accordance with ARM §17.30.636, which states that owners and operators of water impoundments that cause conditions harmful to prescribed beneficial uses of state water shall demonstrate to the satisfaction of the department that continued operations will be done in the best practicable manner to minimize harmful effects. Flushing flow is considered a reasonable operation under most conditions (an exception being drought conditions) to keep from creating depositional areas harmful to fish and aquatic life. DEQ recognizes that water rights may override managing reservoir releases to provide flushing flows for sediment mobility. The BOR flushing flow analysis should be expanded to the lower portion of the Beaverhead River, beyond the irrigation diversion at Barretts, to determine the spatial distribution of sediment and the types of flows necessary to mobilize and flush sediment throughout the entire Beaverhead River.

The banks of the Beaverhead River consist primarily of reworked gravel and sand from the Neogene Sixmile Creek Formation (Thomas, Dr. R., personal communication 2011). Historic and current grazing in the riparian area and along streambanks downstream of Dillon was liberating sediment contained within the banks. Excess sediment is an issue in the Beaverhead River because of inadequate grazing management practices along the mainstem of the river, a large contribution of sediment from tributaries, and dam operations that are not currently releasing flushing flows that coordinate with spring runoff events. Therefore, a sediment TMDL will be developed for the lower segment of the Beaverhead River.

5.4.2.3 Blacktail Deer Creek MT41B002_030

Blacktail Deer Creek is listed for sedimentation/siltation on the 2012 303(d) List. In addition, Blacktail Deer Creek is listed for alterations in streamside or littoral vegetative covers and low flow; which are non-pollutant forms of pollution commonly linked to sediment impairment. Blacktail Deer Creek flows 39.9 miles from the confluence of the West and East Forks of Blacktail Deer Creek to the mouth (Beaverhead River).

Physical Condition and Sediment Sources

In 2010, DEQ performed sediment and habitat assessments at three monitoring sites on Blacktail Deer Creek. The uppermost site (BLKD 02-08) was located on the Matador Ranch, downstream of the USGS gaging station. Stream channel conditions at the reach included good pool diversity, a gravel-dominated substrate, and many meanders. Fine sediment was found close to banks and under aquatic vegetation, with moderately high fines in pool tail-outs. Stream channel measurements throughout the reach resembled Rosgen type C4 and E4. Bank erosion was mostly from low natural scour under sedges. An occasional cattle or game crossing area contributed some sediment. One high eroding bank was noted as the major source of sediment in the system and was naturally occurring on a high terraced outside meander bend. Riparian vegetation was highly diverse with sedges predominate in the understory and thick growth of willow, river birch and dogwood throughout. Some juniper encroachment was found within the floodprone area. Recent grazing had occurred in this area, but cattle access to the stream was limited, and the area seemed to be recovering from heavy historic grazing.

The middle site on Blacktail Deer Creek (BLKD 02-14) was located downstream of Buster Brown Road, east of Blacktail Road. Stream channel conditions at the reach included a few good deep pools, generally under cottonwood trees and good gravels. The channel appeared to have been straightened, with minimal overhanging vegetation and large woody debris. Stream channel measurements throughout the reach resembled Rosgen type C4/F. The reach had many eroding banks mainly due to grazing. Riparian vegetation included a narrow band of decadent cottonwoods with few, heavily browsed willow and cottonwood seedlings. Wetland graminoids were found near the water’s edge, but the understory was otherwise covered in grasses, with houndstongue and Canada thistle prevalent throughout. This reach showed signs of overgrazing.

The downstream site (BLKD 02-30) was located in Dillon at the Blacktail Meadows Fishing Access Site on Blacktail Deer Creek. Stream channel conditions at the site included many deep pools with high fines in slower water. Gravels were highly embedded with a fine layer of silt on top and a mineral crust found on rocks and other objects in the stream. Stream channel measurements throughout the reach resembled Rosgen type C4. Streambanks were mostly low naturally scoured banks, found under willows, with some banks trampled due to recreational foot traffic. One high actively eroding bank was found at a pumping site along the stream. Streambanks had moderate willow cover, with areas of reed canary grass, meadow foxtail, and wetland graminoids near the water’s edge. This reach is heavily used for recreation and had a lot of garbage, cement rubble, and rusty metal parts found in the channel.

Comparison to Water Quality Targets

The existing data in comparison to the targets for Blacktail Deer Creek are summarized in **Table 5-15**. The macroinvertebrate bioassessment data for Blacktail Deer Creek is located in **Table 5-16** (See **Figure 5-7** for map). All bolded cells represent conditions where target values are not met.

Table 5-15. Existing Sediment-Related Data for Blacktail Deer Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Riparian Health		Sediment supply
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm (mean)	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline% Bare Ground	RSI
BLKD 02-08	*2010*	*30*	*C4/E4*	*C4/E4*	**28**	**20**	**19**	*17*	*8.9*	*1.6*	**48**	**42**	**22**	
BLKD 02-14	2010	24	C4/F	C4	**22**	**17**	3	17	**1.3**	**1.3**	**42**	**38**	**6**	68
BLKD 02-30	2010	24	C4	C4	**22**	**16**	**18**	22	7.1	**1.3**	69	68	0	

Values that do not meet the target are in **bold**.

Table 5-16. Macroinvertebrate Bioassessment Data for Blacktail Deer Creek

Station ID	Location		Site Class	Collection Date	Collection Method	O/E
REFBDC	45.005278	-112.445	Mountains	30-Aug-03	WEMAP-RW	1.2
REFBDC	45.005278	-112.445	Mountains	30-Aug-03	WEMAP-TR	1.2
REFBDC	45.005278	-112.445	Mountains	06-Oct-03	WEMAP-RW	1.4
REFBDC	45.005278	-112.445	Mountains	06-Oct-03	WEMAP-TR	1.2
REFBDC	45.005278	-112.445	Mountains	13-Aug-04	HESS	0.9
REFBDC	45.005278	-112.445	Mountains	13-Aug-04	KICK	0.9
REFBDC	45.005278	-112.445	Mountains	13-Aug-04	WEMAP-RW	1.4
REFBDC	45.005278	-112.445	Mountains	13-Aug-04	WEMAP-TR	1.4

Values that do not meet the target are in **bold**.

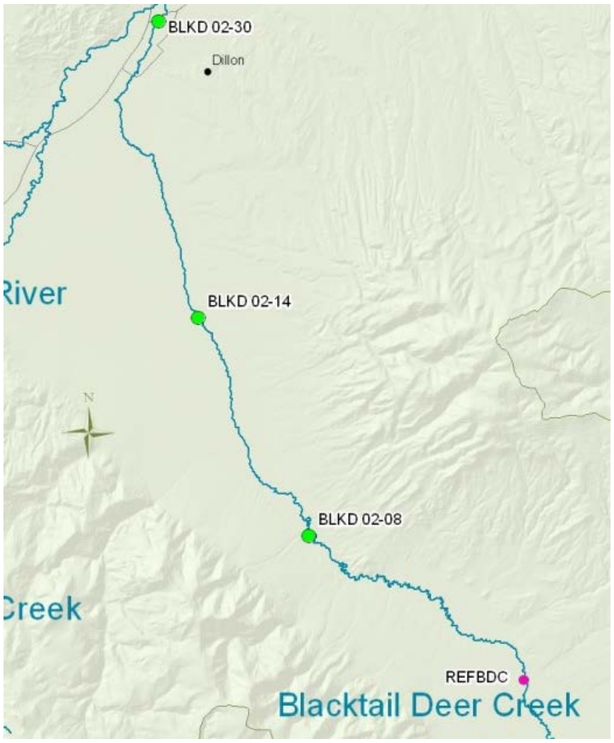

Figure 5-7. Blacktail Deer Creek DEQ Assessment Sites and Macro Sites

See **Appendix D** for additional data collected by KirK and HSI.

Summary and TMDL Development Determination

All reaches exceeded fine sediment targets in riffles and two reaches exceeded fines targets for pool tails. Both the upstream and middle reaches failed to meet pool frequency and riparian health targets. The lower and middle reach failed to meet the residual pool depth targets. Although current grazing management practices at the upper reach seemed to be allowing the riparian area to recover, shrub cover was limited by historic overgrazing within the riparian zone. Although recreational activity was liberating some bank sediment at the downstream site, throughout the majority of the stream impairment of the riparian habitat caused by historical and current grazing activities was linked to excess fine sediment loading to the stream that is likely limiting its ability to support fish and aquatic life. Therefore, a sediment TMDL will be prepared for Blacktail Deer Creek.

5.4.2.4 Clark Canyon Creek MT41B002_110

Clark Canyon Creek is listed for sedimentation/siltation on the 2012 303(d) List. In addition, Clark Canyon Creek is listed for alterations in streamside or littoral vegetative covers; which is a non-pollutant form of pollution commonly linked to sediment impairment. Clark Canyon Creek flows 8.4 miles from its headwaters to the mouth (Beaverhead River).

Physical Condition and Sediment Sources

In 2010, DEQ performed sediment and habitat assessments at two monitoring sites and a bank erosion only assessment on one site on Clark Canyon Creek. The uppermost site (CLCK 18-02), a bank erosion only site, was located on Clark Canyon Ranch property, upstream of the North Fork stream crossing. The stream channel was entrenched. Bank erosion was mostly natural with some evidence of grazing impacts. Most of the slowly eroding banks ranged from 3 to 6 feet, had a 20 degree slope, and minimal surface protection. The bank composition was made up of fines with some cobble interspersed. The actively eroding banks were lower and had evidence of hoof shear. Banks had minimal vegetated cover, mostly grasses and invasive weeds. Clark Canyon Creek had significant natural upland sediment sources (**Figure 5-8)**.

Figure 5-8. Natural upland sediment sources in Clark Canyon Creek

The middle site (CLCK 19-02) was located on Clark Canyon Ranch property. Stream channel was incised throughout the reach. Substrate was gravel and cobble with many fines in riffles and pool tail outs. Stream channel measurements throughout the reach resembled Rosgen type B4. Streambanks were scoured throughout the reach from natural high water events, and other banks were trampled from both historic and current grazing. Riparian vegetation included decadent cottonwoods, encroaching junipers, and limited shrub cover. Entrenched stream seemed to limit water access to the riparian vegetation.

The most downstream site (CLCK 32-01) was located on Clark Canyon Ranch property, just above the culvert leading under the train track and frontage road. The stream channel was entrenched in places and aggraded and braided in others, with overland flow from side channels common. There were large areas of exposed bare cobble/large gravel, including depositional areas on the floodplain. Stream channel measurements throughout the reach resembled Rosgen type B4. Streambank conditions included many actively eroding banks due to past riparian grazing, with signs of hoof shear and a lack of stabilizing riparian vegetation. Riparian vegetation seemed to be lacking due to years of overgrazing and trampling. Willows were regenerating throughout the riparian area. Cattle appeared to have been fenced out of the riparian area in recent years.

Comparison to Water Quality Targets

The existing data in comparison to the targets for Clark Canyon Creek are summarized in **Table 5-17**. The macroinvertebrate bioassessment data for Clark Canyon Creek is located in **Table 5-18** (See **Figure 5-9** for map). All bolded cells represent conditions where target values are not met.

Table 5-17. Existing Sediment-Related Data for Clark Canyon Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Riparian Health		Sediment supply
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm (mean)	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline % Bare Ground	RSI
CLKC 19-02	2010	10	B4	B3	**19**	**15**	**14**	**11**	1.7	0.9	**21**	**44**	**40**	**113**
CLKC 32-01	2010	11	B4	B3	**17**	**13**	**11**	12	1.8	0.9	**84**	**35**	**24**	**106**

Values that do not meet the target are in **bold**.

Table 5-18. Macroinvertebrate Bioassessment Data for Clark Canyon Creek

Station ID	Location		Site Class	Collection Date	Collection Method	O/E
M02CLKCC01	45.0006	-112.7822	Mountains	02-Sep-05	KICK	0.6
M02CLKCC02	45.0153	-112.8357	Low Valley	02-Sep-05	KICK	0.7
M02CLKCC03	45.0158	-112.8368	Low Valley	21-Jul-05	KICK	0.6

Values that do not meet the target are in bold.

Figure 5-9. Clark Canyon Creek DEQ Assessment Sites and Macro Sites

See **Appendix D** for additional data collected by HSI.

Summary and TMDL Development Determination

Clark Canyon Creek failed to meet fine sediment targets in pools and riffles, pool frequency targets, RSI targets, and riparian health targets. Additionally, the macroinvertebrate samples, collected during two time frames in 2005 failed to meet the Montana O/E targets. Clark Canyon Creek has a geological source of fine-grained sediment in highly erodible upland areas (concentrated in the North Fork) that are subject to mass failure and erosion. However, poor historical land management has also contributed to liberating sediments from exposed banks and removal of riparian habitat. Streambanks are composed of both cobble and fine sediment. Coarse material from streambanks has been exposed and deposited where fine sediments have washed out. Coarse sediment is mobilized during high precipitation and rain on snow events, leading to aggradation in some areas of the stream channel. Clark Canyon Creek has issues with both fine and coarse sediment and although much of the fine sediment is contributed from natural upland sources, historically poor grazing management practices have led to a sediment issue in Clark Canyon Creek and therefore a TMDL will be written. A memorandum to the FWP from Karin Boyd at Applied Geomorphology Inc. (AGI) presents several BMP recommendations for sediment reduction (see **Attachment B**)

5.4.2.5 Dyce Creek MT41B002_140

Dyce Creek is listed for sedimentation/siltation on the 2012 303(d) List. In addition, Dyce Creek is listed for alterations in streamside or littoral vegetative covers and low flow; which are non-pollutant forms of pollution commonly linked to sediment impairment. Dyce Creek flows 4.1 miles from the confluence of the East and West Forks of Dyce to Grasshopper Creek.

Physical Condition and Sediment Sources

In 2010, DEQ performed a sediment and habitat assessment at one monitoring site on Dyce Creek. The site (DYCE 02-02), was located half a mile up Rd 1878 (off of Taylor Creek Rd). Stream channel conditions included an overwidened channel, substrate of coarse gravel and few pools of low quality. Stream channel measurements throughout the reach resembled Rosgen type C4. Bank erosion was widespread, primarily due to bank trampling and pugging from riparian grazing. Riparian vegetation included browsed sedges on lower banks and willows. This reach showed signs of historic and current overgrazing. Additionally, the Dillon Field Office of the BLM notes that historic placer mining has altered the stream dimension, pattern, profile, and likely the bed materials. Sediment from ongoing recreational placer mining continues to impact the stream and the Westslope Cutthroat Trout population.

Comparison to Water Quality Targets

The existing data in comparison to the targets for Dyce Creek are summarized in **Table 5-19**. The macroinvertebrate bioassessment data for Dyce Creek is located in **Table 5-20** (See **Figure 5-10** for map). All bolded cells represent conditions where target values are not met.

Table 5-19. Existing Sediment-Related Data for Dyce Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Riparian Health	
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm (mean)	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline % Bare Ground
DYCE 02-02	2010	9	C4	C3	**42**	**30**	**36**	17	20.3	**0.5**	**42**	**29**	0

Values that do not meet the target are in **bold**.

Table 5-20. Macroinvertebrate Bioassessment Data for Dyce Creek

Station ID	Location		Site Class	Collection Date	Collection Method	O/E
M02DYCEC01	45.275	-113.03333	Mountains	07-Jul-04	KICK	0.98
M02DYCEC02	45.238	-113.04111	Mountains	07-Jul-04	KICK	**0.50**

Values that do not meet the target are in **bold**.

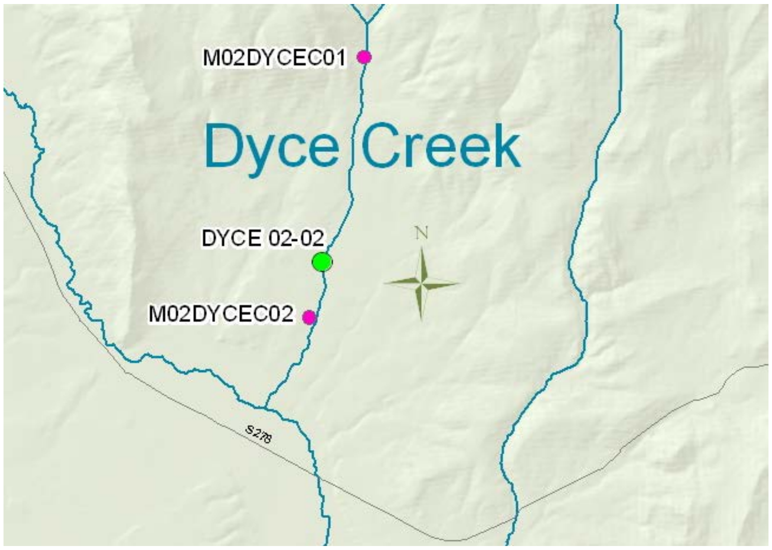

Figure 5-10. Dyce Creek DEQ Assessment Site and Macro Sites

See **Appendix D** for additional data collected by HSI.

Summary and TMDL Development Determination
Fine sediment targets were well exceeded in both riffles and pools at the reach in Dyce Creek. Pool frequency and residual pool depth failed to meet target values. Riparian health throughout the reach was compromised because of recent browse. The lower macroinvertebrate site failed to meet its target in 2004. Current and historic grazing practices contribute to high fine sediment percentages within the stream, which is likely limiting its ability to support fish and aquatic life. Because fine sediment targets were more than double the target values in both riffles and pools; and pool habitat targets were not met, a sediment TMDL will be written for Dyce Creek.

5.4.2.6 Farlin Creek MT41B002_020
Farlin Creek is listed for sedimentation/siltation on the 2012 303(d) List. In addition, Farlin Creek is listed for alterations in streamside or littoral vegetative covers; which is a non-pollutant form of pollution commonly linked to sediment impairment. Farlin Creek flows 6 miles from its headwaters to the mouth (Grasshopper Creek).

Physical Condition and Sediment Sources
In 2010, DEQ performed a sediment and habitat assessment at one monitoring site on Farlin Creek. The site (FARL 28-01), was located off of HWY 278, just before Polaris, upstream from the schoolhouse. Stream channel conditions included an incised and overwidened channel with few gravels, high loads of fine sediment, and pools of generally low quality. Stream channel measurements throughout the reach resembled Rosgen type C4. Bank erosion was widespread due to hoof shear, trampling, and removal of riparian vegetation from overgrazing. Riparian vegetation includes decadent shrubs and pasture grasses, with limited shrub regeneration because of livestock grazing.

Comparison to Water Quality Targets

The existing data in comparison to the targets for Farlin Creek are summarized in **Table 5-21**. The macroinvertebrate bioassessment data for Farlin Creek is located in **Table 5-22** (See **Figure 5-11** for map). All bolded cells represent conditions where target values are not met.

Table 5-21. Existing Sediment-Related Data for Farlin Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Streamside Habitat	
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm (mean)	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline % Shrub Cover
FARL 28-01	2010	7	C4	C3	**42**	**25**	**80**	**10**	2.7	**0.7**	148	**46**	1

Values that do not meet the target are in **bold**.

Table 5-22. Macroinvertebrate Bioassessment Data for Farlin Creek

Station ID	Location		Site Class	Collection Date	Collection Method	O/E
M02FRLNC01	45.338889	-113.12	Mountains	07-Jul-04	KICK	0.9

Values that do not meet the target are in **bold**.

Figure 5-11. Farlin Creek DEQ Assessment Site and Macro Site

See **Appendix D** for additional data collected by HSI.

Summary and TMDL Development Determination

Fine sediment in the reach was more than double the target value in riffles and more than eight times the target value in pools. Residual pool depth failed to meet the target value. Riparian health throughout the reach was limited from recent livestock grazing. Bank trampling, erosion, and removal of riparian vegetation from current grazing contribute to high fine sediment percentages within the stream, which is likely limiting its ability to support fish and aquatic life. Because fine sediment targets were more than double the target values in riffles and far exceeded target values in pools; and residual pool depth and shrub cover targets were not met, a sediment TMDL will be written for Farlin Creek.

5.4.2.7 French Creek MT41B002_100

French Creek is listed for sedimentation/siltation on the 2012 303(d) List. In addition, French Creek is listed for alterations in streamside or littoral vegetative covers; which is a non-pollutant form of pollution commonly linked to sediment impairment. French Creek flows 6.5 miles from its headwaters to the mouth (Rattlesnake Creek).

Physical Condition and Sediment Sources

In 2010, DEQ performed a sediment and habitat assessment at one monitoring site on French Creek. The site (FREN 23-01), was located off of Argenta Rd on USFS land. Stream channel has been altered from historic placer mining, with many fines and small gravel moving through the system. Stream channel measurements throughout the reach resembled Rosgen type B4. Bank erosion was limited to slowly eroding banks located on both sides of the reach. Riparian vegetation included good cover of willows and aspen, with riparian forbs and shrubs in the understory. The reach showed signs of impact from historic grazing and upstream mining. The road that parallels the stream may be an additional source of sediment.

Comparison to Water Quality Targets

The existing data in comparison to the targets for French Creek are summarized in **Table 5-23 (**See **Figure 5-12** for map**)**. All bolded cells represent conditions where target values are not met.

Table 5-23. Existing Sediment-Related Data for French Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Riparian Health	
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm (mean)	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline % Bare Ground
FREN 23-01	2010	7	B4	B3	**33**	**27**	**10**	**11**	2.0	**0.6**	127	70	**6**

Values that do not meet the target are in **bold**.

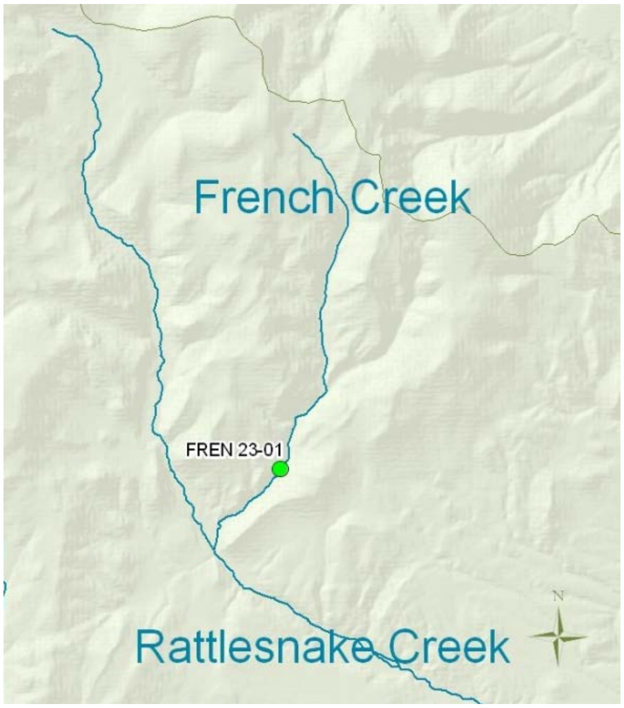

Figure 5-12. French Creek DEQ Assessment Site

See **Appendix D** for additional data collected by USFS, KirK, and HSI.

Summary and TMDL Development Determination
Fine sediment in the reach exceeded the target values in both riffles and pools. Both the width to depth ratio and residual pool depth failed to meet target values. Historic mining and grazing impacts and parallel road segments contribute sediment to the stream, which is likely limiting its ability to support fish and aquatic life. Because fine sediment targets were exceeded in both riffles and pools, and width to depth ratio, residual pool depth, and bare ground targets were not met, a sediment TMDL will be written for French Creek.

5.4.2.8 Grasshopper Creek MT41B002_010
Grasshopper Creek is not listed for sedimentation/siltation on the 2012 303(d) List; however, it is listed for alterations in streamside or littoral vegetative covers and low flow; which are non-pollutant forms of pollution commonly linked to sediment impairment. Grasshopper Creek flows 47.5 miles from its headwaters to the mouth (Beaverhead River).

Physical Condition and Sediment Sources
In 2010, DEQ performed sediment and habitat assessments at two monitoring sites on Grasshopper Creek. The first site (GRAS 12-01), was located off of HWY 278, approximately 1.5 miles east of the W. Taylor Creek Rd. Stream channel was overwidened, with an embedded gravel substrate. Stream channel measurements throughout the reach resembled Rosgen type C4. The majority of streambanks were naturally scoured below the roots, with significant erosion at animal crossings and at banks with hoof shear. Riparian vegetation was dominated by sedge and rush; with some pasture grass, riparian forbs, thistle, and browsed willows. Possible impacts from human sources include historic and current grazing and flow manipulation from irrigation use.

The downstream site (GRAS 20-11) was located off of I-15 south of Dillon, following the dirt road that parallels Grasshopper Creek to the USGS gaging station. The stream channel was entrenched and very sinuous, with deep and frequent pools. The substrate had some embedded gravels, and silt to coarse sand in depositional areas. Stream channel measurements throughout the reach resembled Rosgen type C4. Bank erosion conditions included natural scour at low and medium bank heights, with some high unstable and actively eroding banks where the stream had cut into high terraces with pasture grasses. The majority of the riparian area was severely degraded, with minimal willow regeneration. Herbaceous wetland vegetation was observed on low terraces, but was usually grazed. Human impacts include intense current grazing pressure.

Comparison to Water Quality Targets

The existing data in comparison to the targets for Grasshopper Creek are summarized in **Table 5-24**. The macroinvertebrate bioassessment data for Grasshopper Creek is located in **Table 5-25** (See **Figure 5-13** for map). All bolded cells represent conditions where target values are not met.

Table 5-24. Existing Sediment-Related Data for Grasshopper Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Riparian Health		Sediment Supply
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm (mean)	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline % Bare Ground	RSI
GRAS 12-01	2010	33	C4	C4	**25**	**13**	6	**27**	10.4	**1.0**	63	**30**	**18**	**86**
GRAS 20-11	2010	29	C4	C4	**29**	**21**	**31**	**24**	**1.5**	2.3	**42**	**55**	**14**	

Values that do not meet the target are in **bold**.

Table 5-25. Macroinvertebrate Bioassessment Data for Grasshopper Creek

Station ID	Location		Site Class	Collection Date	Collection Method	O/E
PIBO_2649			Mountains	20-Aug-08	Surber	**0.6**
M02GHPRC01	45.474444	-113.12	Mountains	15-Sep-04	KICK	0.8
M02GHPRC01	45.474444	-113.12	Mountains	15-Sep-04	WEMAP-RW	**0.7**
M02GHPRC01	45.474444	-113.12	Mountains	15-Sep-04	WEMAP-TR	**0.7**

Values that do not meet the target are in **bold**.

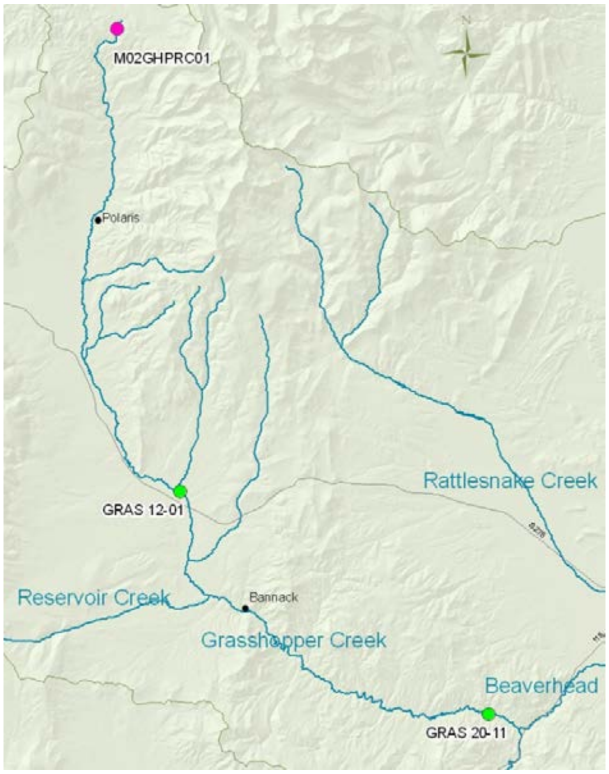

Figure 5-13. Grasshopper Creek DEQ Assessment Sites and Macro Site

See **Appendix D** for additional data collected by the USFS and HSI.

Summary and TMDL Development Determination
There were several exceedances of sediment targets in Grasshopper Creek. The upper site met its targets only in pool frequency and the pool grid toss. The lower site failed to meet every target except for residual pool depth. The macroinvertebrate samples, collected at both PIBO and DEQ sites, failed to meet the Montana O/E target in both 2004 and 2008 (with the exception of the sample collected using the kick method). Collectively, the field measurements and observations indicate that fine sediment liberated from exposed banks due to current grazing, impairment of the riparian habitat caused by historical activities and current overgrazing, and placer mining operations downstream from Bannack are all linked to excess sediment loading to the stream that is likely limiting its ability to support fish and aquatic life. Stakeholders have also expressed concern regarding the sediment contribution to the Beaverhead River from Grasshopper Creek. Therefore, a sediment TMDL will be prepared for Grasshopper Creek.

5.4.2.9 Rattlesnake Creek (upper) MT41B002_091
Upper Rattlesnake Creek is listed for sedimentation/siltation on the 2012 303(d) List. In addition, upper Rattlesnake Creek is listed for alterations in streamside or littoral vegetative covers; which is a non-pollutant form of pollution commonly linked to sediment impairment. Upper Rattlesnake Creek flows 18.3 miles from the headwaters to Dillon PWS off-channel well (T7S R10W S11).

Physical Condition and Sediment Sources
In 2010, DEQ performed a sediment and habitat assessment at one monitoring site on upper Rattlesnake Creek. The site (RATT 54-04), was located off of Argenta Rd on private land. Stream channel

was split throughout the reach, with poorly formed pools, embedded sediment, and many fines throughout the reach. Stream channel measurements throughout the reach resembled Rosgen type C3. Bank erosion occurred mostly because of extensive grazing in the area. Riparian vegetation included large willows, alder, birch, red osier dogwood. Grazing was having a major impact on the reach, causing extensive bank erosion and fines contribution at animal crossings.

Comparison to Water Quality Targets

The existing data in comparison to the targets for the upper segment of Rattlesnake Creek are summarized in **Table 5-26**. The macroinvertebrate bioassessment data for the upper segment of Rattlesnake Creek is located in **Table 5-27** (See **Figure 5-14** for map). All bolded cells represent conditions where target values are not met.

Table 5-26. Existing Sediment-Related Data for Upper Rattlesnake Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Riparian Health	
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm (mean)	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline % Bare Ground
RATT 54-04	2010	18	C3	C3	**23**	**19**	**12**	15	5.0	**1.3**	53	86	**18**

Values that do not meet the target are in **bold**.

Table 5-27. Macroinvertebrate Bioassessment Data for Upper Rattlesnake Creek

Station ID	Location		Site Class	Collection Date	Collection Method	O/E
M02RATSC01	45.29611	-112.90528	Mountains	20-Jul-04	KICK	0.9

Values that do not meet the target are in **bold**.

Figure 5-14. Upper Rattlesnake Creek DEQ Assessment Site and Macro Site

See **Appendix D** for additional data collected by HSI.

Summary and TMDL Development Determination

Fine sediment targets were exceeded in both riffles and pools at the reach in the upper segment of Rattlesnake Creek. Residual pool depth in the reach was just below the target value. The reach failed to meet one of the riparian health targets because of extensive bare ground at animal crossings. The upper segment of Rattlesnake Creek was heavily grazed, and eroding banks and animal crossings were contributing sediment loading to the stream that is likely limiting its ability to support fish and aquatic life. Because fines were notably high in field observations and field measurements showed that fine sediment targets were not being met, a sediment TMDL will be written for the upper segment of Rattlesnake Creek.

5.4.2.10 Rattlesnake Creek (lower) MT41B002_090

Lower Rattlesnake Creek is listed for sedimentation/siltation and solids on the 2012 303(d) List. In addition, lower Rattlesnake Creek is listed for alterations in streamside or littoral vegetative covers and low flow; which are non-pollutant forms of pollution commonly linked to sediment impairment. Lower Rattlesnake Creek flows 8.8 miles from the Dillon PWS off-channel well (T7S R10W S11) to the mouth (Van Camp Sough).

Physical Condition and Sediment Sources

In 2010, DEQ performed a sediment and habitat assessment at one monitoring site on lower Rattlesnake Creek. The site (RATT 60-04), was located off of HWY 287 on private land. Stream channel was dewatered, and has been channelized, with very with few pools (of low quality) and little habitat diversity. Stream channel measurements throughout the reach resembled Rosgen type C4/E. Bank erosion was minimal throughout the reach because banks are held together with sedge and other grasses, and stream energy is low. There were signs of seasonal grazing, but flow manipulation seemed to be the major influence on this reach.

Comparison to Water Quality Targets

The existing data in comparison to the targets for the lower segment of Rattlesnake Creek are summarized in **Table 5-28**. The macroinvertebrate bioassessment data for the lower segment of Rattlesnake Creek is located in **Table 5-29** (See **Figure 5-15** for map). All bolded cells represent conditions where target values are not met.

Table 5-28. Existing Sediment-Related Data for Lower Rattlesnake Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Riparian Health	
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm (mean)	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline % Bare Ground
RATT 60-04	2010	5	F	C4/E	**33**	**21**	**25**	16	3.2	**0.5**	**21**	**0**	0

Values that do not meet the target are in **bold**.

Table 5-29. Macroinvertebrate Bioassessment Data for Lower Rattlesnake Creek

Station ID	Location		Site Class	Collection Date	Collection Method	O/E
M02RATSC02	45.2069444	-112.758611	Low Valley	20-Jul-04	KICK	0.9

Values that do not meet the target are in **bold**.

Figure 5-15. Lower Rattlesnake Creek DEQ Assessment Site and Macro Site

See **Appendix D** for additional data collected by HSI.

Summary and TMDL Development Determination

Fine sediment targets were exceeded in both riffles and pools at the reach in the lower segment of Rattlesnake Creek. Both instream pool habitat targets were not met. The reach failed to meet the target value for shrub cover and was entirely comprised of grasses and sedges as it was located in the middle of an agricultural field. Flow just upstream of the reach across HWY 278 appeared to be at least double of that at the reach. The lower segment of Rattlesnake Creek is located in primarily agricultural land, and flow is diverted for irrigation purposes. Fines from upstream sources were accumulating in this reach as stream energy was very low. Because fines were notably high in field observations and field measurements showed that fine sediment targets were not being met, a sediment TMDL will be written for the lower segment of Rattlesnake Creek. The lower segment of Rattlesnake Creek is also listed for solids (suspended bedload), which is a pollutant that falls within the sediment pollutant category. In developing the sediment TMDL, it is assumed that solids are also addressed since satisfying the sediment TMDL targets and sediment allocations addressing both fine and coarse sediment, will result in conditions consistent with reference or naturally occurring conditions.

5.4.2.11 Reservoir Creek MT41B002_120

Reservoir Creek is listed for sedimentation/siltation on the 2012 303(d) List. In addition, Reservoir Creek is listed for alterations in streamside or littoral vegetative covers; which is a non-pollutant form of pollution commonly linked to sediment impairment. Reservoir Creek flows 12.2 miles from its headwaters to the mouth (Grasshopper Creek).

Physical Condition and Sediment Sources

In 2010, DEQ performed a sediment and habitat assessment at one monitoring site on Reservoir Creek. The site (RESR 11-01), was located off of Reservoir Creek Rd on state land. The stream channel was overwidened, with low quality pools and excess fines. Stream channel measurements throughout the reach resembled Rosgen type C4. Bank erosion included both naturally scoured banks and banks eroding due to past and current grazing. Riparian vegetation included decadent willows, sedge, rush, a variety of grasses, milk thistle and Canada thistle. Historic and current grazing have increased sediment and reduced habitat on this reach; however, the reach had not been recently grazed and appeared to be recovering with good riparian vegetation cover.

Comparison to Water Quality Targets

The existing data in comparison to the targets for Reservoir Creek are summarized in **Table 5-30**. The macroinvertebrate bioassessment data for Reservoir Creek is located in **Table 5-31** (See **Figure 5-16** for map). All bolded cells represent conditions where target values are not met.

Table 5-30. Existing Sediment-Related Data for Reservoir Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Riparian Health	
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm (mean)	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline % Bare Ground
RESR 11-01	2010	6	C4	C4	**28**	**17**	**16**	12	3.0	**0.7**	127	57	**6**

Values that do not meet the target are in **bold**.

Table 5-31. Macroinvertebrate Bioassessment Data for Reservoir Creek

Station ID	Location		Site Class	Collection Date	Collection Method	O/E
M02RESVC01	45.14306	-113.198	Mountains	14-Jul-04	KICK	0.9
M02RESVC02	45.14778	-113.123	Mountains	19-Jul-04	KICK	**0.6**

Values that do not meet the target are in **bold**.

Figure 5-16. Reservoir Creek DEQ Assessment Site and Macro Sites

See **Appendix D** for additional data collected by HSI.

Summary and TMDL Development Determination

Fine sediment targets were exceeded in both riffles and pools at the reach in Reservoir Creek. Residual pool depth and the bare ground riparian health measurements in the reach failed to meet target values. In 2004, the lower macroinvertebrate site failed to meet the O/E target value. Historic and recent grazing practices have contributed sediment loading to the stream that is likely limiting its ability to support fish and aquatic life. Because fines were high in field observations and field measurements showed that fine sediment targets were not being met, a sediment TMDL will be written for Reservoir Creek.

5.4.2.12 Scudder Creek MT41B002_180

Scudder Creek is listed for sedimentation/siltation on the 2012 303(d) List. In addition, Scudder Creek is listed for alterations in streamside or littoral vegetative covers; which is a non-pollutant form of pollution commonly linked to sediment impairment. Scudder Creek flows 4.7 miles from its headwaters to the mouth (Grasshopper Creek).

Physical Condition and Sediment Sources

In 2010, DEQ performed a sediment and habitat assessment at one monitoring site on Scudder Creek. The site (SCUD 11-01), was located off of Scudder Creek Rd. (accessed from the Pioneer Mountains Scenic Byway) on private land. The stream channel was overwidened in areas and incised in others, with shallow and short pools filled with fine sediment. Stream channel measurements throughout the reach resembled Rosgen type B5. Bank erosion occurred mostly due to bank trampling, with some low banks having natural scour. Riparian vegetation included decadent willows, sedge, rush, pasture grass, and Canada thistle. The main influence on the reach was current grazing which was causing bank shear and channel widening.

Comparison to Water Quality Targets

The existing data in comparison to the targets for Reservoir Creek are summarized in **Table 5-32**. The macroinvertebrate bioassessment data for Reservoir Creek is located in **Table 5-33** (See **Figure 5-17** for map). All bolded cells represent conditions where target values are not met.

Table 5-32. Existing Sediment-Related Data for Scudder Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Riparian Health	
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm (mean)	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline % Bare Ground
SCUD 11-01	2010	4	B5	B4	**68**	**31**	**87**	**9**	**3.3**	**0.4**	127	68	0

Values that do not meet the target are in **bold**.

Table 5-33. Macroinvertebrate Bioassessment Data for Scudder Creek

Station ID	Location		Site Class	Collection Date	Collection Method	O/E
M02SCDRC01	45.306944	-113.095278	Mountains	19-Jul-04	JAB	**0.5**

Values that do not meet the target are in **bold**.

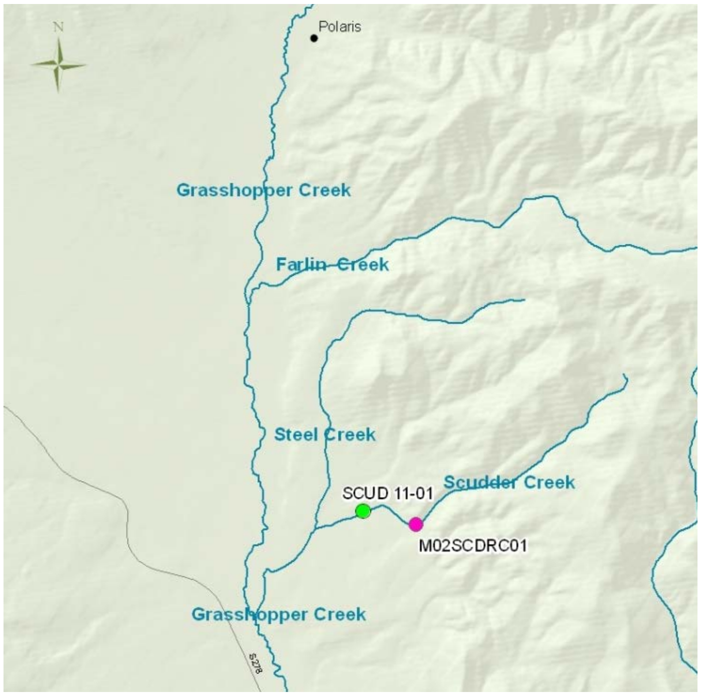

Figure 5-17. Scudder Creek DEQ Assessment Site and Macro Site

See **Appendix D** for additional data collected by HSI.

Summary and TMDL Development Determination

Measurements taken within the reach failed to meet fine sediment targets in both riffles and pools, channel form targets, and residual pool depth and macroinvertebrate target values. Fines sediment in the stream is of particular concern, as target values were well exceeded in riffles and fines in pools were almost ten times the target value. Current grazing has affected the stream and trampled banks were loading sediment to the stream that is likely limiting its ability to support fish and aquatic life. Fish were observed throughout the reach. Because fines were notably high in field observations and field measurements showed that fine sediment targets were well exceeded, a sediment TMDL will be written for Scudder Creek.

5.4.2.13 Spring Creek MT41B002_080

Spring Creek is listed for sedimentation/siltation on the 2012 303(d) List. In addition, Spring Creek is listed for alterations in streamside or littoral vegetative covers and low flow; which are non-pollutant forms of pollution commonly linked to sediment impairment. Spring Creek flows 14.9 miles from its headwaters to the mouth (Beaverhead River).

Physical Condition and Sediment Sources

In 2010, DEQ performed a sediment and habitat assessment at one monitoring site on Spring Creek. The site (SPRG 30-01), was located off of Spring Creek Rd on private land. The stream channel was incised with many fines moving through the system, and few pools. Groundwater was seeping in at mid-bank. Stream channel measurements throughout the reach resembled Rosgen type G4. Bank erosion was severe and widespread from channel downcutting and trampled banks. Riparian vegetation was minimal with mostly raw banks or banks covered in Canada thistle and pasture grass. Some wetland vegetation was starting to form on new low terrace. Historic and current grazing pressure was contributing to deteriorating channel conditions in the reach.

Comparison to Water Quality Targets
The existing data in comparison to the targets for Spring Creek are summarized in **Table 5-34** (See **Figure 5-18** for map). All bolded cells represent conditions where target values are not met.

Table 5-34. Existing Sediment-Related Data for Spring Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Riparian Health	
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm (mean)	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline % Bare Ground
SPRG 30-01	2011	5	G4	C4	**28**	**12**	**29**	**7**	**1.7**	**0.6**	**74**	**9**	**26**

Values that do not meet the target are in **bold**.

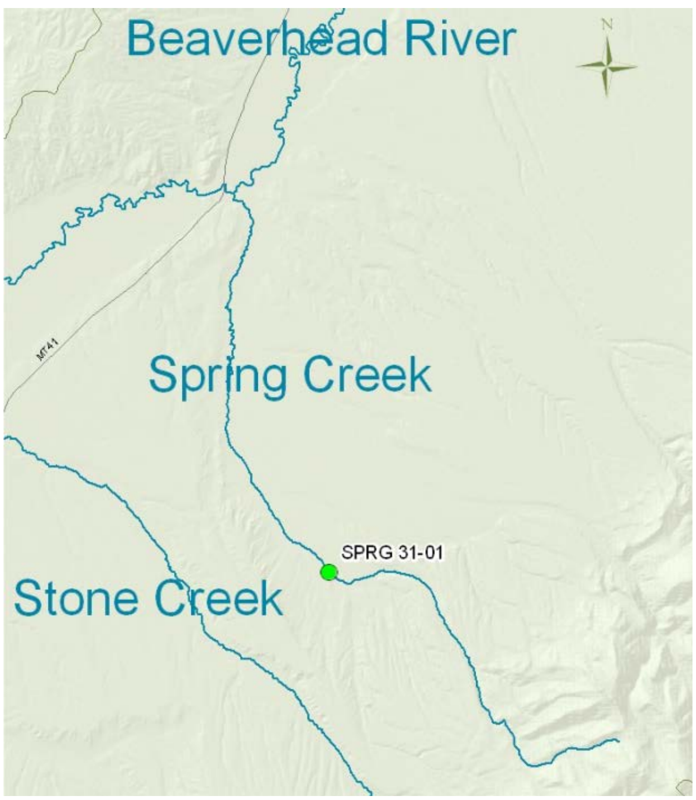

Figure 5-18. Spring Creek DEQ Assessment Site

See **Appendix D** for additional data collected by KirK and HSI.

Summary and TMDL Development Determination

All parameters measured at the reach in Spring Creek failed to meet target values. Grazing, both historical and current, has had an effect on the upper portion of the stream. The lower portion of Spring Creek was in agricultural land, to which DEQ was denied access. The stream channel was incised at the reach and bank erosion was severe and widespread, with little to no vegetative cover, contributing sediment loading to the stream that is likely limiting its ability to support fish and aquatic life. Because fines were notably high in field observations and field measurements showed that all targets were not being met, a sediment TMDL will be written for Spring Creek.

5.4.2.14 Steel Creek MT41B002_160

Steel Creek is listed for sedimentation/siltation and solids on the 2012 303(d) List. In addition, Steel Creek is listed for alterations in streamside or littoral vegetative covers; which is a non-pollutant form of pollution commonly linked to sediment impairment. Steel Creek flows 3.8 miles from its headwaters to the mouth (Driscol Creek).

Physical Condition and Sediment Sources

In 2010, DEQ performed a full sediment and habitat assessment at one monitoring site and one visual assessment on Steel Creek. The fully assessed site (STEL 05-01), was located off of a USFS road from Scudder Rd on BLM land. The stream channel was steeper at the top of the reach and alternated between riffle and run sections and had very few and shallow pools. Stream channel measurements throughout the reach resembled Rosgen type A5. Banks were generally low, well vegetated, and pugged throughout the reach, creating small islands where browsed willows were holding the sediment together. Riparian overstory was dominated by aspen and alder with some willow, prickly currant, and rose on the ground. Regeneration of willows was limited by heavy browse and understory was predominately pasture grasses with some sedge cover. This reach was heavily grazed.

The downstream reach (STEL 10-01) that was visually assessed was located just off of Scudder Rd. The stream channel was dry at the reach in both the fall of 2010 and the spring of 2011. The lower end of the reach had a dry defined channel with long eroding banks (**Figure 5-19**). Moving up the reach, the stream channel remained dry and was difficult to define. The substrate was a mix of fines and gravel, with a few cobble noted in mid-reach. Stream appears to sink at slope change where the alluvial fan begins. The reach had long banks at the bottom of the reach that were approximately three feet high and composed of fines. Vegetation at the downstream end of the reach to the lower end of the wetted channel was composed of sagebrush with a few grasses. Human impacts include historic and current grazing throughout the reach.

Figure 5-19. Steel Creek – Dry channel

Comparison to Water Quality Targets

The existing data in comparison to the targets for Steel Creek are summarized in **Table 5-35** (See **Figure 5-20** for map). All bolded cells represent conditions where target values are not met.

Table 5-35. Existing Sediment-Related Data for Steel Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Riparian Health	
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm (mean)	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline % Bare Ground
STEL 05-01	2011	3	A5	A4	**69**	**54**		8	3.1	**0.5**	**53**	60	0

Values that do not meet the target are in **bold**.

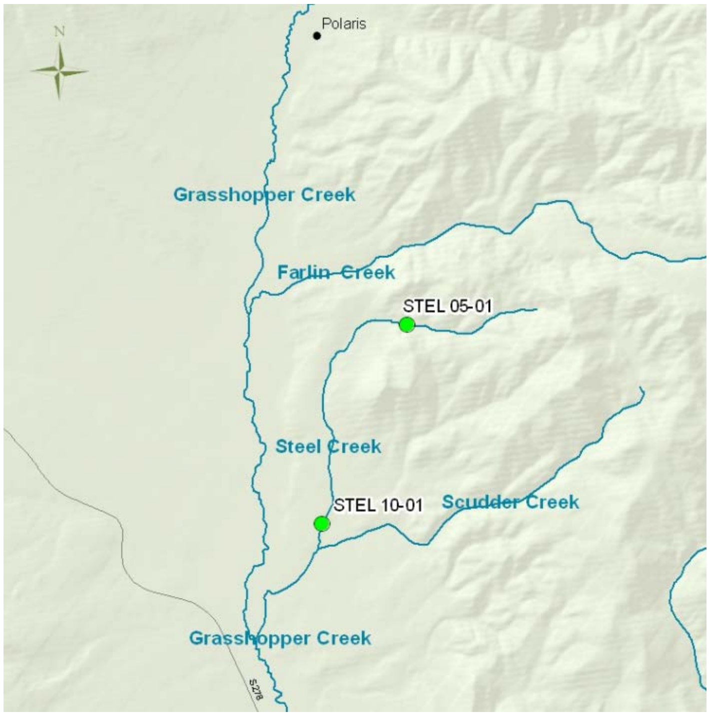

Figure 5-20. Steel Creek DEQ Assessment Sites

Summary and TMDL Development Determination

Fine sediment targets were exceeded in both riffles and pools at the upper reach in Steel Creek. Both instream pool habitat targets were not met. Fine sediment measurements in riffles were seven times the target values. The stream banks were trampled from cattle, contributing fine sediment to the stream that is likely limiting its ability to support fish and aquatic life. Because of the grazing practices throughout the stream and fine sediment targets were well exceeded, a sediment TMDL will be written for Steel Creek. Steel Creek is also listed for solids (suspended bedload), which is a pollutant that falls within the sediment pollutant category. In developing the sediment TMDL, it is assumed that solids are also addressed since satisfying the sediment TMDL targets and sediment allocations addressing both fine and coarse sediment, will result in conditions consistent with reference or naturally occurring conditions.

5.4.2.15 Stone Creek (upper) MT41B002_132

Upper Stone Creek is listed for sedimentation/siltation and turbidity on the 2012 303(d) List. In addition, upper Stone Creek is listed for alterations in streamside or littoral vegetative covers and low flow; which are non-pollutant forms of pollution commonly linked to sediment impairment. Upper Stone Creek flows 10 miles from the confluence of the Left and Middle forks to the confluence of an unnamed tributary (T6S R7W S34).

Physical Condition and Sediment Sources

In 2010, DEQ performed full sediment and habitat assessments at two monitoring sites on upper Stone Creek. The upstream site (STON 05-01), was located off of Stone Creek Rd on private land. The stream channel was incised throughout most of the channel and overwidened at animal crossings. Armoring set along the channel to stabilize banks was cutting off the stream from the floodplain and increasing stream energy. The channel substrate was fairly embedded with excess fines moving through the system. Stream channel measurements throughout the reach resembled Rosgen type B/G. Bank erosion throughout the reach was caused by livestock hoof shear. Banks have been armored in some areas, with large cobble and boulders held together by rebar. Riparian vegetation includes several shrub species, pasture grasses, thistle, houndstongue, and encroaching juniper. Historic and current grazing pressure was affecting the reach with sheared and trampled banks and browsed vegetation.

The downstream site on upper Stone Creek (STON 20-02) was located off of Stone Creek Rd. on private land. The channel was incised, with few pools of poor quality, no large woody debris, and an abundance of fines. The channel has been manipulated and resembles and irrigation ditch. Stream channel measurements throughout the reach resembled Rosgen type F. Banks were low-slowly eroding with very low shear stress all throughout the reach. Riparian vegetation was dominated by upland pasture grass with Canada thistle, cocklebur, and houndstongue. Very few herbaceous riparian species were found. Human influences on the stream include agriculture and some previous grazing.

Comparison to Water Quality Targets

The existing data in comparison to the targets for the upper segment of Stone Creek are summarized in **Table 5-36** (See **Figure 5-21** for map). All bolded cells represent conditions where target values are not met.

Table 5-36. Existing Sediment-Related Data for Upper Stone Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Riparian Health	
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm (mean)	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline % Bare Ground
STON 05-01	2010	7	B4/G	B4	**36**	**31**	**11**	**11**	2.1	**0.6**	127	**41**	**12**
STON 20-02	2010	6	F4	C4	**56**	**54**	**42**	**7**	**2.0**	**0.6**	**21**	**0**	**12**

Values that do not meet the target are in **bold**.

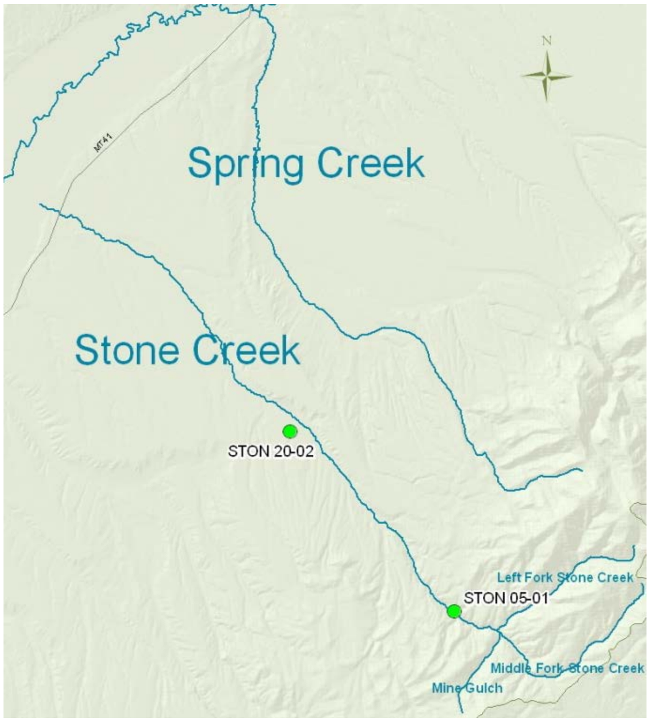

Figure 5-21. Upper Stone Creek DEQ Assessment Sites

See **Appendix D** for additional data collected by KirK and HSI.

Summary and TMDL Development Determination

Fine sediment targets were exceeded in both riffles and pools at both reaches in the upper segment of Stone Creek. Both channel form targets were exceeded in the lower reach and width to depth ratio did not meet the target value in the upper reach. Both instream pool habitat targets were not met in the lower reach and residual pool depth failed to meet the target value in the upper reach. Both reaches failed to meet target values for shrub cover and bare ground. Historic and current grazing were impacting the upper segment of Stone Creek, and eroding banks and animal crossings were contributing sediment loading to the stream that is likely limiting its ability to support fish and aquatic life. Because fines were high in field observations and field measurements showed that most of the sediment targets were not being met, a sediment TMDL will be written for the upper segment of Stone Creek. The upper segment of Stone Creek is also listed for turbidity, which is a pollutant that falls within the sediment pollutant category. In developing the sediment TMDL, it is assumed that turbidity is also addressed since satisfying the sediment TMDL targets and sediment allocations addressing both fine and coarse sediment, will result in conditions consistent with reference or naturally occurring conditions.

5.4.2.16 Stone Creek (lower) MT41B002_131

Lower Stone Creek is listed for sedimentation/siltation on the 2012 303(d) List. In addition, lower Stone Creek is listed for alterations in streamside or littoral vegetative covers; which is a non-pollutant form of pollution commonly linked to sediment impairment. Lower Stone Creek flows 3.4 miles from the confluence of an unnamed tributary (T6S R7W S34) to an unnamed ditch.

Physical Condition and Sediment Sources

In 2010, DEQ performed full sediment and habitat assessments at two adjacent monitoring sites on lower Stone Creek. The sites were split by a large irrigation return. The upstream site (STON 22-02B), was located approximately 1000 feet upstream from HWY 41. The stream channel was incised and resembled a spring creek, as groundwater and irrigation returns appeared to be the primary water sources. Pool quality was low yet runs and glides provided some spawning gravels. Stream channel measurements throughout the reach resembled Rosgen type F. Streambank erosion was minimal, as the banks were lined with large grasses and the flow was low energy. One large cut bank was found at an outside meander and irrigation returns were slowly cutting away at banks. Riparian vegetation was dominated by pasture grasses (meadow foxtail, smooth brome, timothy, Canada thistle, slow thistle) and thick macrophyte aquatic vegetation. The reach is impacted by adjacent cropland and changes in flow from irrigation.

The downstream site (STON 22-02), was split by HWY 41 with 600 feet located upstream of the bridge and 400 feet downstream of the bridge. Stream channel was mostly run dominated with an abundance of fines above the bridge and had significantly faster moving water and fewer fines below the bridge. Stream channel measurements throughout the reach resembled Rosgen type F. Bank erosion was minimal throughout the reach as banks were stabilized with vegetation. Riparian vegetation was mostly smooth brome, pasture grasses, and Canada thistle; with an abundance of watercress above the bridge and some sandbar willow below the bridge. The reach is impacted by flow manipulation, with one large irrigation return entering the channel at the top of the reach and significantly increasing flow.

Comparison to Water Quality Targets

The existing data in comparison to the targets for the lower segment of Stone Creek are summarized in **Table 5-37** (See **Figure 5-22** for map). All bolded cells represent conditions where target values are not met.

Table 5-37. Existing Sediment-Related Data for Lower Stone Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Riparian Health	
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline % Bare Ground
STON 22-02	2010	14	F5	C4	**71**	**68**	**37**	12	2.5	**0.8**	**16**	**6**	0
STON 22-02B	2010	11	F5	C4	**58**	**40**	**11**	13	**1.6**	**0.5**	**32**	**0**	**2**

Values that do not meet the target are in **bold**.

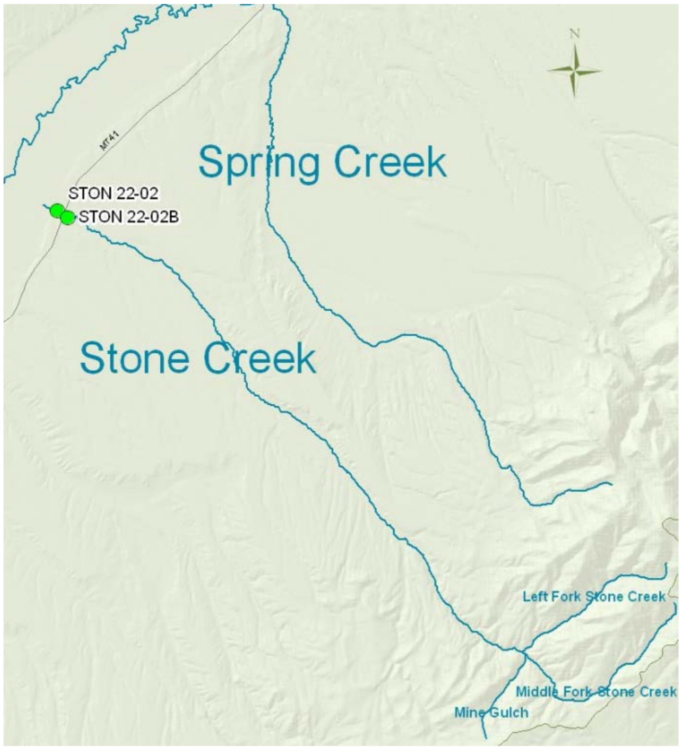

Figure 5-22. Lower Stone Creek DEQ Assessment Sites

See **Appendix D** for additional data collected by KirK

Summary and TMDL Development Determination
Fine sediment targets were exceeded in both riffles and pools at the both reaches in the lower segment of Stone Creek. At each reach, both instream pool habitat targets were not met. The reaches failed to meet the target for shrub cover and the upper reach (STON 22-02B) was mostly comprised of pasture grasses. The two reaches were separated by an irrigation return flow. Reach STON 22-02 was split by highway MT-41 with slower water and higher fine sediment deposits upstream of the bridge and faster water and less fines downstream from the bridge. The lower segment of Stone Creek is located in primarily agricultural land, and flow is manipulated for irrigation purposes. Because fines were notably high in field observations and field measurements showed that fine sediment well exceeded target values, along with pool habitat and other parameters not meeting target values, a sediment TMDL will be written for the lower segment of Stone Creek.

5.4.2.17 Taylor Creek MT41B002_170
Taylor Creek is listed for sedimentation/siltation on the 2012 303(d) List. In addition, Taylor Creek is listed for alterations in streamside or littoral vegetative covers; which is a non-pollutant form of pollution commonly linked to sediment impairment. Taylor Creek flows 11.4 miles from its headwaters to the mouth (Grasshopper Creek).

Physical Condition and Sediment Sources
In 2010, DEQ performed full sediment and habitat assessments at two monitoring sites on lower Taylor Creek. The upstream site (TAYL 27-01), was located off of Taylor Creek Rd. The stream channel had many pools, but few were deep. The channel substrate was gravel, with high amounts of fine sediment in pool tails and riffles. Stream channel measurements throughout the reach resembled Rosgen type C5.

Bank erosion was minimal and mostly due to natural scour; with some erosion occurring at animal crossings. Riparian vegetation included sedges and rushes, with some bulrush on the lower terraces. Grass and riparian forbs were found from bankfull to the floodprone area, with spotty willow cover and few seedling willows due to browse. Canada thistle was common at the upper bank level. This area appeared to be recovering from heavy historic grazing.

The downstream site (TAYL 32-01), was located off of Bannack Rd. approximately 1.5 miles from HWY 278. The stream channel was dominated by runs, with some cobble at the downstream end of the reach and predominately fines at the upstream end of the reach. There were few pools with many fines in pool tail-outs. Channel was narrow, deep, and very sinuous. Stream channel measurements throughout the reach resembled Rosgen type E5. Streambank erosion was minimal with natural scour on low vegetated and stable banks. Riparian vegetation included sedges, rushes, pasture grass, and Canada thistle. Willows were primarily of mature size with some regeneration occurring. The area seems to have been grazed in the past, and may have had beaver complex removal.

Comparison to Water Quality Targets

The existing data in comparison to the targets for Taylor Creek are summarized in **Table 5-38**. The macroinvertebrate bioassessment data for Taylor Creek is located in **Table 5-39** (See **Figure 5-23** for map). All bolded cells represent conditions where target values are not met.

Table 5-38. Existing Sediment-Related Data for Taylor Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Riparian Health	
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm (mean)	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline % Bare Ground
TAYL 27-01	2010	7	C5	C4	**55**	**41**	**22**	**11**	14.1	**0.6**	148	**22**	1
TAYL 32-01	2010	3	E5	E4	**48**	**24**	*28**	3	25.3	1.1	**74**	**38**	**11**

Values that do not meet the target are in **bold**.
*No target value for pool grid toss on E channel

Table 5-39. Macroinvertebrate Bioassessment Data for Taylor Creek

Station ID	Location		Site Class	Collection Date	Collection Method	O/E
M02TALRC01	45.295	-112.983611	Mountains	08-Jul-04	KICK	**0.62**
M02TALRC03	45.1886	-113.025833	Mountains	12-Jul-04	KICK	**0.31**

Values that do not meet the target are in **bold**.

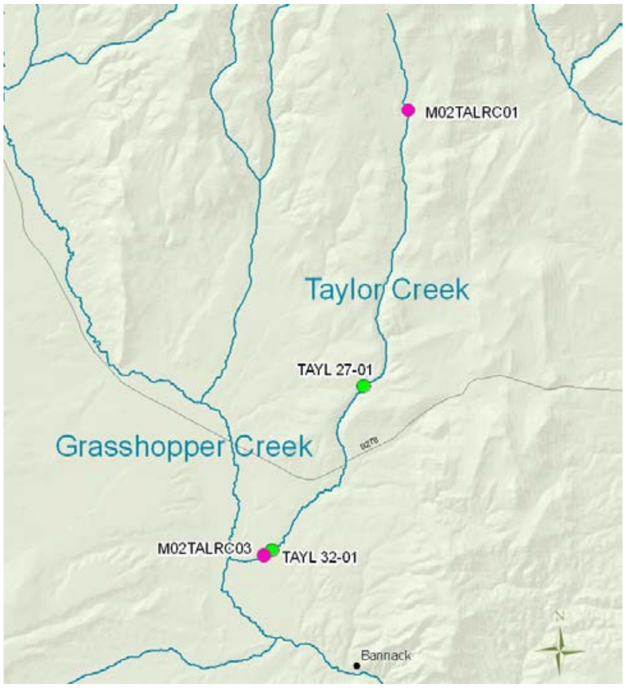

Figure 5-23. Taylor Creek DEQ Assessment Sites and Macro Sites

See **Appendix D** for additional data collected by HSI.

Summary and TMDL Development Determination
Fine sediment targets were exceeded in both reaches in Taylor Creek. The upper reach had high fines in pools and did not meet its residual pool depth target. Both reaches failed to meet the target for shrub cover. Observed over expected macroinvertebrate targets were not met. The downstream reach is an E channel and therefore expected to have higher fine sediment; however, the reach still exceeded E channel targets for fine sediment. Both reaches show signs of heavy historic grazing, however vegetation and eroding banks seemed to be recovering. Nonetheless, because fines were notably high in field observations and field measurements showed that fine sediment targets were not being met, a sediment TMDL will be written for Taylor Creek.

5.4.2.18 West Fork Blacktail Deer Creek MT41B002_060
West Fork Blacktail Deer Creek is listed for sedimentation/siltation on the 2012 303(d) List. In addition, Taylor Creek is listed for alterations in streamside or littoral vegetative covers; which is a non-pollutant form of pollution commonly linked to sediment impairment. West Fork Blacktail Deer Creek flows 15.9 miles from its headwaters to the mouth (Blacktail Deer Creek).

Physical Condition and Sediment Sources
In 2010, DEQ performed a full sediment and habitat assessment at one monitoring site on West Fork Blacktail Deer Creek. The site (WFBK 08-04), was located up Blacktail Road past the East Fork turnoff where the West Fork Road crosses with the stream. The stream channel had a lot of fine sediments, most likely due to beaver activity; as the reach was between beaver pond complexes. Gravels were common; generally well-embedded with varying amounts of fine sediment in the lower half. Many of the pools were deep and there was a variety of fish habitat. Stream channel measurements throughout the reach resembled Rosgen type C4/E4. Banks were trampled throughout the reach, but were also covered in wetland vegetation. Riparian vegetation included a variety of wetland vegetation and

moderate willow cover. Grazing suppressed willow and shrub regeneration and caused the channel to overwiden in places.

Comparison to Water Quality Targets

The existing data in comparison to the targets for West Fork Blacktail Deer Creek are summarized in **Table 5-40** (See **Figure 5-24** for map). All bolded cells represent conditions where target values are not met.

Table 5-40. Existing Sediment-Related Data for West Fork Blacktail Deer Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Riparian Health	
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm (mean)	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline % Bare Ground
WFBK 08-04	2010	13	C4/E4	C4	**32**	**43**	**19**	14.2	2.6	1.5	**84**	**41**	1

Values that do not meet the target are in **bold**.

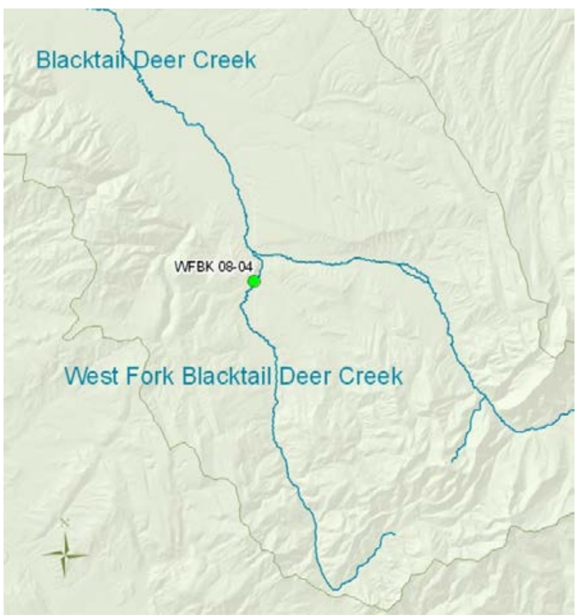

Figure 5-24. West Fork Blacktail Creek DEQ Assessment Sites and Macro Sites

See **Appendix D** for additional data collected by KirK and HSI.

Summary and TMDL Development Determination

Fine sediment targets were exceeded in both riffles and pools at the reach in West Fork Blacktail Deer Creek. Pool frequency targets were not met. The reach failed to meet the target for shrub cover and shrub regeneration was limited by current grazing. Throughout the stream, some areas of bank trampling from riparian grazing was contributing sediment. The road was also contributing sediment where it parallels close to the stream. Because fines were notably high in field observations and field measurements showed that fine sediment targets were not being met, a sediment TMDL will be written for West Fork Blacktail Deer Creek.

5.4.2.19 West Fork Dyce Creek MT41B002_070

West Fork Dyce Creek is listed for sedimentation/siltation on the 2012 303(d) List. In addition, West Fork Dyce Creek is listed for alterations in streamside or littoral vegetative covers; which is a non-pollutant form of pollution commonly linked to sediment impairment. West Fork Dyce Creek flows 4.6 miles from its headwaters to the mouth (Dyce Creek).

Physical Condition and Sediment Sources

In 2010, DEQ performed a full sediment and habitat assessment at one monitoring site on West Fork Dyce Creek. The site (WFDY 17-01), was located off of the western fork of Dyce Creek Rd. The stream was overwidened, except in areas of dense willows. The channel had few pools that were generally shallow due to excess fine sediment. Stream channel measurements throughout the reach resembled Rosgen type G5. Banks were trampled throughout the reach and composed of silt that was highly susceptible to erosion. Some tall actively eroding banks were present at cattle crossings. Riparian vegetation was heavily browsed. Most willows were mature and decadent. The understory was dominated by pasture grasses with some sedge at the water's edge. Past and current grazing were the primary impacts to the reach, with the road as a secondary source. As with the mainstem of Dyce Creek, the Dillon Field Office of the BLM notes that historic and ongoing placer mining have altered the stream dimension, pattern, profile, and likely the bed materials.

Comparison to Water Quality Targets

The existing data in comparison to the targets for West Fork Dyce Creek are summarized in **Table 5-41**. The macroinvertebrate bioassessment data for West Fork Dyce Creek is located in **Table 5-42** (See **Figure 5-25** for map). All bolded cells represent conditions where target values are not met.

Table 5-41. Existing Sediment-Related Data for West Fork Dyce Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count		Grid Toss	Channel Form		Instream Habitat		Riparian Health	
					% < 6mm (mean)	% < 2mm (mean)	Pool % < 6mm (mean)	W/D Ratio (mean)	Entrenchment Ratio (median)	Residual Pool Depth (ft)	Pools / Mile	Greenline % Shrub Cover	Greenline % Bare Ground
WFDY 17-01	2010	4	G5	B4	**49**	**29**	**35**	**7.5**	2.6	**0.6**	95	62	0

Values that do not meet the target are in **bold**.

Table 5-42. Macroinvertebrate Bioassessment Data for West Fork Dyce Creek

Station ID	Location		Site Class	Collection Date	Collection Method	O/E
M02DYWFC02	45.31583	-113.04611	Mountains	23-Jun-04	KICK	0.9
M02DYWFC03	45.28167	-113.03556	Mountains	23-Jun-04	KICK	0.9

Values that do not meet the target are in **bold**.

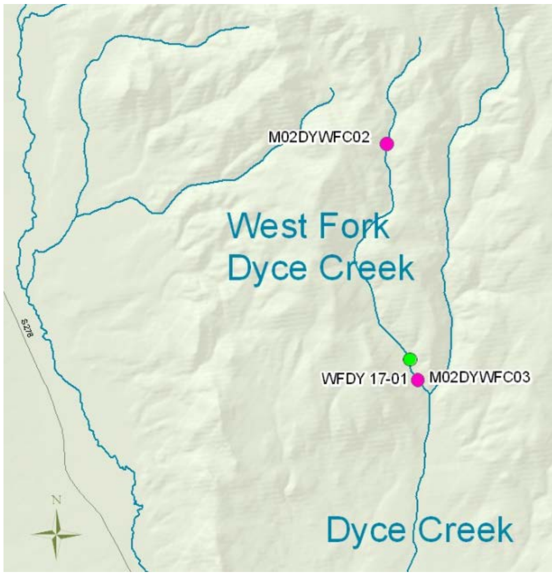

Figure 5-25. West Fork Blacktail Creek DEQ Assessment Sites and Macro Sites

See **Appendix D** for additional data collected by HSI.

Summary and TMDL Development Determination

Fine sediment targets were exceeded in both riffles and pools at the reach in West Fork Dyce Creek. Pool frequency targets were not met. The reach failed to meet the target for shrub cover and shrub regeneration was limited by current grazing. Grazing impacts and parallel road segments were contributing sediment into the stream. Because fine sediment targets were exceeded in both riffles and pools, and pool frequency and shrub cover targets were not met, a sediment TMDL will be written for West Fork Dyce Creek.

5.5 TMDL Development Summary

Based on the comparison of existing conditions to water quality targets, 17 sediment TMDLs will be developed in the Beaverhead TPA. **Table 5-43** summarizes the sediment TMDL development determinations and corresponds to **Table 1-1**, which contains the TMDL development status for listed waterbody segments in the Beaverhead TPA on the 2012 303(d) List.

Table 5-43. Summary of TMDL Development Determinations

Stream Segment	Waterbody ID	TMDL Development Determination (Y/N)
Beaverhead River (upper)*, Clark Canyon Dam to Grasshopper Creek	MT41B001_010	N
Beaverhead River (lower), Grasshopper Creek to mouth (Jefferson River)	MT41B001_020	Y
Blacktail Deer Creek, headwaters to mouth (Beaverhead River)	MT41B002_030	Y
Clark Canyon Creek, headwaters to mouth (Beaverhead River)	MT41B002_110	Y
Dyce Creek, confluence of East and West Forks to Grasshopper Creek	MT41B002_140	Y
Farlin Creek, headwaters to mouth (Grasshopper Creek)	MT41B002_020	Y
French Creek, headwaters to mouth (Rattlesnake Creek)	MT41B002_100	Y
Grasshopper Creek*, headwaters to mouth (Beaverhead River)	MT41B002_010	Y

Table 5-43. Summary of TMDL Development Determinations

Stream Segment	Waterbody ID	TMDL Development Determination (Y/N)
Rattlesnake Creek (upper), headwaters to Dillon PWS off-channel well T7S R10W S11	MT41B002_091	Y
Rattlesnake Creek (lower), from the Dillon PWS off-channel well T7S R10W S11 to the mouth (Van Camp Slough)	MT41B002_090	Y
Reservoir Creek, headwaters to mouth (Grasshopper Creek)	MT41B002_120	Y
Scudder Creek, headwaters to mouth (Grasshopper Creek)	MT41B002_180	Y
Spring Creek, headwaters to mouth (Beaverhead River)	MT41B002_080	Y
Steel Creek, headwaters to mouth (Driscol Creek)	MT41B002_160	Y
Stone Creek (upper), Left Fork and Middle Fork to confluence of un-named tributary, T6S R7W S34	MT41B002_132	Y
Stone Creek (lower), confluence with unnamed creek in T6S R7W S34 near Beaverhead/Madison county border	MT41B002_131	Y
Taylor Creek, headwaters to mouth (Grasshopper Creek)	MT41B002_170	Y
West Fork Blacktail Deer Creek, headwaters to mouth (Blacktail Deer Creek)	MT41B002_060	Y
West Fork Dyce Creek, headwaters to mouth (Dyce Creek)	MT41B002_070	Y

* Upper Beaverhead River and Grasshopper Creek were not on Montana's 2012 303(d) List for sediment

5.6 Source Assessment

This section summarizes the assessment approach, current sediment load estimates, and rationale for load reductions within the Beaverhead TPA. Focus is on the below list of four potentially significant sediment source categories and associated controllable human loading associated with each of these sediment source categories.

- streambank erosion
- upland erosion
- roads
- permitted point sources

EPA sediment TMDL development guidance for source assessments states that the basic source assessment procedure includes compiling an inventory of all sources of sediment to the waterbody and using one or more methods to determine the relative magnitude of source loading, focusing on the primary and controllable sources of loading (U.S. Environmental Protection Agency, 1999). Additionally, regulations allow that loadings "may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading" (Water quality planning and management, 40 CFR § 130.2(G)). The source assessments evaluated loading from the primary sediment sources using standard DEQ methods, but the sediment loads presented herein represent relative loading estimates within each source category, and, as no calibration has been conducted, should not be considered as actual loading values. Rather, relative estimates provide the basis for percent reductions in loads that can be accomplished via improved land management practices for each source category. These estimates of percent reduction provide a basis for setting load or wasteload allocations. As better information becomes available and the linkages between loading and instream conditions improve, the loading estimates presented here can be further refined in the future through adaptive management.

For each impaired waterbody segment, sediment loads from each source category were estimated based on field surveys, watershed modeling, and load extrapolation techniques (described below). The results include a mix of sediment sizes, particularly for bank erosion that involves both fine and coarse sediment loading to the receiving water, whereas loads from roads, upland erosion, and permitted point source discharges are predominately fine sediment.

The complete methods and results for source assessments for upland erosion, roads, and streambank erosion are located in **Appendices E, F,** and **G.** The following sections provide a summary of the load assessment results along with the basis for load reductions via improved land management practices. This load reduction basis provides the rationale for the TMDL load and wasteload allocations defined in **Section 5.7**.

5.6.1 Eroding Streambank Sediment Assessment

Streambank erosion was assessed in 2010/2011 at 29 assessment reaches discussed in **Section 5.3** to help obtain a representative dataset of existing loading conditions, causes, and the potential for loading reductions associated with improvements in land management practices. Sediment loading from eroding streambanks was assessed by performing Bank Erosion Hazard Index (BEHI) measurements and evaluating the Near Bank Stress (NBS) (Rosgen, 2006) along monitoring reaches in 2010/2011. BEHI scores were determined at each eroding streambank based on the following parameters: bank height, bankfull height, root depth, root density, bank angle, and surface protection. In addition to BEHI data collection, the source of streambank erosion was evaluated based on observed human-caused disturbances and the surrounding land-use practices based on the following near-stream source categories:

- transportation
- riparian grazing
- cropland
- mining
- silviculture
- irrigation-shifts instream energy
- natural sources
- other (typically refers to disturbance from past human activity that is not easily discernible due to elapsed time)

Based on the aerial assessment process (described in **Section 5.3**) in which each assessed stream segment is divided into different reaches, streambank erosion data from each 2010/2011 monitoring site was used to extrapolate data and provide load estimates to the stream reach, stream segment and sub-watershed scales. Sediment load reductions were calculated by estimating the load that would result if reasonable Best Management Practices (BMPs) were in place; therefore achieving the naturally occurring condition.

For bank erosion, some sources are the result of historical land management activities that are not easily mitigated through changes in current management, and they may be costly to restore and have been irreversibly altered. Therefore, although the sediment load associated with bank erosion is presented in separate source categories (e.g., transportation, grazing, cropland), the allocation is presented as a percent reduction expected collectively from human sources. A more detailed description of this assessment can be found in *Streambank Erosion Source Assessment,* which is included as **Appendix E**.

Assessment Summary

Based on the source assessment, streambank erosion contributes an estimated 68,525 tons of sediment per to the Beaverhead TPA. It is estimated that this sediment load can be reduced to 21,122 tons per year, which is a 69% reduction in sediment load from streambank erosion. Sediment loads due to streambank erosion range from 396 tons/year in West Fork Dyce Creek to 27,505 tons per year in the lower Beaverhead River. For the whole watershed, 18% of the sediment load from streambank erosion is attributed to natural sources (no human impacts), while 82% is attributable to human sources. Current riparian grazing and historic uses (including historic clearing, mining, and grazing) are the greatest anthropogenic contributors of sediment loads due to streambank erosion for most assessed sites in the Beaverhead TPA. Irrigation and hay production in Stone Creek and hay production in Blacktail Dear Creek are the major sources contributing to bank erosion in those creeks, but are not primary sources throughout the TPA. **Appendix E** contains additional information about sediment loads from eroding streambanks in the Beaverhead TPA by subwatershed, including all that were assessed. **Table 5-44** provides a summary of the bank erosion loads by each watershed where TMDLs are being developed in this document. **Table 5-44** also includes sediment load reduction information based on the application of best management practices. The load reduction approach and associated assumptions are described in **Appendix E**.

Table 5-44. Bank Erosion Results; Estimated Load Reduction Potential and Resulting Modeled Loads after Application of Best Management Practices

Watershed	Total Bank Erosion Load (tons/yr)	Avg. % Reduction	Modeled Load After Application of Best Management Practices (tons/yr)
Beaverhead River Lower (Beaverhead River Upper Total and Beaverhead River Lower Total)	68,525	69%	21,122
Beaverhead River Upper (Clark Canyon Ck and Beaverhead River Upper)	6,134	67%	2,052
Blacktail Deer Creek (W.F. Blacktail Deer Ck and Blacktail Deer Ck)	8,572	61%	3,376
Clark Canyon Creek	1,083	62%	409
Dyce Creek (West Fork Dyce Ck and Dyce Ck)	1,499	61%	582
Farlin Creek	731	56%	319
French Creek	853	67%	283
Grasshopper Creek (Farlin Ck, Steel Ck, Scudder Ck, W.F. Dyce Ck, Dyce Ck, Taylor Ck, Reservoir Ck, and Grasshopper Ck)	13,459	62%	5,135
Rattlesnake Creek - Lower (Rattlesnake Ck Upper Total and Rattlesnake Ck Lower)	4,513	57%	1,937
Rattlesnake Creek - Upper (French Ck and Rattlesnake Ck Upper)	3,580	54%	1,661
Reservoir Creek	2,612	64%	952
Scudder Creek (Steel Ck and Scudder Ck)	1,190	59%	488
Spring Creek	4,038	72%	1,144
Steel Creek	414	62%	157
Stone Creek Lower (Stone Ck Upper and Stone Ck Lower)	4,306	75%	1,089
Stone Creek Upper	2,938	75%	745
Taylor Creek	2,298	58%	974
West Fork Blacktail Deer Creek	1,730	55%	784
West Fork Dyce Creek	396	63%	148

5.6.2 Upland Erosion and Riparian Buffering Capacity

Upland sediment loading due to hillslope erosion was modeled using the Universal Soil Loss Equation (USLE). Sediment delivery to the stream was predicted using a sediment delivery ratio, taking into account riparian buffering. The USLE results are useful for source assessment as well as for determining allocations to human-caused upland erosion. This model provided an estimate of existing sediment loading from upland sources and an estimate of potential sediment loading reductions that could be achieved by applying best management practices (BMPs) in the uplands and in the near stream riparian area.

The sediment load allocation strategy for upland erosion sources provides for a potential decrease in loading through BMPs applied to upland land uses, as well as those land management activities that have the potential to improve the overall heath and buffering capacity of the vegetated riparian buffer. The allocation to these sources includes both present and past influences and is not meant to represent only current management practices; many of the restoration practices that address current land use will reduce pollutant loads that are influenced from historic land uses. A more detailed description of the assessment can be found in **Appendix F**.

Assessment Summary

Based on the source assessment, upland erosion contributes approximately 17,952 tons per year to the Beaverhead TPA. The assessment indicates that rangeland grazing and hay production within the near stream riparian buffer are the most significant contributors to accelerated upland erosion. Sediment loads due to upland erosion range from 61 tons/year in the Steel Creek sub-watershed to 3,846 tons/year in the lower Beaverhead River sub-watershed. Since this assessment was conducted at the sub-watershed scale, it is expected that larger watersheds will have greater sediment loads. A significant portion of the sediment load due to upland erosion is contributed by natural sources. **Appendix F** contains additional information about sediment loads from upland erosion in the Beaverhead TPA by subwatershed, including all 6th code HUCs in the TPA. In order to facilitate reporting of the upland sediment loading information following the allocation strategy specific to this source category the data from each sub-watershed located in the appendix was further manipulated by:

- All sources that generate < 1 ton of sediment per year were considered insignificant and were removed;
- Land use categories were lumped into these classes;
  - Forest – Evergreen Forest, Wetlands, Transitional
  - Range – Shrub / Scrub, Grassland / Herbaceous
  - Agricultural – Pasture / Hay, Cultivated Crops
  - Other – Mixed land use
- All sediment loads were rounded to the nearest ton

Table 5-45 below reports the total potential load reductions and resulting loads after applying the BMP reductions**.** This information can be used as a basis for setting TMDL load allocations. (See **Appendix F** for more detailed information**).**

Table 5-45. Existing Upland Sediment Loads and Estimated Load Reduction Potential after Application of Upland and Riparian BMPs

Watershed	Estimated Existing Upland Sediment Load (tons/year)	Estimated Load Reduction Potential (% reduction)	Modeled Load After Application of Best Management Practices
Beaverhead River Lower (Beaverhead River Upper Total and Beaverhead River Lower Total)	17952	69%	5541
Beaverhead River Upper (Clark Canyon Ck and Beaverhead River Upper)	596	59%	245
Blacktail Deer Creek (W.F. Blacktail Deer Ck, E.F. Blacktail Deer Ck, and Blacktail Deer Ck)	6473	69%	2013
Clark Canyon Creek	146	38%	91
Dyce Creek (West Fork Dyce Ck and Dyce Ck)	250	69%	77
Farlin Creek	94	62%	36
French Creek	220	58%	92
Grasshopper Creek (Farlin Ck, Steel Ck, Scudder Ck, W.F. Dyce Ck, Dyce Ck, Taylor Ck, Reservoir Ck, and Grasshopper Ck)	3859	68%	1236
Rattlesnake Creek - Lower (Rattlesnake Ck Upper Total and Rattlesnake Ck Lower)	1486	65%	513
Rattlesnake Creek - Upper (French Ck and Rattlesnake Ck Upper)	713	59%	292
Reservoir Creek	116	70%	35
Scudder Creek (Steel Ck and Scudder Ck)	164	71%	48
Spring Creek	763	68%	242
Steel Creek	103	74%	27
Stone Creek Lower (Stone Ck Upper and Stone Ck Lower)	929	74%	242
Stone Creek Upper	716	75%	182
Taylor Creek	344	75%	87
West Fork Blacktail Deer Creek	1212	75%	304
West Fork Dyce Creek	88	71%	25

5.6.3 Road Sediment Assessment

5.6.3.1 Erosion from Unpaved Roads

Sediment loading from unpaved roads was assessed using GIS, field data collection, and sediment modeling. Each identified unpaved road crossing and near-stream road segment was assigned attributes for road name, surface type, road ownership, stream name, subwatershed, and landscape type (i.e., mountain, foothill, or valley). Twenty-six crossings and seven near-stream parallel segments representing the range of conditions within the watershed were field assessed in 2010, and sediment loading was estimated using the Water Erosion Prediction Project Methodology (WEPP:Road). The average sediment contribution from unpaved road crossings and near-stream road segments were extrapolated to all unpaved roads in the watershed based on Level IV Ecoregion. To address sediment from unpaved roads in the TMDLs and allocations that follow in **Section 5.7**, the WEPP:Roads analysis was also run using BMPs, reducing contributing road segment lengths to 100 feet. The 100-foot BMP scenario is used in this document as a general approximation of achievable modeled loading reduction to help develop the road crossing allocations. The intent is to ensure that all road crossings have the appropriate BMPs in place to protect water quality via reduced sediment loading. Other potential BMPs include the installation of full structural BMPs at existing road crossings (drive through dips, culvert drains, settling basins, silt fence, etc), road surface improvement, reduction in road traffic levels (seasonal or permanent road closures), and timely road maintenance to reduce surface rutting. A more detailed description of this assessment can be found in **Appendix G**.

Assessment Summary
Based on the source assessment, unpaved roads are contributing 66 tons of sediment per year to the Beaverhead TPA. This includes 45 tons from unpaved road crossings and 21 tons per year from parallel unpaved road segments for the Beaverhead TPA. Sediment loads range from < 1 ton/year in the Clark Canyon Creek watershed to 66 tons/year in the lower Beaverhead watershed. Factors influencing sediment loads from unpaved roads at the watershed scale include the overall road density within the watershed, watershed size, and the configuration of the road network, along with factors related to road construction and maintenance. **Table 5-46** contains annual sediment loads from unpaved roads (crossings & parallel segments) from the watersheds where TMDLs are developed within this document. **Table 5-46** also includes the percent load reduction by watershed based on the contributing road length BMP scenario which is further defined within **Appendix G**.

Table 5-46. Annual Sediment Load (tons/year) from Unpaved Roads (Crossings + Parallel Segments) within the Beaverhead TPA.

Watershed	Total Estimated Existing Load (tons/year)	Percent Load Reduction After BMP Application	Total Sediment Load After BMP Application
Beaverhead River Lower (Beaverhead River Upper Total and Beaverhead River Lower Total)	66.4	70%	19.6
Beaverhead River Upper (Clark Canyon Ck and Beaverhead River Upper)	1.5	69%	0.5
Blacktail Deer Creek (W.F. Blacktail Deer Ck, E.F. Blacktail Deer Ck, Middle Blacktail Deer Ck, and Blacktail Deer Ck)	17.5	72%	4.9
Clark Canyon Creek	0.3	67%	0.1
Dyce Creek (West Fork Dyce Ck and Dyce Ck)	1.9	74%	0.5
Farlin Creek	0.4	75%	0.1
French Creek	1.7	73%	0.5
Grasshopper Creek (Farlin Ck, Steel Ck, Scudder Ck, W.F. Dyce Ck, Dyce Ck, Taylor Ck, Reservoir Ck, and Grasshopper Ck)	16.5	72%	4.6
Rattlesnake Creek - Lower (Rattlesnake Ck Upper Total, Ermont Gulch, and Rattlesnake Ck Lower)	7.3	70%	2.2
Rattlesnake Creek - Upper (French Ck and Rattlesnake Ck Upper)	3.7	73%	1.0
Reservoir Creek	0.5	67%	0.2
Scudder Creek (Steel Ck and Scudder Ck)	1.1	69%	0.3
Spring Creek	2.5	70%	0.7
Steel Creek	0.7	66%	0.2
Stone Creek Lower (Stone Ck Upper and Stone Ck Lower)	2.0	66%	0.7
Stone Creek Upper	1.7	66%	0.6
Taylor Creek	1.1	74%	0.3

Table 5-46. Annual Sediment Load (tons/year) from Unpaved Roads (Crossings + Parallel Segments) within the Beaverhead TPA.

Watershed	Total Estimated Existing Load (tons/year)	Percent Load Reduction After BMP Application	Total Sediment Load After BMP Application
West Fork Blacktail Deer Creek	3.1	77%	0.7
West Fork Dyce Creek	0.6	70%	0.2

5.6.3.2 Traction Sand Application

Montana Department of Transportation traction sand application rates based on the three year average (2009-2011) along State Highway 278, State Highway 41, State Highway 91, and Interstate 15 indicate State Highway 278 has the highest rate of application per plowed mile, while Interstate 15 has the lowest rate of application per plowed mile (**Table G-9**, **Appendix G**). An average of 3,447 tons of traction sand are applied to these four travel routes annually, with application rates per plowed mile ranging from 0.11 tons along Interstate 15 to 0.20 tons along State Highway 278. Average annual traction sand application rates range from 149 tons along State Highway 91 to 1,703 tons along Interstate 15. No data was available from the Beaverhead Roads Department for traction sand application rates along the Pioneer Mountains Scenic Byway or Blacktail Road. No estimate of road sand contribution to the annual sediment load was calculated due to insufficient information; however, significant application rate reductions have already been achieved for state roadways by the transition from road sand to road salt.

5.6.3.3 Culvert Failure and Fish Passage Analysis

Undersized or improperly installed culverts may be a chronic source of sediment to streams or a large acute source during failure, and they may also be passage barriers to fish. Therefore, during the roads assessment, the flow capacity and potential to be a fish passage barrier was evaluated for a subset of culverts. The flow capacity culvert analysis was performed on 19 culverts and incorporated bankfull width measurements taken upstream of each culvert to determine the stream discharge associated with different flood frequencies (e.g., 2, 5, 10, 25, 50, and 100 year) and measurements for each culvert to estimate its capacity and amount of fill material.

Though culvert failure represents a potential load of sediment to streams, a yearly load estimate is not incorporated into the TMDL due to the uncertainty regarding estimating the timing of such failures and a lack of monitoring information to track the occurrence of these failures.

Fish passage assessments were performed on 19 culverts. The assessment was based on the methodology defined in **Appendix G**, which is geared toward assessing passage for juvenile salmonids. Considerations for the assessment include streamflow, the culvert slope, culvert perch/outlet drop, culvert blockage, and constriction ratio (i.e., culvert width to bankfull width). The assessment is intended to be a coarse level evaluation of fish passage that quickly identifies culverts that are likely fish passage barriers and those that need a more in-depth analysis. Culverts with fish passage concerns may have elevated road failure concerns since fish passage is often linked to undersized culvert design.

Assessment Summary

Within the Beaverhead TPA, all 19 culverts assessed in the field are capable of passing the two-year flood event, while only two of these culverts (11%) pass a 100-year flood event (see **Appendix G** for more details). Assessed culverts passing the Q25 flood event varied by land ownership with 100% of the culverts located on USFS land passing, 60% of the culverts located on BLM land passing, 33% of culverts located on state land passing, and 50% of the culverts located on private land passing.

In the Beaverhead TPA, five of the culverts (26%) allowed fish passage, while 14 culverts (74%) were classified as fish passage barriers (**Appendix G**). No estimated annual load was incorporated into the TMDL due to an uncertainty of failure events and deficient monitoring information.

5.6.4 Point Sources

As of January 19, 2012, there were seventeen Montana Pollutant Discharge Elimination System (MPDES) permitted point sources within the Beaverhead TPA (**Appendix A**, **Map A-14**):

- City of Dillon WWTF (MT0021458),
- Beaverhead Talc Mine (MT0027821)
- Barretts Minerals Inc (MT0029891)
- Two Concentrated Animal Feeding Operations (MTG010165 and MTG010212)
- Three Storm Water Mining Permits (MTR300135, MTR300136, and MTR300160), and
- Nine general permits for construction stormwater

To provide the required wasteload allocation for permitted point sources, a source assessment was performed for these point sources. However, because of the nature of sediment loading associated with these permits, the WLAs are not intended to add load limits to the permits. It is assumed that the WLAs will be met by adherence to permit requirements.

5.6.4.1 Dillon Wastewater Treatment Facility (MT0021458)

The Dillon WWTF, which discharges to the Beaverhead River, is a partially-aerated five cell lagoon treatment system with a design capacity of 0.75 million gallons per day (MGD) and Ultra Violet light disinfection. The facility is authorized under an individual permit (MT0021458), which has a 7-day average total suspended solids (TSS) concentration limit of 135 mg/L and a 30-day average TSS concentration limit of 100 mg/L. Like most wastewater discharge, the suspended solids in the effluent are likely predominantly organic matter and not sediment. Based on Discharge Monitoring Reports submitted by the facility, monthly, TSS samples were collected from February 2009 through January 2012 and none exceeded the 30-day average concentration limit of 100 mg/L. The highest concentration was 52 mg/L in September 2010 and May 2009, and the average value of all samples was 22 mg/L. A conservative calculation of the existing load was made by assuming an average daily discharge of 0.6 MGD, which is the maximum measured discharge in the permit file, at a TSS concentration of 22 mg/L. This would result in an annual load of 20.1 tons.

The maximum allowable permit values can be used to evaluate impact to the Beaverhead River by evaluating the potential increase in TSS loading to the Beaverhead River from the Dillon discharge. Based on water quality chemistry and flow data collected by HSI in 2008/2009, the typical low flow for the Beaverhead River was about 35 cfs, and the average TSS value during these low flow events was about 5.5 mg/l. The Dillon facility design capacity discharge of 0.75 MGD is approximately 1.2 cfs. If the Dillon facility was discharging with a TSS concentration of 135 mg/l into the Beaverhead River when the Beaverhead River was flowing at 35 cfs, the result would be an increase in TSS concentration in the Beaverhead River from 5.5 mg/l to 9.8 mg/l. Although this represents close to a doubling of the TSS concentration, 9.8 mg/l represents an acceptably low level that is not expected to cause harm to aquatic life (Newcombe and Jensen, 1996) nor is it expected to result in aesthetic concerns.

5.6.4.2 Beaverhead Talc Mine (MT0027821)
The Beaverhead Talc Mine is a historically active open-pit mining and sorting operation in the Middle Fork Stone Creek drainage that utilized conventional hard rock mining methods to produce cosmetic grade talc. In 1986, the open-pit operations ceased and underground mining operations commenced. Water generated from the underground operations and on-site was pumped or diverted to the Mine Pit prior to the first of four sedimentation ponds. In 1999, Luzenac America, Inc. (LAI) closed the underground mine and upon reissuance of the current MPDES permit, LAI was undergoing post-closure reclamation work for the entire site. Currently water is collected from mine seepage, runoff, and seepage from the reclaimed and partially stabilized waste rock pile and routed to two sedimentation ponds prior to discharge to Outfall 001. Discharge is intermittent to the unnamed tributary to the Middle Fork Stone Creek.

MPDES permit MT0027821 has numeric limits for turbidity and monitoring requirements for TSS. LAI is required to not cause a net increase in turbidity within the unnamed tributary to Middle Fork of Stone Creek in excess of 5 NTU as measured by subtracting the analytical results at sampling sites CRK B from A. Discharge occurs from the sedimentation pond during late spring to early fall and is continuous during this timeframe. Discharge is attributed to runoff generated on-site during periods of snow-melt and precipitation. Because turbidity cannot be expressed as a load, TSS values were developed using a 2:1 relationship of TSS and turbidity established in a study by Bansak et al. (2000), used in Swan TMDL development. Although it is recognized that the TSS to NTU relationships in the Swan Lake Watershed could be inherently different than those in the Beaverhead TPA, the relationship also correlates well with a study done by Water Consulting (2002) for the Boulder River. The Boulder River resides within the Middle Rockies Ecoregion, as does the Beaverhead, and has similar characteristics to the Beaverhead TPA.

The permit states that discharge from Outfall 001 shall not cause a net increase in turbidity within the unnamed tributary to Middle Fork Stone Creek in excess of 5 NTU as measured by subtracting analytical results at the sampling site downstream from the sampling site upstream. The typical flow downstream from the permitted effluent is 75 gpm and typically flows from the late spring to early fall. A conservative calculation of the existing load was made by assuming an average discharge of 75 gpm at the downstream site, at a TSS concentration of 10 mg/L (using the ratio from Bansak). This would result in an annual load of 0.7 tons.

5.6.4.3 Barretts Minerals Inc (MT0029891)
Barretts Minerals Inc.'s Treasure Mine is an open-pit talc mine in the Left Fork Stone Creek drainage. The mine has been operating since the late 1950's utilizing conventional hard rock mining methods. The mine pit has been constructed adjacent to the pre-mining Left Fork Stone Creek (LFSC) drainage and a waste rock pile has been placed in the drainage-way with an engineered rock drain at its base. The Mine's MPDES Private Minor Industrial Discharge Permit allows discharge of mine dewatering wastewater, runoff and mine drainage from disturbed areas, and stormwater runoff from precipitation events in excess of one inch to the LFSC. Two outfalls are permitted: Outfall 001 is located at the toe of the waste rock dump, and constitutes the entire flow of LFSC (discharge is continuous and sources of wastewater include mine drainage from the waste rock pile constructed in the LFSC drainage). Outfall 002 is located inside the mine where water is infiltrated to the rock drain at Site I (discharge is continuous and the source of wastewater is pit dewatering). Water quality monitoring is conducted at Outfalls 001 and 002, as well as upstream influent locations of LFSC and two unnamed drainages.

The quality of effluent discharged by the facility from Outfall 002 has a numerical limitation for Total Suspended Solids of 25 mg/L for the average monthly limit and 45 mg/L as the daily maximum. The load will be calculated using the typical (median) flow at Outfall 002, which is around 200 gpm. A conservative calculation of the existing load was made by assuming a typical discharge of 200 gpm, at a TSS concentration of 25 mg/L. This would result in an annual load of approximately 11 tons.

However, because Outfall 001 receives the discharge from within the mine (through Outfall 002), as well as the runoff from the mine's waste rock dump, a separate analysis was conducted to see if monitoring and compliance should take place at Outfall 001. In order to evaluate if the Mine is causing an increase in turbidity within Left Fork Stone Creek in excess of 5 NTU, turbidity data was analyzed from a 2011 report written by Rithron for Barretts Minerals Inc. The average turbidity in the 2007-2010 period from sampling site D (Left Fork Stone Creek downstream of the Mine site) was subtracted from the average turbidity from that same period at sampling site A (Left Fork Stone Creek upstream of the Mine site). The average increase in turbidity over the four year time period was 1.6 NTU and below the maximum allowable increase above naturally occurring turbidity for B-1 streams, which is 5 NTU. Additionally, a load was calculated using the maximum allowable increase of 5 NTU from Site A to Site D. Using the 2011 Rithron report, the typical (median) flow downstream from the permitted effluent is 507 gpm. A conservative calculation of the existing load was made by assuming an average discharge of 507 gpm at the downstream site, at a TSS concentration of 10 mg/L (using the ratio from Bansak as discussed in permit MT0027821). This would result in an annual load of 11 tons.

The analysis of Outfall 001 provides an estimated load that is equivalent to the estimated load from Outfall 002. Additionally, the analysis of Outfall 001 indicates that the average increase in turbidity is below the maximum allowable increase. Therefore, the TMDL will be met by adherence to all requirements within the permit, specifically to the numeric TSS limitations for Outfall 002.

5.6.4.4 Storm Water – Mining, Oil, & Gas Extraction

5.6.4.4.1 Barretts Minerals Inc – Treasure Mine (MTR300135)

The Barretts Minerals Inc – Treasure Mine facility is also authorized under the General Permit for Storm Water Discharges Associated with Mining and with Oil and Gas Activities (MTR300000) and the facility is located in the Left Fork Stone Creek drainage. The permit (MTR300135) includes a Storm Water Pollution Prevention Plan (SWPPP) and requires biannual reporting of discharge monitoring data. The SWPPP sets forth the procedures, methods, and equipment used to prevent the pollution of stormwater discharges from the facility. In addition, this SWPPP describes general practices used to reduce pollutants in stormwater discharges. DEQ conducted an inspection of the 960 acre site in June 2010 and concluded the SWPPP was being followed.

According to Attachment B (Monitoring Parameter Benchmark Concentrations) within the general stormwater permit, the benchmark value for TSS is 100 mg/l. The SWPPP for the Treasure Mine provides information pertaining to site conditions. The annual average precipitation for this site is approximately 16 inches. Although the permitted area is 960 acres, the majority of this area is drained to the main pit sump located inside of the mine, which allows sediment to settle before discharging at Outfall 002 (Outfall 002 has a TSS limitation under permit MT0029891 - see **Section 5.6.4.3**). However, 13 of the 960 acres are a waste rock pile that does not drain to the main pit sump and has the potential to contribute sediment to Left Fork Stone Creek during storm events. Given the 13 acres of disturbed area, 16 inches of precipitation, and using the condition of the benchmark value (100 mg/l) found in the permit, the area from the waste rock pile has an estimated load of 2.4 tons a year.

In order to estimate the total load due to stormwater runoff the load of 2.4 tons per year from the mine's waste rock pile is added to stormwater runoff that discharges at Outfall 002 (main pit sump location). At Outfall 002 in permit MT0029891 the daily maximum TSS limitation is 45 mg/L and the highest recorded flow since 2009 is 360 gpm. A conservative calculation of the existing load was made by assuming a high flow of 360 gpm, at a TSS concentration of 45 mg/L. This would result in a load of approximately 0.1 tons per event. Using a conservative assumption of 3 major storm events per year, the load at Outfall 002 for storm events would be increased by 0.3 tons per year. Therefore, the maximum estimated annual sediment load from this site due to stormwater runoff would equate to approximately 2.7 tons/year. The WLA is provided because it is a requirement for permitted point sources (of the pollutant category of concern) but is not intended to add load limits to the permit; it is assumed that the WLA will be met by adherence to the General Permit requirements (MTR300000), which include a Storm Water Pollution Prevention Plan (SWPPP) with numerous BMPs and site stabilization before a permit can be terminated.

5.6.4.4.2 Barretts Minerals Inc – Regal Mine (MTR300136)

The Barretts Minerals Inc – Regal Mine facility is authorized under the General Permit for Storm Water Discharges Associated with Mining and with Oil and Gas Activities (MTR300000) and the facility is located in the Carter Creek drainage. Because no sediment TMDL is being presented for Carter Creek, the WLA for the permit will be part of the TMDL for the lower segment of the Beaverhead River. The permit (MTR300136) includes a Storm Water Pollution Prevention Plan (SWPPP) and requires biannual reporting of discharge monitoring data. The SWPPP sets forth the procedures, methods, and equipment used to prevent the pollution of stormwater discharges from the facility. In addition, this SWPPP describes general practices used to reduce pollutants in stormwater discharges. DEQ conducted an inspection of the 190 acre site in July 2007 and concluded the SWPPP was being followed.

According to Attachment B (Monitoring Parameter Benchmark Concentrations) within the general stormwater permit, the benchmark value for TSS is 100 mg/l. According to PRISM data the annual average precipitation for this site is approximately 18 inches. Given the 190 acres of disturbed area, 18 inches of precipitation, and using the condition of the benchmark value (100 mg/l) found in the permit, the maximum estimated annual sediment load from this site due to stormwater runoff would equate to approximately 39 tons/year. The WLA is provided because it is a requirement for permitted point sources (of the pollutant category of concern) but is not intended to add load limits to the permit; it is assumed that the WLA will be met by adherence to the General Permit requirements (MTR300000), which include a Storm Water Pollution Prevention Plan (SWPPP) with numerous BMPs and site stabilization before a permit can be terminated.

5.6.4.4.3 Barretts Minerals Inc – Talc Mill (MTR300160)

The Barretts Minerals Inc – Talc Mill facility is authorized under the General Permit for Storm Water Discharges Associated with Mining and with Oil and Gas Activities (MTR300000) and is located in the lower Beaverhead River drainage. The permit (MTR300160) includes a Storm Water Pollution Prevention Plan (SWPPP) and requires biannual reporting of discharge monitoring data. The SWPPP sets forth the procedures, methods, and equipment used to prevent the pollution of stormwater discharges from the facility. In addition, this SWPPP describes general practices used to reduce pollutants in stormwater discharges. DEQ conducted an inspection of the 72 acre site in June 2010 and concluded the SWPPP was being followed.

According to Attachment B (Monitoring Parameter Benchmark Concentrations) within the general stormwater permit, the benchmark value for TSS is 100 mg/l. According to PRISM data the annual average precipitation for this site is approximately 10 inches. Given the 72 acres of disturbed area, 10 inches of precipitation, and using the condition of the benchmark value (100 mg/l) found in the permit, the maximum estimated annual sediment load from this site due to stormwater runoff would equate to approximately 8 tons/year. The WLA is provided because it is a requirement for permitted point sources (of the pollutant category of concern) but is not intended to add load limits to the permit; it is assumed that the WLA will be met by adherence to the General Permit requirements (MTR300000), which include a Storm Water Pollution Prevention Plan (SWPPP) with numerous BMPs and site stabilization before a permit can be terminated.

5.6.4.5 Concentrated Animal Feeding Operations

Big West Management LLC (MTG010212) and Matador Cattle Company (MTG010165)

Big West Management Cattle Development Center is located east of Dillon on Sweetwater Road in the Carter Creek drainage. Matador Cattle Company is located southeast of Dillon on Blacktail Road in the Blacktail Deer Creek drainage. Both facilities operate under a Concentrated Animal Feeding Operation General Permit.

In addition to the general permit requirements, the permits for Big West Management LLC and Matador Cattle Company include additional considerations which must be met, two of which are observed here in the development of the sediment TMDLs.

1) The facility must be designed, constructed, and operated to contain all process generated wastewaters, plus the precipitation from the runoff of a 25-year, 24-hour rain event. The weather station to determine the amount of precipitation that occurs at the facility shall be the Dillon Airport. The permittee has the option of maintaining a comparable precipitation gage at the facility.

2) The facility shall prepare an Annual Report Form (AR2) that is site-specific and addresses manure, wastewater handling, storage, land application of manure, actual animal counts and other nutrient sources, site management, record keeping, and other items outlined in the report.

Compliance with the Concentrated Animal Feeding Operation General Permit, and the associated DEQ approved Annual Report Form (AR2) constitute the meeting of all TMDL requirements for sediment for these facilities. Under the conditions of the permits, all pollutants are to be contained on site during any and all storm events less than a 25-year, 24 hour rain event. Therefore the TMDL is 0 for this source, under typical rainfall events (less than 25-year storm event).

5.6.4.6 Construction Storm Water Permits

All construction stormwater permits were authorized under General Permit MTR100000. Since construction activities at a site are relatively temporary and short term in nature, the number of construction sites covered by the general permit at any given time varies. Collectively, these areas of severe ground disturbance have the potential to be significant sediment sources if proper BMPs are not implemented and maintained. Each construction stormwater permittee is required to develop a SWPPP that identifies the stormwater BMPs that will be in place during construction. Prior to permit termination, disturbed areas are required to have a vegetative density equal to or greater than 70% of the pre-disturbed level (or an equivalent permanent method of erosion prevention). Inspection and maintenance of BMPs is required, and although Montana stormwater regulations provide the authority to require stormwater monitoring, water quality sampling is typically not required (Heckenberger, Brian, personal communication 2009).

To estimate the disturbed acreage associated with construction stormwater permits, the permit files were reviewed for anticipated acres to be disturbed. As of January 17, 2012 there were nine of construction stormwater permits in the Beaverhead TMDL planning area:

- 7 projects in the Beaverhead River watershed – 40 disturbed acres total
- 2 projects in the Blacktail Deer Creek watershed - 23 disturbed acres total

Because TMDLs are allocated to the watershed scale, all permitted construction project loading within the Beaverhead TPA will be evaluated cumulatively to facilitate development of a composite wasteload allocation.

Two approaches were used to estimate sediment loading from permitted construction sites. The first approach provides an estimate of the sediment loads if inadequate BMPs were in place. The second approach then provides an estimate of the sediment loads with BMPs in place, consistent with storm water construction permit expectations. Loads from both approaches were derived using the output from the upland erosion assessment (**Section 5.6.2** and **Appendix F**). Construction sites have the potential to have C-factors ranging from 0.3 to 1 (Toy and Foster, 1998; Pudasaini, et al., 2004; Sinha and Labi, 2007), with variability associated with soil type and slope, stage of construction, and level of BMP implementation. To estimate impacts from a site with inadequate BMPs, the existing annual erosion rate normalized per acre for the Beaverhead TPA for cultivated crops was tripled to represent construction sites with some ground cover but inadequate BMP implementation (i.e., approximate C-factor = 0.6), resulting in an erosion rate of 0.05 tons/acre/year. This value is then multiplied by the disturbed acreage associated with construction stormwater permits, resulting in 2 tons/year (0.05 * 40 acres = 2) for the Beaverhead watershed and about 1.2 tons for the Blacktail Deer Creek watershed (0.05 * 23 acres = 1.15).

To estimate impacts from these same sites with BMPs in place, the loading rate associated with implementation of upland and riparian BMPs from the desired condition of the cultivated crops category used in **Appendix F** was used as an equivalent condition. This loading rate is equal to 0.009 tons/acre/year and equates to a C-factor of 0.1. This loading rate is then multiplied by the disturbed acreage resulting in a load of 0.4 tons/year for the Beaverhead watershed and 0.2 tons/year for the Blacktail Deer Creek watershed. These lower values represent the estimated existing loads from permitted construction sites based on the assumption that appropriate BMPs are in place and being properly maintained.

Assessment Summary

Based on the source assessment, MPDES permits in the Beaverhead TPA have an allowable load of 153 tons of sediment per year (**Table 5-47**). Allowable loads assume the resultant load when all permit required BMPs are in place. Depending on actual implementation and maintenance of BMPs, the existing load may be less than the allowable load; or, if BMPs are currently not in place or insufficient to meet the permit requirements, the existing load may be exceeding the allowable load. For the purpose of the estimated existing loads in **Table 5-47**, permitted entities were assumed to be in compliance with BMP requirements when no site-specific BMP data was available.

Table 5-47. Annual Sediment Load (tons/year) from Point Sources within the Beaverhead TPA.

Watershed	Facility	Permit	Total Estimated Existing Load (tons/year)	Total Allowable Load (tons/year)	Sediment Load Allocation (Percent Reduction)
Beaverhead River Lower (includes WLAs for Carter Creek)	Dillon WWTF	MT0021458	20	91*	0%
	BMI Talc Mill	MTR300160	8	8	0%
	BMI Regal Mine	MTR300136	39	39	0%
	Storm Water Construction	MTR100000 (7 projects)	0.4	0.4	0%
	Big West Management	MTG010212	0	0	0%
Blacktail Deer Creek	Storm Water Construction	MTR100000 (2 projects)	0.2	0.2	0%
	Matador Cattle Company	MTG010165	0	0	0%
Stone Creek Upper	Beaverhead Talc Mine	MT0027821	0.7	0.7	0%
	BMI Treasure Mine	MT0029891	11	11	0%
	BMI Treasure Mine	MTR300135	2.7	2.7	0%

*Permit allows for loading above current levels

5.6.5 Source Assessment Summary

The estimated annual sediment load from all identified sources throughout the Beaverhead TPA is 86,564 tons. Each source category has different seasonal loading rates, and the relative percentage of the total load from each source category does not necessarily indicate its importance as a loading source. Instead, due to the uncalibrated nature of the source assessment work and the unique uncertainties involved with each source assessment category, the intention is to separately evaluate source impacts within each assessment category (e.g., bank erosion, upland erosion, roads). Results for each source assessment category provide an adequate tool to focus waters quality restoration activities in the Beaverhead TMDL planning area by indicating the relative contribution of different subwatersheds or landcover types for that source category and the percent loading reductions that can be achieved with the implementation of improved management practices (**Appendices E**, **F**, and **G**).

5.7 Sediment TMDLs and Allocations

This section is organized by the following topics:

- Application of Percent Reduction and Yearly Load Approaches
- Development of Sediment Allocations by Source Categories
- Allocations and TMDLs for Each Stream
- Meeting the Intent of TMDL Allocations

5.7.1 Application of Percent Reduction and Yearly Load Approaches

The sediment TMDLs for the Beaverhead TPA will be based on a percent reduction approach discussed in **Section 4.** This approach will apply to the loading allocated among sources as well as each individual waterbody TMDLs. An implicit margin of safety will be applied as further discussed in **Section 5.8**. (Cover, et al., 2008) observed a correlation between sediment supply and instream measurements of fine sediment in riffles and pools; it is assumed that a decrease in sediment supply, particularly fine sediment, will correspond to a decrease in the percent fine sediment deposition within the streams of interest and result in attainment of the sediment related water quality standards. A percent-reduction approach is preferable because there is no numeric standard for sediment to calculate the allowable load and because of the uncertainty associated with the loads derived from the source assessment (which are used to establish the TMDL), particularly when comparing different load categories such as road crossings to bank erosion. Additionally, the percent-reduction TMDL approach is more applicable for restoration planning and sediment TMDL implementation because this approach helps focus on implementing water quality improvement best practices (i.e., BMPs), versus focusing on uncertain loading values.

An annual expression of the TMDLs was determined as the most appropriate timescale because sediment generally has a cumulative effect on aquatic life or other designated uses, and all sources in the watershed are associated with periodic loading. Each sediment TMDL is stated as an overall percent reduction of the average annual sediment load that can be achieved after summing the individual annual source allocations and dividing them by the existing annual total load. EPA encourages TMDLs to be expressed in the most applicable timescale but also requires TMDLs to be presented as daily loads (Grumbles, B., personal communication 2006). Daily loads are provided in **Appendix H**.

5.7.2 Development of Sediment Allocations by Source Categories

The percent-reduction allocations are based on the modeled BMP scenarios for each major source type (e.g., streambank erosion, upland erosion, roads and permitted point sources). These BMP scenarios are discussed within **Section 5.6** and associated appendices, and reflect reasonable reductions as determined from literature, agency and industry documentation of BMP effectiveness, and field assessments. Sediment loading reductions can be achieved through a combination of BMPs, and the most appropriate BMPs will vary by site. Sediment loading was evaluated at the watershed scale and associated sediment reductions are also applied at the watershed scale based on the fact that many sources deliver sediment to tributaries that then deliver the sediment load to the impaired waterbodies.

It is important to recognize that the first critical step toward meeting the sediment allocations involves applying and/or maintaining the land management practices or BMPs that will reduce sediment loading. Once these actions have been completed at a given location, the landowner or land manager will have taken action consistent with the intent of the sediment allocation for that location. For many nonpoint source activities, it can take several years to achieve the full load reduction at the location of concern, even though full BMP implementation is in effect. For example, it may take several years for riparian areas to fully recover after implementing grazing BMPs or allowing re-growth in areas of historic riparian harvest. It is also important to apply proper BMPs and other water quality protection practices for all new or changing land management activities to limit any potential increased sediment loading.

Progress towards TMDL and individual allocation achievement can be gaged by adherence to point source permits, BMP implementation for nonpoint sources, and improvement in or attainment of water quality targets defined in **Section 5.4**. Any effort to calculate loads and percent reductions for purposes of comparison to TMDLs and allocations in this document should be accomplished via the same methodology and/or models used to develop the loads and percent reductions presented within this document.

The following subsections present additional allocation details for each sediment source category.

5.7.2.1 Streambank Erosion
Sediment loads associated with bank erosion were identified by separate source categories (e.g., transportation, grazing, natural) in Appendix E. Because of the inherent uncertainty in extrapolating this level of detail to the watershed scale, and also because of uncertainty regarding impacts from historical land management activity, all human caused sources of bank erosion were combined for the purpose of expressing the TMDL and allocations. Streambank stability and erosion rates are very closely linked to the health of the riparian zone; reductions in sediment loading from bank erosion are expected to be achieved by applying BMPs within the riparian zone.

5.7.2.2 Upland Erosion
No reductions were allocated to natural sources, which are a significant portion of all upland land use categories. The allocation to upland sources includes application of BMPs to present land use activities as well as recovery from past land use influences such as riparian harvest. For all upland sources, the largest percent reduction will be achieved via riparian improvements.

5.7.2.3 Roads
The unpaved road allocation can be met by incorporating and documenting that all road crossings and parallel segments with potential sediment delivery to streams have the appropriate BMPs in place. Routine maintenance of the BMPs is also necessary to ensure that sediment loading remains consistent with the intent of the allocations. At some locations, road closure or abandonment alone may be appropriate and, due to very low erosion potential linked to native vegetation growth on the road surface, additional BMPs may not be necessary.

5.7.2.4 Permitted Point Sources
Due to the limited number of subwatersheds with permitted point sources, WLAs are only presented in the TMDLs for the Beaverhead River, Blacktail Deer Creek, and Stone Creek. WLAs are expected to be met by adherence to permit conditions.

5.7.3 Allocations and TMDLs for Each Stream
The following subsections present of the existing quantified sediment loads, allocations and TMDL for each waterbody.

Allocation Assumptions

Sediment load reductions are given at the watershed scale, and are based on the assumption that the same sources that affect a listed stream segment affect other streams within the watershed and that a similar percent sediment load reduction can be achieved by applying BMPs throughout the watershed. However, it is acknowledged that conditions are variable throughout a watershed, and even within a 303(d) stream segment, and this affects the actual level of BMPs needed in different areas, the practicality of changes in some areas (e.g. considering factors such as public safety and cost-effectiveness), and the potential for significant reductions in loading in some areas. Also, as discussed in **Section 4.4**, note that BMPs typically correspond to all reasonable land, soil, and water conservation practices, but additional conservation practices above and beyond BMPs may be required to achieve compliance with water quality standards and restore beneficial uses.

Sediment loading values and the resulting TMDLs and allocations are acknowledged to be coarse estimates. Progress towards TMDL achievement will be gauged by permit adherence for WLAs, BMP implementation for nonpoint sources, and improvement in or attainment of water quality targets. Any effort to calculate loads and percent reductions for purposes of comparison to TMDLs and allocations in this document should be accomplished via the same methodology and/or models used to develop the loads and percent reductions presented within this document.

The sediment TMDLs for all streams and stream segments presented below are expressed as a yearly load, and a percent reduction in the total yearly sediment loading achieved by applying the load allocation reductions identified in the associated tables (**Tables 5-48** through **5-65).** Each impaired segment's TMDL consists of any upstream allocations.

5.7.3.1 Beaverhead River, lower segment (MT41B001_020)

Table 5-48. Sediment Source Assessment, Allocations and TMDL for the Lower Beaverhead River

Sediment Sources		Current Estimated Load (Tons/Year)	Total Allowable Load (Tons/Year)	Load Allocations (% Reduction)
Roads		66	20	70%
Eroding Banks	Human Influenced	55,924	21,122	69%
	Natural	12,600		
Upland Erosion	All Land Uses	17,952	5,541	69%
Point Source	Dillon WWTF	20	*91	0%
	BMI Talc Mill	8	8	0%
	BMI Regal Mine	39	39	0%
	Storm Water Construction	0.4	0.4	0%
	Big West Management	0	0	0%
	Upstream Point Sources**	14.6	14.6	0%
Total Sediment Load		86,624	26,836	69%

Sediment loads and percent reductions were rounded and may not exactly match the loads presented in the appendices.
*Permit allows for loading above current levels
**Allocations for upstream point sources can be found in the Upper Stone Creek and Blacktail Deer Creek TMDLs

Additional Condition: BOR Flushing Flow Release
Sediment from Clark Canyon Creek, Grasshopper Creek, and other tributaries is known to create depositional areas in the Beaverhead River during the spring because of limited flow releases from the Clark Canyon Dam. The dam needs to be operated in a reasonable manner, in accordance with ARM §17.30.636, which states that owners and operators of water impoundments that cause conditions harmful to prescribed beneficial uses of state water shall demonstrate to the satisfaction of the department that continued operations will be done in the best practicable manner to minimize harmful effects. Flushing flow is considered a reasonable operation under most conditions (an exception being drought conditions) to keep from creating depositional areas harmful to fish and aquatic life. This is particularly applicable for the occasional early season high flow events within Clark Canyon Creek that lead to high levels of sediment deposition in the Beaverhead River. DEQ recognizes that water rights may override managing reservoir releases to provide flushing flows for sediment mobility.

5.7.3.2 Blacktail Deer Creek (MT41B002_030)

Table 5-49. Sediment Source Assessment, Allocations and TMDL for Blacktail Deer Creek

Sediment Sources		Current Estimated Load (Tons/Year)	Total Allowable Load (Tons/Year)	Load Allocations (% Reduction)
Roads		18	5	72%
Eroding Banks	Human Influenced	6,266	3,376	61%
	Natural	2,305		
Upland Erosion	All Land Uses	6,473	2,013	69%
Point Source	Storm Water Construction	0.2	0.2	0%
	Matador Cattle Company	0	0	0%
Total Sediment Load		15,062	5,394	64%

Sediment loads and percent reductions were rounded and may not exactly match the loads presented in the appendices.

5.7.3.3 Clark Canyon Creek (MT41B002_110)

Table 5-50. Sediment Source Assessment, Allocations and TMDL for Clark Canyon Creek

Sediment Sources		Current Estimated Load (Tons/Year)	Total Allowable Load (Tons/Year)	Load Allocations (% Reduction)
Roads		0.3	0.1	67%
Eroding Banks	Anthropogenically Influenced	807	409	62%
	Natural	277		
Upland Erosion	All Land Uses	146	91	38%
Total Sediment Load		1,230	500	59%

Sediment loads and percent reductions were rounded and may not exactly match the loads presented in the appendices.

5.7.3.4 Dyce Creek (MT41B002_140)

Table 5-51. Sediment Source Assessment, Allocations and TMDL for Dyce Creek

Sediment Sources		Current Estimated Load (Tons/Year)	Total Allowable Load (Tons/Year)	Load Allocations (% Reduction)
Roads		1.9	0.5	74%
Eroding Banks	Anthropogenically Influenced	1,104	582	61%
	Natural	395		
Upland Erosion	All Land Uses	250	77	69%
Total Sediment Load		1,751	660	62%

Sediment loads and percent reductions were rounded and may not exactly match the loads presented in the appendices.

5.7.3.5 Farlin Creek (MT41B002_020)

Table 5-52. Sediment Source Assessment, Allocations and TMDL for Farlin Creek

Sediment Sources		Current Estimated Load (Tons/Year)	Total Allowable Load (Tons/Year)	Load Allocations (% Reduction)
Roads		0.4	0.1	75%
Eroding Banks	Anthropogenically Influenced	500	319	56%
	Natural	231		
Upland Erosion	All Land Uses	94	36	62%
Total Sediment Load		825	355	57%

Sediment loads and percent reductions were rounded and may not exactly match the loads presented in the appendices.

5.7.3.6 French Creek (MT41B002_100)

Table 5-53. Sediment Source Assessment, Allocations and TMDL for French Creek

Sediment Sources		Current Estimated Load (Tons/Year)	Total Allowable Load (Tons/Year)	Load Allocations (% Reduction)
Roads		1.7	0.5	73%
Eroding Banks	Anthropogenically Influenced	677	283	67%
	Natural	177		
Upland Erosion	All Land Uses	220	92	58%
Total Sediment Load		1,076	376	65%

Sediment loads and percent reductions were rounded and may not exactly match the loads presented in the appendices.

5.7.3.7 Grasshopper Creek (MT41B002_010)

Table 5-54. Sediment Source Assessment, Allocations and TMDL for Grasshopper Creek

Sediment Sources		Current Estimated Load (Tons/Year)	Total Allowable Load (Tons/Year)	Load Allocations (% Reduction)
Roads		16.5	4.6	72%
Eroding Banks	Anthropogenically Influenced	9,992	5,135	62%
	Natural	3,467		
Upland Erosion	All Land Uses	3,859	1,236	68%
Total Sediment Load		17,335	6,376	63%

Sediment loads and percent reductions were rounded and may not exactly match the loads presented in the appendices.

5.7.3.8 Rattlesnake Creek, upper segment (MT41B002_091)

Table 5-55. Sediment Source Assessment, Allocations and TMDL for the Upper Rattlesnake Creek

Sediment Sources		Current Estimated Load (Tons/Year)	Total Allowable Load (Tons/Year)	Load Allocations (% Reduction)
Roads		3.7	1	73%
Eroding Banks	Anthropogenically Influenced	2,341	1,661	54%
	Natural	1,240		
Upland Erosion	All Land Uses	713	292	59%
Total Sediment Load		4,298	1,954	55%

Sediment loads and percent reductions were rounded and may not exactly match the loads presented in the appendices.

5.7.3.9 Rattlesnake Creek, lower segment (MT41B002_090)

Table 5-56. Sediment Source Assessment, Allocations and TMDL for Lower Rattlesnake Creek

Sediment Sources		Current Estimated Load (Tons/Year)	Total Allowable Load (Tons/Year)	Load Allocations (% Reduction)
Roads		7.3	2.2	70%
Eroding Banks	Anthropogenically Influenced	3,114	1,937	57%
	Natural	1,399		
Upland Erosion	All Land Uses	1,486	513	65%
Total Sediment Load		6,006	2,452	59%

Sediment loads and percent reductions were rounded and may not exactly match the loads presented in the appendices.

5.7.3.10 Reservoir Creek (MT41B002_120)

Table 5-57. Sediment Source Assessment, Allocations and TMDL for Reservoir Creek

Sediment Sources		Current Estimated Load (Tons/Year)	Total Allowable Load (Tons/Year)	Load Allocations (% Reduction)
Roads		0.5	0.2	67%
Eroding Banks	Anthropogenically Influenced	1,982	952	64%
	Natural	630		
Upland Erosion	All Land Uses	116	35	70%
Total Sediment Load		2,729	987	64%

Sediment loads and percent reductions were rounded and may not exactly match the loads presented in the appendices.

5.7.3.11 Scudder Creek (MT41B002_180)

Table 5-58. Sediment Source Assessment, Allocations and TMDL for Scudder Creek

Sediment Sources		Current Estimated Load (Tons/Year)	Total Allowable Load (Tons/Year)	Load Allocations (% Reduction)
Roads		1.1	0.3	69%
Eroding Banks	Anthropogenically Influenced	846	488	59%
	Natural	344		
Upland Erosion	All Land Uses	164	48	71%
Total Sediment Load		1,355	536	60%

Sediment loads and percent reductions were rounded and may not exactly match the loads presented in the appendices.

5.7.3.12 Spring Creek (MT41B002_080)

Table 5-59. Sediment Source Assessment, Allocations and TMDL for Spring Creek

Sediment Sources		Current Estimated Load (Tons/Year)	Total Allowable Load (Tons/Year)	Load Allocations (% Reduction)
Roads		2.5	0.7	70%
Eroding Banks	Anthropogenically Influenced	3,399	1,144	72%
	Natural	639		
Upland Erosion	All Land Uses	763	242	68%
Total Sediment Load		4,804	1,387	71%

Sediment loads and percent reductions were rounded and may not exactly match the loads presented in the appendices.

5.7.3.13 Steel Creek (MT41B002_160)

Table 5-60. Sediment Source Assessment, Allocations and TMDL for Steel Creek

Sediment Sources		Current Estimated Load (Tons/Year)	Total Allowable Load (Tons/Year)	Load Allocations (% Reduction)
Roads		0.7	0.2	66%
Eroding Banks	Anthropogenically Influenced	307	157	62%
	Natural	107		
Upland Erosion	All Land Uses	103	27	74%
Total Sediment Load		518	184	64%

Sediment loads and percent reductions were rounded and may not exactly match the loads presented in the appendices.

5.7.3.14 Stone Creek, upper segment (MT41B002_132)

Table 5-61. Sediment Source Assessment, Allocations and TMDL for Upper Stone Creek

Sediment Sources		Current Estimated Load (Tons/Year)	Total Allowable Load (Tons/Year)	Load Allocations (% Reduction)
Roads		1.7	0.6	66%
Eroding Banks	Anthropogenically Influenced	2,560	745	75%
	Natural	378		
Upland Erosion	All Land Uses	716	182	75%
Point Source	Beaverhead Talc Mine	0.7	0.7	0%
	BMI Treasure Mine	11	11	0%
	BMI Treasure Mine (stormwater)	2.7	2.7	0%
Total Sediment Load		3,670	942	74%

Sediment loads and percent reductions were rounded and may not exactly match the loads presented in the appendices.

5.7.3.15 Stone Creek, lower segment (MT41B002_131)

Table 5-62. Sediment Source Assessment, Allocations and TMDL for Lower Stone Creek

Sediment Sources		Current Estimated Load (Tons/Year)	Total Allowable Load (Tons/Year)	Load Allocations (% Reduction)
Roads		2	0.7	66%
Eroding Banks	Anthropogenically Influenced	3,755	1,089	75%
	Natural	551		
Upland Erosion	All Land Uses	929	242	74%
Point Source	Upstream Point Sources*	14.4	14.4	0%
Total Sediment Load		5,251	1,346	74%

Sediment loads and percent reductions were rounded and may not exactly match the loads presented in the appendices.
*Allocations for upstream point sources can be found in the Upper Stone Creek TMDL

5.7.3.16 Taylor Creek (MT41B002_170)

Table 5-63. Sediment Source Assessment, Allocations and TMDL for Taylor Creek

Sediment Sources		Current Estimated Load (Tons/Year)	Total Allowable Load (Tons/Year)	Load Allocations (% Reduction)
Roads		1.1	0.3	74%
Eroding Banks	Anthropogenically Influenced	1,611	974	58%
	Natural	687		
Upland Erosion	All Land Uses	344	87	75%
Total Sediment Load		2,643	1,061	60%

Sediment loads and percent reductions were rounded and may not exactly match the loads presented in the appendices.

5.7.3.17 West Fork Blacktail Deer Creek (MT41B002_060)

Table 5-64. Sediment Source Assessment, Allocations and TMDL for West Fork Blacktail Deer Creek

Sediment Sources		Current Estimated Load (Tons/Year)	Total Allowable Load (Tons/Year)	Load Allocations (% Reduction)
Roads		3.1	0.7	77%
Eroding Banks	Anthropogenically Influenced	1,161	784	55%
	Natural	569		
Upland Erosion	All Land Uses	1,212	304	75%
Total Sediment Load		2,945	1,089	63%

Sediment loads and percent reductions were rounded and may not exactly match the loads presented in the appendices.

5.7.3.18 West Fork Dyce Creek (MT41B002_070)

Table 5-65. Sediment Source Assessment, Allocations and TMDL for West Fork Dyce Creek

Sediment Sources		Current Estimated Load (Tons/Year)	Total Allowable Load (Tons/Year)	Load Allocations (% Reduction)
Roads		0.6	0.2	70%
Eroding Banks	Anthropogenically Influenced	298	148	63%
	Natural	98		
Upland Erosion	All Land Uses	88	25	71%
Total Sediment Load		485	173	64%

Sediment loads and percent reductions were rounded and may not exactly match the loads presented in the appendices.

5.7.4 Meeting the Intent of TMDL Allocations

It is important to recognize that the first critical step toward meeting the sediment allocations involves applying and/or maintaining the land management practices or BMPs that will reduce sediment loading. Once these actions have been completed at a given location, the landowner or land manager will have taken action consistent with the intent of the sediment allocation for that location. For many nonpoint source activities, it can take several years to achieve the full load reduction at the location of concern, even though full BMP implementation is in effect. For example, it may take several years for riparian areas to fully recover after implementing grazing BMPs or allowing re-growth in areas of historic riparian harvest.

It is also important to apply proper BMPs and other water quality protection practices for all new or changing land management activities to limit any potential increased sediment loading. For example, a landowner or land manager that negatively impacts an existing healthy riparian area might increase sediment loading in a manner that is not consistent with the bank erosion and/or upland sediment load allocations that apply throughout the watershed.

Additional information regarding the implementation of the allocations and associated BMPs is contained in **Sections 6** and **7**.

5.8 Seasonality and Margin of Safety

Seasonality and margin of safety are both required elements of TMDL development. This section describes how seasonality and margin of safety were applied during development of the Beaverhead TPA sediment TMDLs.

5.8.1 Seasonality

All TMDL documents must consider the seasonal applicability of water quality standards as well as the seasonal variability of pollutant loads to a stream. Seasonality was addressed in several ways as described below.

- The applicable narrative water quality standards (**Appendix B**) are not seasonally dependent, although low flow conditions provide the best ability to measure harm to use based on the selected target parameters. The low flow or base flow condition represents the most practical time period for assessing substrate and habitat conditions, and also represents a time period when high fine sediment in riffles or pool tails will likely influence fish and aquatic life. Therefore, meeting targets during this time frame represents an adequate approach for determining standards attainment.
- The substrate and habitat target parameters within each stream are measured during summer or autumn low flow conditions consistent with the time of year when reference stream measurements are conducted. This time period also represents an opportunity to assess effects of the annual snow runoff and early spring rains, which is the typical time frame for sediment loading to occur.
- The DEQ sampling protocol for macroinvetebrates identifies a specific time period for collecting samples based on macroinvertebrate life cycles. This time period coincides with the low flow or base flow condition.
- All assessment modeling approaches are standard approaches that specifically incorporate the yearly hydrologic cycle specific to the Beaverhead TPA. The resulting loads are expressed as average yearly loading rates to fully assess loading throughout the year.
- Allocations are based on average yearly loading and the preferred TMDL expression is as an average yearly load reduction, consistent with the assessment methods.

5.8.2 Margin of Safety

Natural systems are inherently complex. Any approach used to quantify or define the relationship between pollutant loading rates and the resultant water quality impacts, no matter how rigorous, will include some level of uncertainty or error. To compensate for this uncertainty and ensure water quality standards are attained, a margin of safety is required as a component of each TMDL. 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 incorporates an implicit MOS in a variety of ways:

- By using multiple targets to assess a broad range of physical and biological parameters known to illustrate the effects of sediment in streams and rivers. These targets serve as indicators of potential impairment from sediment and also help signal recovery, and eventual standards attainment, after TMDL implementation. Conservative assumptions were used during development of these targets.
- TMDL development was pursued for all listed streams evaluated, even though some streams were close to meeting all target values. This approach addresses some of the uncertainty

associated with sampling variability and site representativeness, and recognizes that sediment source reduction capabilities exist throughout the watershed.

- By using standards, targets, and TMDLs that address both coarse and fine sediment delivery.
- By properly incorporating seasonality into target development, source assessments, and TMDL allocations.
- By using an adaptive management approach to evaluate target attainment and allow for refinement of load allocation, targets, modeling assumptions, and restoration strategies to further reduce uncertainties associated with TMDL development (discussed below in **Section 5.9** and in **Sections 6** and **7**).
- By using naturally occurring sediment loads as described in ARM 17.30.602(17) (see **Appendix B**) to establish the TMDLs and allocations based on reasonably achievable load reductions for each source category. Specifically, each major source category must meet percent reductions to satisfy the TMDL because of the relative loading uncertainties between assessment methodologies.
- TMDLs are developed at the watershed scale addressing all potentially significant human related sources beyond just the impaired waterbody segment scale. This approach should also reduce loading and improve water quality conditions within other tributary waterbodies throughout the watershed.

5.9 TMDL Development Uncertainties and Adaptive Management

A degree of uncertainty is inherent in any study of watershed processes. While uncertainties are an undeniable fact of TMDL development, mitigation and reduction of uncertainty through adaptive management is a key component of TMDL implementation. The process of adaptive management is predicated on the premise that TMDLs, allocations and their supporting analyses are not static, but are processes that can be subject to periodic modification or adjustment as new information and relationships are better understood. Within the Beaverhead TPA, adaptive management for sediment TMDLs relies on continued monitoring of water quality and stream habitat conditions, continued assessment of impacts from human activities and natural conditions, and continued assessment of how aquatic life and coldwater fish respond to changes in water quality and stream habitat conditions.

As noted in **Section 5.8.2**, adaptive management represents an important component of the implicit margin of safety. This document provides a framework to satisfy the MOS by including a section focused on TMDL implementation, monitoring and adaptive management (**Section 6**). Furthermore, state law (ARM 75-5-703), requires monitoring to gage progress toward meeting water quality standards and satisfying TMDL requirements. These TMDL implementation monitoring reviews represent an important component of adaptive management in Montana.

Perhaps the most significant uncertainties within this document involve the accuracy and representativeness of 1) field data and target development and 2) the accuracy and representativeness of the source assessments and associated load reductions. These uncertainties and approaches used to reduce uncertainty are discussed in following subsections.

5.9.1 Sediment and Habitat Data Collection and Target Development

Some of the uncertainties regarding accuracy and representativeness of the data and information used to characterize existing water quality conditions and develop water quality targets are discussed below.

Data Collection

The stream sampling approach used to characterize water quality is described within **Appendix C**. To control sampling variability and improve accuracy, the sampling was done by trained environmental professionals using a standard DEQ procedure developed for the purpose of sediment TMDL development (Montana Department of Environmental Quality, 2010). This procedure defines specific methods for each parameter, including sampling location and frequency to ensure proper representation and applicability of results. Prior to any sampling, a sampling and analysis plan (SAP) was developed to ensure that all activity was consistent with applicable quality control and quality assurance requirements. Site selection was a major component of the SAP, and was based on a stratification process described in **Appendix C**. The stratification work ensured that each stream included one or more sample sites representing a location where excess sediment loading or altered stream habitat could affect fish or aquatic life.

Even with the applied quality controls, a level of uncertainty regarding overall accuracy of collected data will exist. There is uncertainty regarding whether or not the appropriate sites were assessed and whether or not an adequate number of sites were evaluated for each stream. Also, there is the uncertainty of the representativeness of collecting data from one sampling season. These uncertainties are difficult to quantify and even more difficult to eliminate given resource limitations and occasional stream access problems.

Target Development

DEQ evaluated several data sets to ensure that the most representative information and most representative statistic was used to develop each target parameter consistent with the reference approach framework outlined in **Appendix B**. Using reference data is the preferred approach for target setting, however, some uncertainty is introduced because of differing protocols between the available reference data and DEQ data for the Beaverhead TPA. These differences were acknowledged within the target development discussion and taken into consideration during target setting. For each target parameter, DEQ stratified the Beaverhead sample results and target data into similar categories, such as stream width or Rosgen stream type, to ensure that the target exceedance evaluations were based on appropriate comparison characteristics.

The established targets are meant to apply under median conditions of natural background and natural disturbance. It is recognized that under some natural conditions such as a large fire or flood event, it may be impossible to satisfy one or more of the targets until the stream and/or watershed recovers from the natural event. The goal, under these conditions, is to ensure that management activities are undertaken in a way that the achievement of targets is not significantly delayed in comparison to the natural recovery time. Also, human activity should not significantly increase the extent of water quality impacts from natural events. For example, extreme flood events can cause a naturally high level of sediment loading that could be significantly increased from a large number of road crossing or culvert failures.

Because sediment target values are based on statistical data percentiles, DEQ recognizes that it may be impossible to meet all targets for some streams even under normal levels of disturbance. On the other hand, some target values may underestimate the potential of a given stream and it may be appropriate to apply more protective targets upon further evaluation during adaptive management. It is important to recognize that the adaptive management approach provides the flexibility to refine targets as necessary to ensure protection of the resource and to adapt to new information concerning target achievability.

5.9.2 Source Assessments and Load Reduction Analyses

Each assessment method introduces uncertainties regarding the accuracy and representativeness of the sediment load estimates and percent load reduction analyses. For each source assessment, assumptions must be made to evaluate sediment loading and potential reductions at the watershed scale, and because of these uncertainties, conclusions may not be representative of existing conditions and achievable reductions at all locations within the watershed. Uncertainties are discussed independently for the three major source categories of bank erosion, upland erosion, and unpaved road crossings.

Bank Erosion

The load quantification approach for bank erosion is based on a standard methodology (BEHI) as defined within **Appendix C**. Field data collection was by trained environmental professionals per a standard DEQ procedure (Montana Department of Environmental Quality, 2010). Prior to any sampling, a SAP was developed to ensure that all activity was consistent with applicable quality control and quality assurance requirements. Site selection was a major component of the SAP, and was based on a stratification process described in **Appendix C**. The results were then extrapolated across the Beaverhead watersheds as defined in **Appendix E** to provide an estimate of the relative bank erosion loading from various streams and associated stream reaches.

Even with the above quality controls, there is uncertainty regarding the bank retreat rates, which directly influence loading rates, since it was necessary to apply bank retreat values established from Wyoming's Lamar River. Even with the increased bank erosion sites, stratifying and assessing each unique reach type was not practical, therefore adding to uncertainty associated with the load extrapolation results. Also, the complexity of the BEHI methodology can introduce error and uncertainty, although this is somewhat limited by the averaging component of the measured variables.

There is additional uncertainty regarding the amount of bank erosion linked to human activities and the specific human sources, as well as the ability to reduce the human related bank erosion levels. This is further complicated by historic human disturbances in the watershed, which could still be influencing proper channel shape, pattern and profile and thus contributing to increased bank erosion loading that may appear natural. Even if difficult to quantify, the linkages between human activity such as riparian clearing and bank erosion, are well established and these linkages clearly exist at different locations throughout the Beaverhead watershed. Evaluating bank erosion levels, particularly where best management practices have been applied along streams, is an important part of adaptive management that can help define the level of human-caused bank erosion as well as the relative impact that bank erosion has on water quality throughout the Beaverhead watershed.

Upland Erosion

A professional modeler determined upland erosion loads applying a standard erosion model as defined in **Appendix F**. As with any model, there will be uncertainty in the model input parameters including uncertainties regarding land use, land cover and assumptions regarding existing levels of BMP application. For example, the model only allows one vegetative condition per land cover type (i.e., cannot reflect land management practices that change vegetative cover from one season to another), so an average condition is used for each scenario in the model. To minimize uncertainty regarding existing conditions and management practices, model inputs were reviewed by stakeholders familiar with the watershed.

The upland erosion model integrates sediment delivery based on riparian health, with riparian health evaluations linked to the stream stratification work discussed above. The potential to reduce sediment loading was based on modest land cover improvements to reduce the generation of eroded sediment particles in combination with riparian improvements. The uncertainty regarding existing erosion prevention BMPs and ability to reduce erosion with additional BMPs represents a level of uncertainty. Also, the reductions in sediment delivery from improved riparian health also introduces some uncertainty, particularly in forested areas where there is uncertainty regarding the influence that historical riparian logging has on upland sediment delivery. Even with these uncertainties, the ability to reduce upland sediment erosion and delivery to nearby waterbodies is well documented in literature and the reduction values used for estimating load reductions and setting allocations are based on literature values coupled with specific assessment results for the Beaverhead watershed.

Roads

As described in **Appendix G**, the road crossings sediment load was estimated via a standardized simple yearly model developed by the U.S. Forest Service. This model relies on a few basic input parameters that are easily measured in the field, as well as inclusion of precipitation data from local weather stations. A total of 26 sites were randomly selected for evaluation, representing about 3% of the total population of roads. A total of 7 parallel road segments were selected for evaluation in the field. The results from these sites were extrapolated to the whole population of roads stratified by Level IV Ecoregion. The potential to reduce sediment loads from unpaved roads through the application of Best Management Practices (BMPs) was assessed by reducing contributing road segment lengths to 100 feet. This approach introduces uncertainty based on how well the sites and associated BMPs represent the whole population. Although the exact percent reduction will vary by road, the analysis clearly shows a high potential for sediment loading reduction by applying standard road BMPs in places where they are lacking or can be improved.

Application of Source Assessment Results

Model results should not be applied as absolute accurate sediment loading values within each watershed or for each source category because of the uncertainties discussed above. Because of the uncalibrated nature of the source assessment work, the relative percentage of the total load from each source category does not necessarily indicate its importance as a loading source. Instead, the intention is to separately evaluate source impacts within each assessment category (e.g., bank erosion, upland erosion, roads) and use the modeling and assessment results from each source category to evaluate reduction potentials based on different BMP scenarios. The process of adaptive management can help sort out the relative importance of the different source categories through time.

6.0 Other Identified Issues or Concerns

6.1 Non-Pollutant Listings

Water quality issues are not limited simply to those streams where TMDLs are developed. In some cases, streams have not yet been reviewed through the assessment process and do not appear on the 303(d) list. In other cases, streams in the Beaverhead TPA may appear on the 303(d) list but may not always require TMDL development for a pollutant, but do have non-pollutant listings such as "alteration in streamside or littoral vegetation covers" that could be linked to a pollutant. These habitat related non-pollutant causes are often associated with sediment issues, may be associated with nutrient or temperature issues, or may be having a deleterious effect on a beneficial use without a clearly defined quantitative measurement or direct linkage to a pollutant to describe that impact. Nevertheless, the issues associated with these streams are still important to consider when working to improve water quality conditions in individual streams, and the Beaverhead watershed as a whole. In some cases, pollutant and *non-pollutant* causes are listed for a waterbody, and the management strategies as incorporated through the TMDL development for the pollutant, inherently address some or all of the non-pollutant listings. **Table 6-1** presents the *non-pollutant* listings in the Beaverhead TPA, and notes those streams listed that either do not have any associated sediment pollutant listings or a TMDL in this document.

Table 6-1. Waterbody segments with non-pollutant listings on the 2012 303(d) List

Stream Segment	Waterbody ID	Non-Pollutant Causes of Impairment Potentially Linked to Sediment Impairment
*Beaverhead River (upper), Clark Canyon Dam to Grasshopper Creek	MT41B001_010	Alteration in streamside or littoral vegetative covers & low flow alterations
Beaverhead River (lower), Grasshopper Creek to mouth (Jefferson River)	MT41B001_020	Alteration in streamside or littoral vegetative covers, low flow alterations, and physical substrate habitat alterations
Blacktail Deer Creek, headwaters to mouth (Beaverhead River)	MT41B002_030	Alteration in streamside or littoral vegetative covers & low flow alterations
Clark Canyon Creek, headwaters to mouth (Beaverhead River)	MT41B002_110	Alteration in streamside or littoral vegetative covers
Dyce Creek, confluence of East and West Forks to Grasshopper Creek	MT41B002_140	Alteration in streamside or littoral vegetative covers & low flow alterations
*East Fork Blacktail Deer Creek, headwaters to mouth (Blacktail Deer Creek)	MT41B002_040	Alteration in streamside or littoral vegetative covers
Farlin Creek, headwaters to mouth (Grasshopper Creek)	MT41B002_020	Alteration in streamside or littoral vegetative covers
French Creek, headwaters to mouth (Rattlesnake Creek)	MT41B002_100	Alteration in streamside or littoral vegetative covers
Grasshopper Creek, headwaters to mouth (Beaverhead River)	MT41B002_010	Alteration in streamside or littoral vegetative covers & low flow alterations
Rattlesnake Creek (upper), headwaters to Dillon PWS off-channel well T7S R10W S11	MT41B002_091	Alteration in streamside or littoral vegetative covers
Rattlesnake Creek (lower), from the Dillon PWS off-channel well T7S R10W S11 to the mouth (Van Camp Slough)	MT41B002_090	Alteration in streamside or littoral vegetative covers & low flow alterations

Table 6-1. Waterbody segments with non-pollutant listings on the 2012 303(d) List

Stream Segment	Waterbody ID	Non-Pollutant Causes of Impairment Potentially Linked to Sediment Impairment
Reservoir Creek, headwaters to mouth (Grasshopper Creek)	MT41B002_120	Alteration in streamside or littoral vegetative covers
Scudder Creek, headwaters to mouth (Grasshopper Creek)	MT41B002_180	Alteration in streamside or littoral vegetative covers
Spring Creek, headwaters to mouth (Beaverhead River)	MT41B002_080	Alteration in streamside or littoral vegetative covers & low flow alterations
Steel Creek, headwaters to mouth (Driscoll Creek)	MT41B002_160	Alteration in streamside or littoral vegetative covers
Stone Creek (upper), Left Fork and Middle Fork to confluence of un-named tributary, T6S R7W S34	MT41B002_132	Alteration in streamside or littoral vegetative covers & low flow alterations
Stone Creek (lower), confluence with unnamed creek in T6S R7W S34 near Beaverhead/Madison county border	MT41B002_131	Alteration in streamside or littoral vegetative covers
Taylor Creek, headwaters to mouth (Grasshopper Creek)	MT41B002_170	Alteration in streamside or littoral vegetative covers
West Fork Blacktail Deer Creek, headwaters to mouth (Blacktail Deer Creek)	MT41B002_060	Alteration in streamside or littoral vegetative covers
West Fork Dyce Creek, headwaters to mouth (Dyce Creek)	MT41B002_070	Alteration in streamside or littoral vegetative covers

* Streams listed for *non-pollutant* with no corresponding sediment pollutant listing and no sediment TMDL in this document.

6.2 Non-Pollutant Causes of Impairment Descriptions

Non-pollutant listings are often used as a probable cause of impairment when available data at the time of assessment does not necessarily provide a direct quantifiable linkage to a specific pollutant, however non-pollutant sources or indicators do indicate impairment. In some cases the pollutant and non-pollutant categories are linked and appear together in the cause listings, however a non-pollutant category may appear independent of a pollutant listing. The following discussion provides some rationale for the application of the identified non-pollutant causes to a waterbody, and thereby provides additional insight into possible factors in need of additional investigation or remediation.

Alteration in Streamside or Littoral Vegetation Covers

This is a form of habitat alteration impairment that refers to circumstances where practices along the stream channel have altered or removed riparian vegetation and subsequently affected channel geomorphology and/or stream temperature. Such instances may be riparian vegetation removal for a road or utility corridor, or overgrazing by livestock along the stream. As a result of altering the streamside vegetation, destabilized banks from loss of vegetative root mass could lead to overwidened stream channel conditions and elevated sediment loads.

Physical Substrate Habitat Alterations

This is a form of habitat alteration impairment that generally describes cases where the stream channel has been physically altered or manipulated, such as through the straightening of the channel or from human-influenced channel downcutting, resulting in a reduction of morphological complexity and loss of habitat (riffles and pools) for fish and aquatic life. For example, this may occur when a stream channel has been straightened to accommodate roads, agricultural fields, or through placer mine operations.

Low Flow Alterations
Streams are typically listed for low flow alterations when irrigation withdrawal management leads to base flows that are too low to support the beneficial uses designated for that system. This could result in dry channels or extreme low flow conditions unsupportive of fish and aquatic life.

It should be noted that while Montana law states that TMDLs cannot impact Montana water rights and thereby affect the allowable flows at various times of the year, the identification of low flow alterations as a probable source of impairment does not violate any state or federal regulations or guidance related to stream assessment and beneficial use determination. Subsequent to the identification of this as a probable cause of impairment, it is up to local users, agencies, and entities to improve flows through water and land management.

6.3 Monitoring and BMPs for Non-Pollutant Affected Streams

Two forms of habitat alteration (alteration in streamside or littoral vegetation covers and physical substrate habitat alterations) can be linked to the sediment TMDL development, where there is overlap between the two (**Table 6-1**). It is likely that meeting the sediment TMDL targets will also equate to addressing the habitat impairment conditions in each of these streams. For the two streams with no sediment TMDL (East Fork Blacktail Deer Creek and upper segment of the Beaverhead River), meeting the sediment targets applied to streams of similar size will likely equate to addressing the habitat impairment condition for each stream.

Streams listed for *non-pollutants* as opposed to a pollutant should not be overlooked when developing watershed management plans. Attempts should be made to collect sediment, nutrient, and temperature information where data is minimal and the linkage between probable cause, non-pollutant listing, and effects to the beneficial uses are not well defined. Watershed management planning should also include strategies to help increase stream flows, particularly during summer low flow periods for those streams with low flow alteration impairment causes. Increasing flow during the winter and spring to address low flow problems in the upper segment of the Beaverhead River should also be part of the watershed management strategy. The monitoring and restoration strategies that follow in **Sections 7.0** and **8.0** are presented to address both pollutant and non-pollutant issues for streams in the Beaverhead TPA with TMDLs in this document, and they are equally applicable to streams listed for the above non-pollutant categories.

7.0 Restoration Objectives and Implementation Strategy

While certain land uses and human activities are identified as sources and causes of water quality impairment during TMDL development, the management of these activities is of more concern than the activities themselves. This document does not advocate for the removal of land and water uses to achieve water quality restoration objectives, but instead for making changes to current and future land management practices that will help improve and maintain water quality. This section describes an overall strategy and specific on-the-ground measures designed to restore beneficial water uses and attain water quality standards in Beaverhead TPA streams. The strategy includes general measures for reducing loading from each significant identified pollutant source.

7.1 Water Quality Restoration Objectives

The following are general water quality goals provided in this TMDL document:

- Provide technical guidance for full recovery of aquatic life beneficial uses to all impaired streams within the Beaverhead TPA by improving sediment water quality conditions. This technical guidance is provided by the TMDL components in the document which include:
  - water quality targets,
  - pollutant source assessments, and
  - a restoration and TMDL implementation strategy.

A watershed restoration plan (WRP) can provide a framework strategy for water quality restoration and monitoring in the Beaverhead TPA, focusing on how to meet conditions that will likely achieve the TMDLs presented in this document, as well as other water quality issues of interest to local communities and stakeholders. Watershed restoration plans identify considerations that should be addressed during TMDL implementation and should assist stakeholders in developing a more detailed adaptive plan in the future. A locally developed WRP will likely provide more detailed information about restoration goals and spatial considerations but may also encompass more broad goals than this framework includes. A WRP would serve as a locally organized “road map” for watershed activities, sequences of projects, prioritizing of projects, and funding sources for achieving local watershed goals, including water quality improvements. The WRP is intended to be a living document that can be revised based on new information related to restoration effectiveness, monitoring results, and stakeholder priorities. The following are key elements suggested for the WRP:

- Support for implementing restoration projects to protect water conditions so that all streams and aquatic resources in the watershed maintain good water quality, with an emphasis on waters with TMDLs completed.
- Detailed cost/benefit analysis and spatial considerations for water quality improvement projects.
- Develop an approach for future BMP installment and efficiency results tracking.
- Provide information and education components to assist with stakeholder outreach about restoration approaches, benefits, and funding assistance.
- Other various watershed health goals, such as weed control initiatives and wetland restoration.
- Other local watershed based issues.

7.2 Agency and Stakeholder Coordination

Successful implementation requires collaboration among private landowners, land management agencies, and other stakeholders. The DEQ does not implement TMDL pollutant reduction projects for nonpoint source activities, but can provide technical and financial assistance for stakeholders interested in improving their water quality. The DEQ will work with participants to use the TMDLs as a basis for developing locally-driven WRPs, administer funding specifically to help fund water quality improvement and pollution prevention projects, and can help identify other sources of funding.

Because most nonpoint source reductions rely on voluntary measures, it is important that local landowners, watershed organizations, and resource managers continue to work collaboratively with local and state agencies to achieve water quality restoration which will progress toward meeting water TMDL targets and load reductions. Specific stakeholders and agencies that have been, and will likely continue to be, vital to restoration efforts include the Beaverhead Watershed Committee, USFS, NRCS, DNRC, FWP, BOR, BLM, NRDP, EPA and DEQ. Other organizations and non-profits that may provide assistance through technical expertise, funding, educational outreach, or other means include Montana Water Center, University of Montana Watershed Health Clinic, Montana Aquatic Resources Services (MARS), and MSU Extension Water Quality Program.

7.3 Sediment Restoration Strategy

The goal of the sediment restoration strategy is to prevent the availability, transport, and delivery of sediment by a combination of minimizing sediment delivery, reducing the rate of runoff, and intercepting sediment transport.

Riparian and wetland vegetation restoration and long term riparian area management are vital restoration practices that must be implemented across the watershed to achieve the sediment TMDLs. Native riparian and wetland vegetation provides root mass which hold streambanks together. Suitable root mass density ultimately slows bank erosion. Riparian vegetation filters pollutants from upland runoff. Therefore, improving riparian and wetland vegetation will decrease bank erosion by improving streambank stability and will also reduce pollutant delivery from upland sources. Sediment is also deposited more heavily in healthy riparian and wetland zones during flooding because water velocities slow in these areas enough for excess sediment to settle out.

Riparian and wetland disturbance has occurred throughout the Beaverhead TPA as a result of many influencing factors. The conversion of forest and valley bottoms for agriculture, livestock production, and residential development have all had varying degrees of impact, depending on the drainage. Restoration recommendations involve the promotion of riparian and wetland recovery through improved land management, floodplain and streambank stabilization, and revegetation efforts where necessary. In general, natural recovery of disturbed systems is preferred however it is acknowledged that existing conditions may not readily allow for unassisted recovery in some areas where disturbance has occurred. Active vegetation planting and bank or stream channel reshaping may increase costs, but may be a reasonable and relatively cost effective restoration approach, depending on the site. When stream channel restoration work is needed because of altered stream channels, cost increases and projects should be assessed on a case by case basis. The restoration of wetlands that have been historically ditched or drained in conjunction with agricultural BMPs and riparian buffers can also be an effective means of reducing sediment inputs. The implementation of BMPs should aim to prevent the availability, transport, and delivery of a pollutant through the most natural or natural-like means possible. Appropriate BMPs will differ by location and are recommended to be included and prioritized as part of a comprehensive watershed scale plan (e.g. WRP).

Improved grazing management is another major component of the sediment restoration approach. This may include adjusting the timing and duration of grazing, the development of multi-pasture systems that include riparian pastures, and the development of off-site watering areas. Additionally, grazing management, combined with some additional fencing in many riparian areas, would promote natural recovery. In general, these are sustainable agricultural practices that promote attainment of conservation objectives while meeting agricultural production goals. The appropriate BMPs will differ by landowner and are recommended to be part of a comprehensive farm/ranch plan.

Although roads may be a small source of sediment at the watershed scale, sediment derived from roads may cause significant localized impact in some stream reaches. Restoration approaches for unpaved roads near streams should be to divert water off of roads and ditches before it enters the stream. The diverted water should be routed through natural healthy vegetation, which will act as filter zones for the sediment laden runoff before it enters streams. Sediment loads from culvert failure and culvert caused scour were not assessed by the TMDL source assessment, but should be considered in road sediment restoration approaches.

All of these best management practices are considered reasonable restoration approaches due to their benefit and generally low costs. Riparian restoration and road erosion control are standard best management practices identified by NRCS. Although the appropriate BMP will vary by waterbody and site, controllable sources and BMP types can be prioritized by watershed to reduce sediment loads in individual streams.

7.4 Restoration Approaches by Source Category

For each major source of human-caused pollutant loads in the Beaverhead TPA, general management recommendations are outlined below. The effect of different sources can change seasonally and be dependent on the magnitude of storm/high flow events. Therefore, restoration activities within the Beaverhead TPA should focus on all major sources for each pollutant category. Yet, restoration should begin with addressing significant sources where large load reductions can be obtained within each source category. For each major source, BMPs will be most effective as part of a management strategy that focuses on critical areas within the watershed, which are those areas contributing the largest pollutant loads or are especially susceptible to disturbance. The source assessment results provided within **Appendices E - G** and summarized in **Section 5.6** provide information that should be used to help determine priorities for each major source type in the watershed and for each of the general management recommendations discussed.

Applying BMPs for existing activities where they are currently needed is the core of TMDL implementation but only forms a part of the restoration strategy. Also important are efforts to avoid future load increases by ensuring that new activities within the watershed incorporate all appropriate BMPs, and ensuring continued implementation and maintenance of those BMPs currently in place or in practice. Restoration might also address other current non-pollutant-causing uses and management practices. In some cases, efforts beyond implementing new BMPs may be required to address key pollutant sources. In these cases, BMPs are usually identified as a first effort followed by an adaptive management approach to determine if further restoration activities are necessary to achieve water quality standards. Monitoring is also an important part of the restoration process; recommendations are outlined in **Section 8.0**.

7.4.1 Riparian Areas, Wetlands, and Floodplains

Riparian areas, wetlands, and floodplains are critical for wildlife habitat, groundwater recharge, reducing the severity of floods and upland and streambank erosion, and filtering pollutants from runoff. The performance of the above named functions is dependent on the connectivity of riparian areas, wetlands and floodplains to both the stream channel and upland areas. Anthropogenic activities affecting the quality of these transitional habitats or their connectivity can alter their performance and greatly affect the transport of water, sediments, and contaminants (e.g. channelization, increased stream power, bank erosion, and habitat loss or degradation). Therefore, restoring, maintaining, and protecting riparian areas, wetlands, and floodplains within the watershed should be a priority of TMDL implementation in the Beaverhead TPA.

Initiatives to protect riparian areas, wetlands, and floodplains will help protect property, increase channel stability, and buffer waterbodies from pollutants. However, in areas with a much smaller buffer or where historical vegetation removal and development have shifted the riparian and wetland vegetation communities and limited their functionality, a tiered approach for restoring stream channels and adjacent riparian and wetland vegetation should be considered. Restoration should prioritize areas based on the existing condition and potential for improvement. In non-conifer dominated areas, the restoration goals should focus on restoring natural shrub cover and local native riparian and wetland vegetation on streambanks. Passive riparian and wetland restoration is preferable, but in areas where stream channels are unnaturally stable or streambanks are eroding excessively, active restoration approaches, such as channel design, woody debris and log vanes, bank sloping, seeding, and shrub planting may be needed. Factors influencing appropriate riparian and wetland restoration would include the severity of degradation, site-potential for various species, and the availability of local and native sources as transplant materials. In general, riparian and wetland plantings would promote the establishment of functioning stands of native riparian species. Weed management should also be a dynamic component of managing riparian and wetland areas.

The use of riprap or other “hard” approaches is not recommended and is not consistent with water quality protection or implementation of this plan. Although they may be absolutely necessary in some instances, these “hard” approaches generally redirect channel energy and exacerbate erosion in other places. Bank armoring should be limited to areas with a demonstrated infrastructure threat. Where deemed necessary, apply bioengineered bank treatments to induce vegetative reinforcement of the upper bank, reduce stream scouring energy, and provide shading and cover habitat.

7.4.2 Grazing

Development of riparian and wetland area grazing management plans should be a goal for landowners in the watershed who are not currently using a plan. Private land owners may be assisted by state, county, federal, and local conservation groups to establish and implement appropriate grazing management plans. The goal of riparian grazing management is not to eliminate all grazing in these areas. Nevertheless, in some areas, a more restrictive management strategy may be necessary for a period in order to accelerate re-establishment of a riparian community with the most desirable species composition and structure. Grazing should be managed to provide filtering capacity via adequate groundcover and streambank stability via mature riparian vegetation communities.

Grazing management includes the timing and duration of grazing, the development of multi-pasture systems, including riparian pastures, and the development of off-site watering areas. The key strategy of the recommended grazing BMPs is to develop and maintain healthy riparian vegetation and minimize disturbance of the streambank and channel. The primary recommended BMPs for the Beaverhead TPA are providing off-site watering sources, limiting livestock access to streams, providing "water gaps" where livestock access to a stream is necessary, planting woody vegetation along streambanks, and establishing riparian buffers. Although passive restoration via new grazing plans or limited bank revegetation are preferred BMPs, in some instances, bank stabilization may be necessary prior to planting vegetation. Other general grazing management recommendations and BMPs to address grazing sources of pollutants and non-pollutant can be obtained in Appendix A of Montana's NPS Management Plan (Montana Department of Environmental Quality, 2007).

7.4.3 Small Acreages

Small acreages are growing rapidly, and many small acreage owners own horses or cattle. Animals grazing on small acreages can lead to overgrazing and a shortage of grass cover, leaving the soil subject to erosion and runoff to surface waters. General BMP recommendations for small acreage lots with animals include creating drylots, developing a rotational grazing system, and maintaining healthy riparian buffers. Small acreage owners should collaborate with MSU Extension Service, NRCS, conservation districts and agriculture organizations to develop management plans for their lots. Further information may be obtained from the Montana Nonpoint Source Management Plan (Montana Department of Environmental Quality, 2007) or the MSU extension website at: http://www.msuextension.org/ruralliving/Index.html.

7.4.4 Animal Feeding Operations

Animal feeding operations (AFOs) can pose a number of risks to water quality. To minimize water quality effects from AFOs, the USDA and EPA released the Unified National Strategy for AFOs in 1999 (U.S. Department of Agriculture and U.S. Environmental Protection Agency, 1999). This plan is a written document detailing manure storage and handling systems, surface runoff control measures, mortality management, chemical handling, manure application rates, schedules to meet crop nutrient needs, land management practices, and other options for manure disposal. An AFO that meets certain specified criteria is referred to as a Concentrated Animal Feeding Operation (CAFO), and in addition may be required to obtain a Montana Pollution Discharge Elimination System (MPDES) permit as a point source. Montana's AFO compliance strategy is based on federal law and has voluntary, as well as, regulatory components. If voluntary efforts can eliminate discharges to state waters, in some cases no direct regulation is necessary through a permit. Operators of AFOs may take advantage of effective, low cost practices to reduce potential runoff to state waters, which additionally increase property values and operation productivity. Properly installed vegetative filter strips, in conjunction with other practices to reduce wasteloads and runoff volume, are very effective at trapping and detaining sediment and reducing transport of nutrients and pathogens to surface waters, with removal rates approaching 90 percent (U.S. Department of Agriculture and U.S. Environmental Protection Agency, 1999). Other options may include clean water diversions, roof gutters, berms, sediment traps, fencing, structures for temporary manure storage, shaping, and grading. Animal health and productivity also benefit when clean, alternative water sources are installed to prevent contamination of surface water.

Opportunities for financial and technical assistance (including comprehensive nutrient management plan development) in achieving voluntary AFO and CAFO compliance are available from conservation districts and NRCS field offices. Voluntary participation may aide in preventing a more rigid regulatory program from being implemented for Montana livestock operators in the future.

Further information may be obtained from the DEQ website at:
http://www.deq.mt.gov/wqinfo/mpdes/cafo.asp

Montana's NPS pollution control strategies for addressing AFOs are summarized in the bullets below:
- Work with producers to prevent NPS pollution from AFOs.
- Promote use of State Revolving Fund for implementing AFO BMPs.
- Collaborate with MSU Extension Service, NRCS, and agriculture organizations in providing resources and training in whole farm planning to farmers, ranchers, conservation districts, watershed groups and other resource agencies.
- Encourage inspectors to refer farmers and ranchers with potential nonpoint source discharges to DEQ watershed protection staff for assistance with locating funding sources and grant opportunities for BMPs that meet their needs. (This is in addition to funds available through NRCS and the Farm Bill).
- Develop early intervention of education & outreach programs for small farms and ranches that have potential to discharge nonpoint source pollutants from animal management activities. This includes assistance from the DEQ Permitting Division, as well as external entities such as DNRC, local watershed groups, conservation districts, and MSU Extension.

7.4.5 Cropland

The primary strategy of the recommended cropland BMPs is to reduce sediment inputs. The major factors involved in decreasing sediment loads are reducing the amount of erodible soil, reducing the rate of runoff, and intercepting eroding soil before it enters waterbodies. The main BMP recommendations for the Beaverhead TPA are vegetated filter strips (VFS) and riparian buffers. Both of these methods reduce the rate of runoff, promote infiltration of the soil (instead of delivering runoff directly to the stream), and intercept sediment. Effectiveness is typically about 70 percent for filter strips and 50 percent for buffers (Montana Department of Environmental Quality, 2007). Filter strips and buffers are most effective when used in conjunction with agricultural BMPs that reduce the availability of erodible soil such as conservation tillage, crop rotation, strip cropping, and precision farming. Filter strips along streams should be composed of natural vegetative communities. Additional BMPs and details on the suggested BMPs can be obtained from NRCS and in Appendix A of Montana's NPS Management Plan (Montana Department of Environmental Quality, 2007).

7.4.6 Flow and Irrigation

Flow alteration and dewatering are commonly considered water quantity rather than water quality issues. However, changes to stream flow can have a profound effect on the ability of a stream to mobilize sediment, allow sediment to accumulate in stream channels, reduce available habitat for fish and other aquatic life, and may cause the channel to respond by changing in size, morphology, meander pattern, rate of migration, bed elevation, bed material composition, floodplain morphology, and streamside vegetation if flood flows are reduced (Andrews and Nankervis, 1995; Schmidt and Potyondy, 2004). See **Attachment A** for Flushing Flow Recommendations for the Beaverhead River. Local coordination and planning are especially important for flow management because State law indicates that legally obtained water rights cannot be divested, impaired, or diminished by Montana's water quality law (MCA 75-5-705).

7.4.7 Unpaved Roads

The road sediment reductions in this document represent an estimation of the sediment load that would remain once appropriate road BMPs were applied at all locations. Achieving this reduction in sediment loading from roads may occur through a variety of methods at the discretion of local land managers and restoration specialists. Road BMPs can be found on the Montana DEQ or DNRC websites and within Montana's Nonpoint Source Management Plan (Montana Department of Environmental Quality, 2007). Examples include:

- Providing adequate ditch relief up-grade of stream crossings.
- Constructing waterbars, where appropriate, and up-grade of stream crossings.
- Instead of cross pipes, using rolling dips on downhill grades with an embankment on one side to direct flow to the ditch. When installing rolling dips, ensure proper fillslope stability and sediment filtration between the road and nearby streams.
- Insloping roads along steep banks with the use of cross slopes and cross culverts.
- Outsloping low traffic roads on gently sloping terrain with the use of a cross slope.
- Using ditch turnouts and vegetative filter strips to decrease water velocity and sediment carrying capacity in ditches.
- For maintenance, grade materials to the center of the road and avoid removing the toe of the cutslope.
- Preventing disturbance to vulnerable slopes.
- Using topography to filter sediments; flat, vegetated areas are more effective sediment filters.
- Where possible, limit road access during wet periods when drainage features could be damaged.
- Limit new road stream crossings and the length of near-stream parallel segments to the extent practicable.

7.4.7.1 Culverts and Fish Passage

Although there are a lot of factors associated with culvert failure and it is difficult to estimate the true at-risk load, the culvert analysis found that approximately 58% of the culverts pass the discharge of a 25-year storm event. The allocation strategy for culverts is no loading from culverts as a result of being undersized, improperly installed, or inadequately maintained. The culvert assessment included 19 culverts in the watershed, which is a small percentage of the total culverts, and it is recommended that the remaining culverts be assessed so that a priority list may be developed for culvert replacement. As culverts fail, they should be replaced by culverts that pass a 100 year flood on fish bearing streams and at least 25 year events on non fish bearing streams. Some road crossings may not pose a feasible situation for upgrades to these sizes because of road bed configuration; in those circumstances, the largest size culvert feasible should be used. If funding is available, culverts should be prioritized and replaced prior to failure.

Another consideration for culvert upgrades should be fish and aquatic organism passage. In a coarse assessment of fish passage, 74% of assessed culverts were determined to pose a significant passage risk to juvenile fish at all flows; this suggests that a large percentage of culverts in the watershed are barriers to fish passage. Each fish barrier should be assessed individually to determine if it functions as an invasive species and/or native species barrier. These two functions should be weighed against each other to determine if each culvert acting as a fish passage barrier should be mitigated. Montana FWP can aid in determining if a fish passage barrier should be mitigated, and, if so, can aid in culvert design.

7.4.7.2 Traction Sand

Severe winter weather and mountainous roads in the Beaverhead TPA will require the continued use of relatively large quantities of traction sand. Nevertheless, closer evaluation of and adjustments to existing practices should be done to reduce traction sand loading to streams to the extent practicable. The necessary BMPs may vary throughout the watershed and particularly between state and private roads but may include the following:

- Utilize a snow blower to directionally place snow and traction sand on cutslopes/fillslopes away from sensitive environments.
- Increase the use of chemical deicers and decrease the use of road sand, as long as doing so does not create a safety hazard or cause undue degradation to vegetation and water quality.
- Improve maintenance records to better estimate the use of road sand and chemicals, as well as to estimate the amount of sand recovered in sensitive areas.
- Continue to fund MDT research projects that will identify the best designs and procedures for minimizing road sand impacts to adjacent bodies of water and incorporate those findings into additional BMPs.
- Street sweeping and sand reclamation.
- Identify areas where the buffer could be improved or structural control measures may be needed.
- Improved maintenance of existing BMPs.
- Increase availability of traction sand BMP training to both permanent and seasonal MDT employees as well as private contractors.

7.4.8 Forestry and Timber Harvest

Timber harvest activities should be conducted by all landowners according to Forestry BMPs for Montana (Montana State University, Extension Service, 2001) and the Montana Streamside Management Zone (SMZ) Law (77-5-301 through 307 MCA). The Montana Forestry BMPs cover timber harvesting and site preparation, road building including culvert design, harvest design, other harvesting activities, slash treatment and site preparation, winter logging, and hazardous substances. While the SMZ Law is intended to guide commercial timber harvesting activities in streamside areas (i.e., within 50 feet of a waterbody), the riparian protection principles behind the law should be applied to numerous land management activities (i.e., timber harvest for personal use, agriculture, development). Prior to harvesting on private land, landowners or operators are required to notify the Montana DNRC. DNRC is responsible for assisting landowners with BMPs and monitoring their effectiveness. The Montana Logging Association and DNRC offer regular Forestry BMP training sessions for private landowners. .

The SMZ Law protects against excessive erosion and therefore is appropriate for helping meet sediment load allocations. USFS INFISH Riparian Habitat Conservation Area guidelines provide significant sediment protection as well as protection from elevated thermal loading (i.e., elevated temperature) by providing adequate shade. This guidance improves upon Montana's SMZ law and includes an undisturbed 300 foot buffer on each side of fish bearing streams and 150 foot buffer on each side of non-fish bearing streams with limited exclusions and BMP guidance for timber harvest, roads, grazing, recreation and other human sources (U.S. Department of Agriculture, Forest Service, 1995).

In addition to the BMPs identified above, effects that timber harvest may have on yearly streamflow levels, such as peak flow, should be considered. Water yield and peak flow increases should be modeled in areas of continued timber harvest and potential effects should be evaluated. Furthermore, noxious weed control should be actively pursued in all harvest areas and along all forest roads.

7.4.9 Beaver Populations and Sediment Yields

Historic trapping of beavers has likely had an effect on sediment yields in the watershed. Before the removal of beavers, many streams had a series of catchments that moderated flow, with smaller unincised multiple channels and frequent flooding. Now some stream segments have incised channels and are no longer connected to the floodplain. This results in more bank erosion because high flows scour streambanks to a greater extent instead of flowing onto the floodplain. Beaver ponds also capture and store sediment and there can be large reductions in total suspended solids (TSS) concentrations below a beaver impoundment in comparison to TSS concentrations above the beaver impoundment (Bason, 2004).

Management of headwaters areas should include consideration of beaver habitat. Long-term management could include maintenance of beaver habitat in headwaters protection areas and even allowing for increased beaver populations in areas currently lacking the beaver complexes that can trap sediment, reduce peak flows, and increase summer low flows. Allowing for existing and even increased beaver habitat is considered consistent with the sediment TMDL water quality goals.

7.4.10 Storm Water Construction Permitting and BMPs

Construction activities disturb the soil, and if not managed properly, they can be substantial sources of sediment. Construction activity disturbing one acre or greater is required to obtain permit coverage through DEQ under the Storm Water General Permit for Construction Activities. A Storm Water Pollution Prevention Plan (SWPPP) must be developed and submitted to obtain a permit. A SWPPP identifies pollutants of concern, which is most commonly sediment, construction related sources of those pollutants, any nearby waterbodies that could be affected by construction activities, and BMPs that will be implemented to minimize erosion and discharge of pollutants to waterbodies. The SWPPP must be implemented for the duration of the project, including final stabilization of disturbed areas, which is a vegetative cover of at least 70% of the pre-disturbance level or an equivalent permanent stabilization measure. Development and implementation of a thorough SWPPP should ensure WLAs within this document are met.

Land disturbance activities that are smaller than an acre (and exempt from permitting requirements) also have the potential to be substantial pollutant sources, and BMPs should be used to prevent and control erosion consistent with the upland erosion allocations. Potential BMPs for all construction activities include construction sequencing, permanent seeding with the aid of mulches or geotextiles, check dams, retaining walls, drain inlet protection, rock outlet protection, drainage swales, sediment basin/traps, earth dikes, erosion control structures, grassed waterways, infiltration basins, terraced slopes, tree/shrub planting, and vegetative buffer strips. An EPA support document for the construction permits has extensive information about construction related BMPs, including limitations, costs, and effectiveness (EPA 2009).

7.4.11 Urban Area Stormwater BMPs

Even though Dillon and Twin Bridges do not have a large enough population to require a municipal stormwater permit, activities to reduce pollutant loading from new development or redevelopment should be pursued consistent with the upland erosion allocations and efforts to avoid future water quality problems. Any BMPs which promote onsite or after collection infiltration, evaporation, transpiration or reuse of the initial flush stormwater should be implemented as practicable on all new or redevelopment projects. EPA provides more comprehensive information about stormwater best

management practices on their website at:
http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm

7.4.12 Nonpoint Source Pollution Education

Because most nonpoint source pollution (NPS) is generated by individuals, a key factor in reducing NPS is increasing public awareness through education. The Beaverhead Watershed Committee provides educational opportunities to both students and adults through local water quality workshops and informational meetings. Continued education is key to ongoing understanding of water quality issues in the Beaverhead TPA, and to the support for implementation and restorative activities.

7.5 Potential Funding Sources

Funding and prioritization of restoration or water quality improvement projects is integral to maintaining restoration activities and monitoring project successes and failures. Several government agencies fund watershed or water quality improvement projects. Below is a brief summary of potential funding sources to assist with TMDL implementation.

7.5.1 Section 319 Nonpoint Source Grant Program

Section 319 grant funds are typically used to help identify, prioritize, and implement water quality protection projects with focus on TMDL development and implementation of nonpoint source projects. Individual contracts under the yearly grant typically range from $20,000 to $150,000, with a 40 percent match requirement. 319 projects typically need to be administered through a non-profit or local government such as a conservation district, a watershed planning group, or a county.

7.5.2 Future Fisheries Improvement Program

The Future Fisheries grant program is administered by FWP and offers funding for on-the-ground projects that focus on habitat restoration to benefit wild and native fish. Anyone ranging from a landowner or community-based group to a state or local agency is eligible to apply. Applications are reviewed annually in December and June. Projects that may be applicable to the Beaverhead watershed include restoring streambanks, improving fish passage, and restoring/protecting spawning habitats.

7.5.3 Watershed Planning and Assistance Grants

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

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

7.5.4 Environmental Quality Incentives Program

The Environmental Quality Incentives Program (EQIP) is administered by NRCS and offers financial (i.e., incentive payments and cost-share grants) and technical assistance to farmers and ranchers to help plan and implement conservation practices that improve soil, water, air and other natural resources on their land. The program is based on the concept of balancing agricultural production and forest management with environmental quality, and is also used to help producers meet environmental regulations. EQIP offers contracts with a minimum length of one year after project implementation to a maximum of 10 years. Each county receives an annual EQIP allocation and applications are accepted continually during the year; payments may not exceed $300,000 within a six-year period.

7.5.5 Resource Indemnity Trust/Reclamation and Development Grants Program

The Resource Indemnity Trust/Reclamation and Development Grants Program (RIT/RDG) is an annual program administered by MT DNRC that can provide up to $300,000 to address environmental related issues. This money can be applied to sites included on the AML priority list, but of low enough priority where cleanup under AML is uncertain. RIT/RDG program funds can also be used for conducting site assessment/ characterization activities such as identifying specific sources of water quality impairment. RIT/RDG projects typically need to be administered through a non-profit or local government such as a conservation district, a watershed planning group, or a county.

8.0 MONITORING FOR EFFECTIVENESS

The monitoring framework discussed in this section is an important component of watershed restoration, a requirement of TMDL development under Montana's TMDL law, and the foundation of the adaptive management approach. While targets and allocations are calculated using the best available data, the data are only an estimate of a complex ecological system. The margin of safety is put in place to reflect some of this uncertainty, but other issues only become apparent when restoration strategies are underway. Having a monitoring strategy in place allows for feedback on the effectiveness of restoration activities (whether TMDL targets are being met), if all significant sources have been identified, and whether attainment of TMDL targets is feasible. Data from long-term monitoring programs also provide technical justifications to modify restoration strategies, targets, or allocations where appropriate.

The monitoring framework presented in this section provides a starting point for the development of more detailed and specific planning efforts regarding monitoring needs; it does not assign monitoring responsibility. Monitoring recommendations provided are intended to assist local land managers, stakeholder groups, and federal and state agencies in developing appropriate monitoring plans to meet aforementioned goals. Funding for future monitoring is uncertain and can vary with economic and political changes. Prioritizing monitoring activities depends on stakeholder priorities for restoration and funding opportunities.

The objectives for future monitoring in the Beaverhead TPA include: 1) tracking and monitoring restoration activities and evaluating the effectiveness of individual and cumulative restoration activities, 2) baseline and impairment status monitoring to assess attainment of water quality targets and identify long-term trends in water quality and 3) refining the source assessments. Each of these objectives is discussed below.

8.1 ADAPTIVE MANAGEMENT AND UNCERTAINTY

An adaptive management approach is used to manage resource commitments as well as achieve success in meeting the water quality standards and supporting all beneficial uses. This approach works in cooperation with the monitoring strategy and allows for adjustments to the restoration goals or pollutant targets, TMDLs, and/or allocations, as necessary. These adjustments would take into account new information as it arises.

The adaptive management approach is outlined below:

- TMDLs and Allocations: The analysis presented in this document assumes that the load reductions proposed for each of the listed streams will enable the streams to meet target conditions and that meeting target conditions will ensure full support of all beneficial uses. Much of the monitoring proposed in this section of the document is intended to validate this assumption. If it looks like greater reductions in loading or improved performance is necessary to meet targets, then updated TMDL and/or allocations will be developed based on achievable reductions via application of reasonable land, soil, and water conservations practices.
- Water Quality Status: As new stressors are added to the watershed and additional data are collected, new water quality targets may need to be developed or existing targets/allocations may need to be modified.

8.2 Tracking and Monitoring Restoration Activities and Effectiveness

Monitoring should be conducted prior to and after project implementation to help evaluate the effectiveness of specific practices or projects. This approach will help track the recovery of the system and the effects, or lack of effects, from ongoing management activities in the watershed. At a minimum, effectiveness monitoring should address the pollutant that is targeted for each project. Information about specific locations, spatial extent, designs, contact information, and any effectiveness evaluation should be compiled about each project. Information about all restoration projects along with tracking overall extent of BMP implementation should be compiled into one location for the entire watershed.

For sediment, which has no numeric standard, loading reductions and BMP effectiveness may be estimated using the approaches used within this document. However, tracking BMP implementation and project-related measurements will likely be most practical for sediment. For instance, for road improvements, it is not anticipated that post-project sediment loads will be measured. Instead, documentation of the BMP, reduced contributing length, and before/after photos documenting the presence and effectiveness of the BMP will be most appropriate. For installation of riparian fencing, before/after photo documentation of riparian vegetation and streambank and a measurement such as greenline that documents the percentage of bare ground and shrub cover may be most appropriate. Evaluating instream parameters used for sediment targets will be one of the tools used to gage the success of implementation when DEQ conducts a formal assessment but may not be practical for most projects since the sediment effects within a stream represent cumulative effects from many watershed scale activities and because there is typically a lag time between project implementation and instream improvements (Meals, et al., 2010).

If sufficient implementation progress is made within a watershed, DEQ will conduct a TMDL Implementation Evaluation (TIE). During this process, recent data are compiled, monitoring is conducted (if necessary), data are compared to water quality targets (typically a subset for sediment), BMP implementation since TMDL development is summarized, and data are evaluated to determine if the TMDL is being achieved or if conditions are trending one way or another. If conditions indicate the TMDL is being achieved, the waterbody will be recommended for reassessment and may be delisted. If conditions indicate the TMDL is not being achieved, according to Montana State Law (75-5-703(9)), the evaluation must determine if:

- The implementation of a new or improved phase of voluntary reasonable land, soil, and water conservation practices is necessary,
- Water quality is improving, but more time is needed for compliance with water quality standards, or
- Revisions to the TMDL are necessary to achieve applicable water quality standards and full support of beneficial uses.

8.3 Baseline and Impairment Status Monitoring

In addition to effectiveness monitoring, watershed scale monitoring should be conducted to expand knowledge of existing conditions and to provide data that can be used during the TIE. Although DEQ is the lead agency for conducting impairment status monitoring, other agencies or entities may collect and provide compatible data. Wherever possible, it is recommended that the type of data and methodologies used to collect and analyze the information be consistent with DEQ methodology so as to allow for comparison to TMDL targets and track progress toward meeting TMDL goals. The information in this section provides general guidance for future impairment status monitoring.

Each of the sediment streams of interest was stratified into unique reaches based on physical characteristics and anthropogenic influence. The assessed sites represent only a percentage of the total number of stratified reaches. Sampling additional monitoring locations could provide additional data to assess existing conditions, and provide more specific information on a per stream basis as well as the TPA as a whole.

It is acknowledged that various agencies and entities have differing objectives, as well as time and resources available to achieve those objectives. However, when possible, it is recommended that at a minimum the following parameters be collected to allow for comparison to TMDL targets:

- Riffle pebble count (using Wolman Pebble Count methodology and/or 49-point grid tosses)
- Residual pool depth and pool frequency measurements
- Greenline assessment

Additional information will undoubtedly be useful and assist impairment status evaluations in the future and may include total suspended solids, identifying percentage of eroding banks, human sediment sources, areas with a high background sediment load, macroinvertebrate studies, McNeil core sediment samples, and fish population surveys and redd counts.

An important part of impairment determination and adaptive management is determining when a stream has fully recovered from past management practices where recovery is still occurring from historical improvements in management but recent BMPs were not applied. Particularly within the Beaverhead Deerlodge National Forest, ongoing PIBO monitoring can provide critical insight into the extent of recovery from past practices via comparisons between reference and managed sites.

8.4 Source Assessment Refinement

In many cases, the level of detail provided by the source assessments only provides broad source categories or areas that need to reduce pollutant loads and additional source inventory and load estimate work may be desirable. Strategies for strengthening source assessments for each of the pollutants may include more thorough sampling or field surveys of source categories and are described by pollutant in this section. Although additional suspended sediment and nutrient data at the USGS gage near Garrison may refine the SWAT model, most of the impairments are in tributaries, and thus resources could be used more efficiently by focusing on identifying the most significant source areas within each impaired stream's watershed to determine where implementation will be most effective. Recommendations for source assessment refinement are described below by pollutant.

Sediment-related information that could help strengthen the source assessments is as follows:

- a bank erosion retreat rate for Beaverhead TPA streams,
- a better understanding of bank erosion impacts from historical land management activities,
- more complex and detailed modeling for upland erosion and sediment delivery to the stream,
- improved modeling for concentrated flow through riparian areas,
- evaluation of seasonal loading aspects for the major sources and potential implications regarding TMDL target parameters,
- a review of land management practices specific to subwatersheds of concern to determine where the greatest potential for improvement can occur for the major land use categories,

- additional sampling in streams with less data to get a better idea of the reductions needed and to identify source areas
- evaluation of “hot spots” that the model may not have adequately addressed, such as a confined animal operation adjacent to a stream, and
- additional field surveys of culverts, roads, and road crossings to help prioritize the road segments/crossings of most concern.

9.0 STAKEHOLDER AND PUBLIC PARTICIPATION

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

9.1 PARTICIPANTS AND ROLES

Throughout completion of the Beaverhead TPA TMDLs, DEQ worked with stakeholders to keep them apprised of project status and solicited input from a TMDL advisory group. A description of the participants in the development of the TMDLs in the Beaverhead TPA and their roles is contained below.

Montana Department of Environmental Quality
Montana state law (MCA 75-5-703) directs DEQ to develop all necessary TMDLs. DEQ has provided resources toward completion of theses TMDLs in terms of staff, funding, internal planning, data collection, technical assessments, document development, and stakeholder communication and coordination. DEQ has worked with other state and federal agencies to gather data and conduct technical assessments. DEQ has also partnered with watershed organizations to collect data and coordinate local outreach activities for this project.

United States Environmental Protection Agency
EPA is the federal agency responsible for administering and coordinating requirements of the Clean Water Act (CWA). Section 303(d) of the CWA directs states to develop TMDLs (see **Section 1.1**), and EPA has developed guidance and programs to assist states in that regard. EPA has provided funding and technical assistance to Montana's overall TMDL program and is responsible for final TMDL approval. Project management was primarily provided by the EPA Regional Office in Helena, MT.

Conservation Districts
The majority of the Beaverhead TPA falls within Beaverhead County. DEQ provided the Beaverhead Conservation District with consultation opportunity during development of TMDLs. This included opportunities to provide comment during the various stages of TMDL development, and an opportunity for participation in the advisory group discussed below.

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

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

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

Area Landowners

Since 46 percent of the planning area is in private ownership, local landowner cooperation in the TMDL process has been critical. Their contribution has included access for stream sampling and field assessments and personal descriptions of seasonal water quality and streamflow characteristics. The DEQ sincerely thanks the planning area landowners for their logistical support and informative participation in impromptu water resource and land management discussions with our field staff and consultants.

9.2 Response to Public Comments

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

This public review period was initiated on April 10th, 2012 and ended on May 9th, 2012. At a public meeting on April 17th in Dillon, MT, DEQ provided an overview of the TMDLs for sediment in the Beaverhead TMDL Planning Area, made copies of the document available to the public, and solicited public input and comment on the plan. The announcement for that meeting was distributed among the Watershed Advisory Group, and advertised in the following newspapers: The Montana Standard in Butte and The Dillon Tribune in Dillon. This section includes DEQ's response to all public comments received during the public comment period.

One letter from Montana Fish, Wildlife, and Parks was submitted to the DEQ during the public comment period. Excerpts from the comment letter are provided below. Responses prepared by DEQ follow each of the individual comments. The original comment letter is held on file at the DEQ and may be viewed upon request.

Montana Fish, Wildlife, and Parks

Comment #1

Riparian Health reference criteria. Because riparian health is a primary factor that directly and indirectly influences stream health, including sediment input, and is dramatically affected by proper implementation of Best Management Practices it is important that particular attention is placed on these parameters. We encourage you to carefully consider whether the sites surveyed in the 2010/2011 assessment are suitable for determining reference criteria. Specifically, it is unclear whether these sites had all reasonable Best Management Practices implemented and are therefore appropriate for consideration as reference conditions. If these sites are not representative of conditions under implementation of Best Management Practices then we strongly encourage you to revisit the reference data used for this portion of the TMDL and augment them with either 1) additional sampling and/or 2) data from literature review and select values that are adequately protective and reflective of riparian conditions associated with Best Management Practices.

Response to #1

The DEQ agrees that riparian health is a primary factor that directly and indirectly influences sediment input to a stream. We believe the use of the 2010/2011 DEQ data to determine the desired or reference condition is reasonable for the statistical analysis used to determine those target values. As discussed in **Appendix B**, there are several statistical approaches DEQ uses for target development; they include using percentiles of reference data or of the entire sample dataset, if reference data are limited. For example, if high values are desired (as are for % understory cover) and there is a high degree of confidence in the reference data, the 25th percentile of the reference dataset is used; or if reference data are not available and the sampled streams are by and large degraded, the 75th percentile of the sample dataset may be used. Several of the reaches sampled in the Beaverhead TPA in 2010/2011, including reaches on Reservoir, French, and Rattlesnake creeks, are within the range of appropriate riparian conditions. The target value is therefore based on the 75^{th} percentile of the sample dataset (56 %). This approach was taken because regional reference data for percent understory shrub cover are not available for the Beaverhead TPA.

2010/2011 DEQ Data	n	25th	Median	75th
Greenline % understory shrub	29	22	39	**56**

In applying the above statistical approach to the sampled streams which are impaired, it is necessary to note a greater level of uncertainty and perhaps a greater level of future monitoring is warranted as part of the adaptive management approach. However, when comparing the Beaverhead TPA greenline percent understory shrub target value to target values in other recently completed sediment TMDL documents from Montana, ≥56% falls within the mid range of those target values (2012 Little Blackfoot: ≥40%; 2011 Tobacco: ≥57%; 2010 West Fork Gallatin ≥53%; Lower Clark Fork: ≥70%). The ≥56% understory shrub target value in conjunction with the ≤1% disturbed ground target value represents the desired condition based on available data, which the DEQ believes is both protective and feasible. However, as new regional reference data is collected, targets may be modified to reflect the potential of the riparian area.

Comment #2

Beaverhead Reference Conditions. No Sediment Targets were provided for several parameters for the Beaverhead River. Because we will be collectively focusing on reducing sediment loads and ultimately delisting all TMDL listed streams, including the Beaverhead River, over the coming years it is necessary that sediment targets be established as a restoration endpoint for all listed streams. We recognize that establishing these values for the Beaverhead River presents unique challenges related to difficulty of sampling and paucity of comparable reference information but still feel that inclusion of sediment targets for this stream is necessary.

Response to #2

The goal of the target section is to identify values for indicators that represent achievement of water quality standards and are linked to the causes of impairment described in the waterbody listing. Indicators may vary depending on any number of relevant factors. As you acknowledge, the size and flows of the Beaverhead River made sampling common sediment and habitat parameters difficult; that compounded with the paucity of comparable reference information made target setting challenging in the Beaverhead River.

Assessment of sediment sources and habitat conditions on tributaries of the Beaverhead River followed Standard Operating Procedures (SOPs) described in *Field Methodology for the Assessment of TMDL Sediment and Habitat Impairments* (Montana Department of Environmental Quality, 2010). Some methods in these SOPs, which are for wadeable streams, were not feasible in many areas of the Beaverhead River. In some reaches, deep water prevented collection of pebble counts, grid toss fine sediment counts, precise cross-sectional measurements, and detailed habitat longitudinal profile. Grid toss measurements in pool tail-outs were not collected at any point on the Beaverhead River, due to the depth of the pools. Precise pool depth and frequency measurements were difficult to obtain in the longitudinal profiles with the methods and equipment available to us. Despite these issues, we believe that a sufficient amount of data was collected to develop targets, and although more limited than tributary targets, they represent the achievement of water quality standards for the Beaverhead River.

Although no sediment targets were provided for pool tail fines via grid toss, residual pool depth, and pools per mile; target values are provided for riffle pebble counts for percent fines less than 6mm and 2mm, percent streambank with understory shrub cover, percent streambank with disturbed bare ground, and macroinvertebrates. Although DEQ was able to measure cross sections in the Beaverhead River, bankfull width to depth ratio targets were not provided because there is a lack of regional reference data for that parameter for larger rivers. Again, as more data is collected by the DEQ or by stakeholders throughout Montana on larger rivers, width to depth ratio and other target values may be added.

Excess sediment is an issue in the Beaverhead River because of inadequate grazing management practices along the mainstem of the river, a large contribution of sediment from tributaries, and dam operations that are not currently releasing flushing flows that coordinate with spring runoff events. When BMPs are put in to place to address eroding banks and diminished riparian areas along the Beaverhead River, tributary contribution of sediment decreases because of BMP implementation, and flow management in the Beaverhead River is improved; then the sediment issues should improve within the mainstem and the established targets should reflect those improvements.

TMDL implementation is an adaptive management process. As methods of data collection improve and more data is collected, targets may be revisited and possibly revised to reflect the potential of the Beaverhead River. For example, if a cost-effective approach is developed to accurately and safely measure pool frequency and residual pool depth in the Beaverhead River, targets may be reviewed and adopted either from regionally relevant data or literature values.

Comment #3

Existing sediment targets. We appreciate the level of thought and effort that went into development of the Sediment Targets for the Beaverhead Sediment TMDL. Aside from the aforementioned exceptions we are pleased with and support the approach, criteria, and values that were proposed in this draft document. However, we are not supportive of modification of any of the Sediment Targets to less protective values in the final document. If any of the Sediment Targets are being considered for modification to less protective values we would appreciate to opportunity to comment on changes prior to finalization.

Response to #3

Thank you for taking the time to review and discuss the sediment target approaches in the Beaverhead TPA. Sediment target values will not be modified for the final document and will be submitted to the EPA as they were proposed in the draft public comment document.

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