WATER QUALITY RESTORATION PLAN AND TOTAL MAXIMUM DAILY LOADS (TMDL) FOR THE BOBTAIL CREEK WATERSHED

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EXECUTIVE SUMMARY

This document presents a Water Quality Protection Plan and Total Maximum Daily Load (TMDL) for the Bobtail Creek Watershed in Montana. A TMDL is a pollutant budget identifying the maximum amount of a particular pollutant that a waterbody can assimilate without causing applicable water quality standards to be exceeded. Section 303 of the Federal Clean Water Act and the Montana Water Quality Act (Section 75-5-703) require development of TMDLs for impaired waterbodies that do not meet Montana water quality standards. Section 303(d) also requires identification of impaired waterbodies on a list, referred to as the 303(d) list. This 303(d) list is updated every two years and submitted to the U. S. Environmental Protection Agency (EPA) by the Montana Department of Environmental Quality (MDEQ).

Bobtail Creek supports a coldwater fishery that is geographically important to native fish. The development of the water quality plan and TMDL included an in-depth analysis of water quality in Bobtail Creek. The analysis focused on physical parameters linked to excess sediment loading. Results were compared to information from reference streams throughout western Montana and reference literature values to help identify potential aquatic life or cold-water fish limitations. Bobtail Creek was identified as having habitat and fishery limitations linked to excess sediment loading. These limitations were linked to a lack of pools, overly wide channels, excessive eroding banks, and a reduction in the health of the riparian corridor linked to forest and agriculture practices. These limitations were sufficient to justify the impairment determination for Bobtail Creek thus requiring development of a sediment TMDL. Many stakeholders are working toward improved water quality in this watershed and have implemented projects toward water quality improvement.

This plan includes the development of TMDL targets and other beneficial use support indicators that must be satisfied to meet Montana Water Quality Standards. These targets focus on water quality limitations such as pool frequency or width to depth. Targets measuring sediment include Wolman pebble counts and Mc Neil core samples.

Restoration objectives, including TMDL and sediment load allocations are developed to address the sediment sources that are contributing to the impairment conditions. These sources include loads of sediment from rain-on-snow events, mass wasting, and other activities mostly linked to timber harvest, forest and private road erosion, and human induced bank erosion.

This plan also includes strategies for implementation and monitoring. Implementation focuses on a continuation of many the ongoing water quality protection activities in the watershed. The Kootenai National Forest, Plum Creek Timber Company, other private landowners, and other agencies play an important role in effective implementation of this plan and water quality protection and restoration. The monitoring strategy focuses on tracking progress toward meeting TMDL targets and other goals. An important component of the monitoring strategy is to provide for adaptive management to address uncertainties that tend to exist when developing numeric goals and applying them to TMDL targets and load allocations. The monitoring strategy also includes tracking implementation projects and pursuing a better understanding of the water quality and habitat capabilities and limitations in the Bobtail Creek Watershed.

Table E-1. Summary of Required TMDL Elements for the Bobtail Creek TMDL Planning Area.

Water Body and Pollutants of Concern	Bobtail Creek Pollutants: Siltation and Turbidity - addressed as sediment in the TMDL.
Impaired Beneficial Uses	Bobtail Creek Impaired Uses: Partially supporting aquatic life and cold-water fishery.
Pollutant Sources	Sediment (including siltation, turbidity, bank erosion, and other habitat alteration): from silviculture, logging road construction and maintenance, and “other” sources.
Target Development Strategies	• The current water quality impairment status of each of the waters originally listed on the 2000 and 2002 303(d) list was evaluated using a suite of targets and supplemental indicators. • Targets for the Bobtail Creek watershed include threshold values for width-to-depth ratios, pool frequency, riffle stability index, Wolman pebble counts, and McNeil core samples.
TMDL	A 95% reduction of total suspended solids during high flow conditions.
Allocation Strategies	• 90% application of road best management practices (BMP) to minimize surface erosion from existing roads. • 75% reduction in bank erosion rates. • No sediment loading from preventable mass wasting events. • No sediment loading from culvert failures where culverts are not up to BMP standards or not maintained. • No sediment loading increases (other than potential, minor, predicted, short-term increases associated with full implementation of applicable BMPs) related to future development. • No sediment loading increases (other than potential, minor, predicted, short-term increases associated with full implementation of applicable BMPs) related to future timber roads and timber harvest.
Restoration Strategies	• Utilize existing restoration programs and plans of the U.S. Forest Service and Plum Creek Timber Company. • Encourage additional restoration actives and BMP implementation by private landowners.
Margin of Safety	For the Bobtail Creek watershed, a margin of safety is provided by conservative assumptions and proposed additional studies to address uncertainties.
Seasonal Considerations	Sediment TMDL and targets consider seasonal variations by setting, related habitat targets and biological targets that are affected by year round processes.

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SECTION 1.0
INTRODUCTION

This document presents a Water Quality Restoration Plan that includes Total Maximum Daily Loads (TMDL) for the Bobtail Creek Watershed in Montana. The Bobtail Creek Watershed TMDL Planning Area (TPA) drains approximately 22 square miles in northwestern Montana (Figure 1-1). Bobtail Creek is a fourth order tributary to the Kootenai River in northwest Montana. Bobtail Creek is included on Montana's 2000 and 2002 Clean Water Act section 303(d) list, and the listing information is shown in Tables 1-1 and 1-2 (MDEQ, 2000; MDEQ, 2002). The causes of impairment include bank erosion, siltation, turbidity, and other habitat alterations. The Bobtail Creek Watershed (also referred to in this document as the Bobtail TMDL Planning Area, or BTPA) is one of more than 90 TMDL planning areas in the State of Montana in which water quality is currently or was previously listed as impaired or threatened. In each of these TMDL planning areas, the State of Montana is required to develop TMDLs to reduce pollutant loading and eliminate other negative impacts to water quality in impaired and threatened waterbodies.

Table 1-1. Summary of 303(d) Listings for Bobtail Creek.

Year	Beneficial Uses Not Supported	Probable Causes	Probable Sources	Stream Miles Listed
1996	Not Listed	Not Listed	Not Listed	0
2000	Aquatic life support* Cold water fishery*	Bank Erosion; Siltation; Turbidity; Other habitat alterations	Silviculture; Logging road construction/maintenance; Other	10
2002	Aquatic life support* Cold water fishery*	Bank Erosion; Siltation; Turbidity; Other habitat alterations	Silviculture; Logging road construction/maintenance; Other	10

*These uses listed as partially supported

Table 1-2. Status of Beneficial Uses from 303(d) Lists.

Stream	Year Listed	Agriculture	Aquatic Life Support	Cold Water Fishery – Trout	Drinking Water Supply	Industrial	Primary Contact (Recreation)
Bobtail Creek	2000	Full	Partial	Partial	Not Assessed	Full	Full
	2002	Full	Partial	Partial	Not Assessed	Full	Full

Impairment Status Definitions for Table 1-2:
Partial = Partial support of Beneficial Use.
Full = Full support of Beneficial Use.

1.1 Background and Purpose

Section 303(d) of the federal Clean Water Act and Section 75-5 of the Montana Water Quality Act provide authority and procedures for monitoring and assessing water quality in Montana's streams and lakes, and for developing restoration plans for those waters not meeting state standards. This document presents a water quality restoration plan for the Bobtail Creek watershed. This plan also defines all necessary Total Maximum Daily Loads (TMDLs) for pollutants of concern in the Bobtail watershed, as specified in the *Montana 303(d) List of Impaired and Threatened Waterbodies in Need of Water Quality Restoration*. A TMDL is the total amount of pollutant that a stream may receive from all sources without exceeding water quality standards. A TMDL may also be defined as a reduction in pollutant loading that results in meeting water quality standards. The 2000, and 2002 Montana 303(d) lists have included Bobtail Creek, but Bobtail Creek was not listed in 1996. This waterbody was scheduled by the Montana Department of Environmental Quality (MDEQ) for development of a restoration plan and the necessary TMDLs. Water quality impairments affecting Bobtail Creek include sediment pollution and aquatic habitat alterations. The restoration plan outlined in this document establishes quantitative restoration goals for the impaired stream for the offending pollutant. The plan provides recommendations for reducing pollutant loads and improving overall stream health, and establishes a monitoring plan and adaptive management strategy for fine-tuning the restoration plan, thus ensuring its ultimate success in restoring water quality in the Bobtail watershed.

1.2 Water Quality Restoration Planning Process

Development of a TMDL water quality restoration plan follows a series of successive steps, which are described below to provide the reader with a general understanding of the process that was used in developing the Bobtail plan.

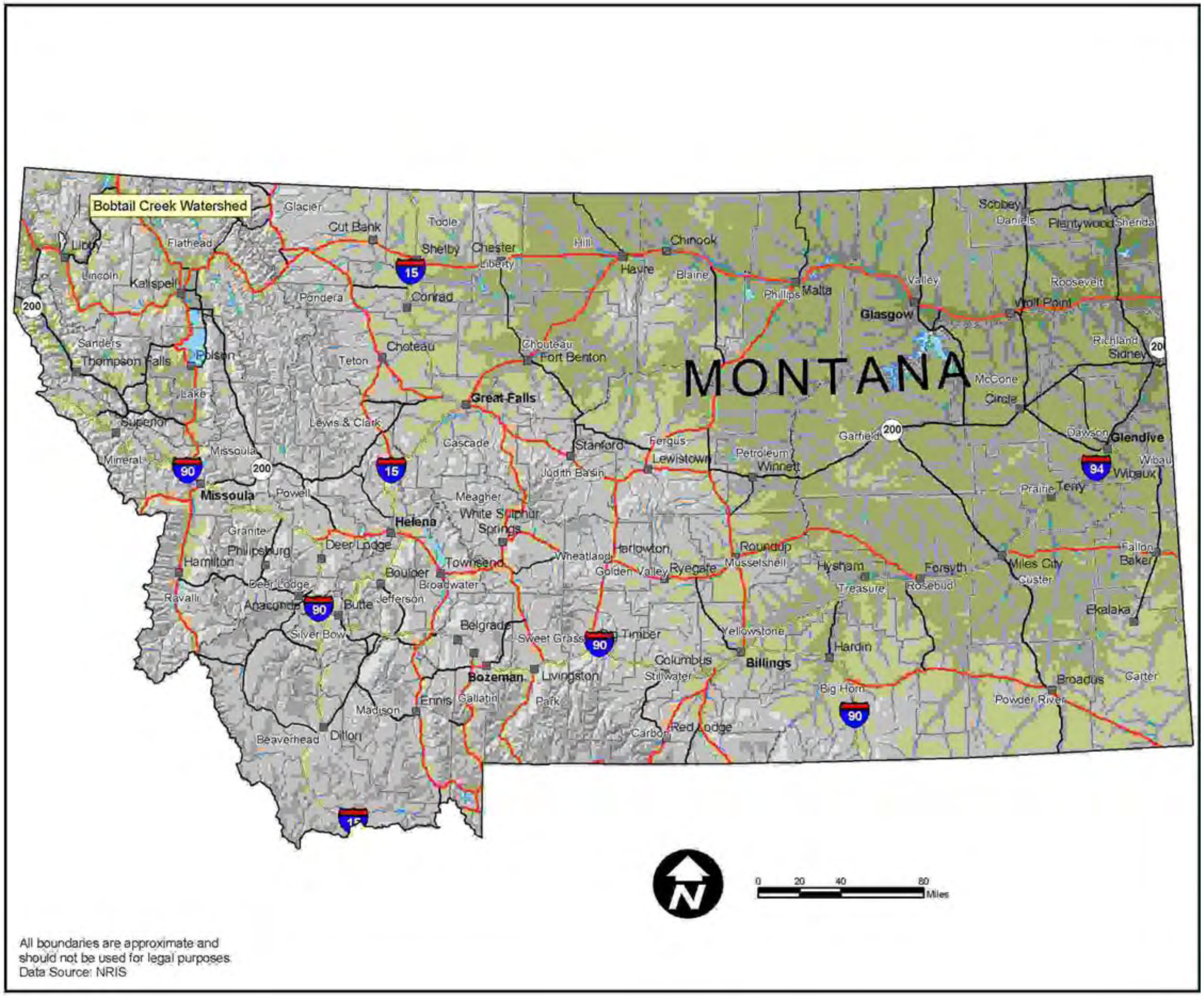
The first step in developing a water quality restoration plan is to thoroughly evaluate and describe the water quality problems of concern. This includes understanding the characteristics and function of the watershed, and documenting the location and extent of the water quality impairments and developing water quality targets, or endpoints, that represent the applicable water quality standards. These targets are used to determine whether beneficial uses are fully supported.

The next step is to identify each of the contributing causes and sources of impairment. Pollution source assessments are performed at a watershed scale because all potential sources of water quality problems must be considered when developing the restoration plan.

The total maximum daily load of each pollutant that will meet water quality standards and allow for full support of beneficial uses is then calculated and compared to the total pollutant load derived in the source assessment. If the current load exceeds the total maximum daily load, then a pollutant reduction plan is developed. Pollutant reductions and corresponding restoration measures are allocated across the watershed planning area. This allocation process may be applied on the basis of land use (e.g. forestry, urban, mining, transportation, etc.), land ownership (federal, state, private), sub-watersheds or tributaries, or any combination of these. Specific allocations are also established for future growth and development in the watershed, and for any natural sources of impairment that may be present.

Lastly, the water quality restoration plan must include a monitoring component designed to evaluate progress in meeting the water quality targets established by the plan, and to ensure that the restoration measures are, in fact, implemented. The monitoring strategy also provides useful information to help strengthen any assumptions made during the initial process. Taken together, the steps in the water quality restoration planning process described above constitute a water quality-based approach to water pollution control, which is also known as the Total Maximum Daily Load process. The end result becomes a “Water Quality Restoration Plan”, that if implemented will result in the restoration of water quality and full support of all beneficial uses.

Figure 1-1. Bobtail Creek Watershed – Location Map.



SECTION 2.0
WATERSHED CHARACTERIZATION

This section should provide the reader with a general understanding of the environmental characteristics of the Bobtail Creek watershed that might have relevance to the 303(d)-listed causes of impairments. This section also provides some detail regarding watershed characteristics that might play a significant role in driving pollutant loading (e.g., geographic distribution of soil types, vegetative cover, land use).

2.1 Location and Regional Description

Bobtail Creek is a fourth order stream located within the Kootenai River drainage in Lincoln County, Montana (Upper Kootenai hydrologic unit 17010101) (Figure 1-1). The Bobtail Creek drainage basin encompasses nearly 22 square miles in the Purcell Mountain Range within the northern Rocky Mountain ecoregion. Elevations within the basin range from approximately 4600 feet above mean sea level in the headwaters of Bobtail Creek, to approximately 2400 feet at the confluence of Bobtail Creek and the Kootenai River.

The largest town in Lincoln County, Libby, is located approximately three miles southwest of the Bobtail Creek/Kootenai River confluence. According to the United States Census Bureau (USCB, 2004), the population of Lincoln County in 2000 was 18,837. The reported population of Libby in 2000 was 2,626. These statistics exemplify the rural and sparsely populated nature of the area.

2.2 Geological Setting

Geologic information for the watershed was obtained from the Pipestone draft EIS (USFS, 2002). The Bobtail Creek watershed is underlain by the sporadically distributed carbonate-bearing strata of the Wallace Formation. The lower portions of the stream-bearing valleys are composed of thick layers of glacial deposits (Figure 2-1). During the most recent glaciation, the Purcell Mountains were mostly covered by montane glaciers resulting in the rounded, smooth upland topography characteristic of the drainage.

Valleys and drainage bottoms in the area exhibit moderate relief with relatively stable, moderate side slope gradients. Valley floor slopes are often less than 4% with poorly developed soils derived from the parent glacial till material. Surficial soils in the area are generally comprised of a gravelly silt layer 7 to 14 inches thick, formed in volcanic ash-influenced loess.

2.3 Land Types and Soils

Land type information was obtained from the *Soil Survey of the Kootenai National Forest Area, Montana and Idaho* (Kuennen and Nielsen-Gerhardt, 1995; Figure 2-2). The soil survey identifies a number of land types within Bobtail Creek drainage, and ranks them based on soil response (erosion potential) for various timber management and road construction activities

(Table 2-1). Table 2-2 includes general descriptions of each land type found in Bobtail Creek drainage.

Land type 103, which covers much of the Bobtail Creek drainage bottom (Figure 2-2), is rated as having a moderate to severe soil erosion potential, and a high sediment delivery efficiency (Table 2-1). Sedimentation can result in this land type from changes in the channel and disruption of the soils on or adjacent to stream banks (Kuennen and Nielsen-Gerhardt, 1995). This is consistent with the location of one or more sediment loading sources and habitat alteration areas identified in this plan (Sections 30 and 32, Figure 2-2). These source areas are associated with unstable stream bank and stream channel configurations as discussed throughout this document.

2.4 Climate

The climate of the Bobtail Creek watershed is characterized by long, cool winters and relatively short, temperate summers. Precipitation within the Bobtail Creek watershed varies from an average of 33 inches at the higher elevations to 19 inches in lower elevations (Figure 2-3). Average annual precipitation in the Bobtail Creek watershed is 30.3 inches. Rain-on-snow events do occur within the basin and have been associated with culverts failures and stream channel altering runoff events.

2.5 Vegetation

The Bobtail Creek watershed is largely a forested basin (Figure 2-4). Based on the United States Geologic Survey Gap Analysis Program vegetation database, dominant cover types include mixed mesic forest and mixed broadleaf and conifer forest. For the most part, forested vegetation types cover most upland areas and border most streams in the drainage, although there are areas of converted pasturelands in the lower reaches. Other vegetation types within the drainage include relatively small areas of grasslands located primarily in the drainage bottom, shrubs, and sub alpine meadows. One small area (approximately 80 acres) in the middle reach of the drainage is identified as agricultural lands (Figure 2-4).

2.6 Land Ownership

The Bobtail Creek watershed is under a mixture of federal, state, and private ownership (Figure 2-5). US Forest Service (USFS) holdings comprise the majority of the watershed (73%) with Plum Creek Timber Company (PCTC) the second largest landowner (16%). The State of Montana owns a small percentage of the watershed (0.03%). Other privately owned lands are concentrated along the drainage bottom and constitute 11% of the watershed. Although non-PCTC private ownership is relatively small in the drainage, the significance of these lands in water quality restoration planning is significant since the mainstream of Bobtail Creek is bordered by these privately-held land parcels for approximately half (5 miles) of its entire length.

Figure 2-1. Geology of the Bobtail Creek Watershed.

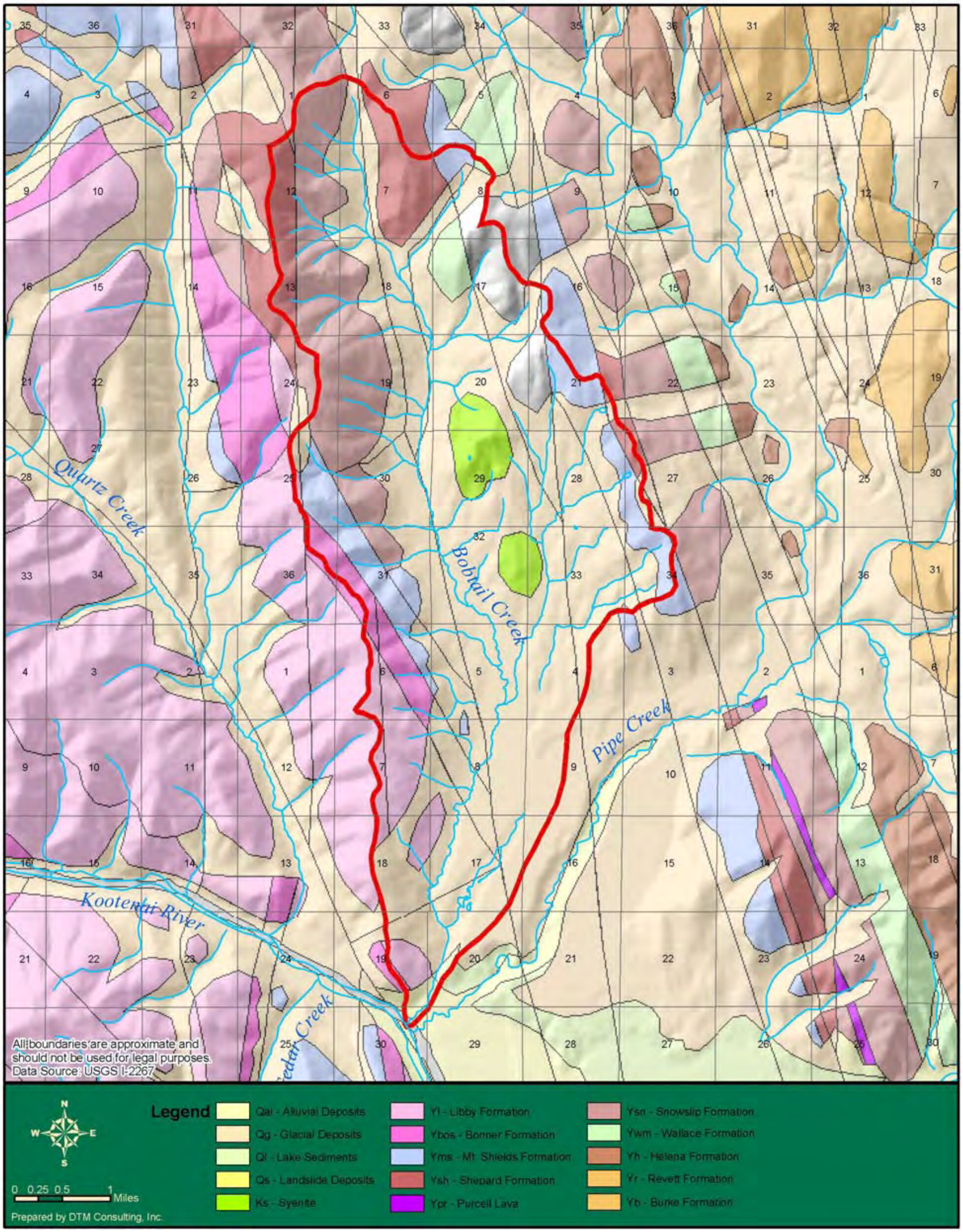


Figure 2-2. Land Types of the Bobtail Creek Watershed.

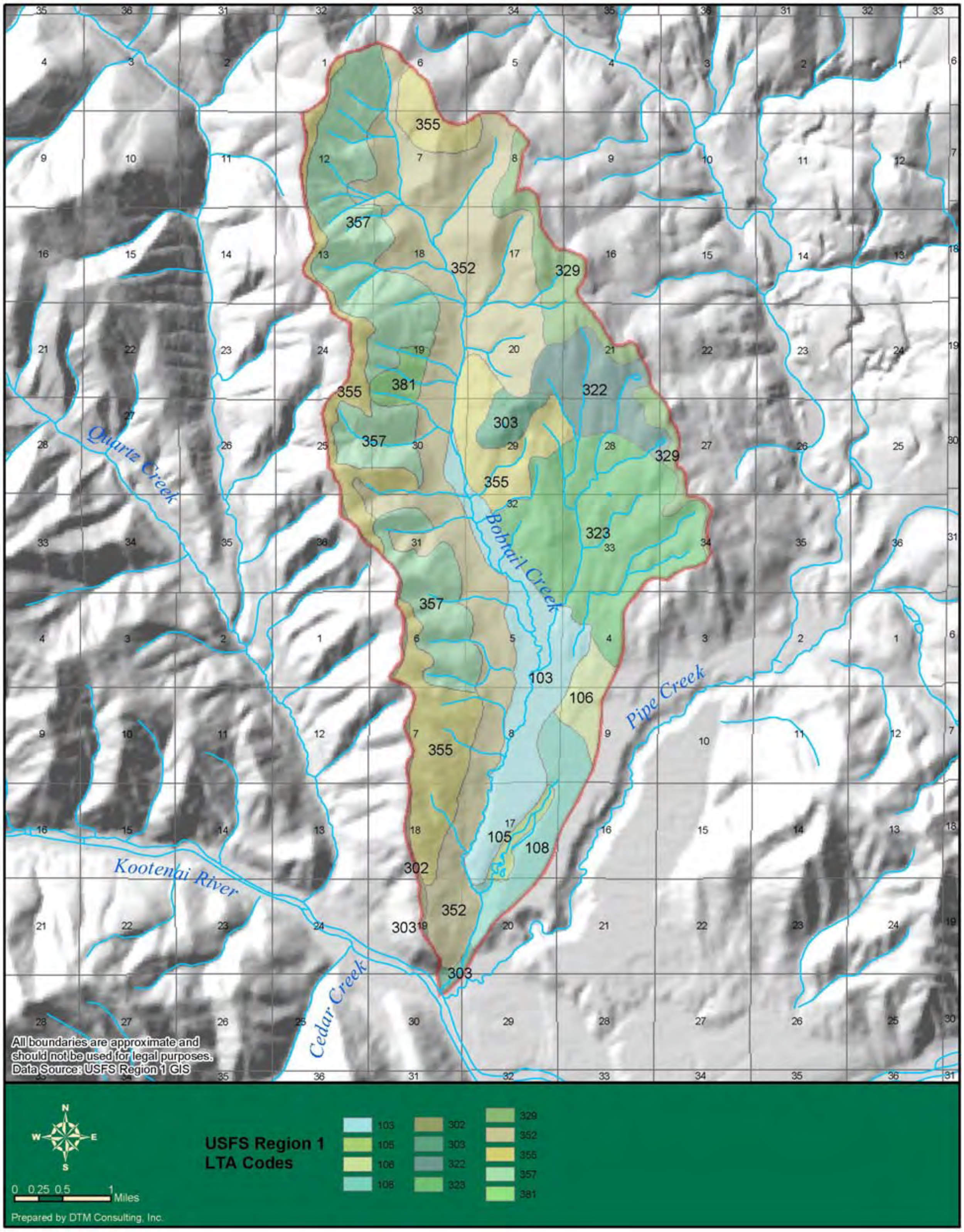


Table 2-1. Land Types, Expected Response of the Soil Resource to Different Activities, Resultant Soil Erosion, and Delivery Efficiency to Surface Waters in the Project Area (Kuennen and Nielsen-Gerhardt, 1995).

	Timber Management and Productivity		Road Construction and Maintenance			Susceptibility of the Soil to Erosion		Sedimentation
Land Types	**Tractor Operation**	**Sediment Hazard**	**Maintenance of cut and fill areas**	**Fill material used for surfacing roads**	**Sediment hazard on roads**	**Surface layer**	**Lower layer**	**Sediment delivery efficiency**
103	Soil damage	Severe	No limitations	Tread erosion	Severe	Moderate	Severe	High
105	Not listed	Not listed	No limitations	No limitations	Moderate	Moderate	Severe	Low
106	Soil damage	Moderate	No limitations	Tread erosion	Moderate	Moderate	Severe	Low
108	Soil damage	Moderate	No limitations	Tread erosion	Severe	Severe	Severe	Low
302	Slope	Moderate	Cut Bank Slough	Tread erosion	Moderate	Moderate	Moderate	Moderate
303	Rock outcrop	Moderate	No limitations	Large stones	Slight	Slight	Slight	Low
322	Soil damage	Moderate	Cut Bank Slough	Rut formation	Severe	Moderate	Severe	Low
323	No limitation	Moderate	Cut Bank Slough	Rut formation	Severe	Severe	Severe	Low
329	Soil damage	Moderate	Cut Bank Slough	Tread erosion	Moderate	Moderate	Moderate	Low
352	Complex slope, Soil damage	Moderate	Cut Bank Slough	Tread erosion	Moderate	Moderate	Moderate	Moderate
355	Rock outcrop	Moderate	No limitations	Large stones	Moderate	Moderate	Moderate	Moderate
357	Slope	Severe	Landslides	Large stones	Severe	Moderate	Moderate	High
381	Slope	Severe	Landslides	Tread erosion	Severe	Moderate	Moderate	High

Table 2-2. Descriptions of Land Types Occurring in the Bobtail Creek Watershed (Kuennen and Nielsen-Gerhardt, 1995).

Land Types	Landform	Slope (%)	Parent Material	Vegetation	Aspect	Elevation (Ft.)	Rock outcrop(%)	Brief Description*
103	Terraces	0-15	Alluvial deposits	Moist, mixed forest	Variable	2000-3500	0	Gently undulating alluvial terraces at low elevations
105	Alluvial basins	0-5	Alluvial deposits	Wet meadows	Variable	2000-4000	0	Poorly drained flood plains and wet mountain meadows
106	Terraces	0-15	Glacial outwash deposits	Moist, mixed forest	Variable	2500-4000	0	Glacial outwash terraces
108	Terraces	0-15	Lacustrine deposits and glacial outwash deposits	Moist, mixed forest	Variable	2000-4000	0	Flat to gently undulating terraces at low elevations
302	Glaciated mountain slopes	30-60	Compact glacial till	Dry, mixed forest	Southerly	3000-4200	0	Convex mid-elevation mountain slopes
303	Glaciated mountain ridges	15-35	Material weathered from metasedimentary rocks	Open-grown forest	Southerly	3500-4700	50	Rounded mountain ridge tops and ridge noses
322	Moraines	15-35	Compact glacial till	Moist, mixed forest	Variable	2500-5000	0	Low relief rolling foothills
323	Moraines	15-35	Compact glacial till	Dry, mixed forest	Variable	2500-5000	0	Rolling foothills and drumlins
329	Moraines	15-35	Compact glacial till	Sub alpine forest	Variable	3000-5500	0	Rolling convex ridges
352	Glaciated mountain slopes	20-60	Compact glacial till	Moist, mixed forest	Northerly	2200-5600	0	Rounded valley side slopes
355	Glaciated mountain slopes	20-50	Compact glacial till	Moist, mixed forest	Northerly	3000-5500	20	Convex mountain slopes: Salish Cabinet and Purcell Ranges
357	Dissected glaciated mountain slopes	30-60	Compact glacial till and material weathered from metasedimentary rocks	Moist, mixed forest	Northerly	3500-5500	0	Strongly dissected long straight mountain slopes
381	Dissected glaciated mountain slopes	30-60	Compact glacial till and material weathered from metasedimentary rocks	Dry, mixed forest	Southerly	3000-5000	0	Steep mountain slopes closely spaced drainages

*The brief description is metadata obtained from the Kootenai National Forest website http://www.fs.fed.us/r1/kootenai/maps/gis

Figure 2-3. Average Precipitation in the Bobtail Creek Watershed.

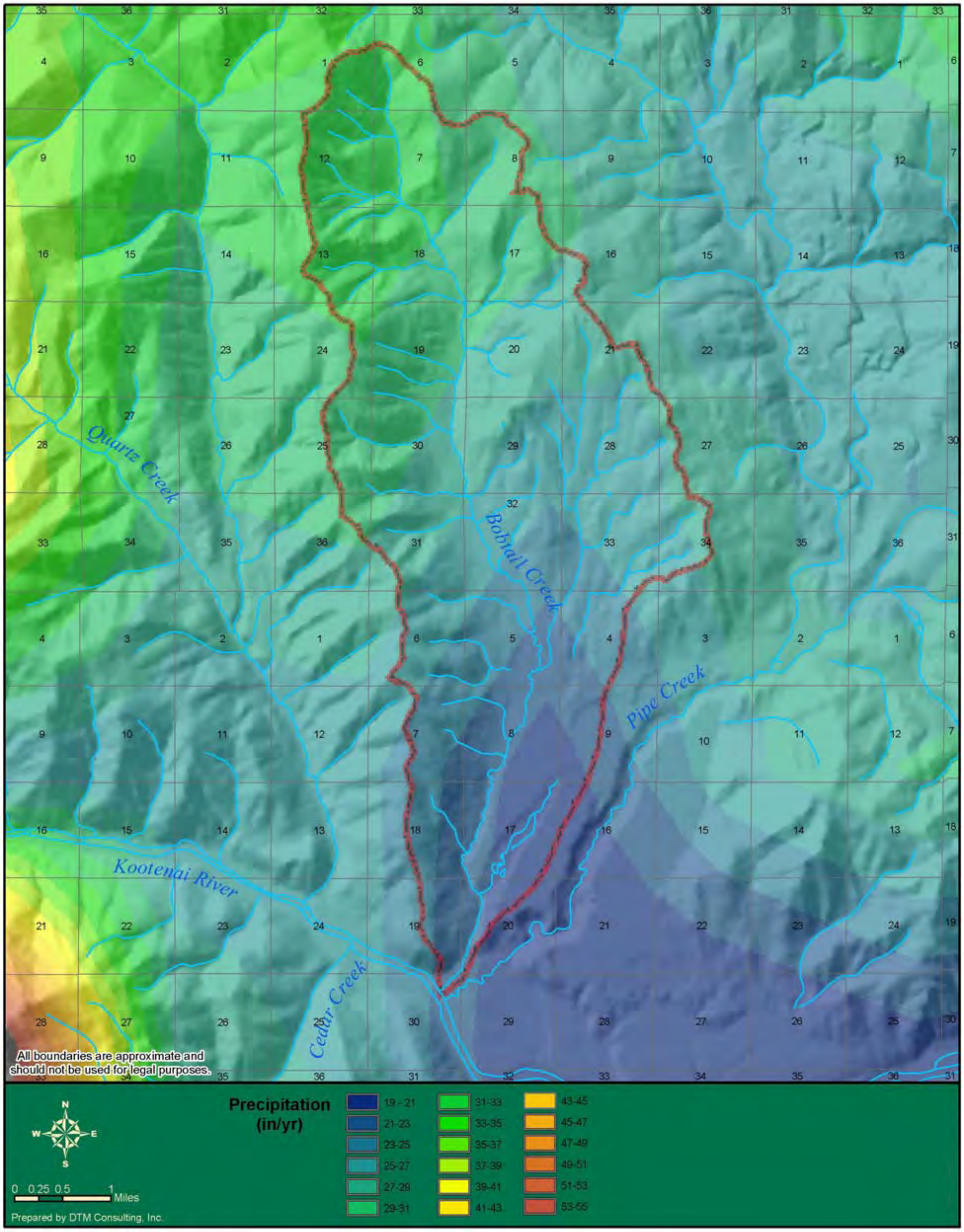


Figure 2-4. Vegetation Cover Types in the Bobtail Creek Watershed.

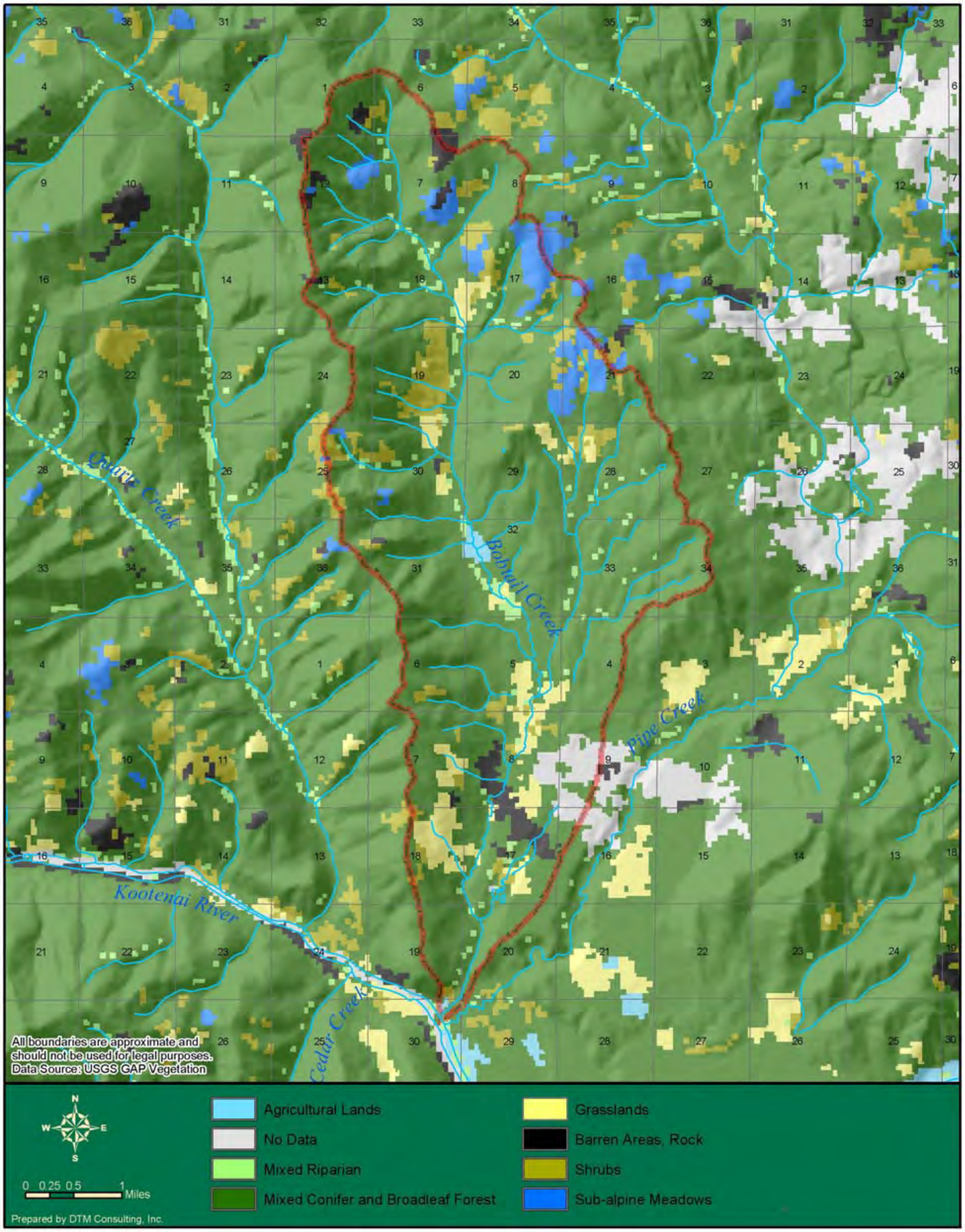
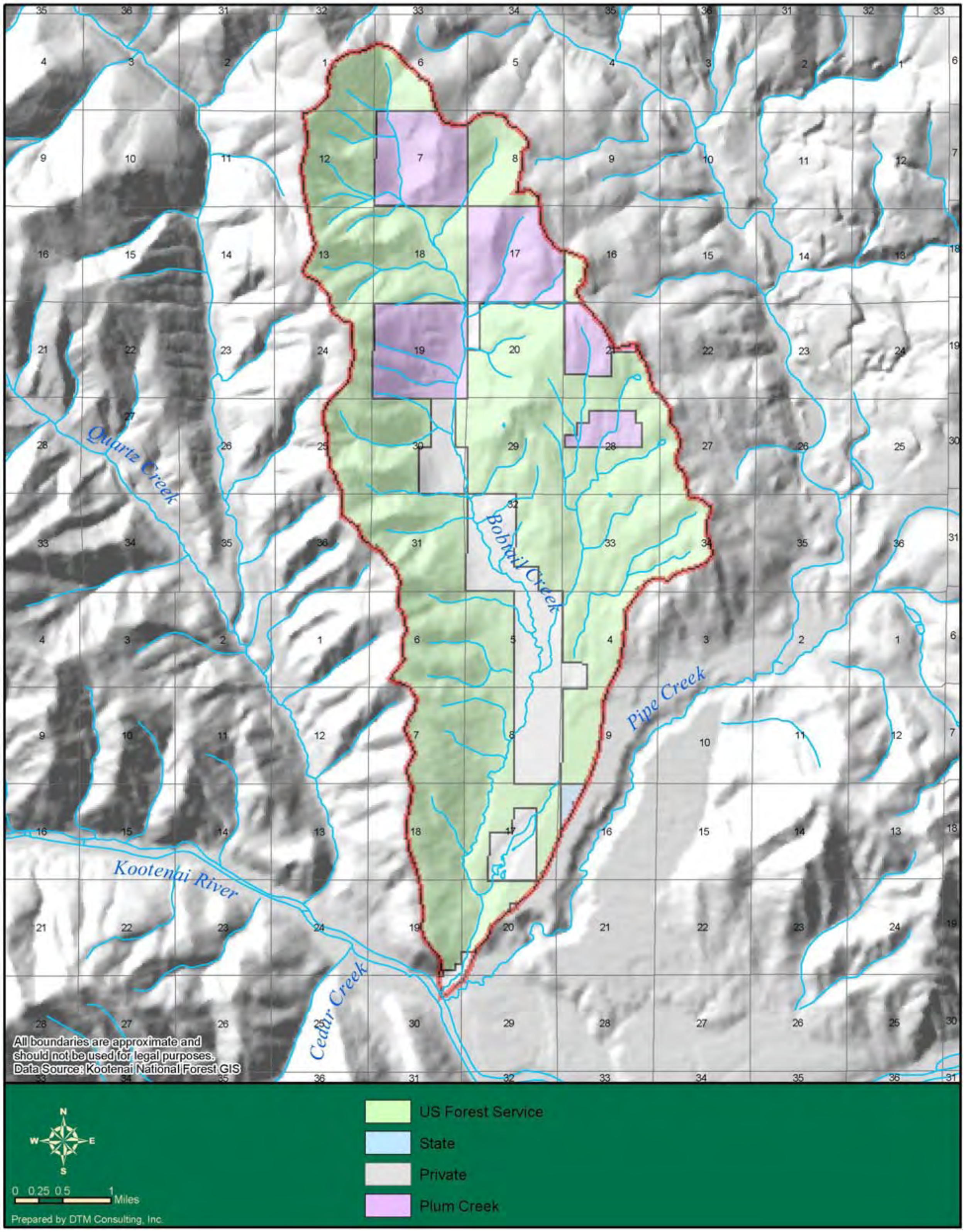


Figure 2-5. Land Ownership in the Bobtail Creek Watershed.



2.7 Land Use

Human land use activities in the basin include silviculture, residential development, agriculture (primarily grazing and hay harvest), and road development/maintenance (forest roads, county roads and private residential roads). Forestry activities have occurred throughout the basin. Residential and agricultural uses are primarily restricted to the drainage bottom in the lower half of the watershed.

Prior to the arrival of Euro-Americans, disturbance in the Bobtail Creek watershed included both natural and human-induced sources. For example, the natural fire regime resulted in periodic stand-replacing fires in the watershed. In addition, less intensive under story fires were common events. Native Americans probably influenced vegetation through under story burns intended to promote berry production. The Bobtail Creek Watershed has experienced four significant fires between 1917 and 1932, burning approximately 1500 acres. There have been no significant fires since 1932 (USFS, 2002).

Logging and associated road construction and maintenance are currently the primary land-use activities in the basin. Since the 1950s, about 24% of the drainage has been harvested with 56% of the harvest occurring in the past 20 years. There are over 128 miles of road in the drainage, equating to nearly six miles of road per square mile of watershed. An assessment of soil characteristics indicates there are over 10 square miles of sensitive soils in the 22 square mile basin. There are over 44 miles of road and 66 stream crossings on these sensitive soils. Results of a watershed screening analysis performed by the USFS (2002) indicate a severe rating for Bobtail Creek drainage based on the magnitude of landscape change experienced, and the sediment production hazard. The analysis also rated the habitat degradation potential as moderate (USFS, 2002). A logging skid-road constructed by a small-acreage private-land owner built adjacent to Bobtail Creek in the late 1980s captured Bobtail Creek during a rain-on snow events in the early 1990's have led to significant erosion and channel aggredation (Plum Creek Timber Company, 2004).

Agricultural practices have also had an adverse impact on Bobtail Creek. Livestock grazing in the stream corridor has resulted in bank erosion and riparian degradation, primarily in Township 32 N, Range 31 W, Section 32 (see Agricultural Lands in Figure 2-4).

Mining activities have been minimal in the Bobtail Creek watershed. A small amount of gravel and fill development has occurred in the basin. These developments have been located away from surface water resources and are not considered to have an appreciable impact. There have been no hard rock mining activities in the basin.

Considerable residential development has occurred along the lower half of Bobtail Creek. This residential development, and associated private road building and stream encroachment, has resulted in impacts to the Bobtail Creek channel and riparian area. Private road crossings, possibly in conjunction with increased water yield resulting from upstream land use activities, has resulted in significant channel instability and stream bank erosion.

2.8 Hydrology

Existing information on the hydrology of Bobtail Creek has been collected primarily by the US Forest Service (USFS). Hydrologic information includes: periodic stream flow and stream stage data collected near the mouth of Bobtail Creek between 1995 and 2003; daily stream stage data collected from 1996 to present; daily stream flow rates for 2000 through 2003 calculated from stream stage data; and estimates of changes in water yield resulting from silvicultural activities in the basin.

2.8.1 Stream Flow Data

Periodic stream flow and corresponding stream stage data have been collected by the USFS between 1995 and 2003 at an established monitoring station near the mouth of Bobtail Creek (site Bobtail 1: SE ¼, SE ¼, Section 19). These stream stage/stream flow data were used to develop a stream stage/stream flow-rating curve for site Bobtail 1. The rating curve was used to calculate daily stream flow rates from daily stream stage readings collected from 2001 through 2003. The calculated daily stream flow data for 2001 through 2003 are shown in Figure 2-6 (along with daily total suspended solids measurements). The 1995-2003 manual stream flow/stream stage measurements are included in Table 2-3. Additional stream stage data are included in Appendix A.

Peak flows in Bobtail Creek typically occur in May or June in response to snow melt runoff. The maximum measured stream flow from 1995 to 2003 was 100 cubic feet per second (cfs), recorded on February 21, 1995 (Table 2-3), while the minimum stream flow was 2.9 cfs recorded on August 23 and October 1, 2001. The maximum flow calculated from the daily stream stage data for water years 2001-2003 was 110.7 cfs on April 16, 2002, and the minimum calculated flow was 0.70 cfs on September 30, 2002 (Figure 2-6, Appendix A). The Pipestone Draft EIS (USFS, 2002) also reports that one section of Bobtail Creek, located in T32N, R31W, Section 30 goes dry on an annual basis.

Rain-on-snow (ROS) events occur sporadically in the Bobtail Creek watershed and can result in rapid increases in stream flows. For example, a ROS event in November 1990 caused major stream channel alterations, including a major shift in the channel location and washout of a number of culverts on privately owned lands. This was followed by another ROS event in April 1991. These two events, both of which occurred in Section 30, T32N, R31W (Figure 2-5), coupled with poor practices are believed to be responsible for much of the stream channel instability and excessive in-stream sediment loading responsible for impairment of Bobtail Creek (MDEQ, 1991). Several restoration projects have been completed or are currently scheduled for implementation in this area as discussed in Section 6.0.

2.8.2 Equivalent Clear-cut Area Model

In 2000, the USFS used the equivalent clear-cut area (ECA) model (USFS, 1991) to estimate the percent increase in peakflow month in Bobtail Creek resulting from vegetation removal (primarily timber harvest). TMDL-related consequences of increased water yield, and particularly percent increase in peakflow month, include potential stream bank instability, stream channel scouring, and culvert failure. All of these consequences have the potential to directly contribute to the sediment-related impairments in Bobtail Creek. The ECA model results indicate that average annual runoff has increased by up to 10% due to land clearing activities in the drainage. The Bobtail percent peakflow increases are discussed further in Section 4.0.

Figure 2-6. Daily Stream flow and TSS Data from Mouth of Bobtail Creek (Bobtail 1) Water Years 2001-2003.

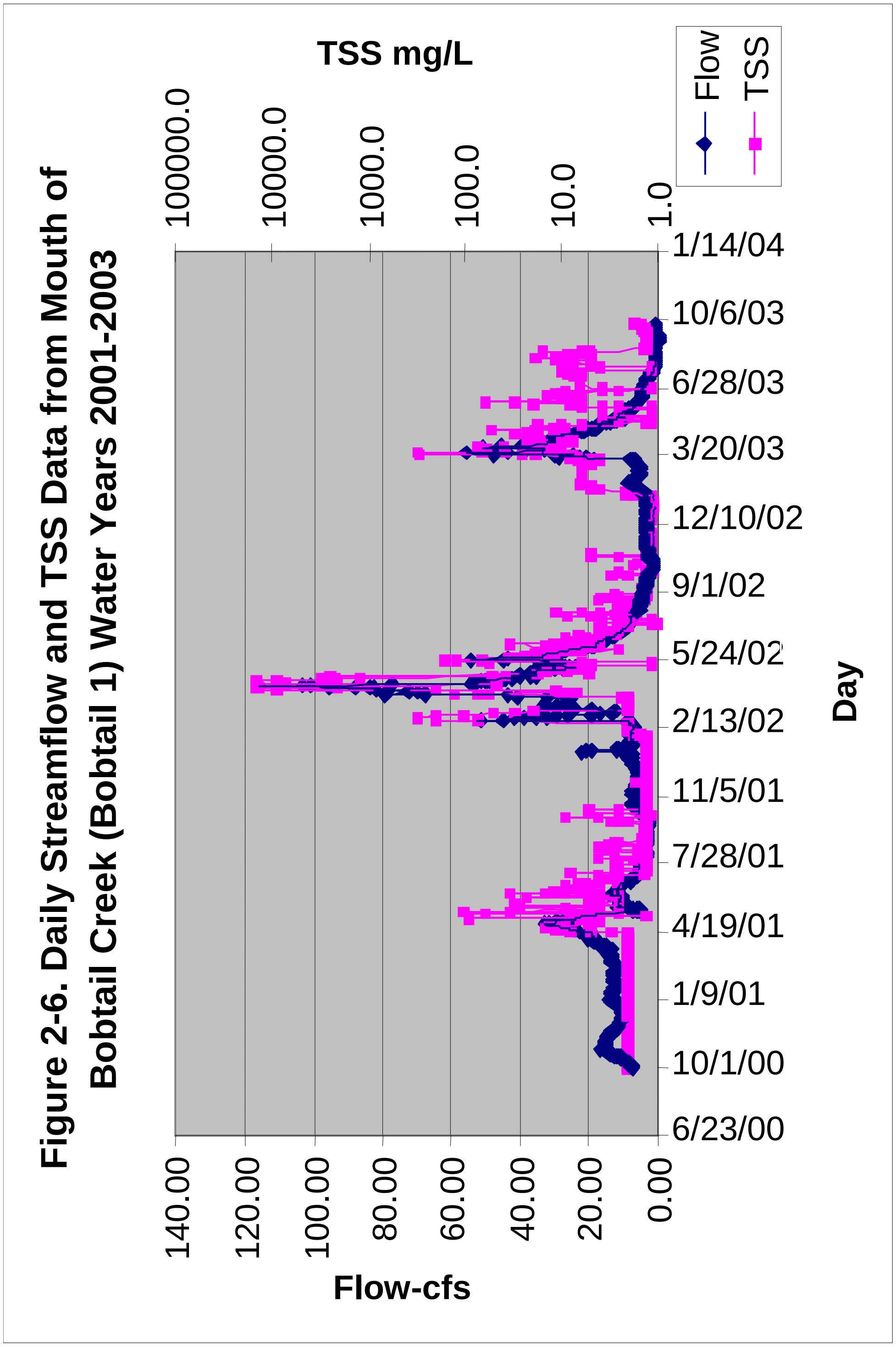


Table 2-3. Measured Stream Flow and Stream Stage Data Pairs at River Road Near Mouth of Bobtail Creek, 1995-2003.

Date	Staff Gage Ht (feet)	Stream Flow (ft^3/sec)
2/21/95	3.12	100.0
4/21/95	1.27	14.3
5/16/95	1.17	12.1
6/29/95	1.05	7.4
7/7/95	1.00	7.8
8/8/95	0.98	4.8
9/7/95	0.90	5.1
10/23/95	0.98	5.2
12/15/95	1.90	50.0
1/25/96	1.47	23.1
3/14/96	1.60	36.4
6/6/96	0.72	28.4
6/28/96	0.28	17.6
7/23/96	0.60	10.0
7/24/96	0.50	9.2
7/30/96	0.78	7.7
8/6/96	0.80	9.9
8/22/96	0.71	7.3
10/3/96	0.68	6.2
3/18/97	1.50	38.0
6/10/97	1.51	22.7
6/23/97	1.35	21.3
7/16/97	1.90	12.3
8/26/97	2.01	8.6
3/13/98	2.15	11.6
3/26/98	2.85	50.7
5/27/98	2.80	44.3
10/28/98	1.96	4.4
3/22/99	3.15	73.4
11/8/99	2.10	7.0
4/5/00	3.20	90.9
7/17/00	2.15	7.5
5/17/01	2.13	7.2
6/6/01	2.21	5.6
8/23/01	2.03	4.1
8/23/01	1.96	2.9
10/1/01	1.89	2.9
4/8/02	3.02	78.4
6/18/02	1.82	13.6
8/19/02	1.57	5.3
3/19/03	2.08	24.6
5/14/03	1.79	9.5
5/29/03	1.70	7.4

All measurements recorded by USFS

2.9 Fisheries and Aquatic Life

2.9.1 Fisheries

Bobtail Creek supports an assemblage of native and introduced species of fish and other vertebrates including the tailed frog (Table 2-4). Native species include westslope cutthroat trout, a Montana species of special concern. Tributaries like Bobtail Creek provide important flow and temperature refugia for subadult bull trout from the Kootenai River. Juvenile bull trout have been recorded in Bobtail Creek but have not been observed in recent years (MFWP, 1999).

Introduced species in the Bobtail Creek watershed include rainbow trout and brook trout. Bobtail Creek supports both resident and adfluvial populations of rainbow trout. Restoring spawning grounds in the lower portions of Bobtail Creek may increase recruitment of rainbow trout to the Kootenai River, a popular recreational fishery.

Electro fishing surveys have indicated a decline in all fish species in Bobtail Creek. Table 2-5 Includes fish population data collected by the Montana Department of Fish, Wildlife and Parks in 1976 and 1997. Although the 1976 and 1997 data are not from the same stream reach, they were performed in areas of similar habitat and thus are considered to be comparable. The data show significant decreases in fish populations in Bobtail Creek in the 21year period. Of considerable interest is the status of westslope cutthroat trout, a species of special concern, which were absent in the 1997 survey.

The combination of siltation and the presence of nonnative brook trout is a significant threat to the westslope cutthroat trout (Shepard et al., 1998).

Table 2-4. Vertebrate Species in Bobtail Creek and its Tributaries.

Family/Common Name	Scientific Name	Introduced/ Native	Status	Stream Use
Fish				
Salmonidae				
Rainbow trout	*Oncorhynchus mykiss*	Introduced		Resident and adfluvial spawners
Westslope cutthroat trout	*O. clarki lewisii*	Native	Species of special concern	Resident
Brook trout	*Salvelinus fontanalis*	Introduced		Resident
Rainbow X cutthroat trout	*O. mykiss x O. clarki*			
Bull trout	*Salvelinus confluentus*	Native	Threatened, species of special concern	Incidental

Table 2-4. Vertebrate Species in Bobtail Creek and its Tributaries.

Family/Common Name	Scientific Name	Introduced/ Native	Status	Stream Use
Cottidae				
Slimy sculpin[1]	*Cottus cognatus*	Native		Unknown
Torrent sculpin[2]	*Cottus rhotheus*	Native	Species of special concern	Unknown
Amphibians				
Tailed frog	*Ascaphus truei*	Native		Resident

[1] Slimy sculpin are present in Pipe Creek. Presence in Bobtail Creek has not been verified.
[2] Torrent sculpin are present in Quartz Creek. Presence in Bobtail Creek has not been verified.

Table 2-5. Trout Estimates for 1976 and 1997 Electro Fishing Sections in Bobtail Creek.

Species	#/500 ft in 1976	#/mile in 1976	#/500 ft 1997	#/mile in 1997
Rainbow Trout	123	1303	59	628
Brook Trout	68	718	10	106
Westslope Cutthroat Trout	33	349	0	0
TOTAL	224	2370	69	734

Data from MFWP, 1999
1976 survey in T32N R31W S20; 1997 survey in T31N R32W S17

2.9.2 Macroinvertebrates

Macroinvertebrate populations demonstrate good biological integrity in Bobtail Creek. Five macroinvertebrate samples collected by PCTC in July 1991 (Table 2-6) showed large proportions of stoneflies and taxa adapted to high flow and colder water conditions (clinger taxa) (Barbour et al., 1999). This indicates substrate free of siltation effects and intact riparian conditions in this section of Bobtail Creek. In should be noted however that these samples were collected immediately upstream (Section 19, T32N, R31W) of the area of significant stream channel damage resulting from the November 1990 ROS event. The samples also were collected prior to the 1997 flood event that caused significant stream channel damage upstream of Section 32. Therefore, these samples may not be representative of current macroinvertebrate populations as affected by these channel altering runoff events.

Macroinvertebrate data collected by the USFS in 2000 and 2001 (Table 2-6) show a decrease in macroinvertebrate population for specialized feeding groups (i.e., shredders and scrapers). The dominant taxa was the subfamily Chironominae. Members of this taxonomic group are typically collector-filterers and collector-gatherers. Collector-filterers and collector-gatherers are generalists, and higher numbers of these taxa are not usually found in healthy streams (Merritt and Cummins, 1978). A diversity of specialized functional feeding group organisms such as shredders and scrapers are expected in healthy streams.

It should be noted that the Plum Creek samples were taken in a fully forested reach of stream at the lower end of Plum Creek ownership where the channel bed is composed of coarse gravel (80% of bed coarser than 1 in), while the USFS samples were taken in downstream reaches of stream influenced by agriculture, grazing, and residential development where the stream gradient is much lower and the substrate is much finer (Plum Creek Timber Company, 2004).

Table 2-6. Bobtail Creek Macroinvertebrate Sampling Results.

	Metric Guidelines*	Plum Creek Timber Company					US Forest Service			
Location		SE 1/4, SE 1/4, SE 1/4, S19, T32N, R31W					SE 1/4, NW 1/4, NE1/4, S5, T31N, R31W			
Date		7/25/1991	7/25/1991	7/25/1991	7/25/1991	7/25/1991	10/3/2000	10/3/2000	10/3/2000	8/30/2001
Replicate/ Sample Number		1	2	3	4	5	114572	114573	114574	118552
Taxa Richness	>28	30	32	29	31	33	33	34	29	28
EPT Richness	>19	25	26	24	23	28	24	22	15	17
Biotic Index	<3	3.69	3.45	2.76	2.89	3	3.2	3.7	5.05	3.07
% Dominant	<25	39.86	38.13	28.8	25.18	31.31	19.8	25.7	31.2	40.1
% Collectors	<60	42.7	40.61	27.87	28.57	30.8	42	22	63	38
% Scrapers + Shredders	>55	47.23	50.32	59.84	55	52.77	37	32	7	7
% EPT	>70	57.73	60.07	71.99	71.25	68.38	80.3	57.5	26.5	19.9
Mountain IBI**		0.76	0.76	0.95	0.90	0.81	0.86	0.76	0.38	0.24

* Mountain region metric guidelines established for Montana wadable streams

** Montana Mountain Macroinvertebrate Index of Biological Integrity

>0.75 indicates full support

0.25 - 0.75 indicates partial support

<0.25 indicates nonsupport

SECTION 3.0
WATER QUALITY IMPAIRMENT STATUS

This section first presents the 303(d) list status of Bobtail Creek. This summary is followed by a list of applicable water quality standards and a translation of those standards into proposed water quality goals or targets. The remainder of the section is devoted to a review of available water quality data and an updated water quality impairment status determination for Bobtail Creek.

3.1 303(d) List Status

A summary of the 303(d) list status and history of listings is provided in Tables 3-1 and 3-2. Bobtail Creek was first placed on the 303(d) list in 2000. The 2000 and 2002 303(d) lists reported that Bobtail Creek is impaired (MDEQ, 2000 and MDEQ, 2002). Listed causes of impairment include bank erosion, siltation, turbidity, and other habitat alterations. The impaired beneficial used are aquatic life support and cold water fishery.

Bank erosion and habitat alterations are considered “pollution,” while siltation and turbidity are considered “pollutants.” It is the Environmental Protection Agency’s position that TMDLs are required only for “pollutants” that are causing or contributing to water quality impairment. However, since the habitat alteration and bank erosion do contribute to the impairment of beneficial uses (cold water fishery and aquatic life support), restoration goals (Section 6.0) are developed in this document for these impairment causes to help ensure that all beneficial uses are ultimately supported in Bobtail Creek.

The inclusion of Bobtail Creek on the 303(d) list is due, partially, to efforts of the Bobtail Watershed Group, a landowner/stakeholder group committed to the restoration of Bobtail Creek. The Watershed Group petitioned the Montana Department of Environmental Quality (MDEQ) for inclusion of Bobtail Creek on the state’s 2000 303(d) list. Based on a review of the available information, MDEQ determined that there is sufficient, credible data that indicate two beneficial uses (cold water fishery and aquatic life support) are only partially supported in the entire ten miles of main stem Bobtail Creek. Although no tributaries to Bobtail Creek are listed as impaired, existing data indicate that conditions in some tributaries may contribute to impairment of Bobtail Creek. Therefore, several elements of the Bobtail Creek restoration strategy (Section 6.0) apply throughout the drainage, thereby addressing potential impairment conditions within tributary drainages as well.

Table 3-1. Summary of 303(d) Listings for Bobtail Creek.

Year	Beneficial Uses Not Supported	Probable Causes	Probable Sources	Stream Miles Listed
1996	Not Listed	Not Listed	Not Listed	0
2000	Aquatic life support* Cold water fishery*	Bank Erosion; Siltation; Turbidity; Other habitat alterations	Silviculture; Logging road construction/maintenance; Other	10
2002	Aquatic life support* Cold water fishery*	Bank Erosion; Siltation; Turbidity; Other habitat alterations	Silviculture; Logging road construction/maintenance; Other	10

*These uses listed as partially supported

Table 3-2. Status of Beneficial Uses from 303(d) Lists.

Stream	Year Listed	Agriculture	Aquatic Life Support	Cold Water Fishery – Trout	Drinking Water Supply	Industrial	Primary Contact (Recreation)
Bobtail Creek	2000	Full	Partial	Partial	Not Assessed	Full	Full
	2002	Full	Partial	Partial	Not Assessed	Full	Full

Impairment Status Definitions for Table 3-2:
Partial = Partial support of Beneficial Use.
Full = Full support of Beneficial Use.

3.2 Applicable Water Quality Standards

Water quality standards include the uses designated for a waterbody, the legally enforceable standards that ensure that the uses are supported, and a non-degradation policy that protects the high quality of a waterbody. The ultimate goal of this water quality restoration plan, once implemented, is to ensure that all designated beneficial uses are fully supported and all standards are met. Water quality standards form the basis for the targets described in Section 3.3. Pollutants addressed in this Water Quality Restoration Plan include siltation and turbidity. This section provides a summary of the applicable water quality standards for each of these pollutants.

3.2.1 Classification and Beneficial Uses

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

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

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

Descriptions of Montana's surface water classifications and designated beneficial uses are presented in Table 3-3. All waterbodies within the Bobtail TPA are classified as B-1.

Table 3-3. Montana Surface Water Classifications and Designated Beneficial Uses.

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

3.2.2 Standards

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

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

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

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

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

The standards applicable to the list of pollutants addressed in the Bobtail TPA are summarized below.

3.2.2.1 Sediment

Sediment (i.e., coarse and fine bed sediment) and suspended sediment are addressed via the narrative criteria identified in Table 3-4. The relevant narrative criteria do not allow for harmful or other undesirable conditions related to increases above naturally occurring levels or from discharges to state surface waters. This is interpreted to mean that water quality goals should strive toward a reference condition that reflects a waterbody's greatest potential for water quality given current and historic land use activities where all reasonable land, soil, and water conservation practices have been applied and resulting conditions are not harmful, detrimental or injurious to beneficial uses (see definitions in Table 3-4).

3.2.2.2 Turbidity

The allowable changes in turbidity (above natural) is a rather small 5 or 10 nephelometric turbidity units (NTU), see Table 3-4. The likely direct effects of increased turbidity are on recreation and aesthetics and drinking water supplies. Indirectly increased turbidity can be linked to an increased pathogen potential, total recoverable metals concentration and increased total suspended sediment. Turbidity cannot be equated with other parameters. Turbidity is a measure of light scatter in water. Suspended or colloidal solids like phytoplankton, metal precipitates or clay may cause the light scatter. In some cases it may be a useful and easily measured surrogate for total suspended solids (TSS) but only after paired flow and seasonal (full hydrograph) turbidity and TSS data have been collected and a statistically significant correlation exists.

Table 3-4. Applicable Rules for Sediment Related Pollutants.

Rule(s)	Standard
17.30.623(2)	No person may violate the following specific water quality standards for waters classified B-1.
17.30.623(2)(f)	No increases are allowed above naturally occurring concentrations of sediment or suspended sediment (except a permitted in 75-5-318, MCA), settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.
17.30.637(1)	State surface waters must be free from substances attributable to municipal, industrial, agricultural practices or other discharges that will.
17.30.637(1)(a)	Settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines.
17.30.637(1)(d)	Create concentrations or combinations of materials that are toxic or harmful to human, animal, plant, or aquatic life.
	The maximum allowable increase above naturally occurring turbidity is: 0 NTU for A-closed; 5 NTU for A-1, B-1, and C-1; 10 NTU for B-2, C-2, and C-3).
17.30.602(17)	"Naturally occurring" means conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil, and water conservation practices have been applied.
17.30.602(21)	"Reasonable land, soil, and water conservation practices" means methods, measures, or practices that protect present and reasonably anticipated beneficial uses. These practices include but are not limited to structural and nonstructural controls and operation and maintenance procedures. Appropriate practices may be applied before, during, or after pollution-producing activities.

3.3 Water Quality Targets and Supplemental Indicators

To develop a TMDL, it is necessary to establish quantitative water quality goals referred to in this document as targets. TMDL targets must represent the applicable numeric or narrative water quality standards and full support of all associated beneficial uses. For many pollutants with established numeric water quality standards, the water quality standard is used directly as the TMDL target. Where targets are established for pollutants with only narrative standards, the target must be a waterbody-specific, measurable interpretation of the narrative standard.

In this Water Quality Restoration Plan siltation and turbidity are jointly considered, as they are derived from the same sources and jointly preclude full support of beneficial uses. Additionally, there is nothing to be gained by addressing these two causes independently in this specific watershed. For the remainder of this document, unless otherwise specifically stated, siltation and turbidity will be referred to jointly as “sediment”.

In the case of the Bobtail TPA, there is no single parameter that can be applied alone to provide a direct measure of beneficial use impairment associated with sediment or nutrients. As a result, a suite of targets and supplemental indicators has been selected to help determine when impairments are present (Tables 3-5). In consideration of the available data for the Bobtail watershed, the targets are the most reliable and robust measures of impairment and beneficial use support available. As described in the one-by-one discussions of individual targets presented in the following paragraphs, there is a documented relationship between the selected target values and beneficial use support, or sufficient reference data are available to establish a threshold value representing “full support of beneficial uses” for this watershed.

In addition to having a documented relationship with the suspected impaired beneficial use, the targets have direct relevance to the pollutant of concern. The targets, therefore, are relied on as threshold values that if exceeded (based on sufficient data), indicate water quality impairment. The targets are also applied as water quality goals by which the ultimate success of implementation of this plan will be measured in the future.

The supplemental indicators provide supporting and/or collaborative information when used in combination with the targets in determining impairment status. In addition, some of the supplemental indicators are necessary to determine whether exceedances of targets are a result of natural versus anthropogenic causes. However, the proposed supplemental indicators are not sufficiently reliable to be used alone as a measure of impairment because (1) the cause-effect relationship between the supplemental indicator(s) and beneficial use impairments is weak or uncertain; (2) the supplemental indicator(s) cannot be used to isolate impairment associated with individual pollutants (e.g., to differentiate between an impairment caused by excessive levels of sediment and an impairment caused by high concentrations of metals); or (3) there is too much uncertainty associated with the supplemental indicator(s) to have a high level of confidence in the result.

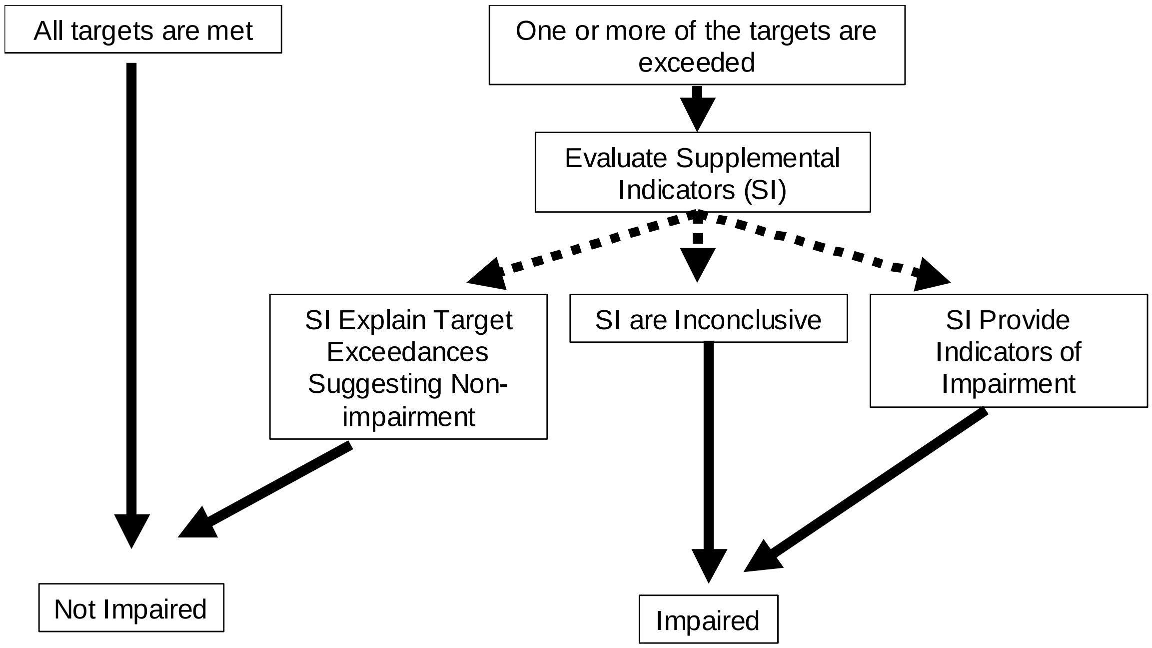
Table 3-5 Proposed Sediment Targets and Supplemental Indicators for the Bobtail Creek Watershed.

Target	Threshold	
Width-to-Depth Ratios	Rosgen Stream Type	Width-to-depth ratio
	B	10 to 28
	C	10 to 21
Pool Frequency	Bankfull Width (ft)	Pools per mile
	<10	96
	10-20	56
	20-25	47
Riffle Stability Index	A range of 45 to 75 in Rosgen B channel types.	
Wolman Pebble Counts	Frequency of less than 20 Percent for sizes < 2 mm	
McNeil Core Percentage of Subsurface Fine Sediment (<6.35 mm)	28 Percent or less	
Supplemental Indicators	**Recommended Values**	
Total Suspended Solids	An average value of 5.7 mg/L A maximum value not to exceed value of 75 mg/L	
Bank Stability	≥80%	
Montana Mountain Macroinvertebrate Index of Biological Integrity	> 75 Percent This shows full support based on Montana Department of Environmental Quality protocol.	

Targets and Supplemental Indicators Applied to Beneficial Use Impairment Determinations

The beneficial use impairment determinations presented in Section 3.4 are based a weight-of-evidence approach in combination with the application of best professional judgment. The weight-of-evidence approach outlined in Figure 3-1, is applied as follows. If none of the target values are exceeded, the water is considered to be fully supporting its beneficial uses and a TMDL is not required. This is true even if one or more of the supplemental indicator values are exceeded. On the other hand, if one or more of the target values are exceeded, the circumstances around the exceedance are investigated and the supplemental indicators are used to provide additional information to support a determination of impairment/non-impairment. In this case, the circumstances around the exceedance of a target value are investigated and it is not automatically assumed that the exceedance represents anthropogenic impairment (e.g., Are the data reliable and representative of the entire reach? Is the exceedance a result of natural causes such as floods, drought, fire, or the physical character of the watershed?). This is also the case where the supplemental indicators assist by providing collaborative and supplemental information, and the weight-of-evidence of the complete suite of targets and supplemental indicators is used to make the impairment determination. A conservative approach is used if the supplemental indicators are inconclusive. When the supplemental indicators support neither impairment nor non-impairment, it is assumed that the water is impaired.

Figure 3-1. Weight-of-Evidence Approach for Determining Beneficial Use Impairments.



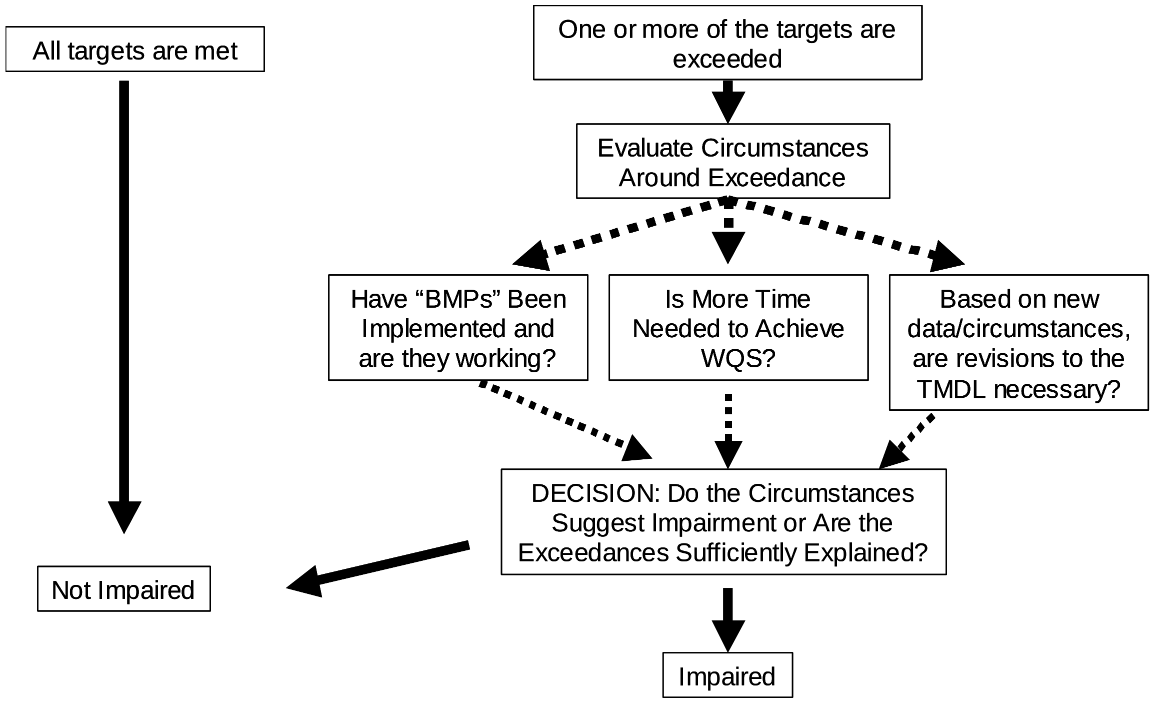
Targets as Water Quality Goals

In accordance with the Montana Water Quality Act (MCA 75-5-703(7) and (9)), the MDEQ is required to assess the waters for which TMDLs have been completed to determine whether compliance with water quality standards has been attained. This assessment will use the suite of targets specified in Table 3-5 to measure compliance with water quality standards and achievement of full support of all applicable beneficial uses (Figure 3-2). The supplemental indicators will not be used directly as water quality goals to measure the success of this water quality restoration plan. If all of the target threshold values are met, it will be assumed that beneficial uses are fully supported and water quality standards have been achieved. Alternatively, if one or more of the target threshold values are exceeded, it will be assumed that beneficial uses are not fully supported and water quality standards have not been achieved. However, it will not be automatically assumed that implementation of a TMDL was unsuccessful just because one or more of the target threshold values have been exceeded. As noted above, the circumstances around the exceedance will be investigated. Supplemental indicators and/or other potentially useful information will be used to evaluate the specific conditions. For example, might the exceedance be a result of natural causes such as floods, drought, fire, or the physical character of the watershed? In addition, in accordance with MCA 75-5-703(9), an evaluation will be conducted to determine whether:

- The implementation of a new or improved suite of control measures is necessary.
- More time is needed to achieve water quality standards.
- Revisions to components of the TMDL are necessary.

Detailed discussions regarding each of the targets and supplemental indicators are presented below.

Figure 3-2. Methodology for Determining Compliance with Water Quality Standards.



3.3.1 Sediment Targets

The proposed sediment targets include width-to-depth ratios, pool frequency, riffle stability index, Wolman pebble counts, and McNeil core substrate fines.

Width-to-Depth Ratios

Bankfull width/depth ratios describe the cross-sectional shape of stream channels and provide a measure of channel stability. As the width/depth ratio increases, the stream becomes wider and shallower. Accelerated stream bank erosion and an increased sediment supply accompany increases in the width/depth ratio (Rosgen, 1996). Lower width/depth ratios are associated with the presence of deep pools that provide better thermal protection for coldwater fish (Riggers et al., 1998).

The Kootenai National Forest developed a set of reference streams for bankfull width to depth ratios, where the upper end of one standard deviation is a ratio of 28 for B streams with average bankfull widths of 16 feet; and the upper end of one standard deviation is a ratio of 21 for C streams with average bankfull width of 24 feet. Based on recommendations from the U.S. Forest Service (2002) a minimum width to depth ratio of 10 is expected in both B and C streams. Therefore, a width to depth ratio reference range of 10 to 28 in B reaches and 10 to 21 in C reaches of the Bobtail TPA are used for targets.

The proposed width/depth ratio targets would help to address sediment supply issues associated with unstable stream banks, fish habitat issues associated with pool abundance, and thermal problems contributed in part by high surface area to volume ratios. Recovery of width to depth ratios may take decades, and long-term monitoring will be necessary to verify the relationship between this target and full support of designated beneficial uses. Monitoring long-term trends in width/depth ratios should be performed at permanently monumented cross-sections. The cross-sections should be established in riffles of unchannelized reaches. The width-to-depth ratio targets are intended to be applied as appropriate representative cross section ratios averaged over the segment length.

Pool Frequency

Pool frequency (pools/mile) is a critical measure of the availability of rearing and refugia habitat for salmonids in the Bobtail TPA. Pools provide the habitat for where salmonids spend the majority of their lives. They provide resting habitat for adult fish and rearing habitat for juveniles and sub-adults, and are in some way important to nearly all life stages of salmonids (Bjorn and Reiser, 1991). Pools provide hiding cover, thermal and hydraulic refugia, and feeding areas where energy expenditure is low. An abundance of high quality pools is necessary to sustain healthy salmonid populations. The frequency of high quality pool habitat in a stream can be affected by land management activities such as logging, mining, road construction, and grazing (Bilby, 1984, Clifton, 1989; Sedell and Froggaht, 1984). This in turn can affect fish populations (Riggers et al., 1998).

The Pipestone Draft Environmental Impact Statement (USFS, 2002) identifies the Riparian Management Objectives (RMO) from the Inland Native Fish Strategy (USFS, 1995) for pool frequency that apply to streams in the Bobtail TPA. Pool frequency RMOs vary by stream width and are presented in Table 3-6**.**

Table 3-6. Riparian Management Objective for Pool Frequency.

Bankfull Width (ft)	Pools per mile
<10	96
10-20	56
20-25	47

Riffle Stability Index

The riffle stability index provides an estimate of sediment supply in a watershed. Kappesser (2002) found that riffle stability index 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 are suggestive of excessively sediment-loaded streams. Rowe et al. (2003) reviewed the RSI as a potential target variable for sediment TMDLs in Idaho and, based largely on Kappesser’s work, recommended an RSI target of < 70. The authors cautioned, however, that this value is most applicable in the belt geology of northern Idaho and would thus likely have to be adjusted in other geologies. In developing sediment TMDLs for the St. Regis River and several of its tributaries, the Montana DEQ conducted an assessment of riffle stability index values, primarily in C-channels. Riffle stability index values of 75 and greater were documented in managed subwatersheds within the St. Regis River drainage. Watersheds were considered to be "managed" in the study if roads existed above a stream survey site. Other managed and unmanaged sub-watersheds within St. Regis drainage produced riffle stability index values of between 46 and 75. The results indicated that there was more mobile bedload in managed areas of the St. Regis watershed as compared to less developed stream segments. The MDEQ study resulted in a recommended RSI target of 45 – 75. The 45 minimum was included because in some cases, heavily riprapped stream reaches for example, a very low RSI can indicate an unnaturally high sediment transport capacity. Based on Kappesser (2002) and the unpublished St. Regis TMDL, the RSI for the Bobtail TPA will be 45 to 75 on Rosgen B channel types.

Wolman Pebble Counts - Percent Surface Substrate Fines < 2mm

Research by macroinvertebrate specialists (Relyea, personal communication, as cited in EPA, 2004) indicates that surface fines (< 2 mm) need to be elevated to levels between 20 – 40%, based on pebble count data, to result in a decrease in macroinvertebrate richness. Development of this target is one of the important criteria for evaluating whether or not excess sediment loading indicates a "siltation" type of impairment cause. A frequency below 20%, for sizes less than 2 mm in riffles, is the target for Wolman pebble count results.

McNeil Core – Percent Subsurface Substrate Fines < 6.35 mm

McNeil core sampling involves the use of a standard 15.2-centimeter hollow core sampler to collect subsurface sediments in stream bottom substrates (Deleray et al., 1999). Measurements of the size range of subsurface substrate material in the streambed are indicative of salmonid spawning and incubation habitat quality. Substrate fine materials smaller than 6.35 millimeters are commonly used to describe spawning gravel quality, and they include the size range typically generated by land management activities (Weaver and Fraley, 1991). Weaver and Fraley (1991) observed a significant inverse relationship between the percentage of material smaller than 6.35 millimeters and the emergence success of westslope cutthroat trout and bull trout. Further, they demonstrated a linkage between ground-disturbing activities and spawning habitat quality. Streambed sediments < 6.35 mm in size can be detrimental to spawning by smothering eggs or entombing alevins. Based on relationships between percent fines and embryo survival developed for cutthroat trout (Weaver and Fraley, 1991) and rainbow trout (Irving and Bjornn, 1984), the fine sediment concentrations observed in Bobtail Creek equate to an estimated survival to emergence for embryos of between 26% for westslope cutthroat trout and 35% for rainbow trout.

Table 3-7 presents reference data for substrate fines. MDEQ and the Flathead National Forest established McNeil core percent fine reference conditions for the Big Creek TMDL, of less than or equal to 30 percent substrate fines (< 6.35 mm) for a McNeil core sample. Most other TMDL target conditions are based on local reference conditions that show achievable substrate fines values typically in the range of 25 to 35 percent fines less than 6.35 mm.

Results from McNeil Core sampling by the Kootenai National Forest show average percent substrate fines at reference sites monitored from 1997 – 2003 ranged from 17 to 29 percent with similar median values (Table 3-7). The 75th percentile values typically fall below 28 percent.

Therefore, a value of 28 percent substrate fines less than 6.35 mm is proposed as a target for the Bobtail TPA.

Table 3-7. Reference Data for Substrate Fines.

Source	Percent Fines			
McNeil Core Substrate Fines (<6.35 mm)				
Big Creek TMDL	30			
Other TMDL targets in Western Montana	25 - 35			
Kootenai Sampling (1997-2003)	Average	Stnd Dev.	75^{th} Percentile	Median
Bear Creek	19.0	6.0	22.5	19.5
Flattail Creek	26.7	7.2	28.3	26.0
Himes Creek #1	29.1	4.4	28.2	27.5
Libby	25.4	4.5	27.9	26.0
West Fork Quartz (Upper)	17.1	3.6	18.0	16.5
Upper Silver Butte	21.0	4.3	23	21.5

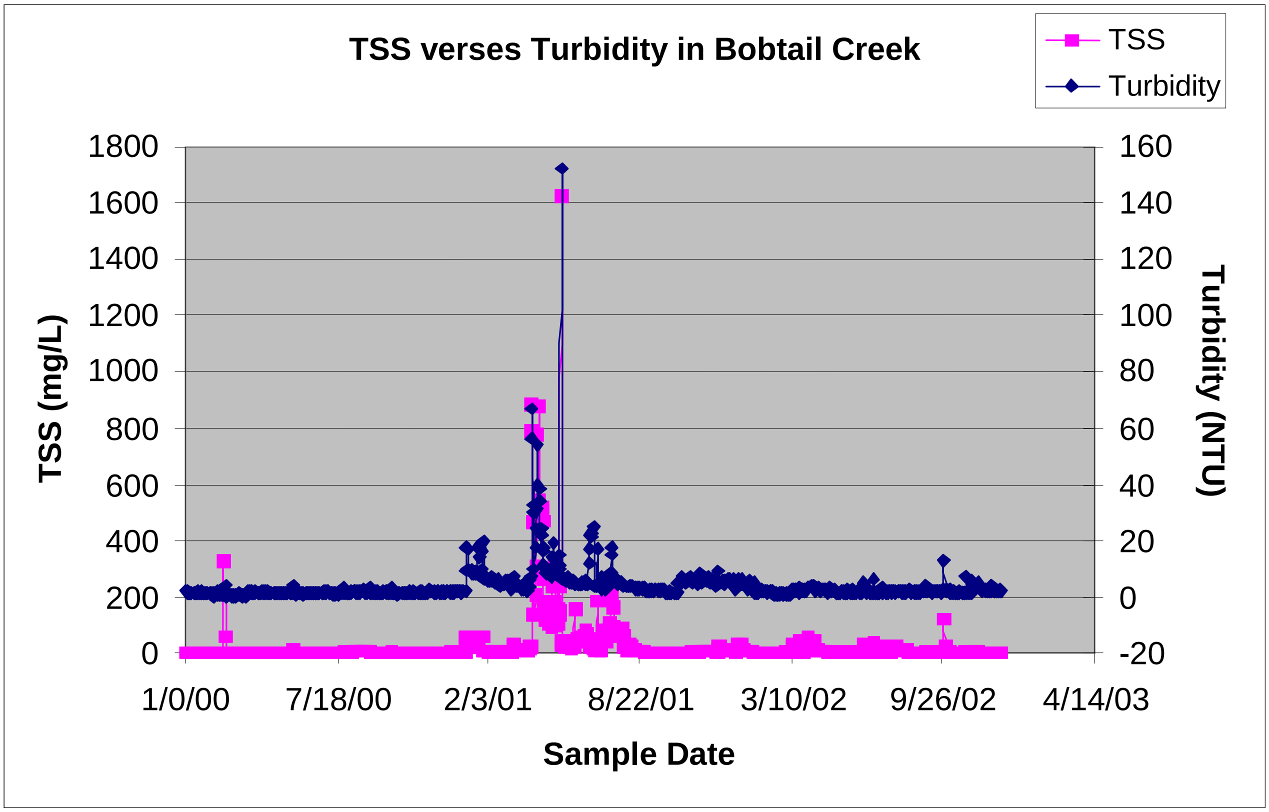
3.3.2 Supplemental Indicators

As stated previously, the proposed supplemental indicators are not sufficiently robust to be used alone as a measure of sediment impairment in Bobtail Creek. These indicators are used as supplemental information, in combination with the targets, to provide better definition of potential sediment impairments. The supplemental indicators, total suspended solids, bank stability, and macroinvertebrates are discussed below. As previously stated, these indicators will be used in the future, if the targets are not met, in evaluating the circumstances around the exceedance of the target. In the future, other supplemental indicators may also be identified.

Total Suspended Solids

The USFS has conducted frequent TSS monitoring in Bobtail Creek over the past several years including daily TSS sampling near the mouth for water years 2001 through 2003. Total suspended solids (TSS) and turbidity (i.e., one of the listed causes of impairment), are interrelated since TSS is the primary cause of elevated turbidity in Bobtail Creek. Because TSS and turbidity are closely associated in terms of causes, sources, and related impairments, they are linked in this document. Figure 3-3 shows the close correlation between TSS and turbidity based on simultaneous TSS and turbidity measurements obtained from Bobtail Creek.

Figure 3-3. Comparison of Simultaneous Measurements of TSS and Turbidity in Bobtail Creek.



A plan for addressing TSS and turbidity must identify the extent to which these pollutants are impacting beneficial uses, and determine the degree to which the pollutants are elevated over baseline or "natural" levels. To provide for a comparison of the available TSS data from Bobtail Creek and reference or "least impaired" streams, data for other drainages were obtained from the USGS, with the following selection criteria applied:

1) Drainages must range from 1 to 45 square miles in area;
2) Drainages must be within the Columbia River drainage in Montana; and
3) Drainages must meet the criteria of least impaired reference conditions.

A total of 12 drainages meeting the screening criteria were identified in the United States Geologic Survey (USGS) database for which TSS data were available. All 12 drainages are located in western Montana with seven of the sites located in northwest Montana. The reference drainages are listed in Table 3-8 along with their individual drainages areas, number of TSS values available, and the minimum, maximum and mean TSS values from the USGS database. Bobtail Creek TSS data are also summarized in Table 3-8. The complete TSS database for Bobtail Creek and the 12 reference drainages are included in Appendix C.

Overall, TSS values were relatively low in the reference drainages, with reference stream values ranging from 1.0 to 75 mg/L. The average of the 186 reference drainage values was 5.7 mg/L, and the median, or mid value, was 3.0 mg/L (Table 3-8). This trend of relatively low average and median TSS values and significantly greater maximum values is typical of TSS concentration trends in mountainous streams. The higher TSS concentrations generally occur during high flow events resulting from snowmelt runoff and/or high intensity rainfall events. Although it is normal for TSS concentrations to increase during high flow periods, significant increases during high flow events usually indicate some level of land disturbance in a drainage.

The TSS supplemental indicator value for Bobtail Creek will be an average value of 5.7 mg/L with a maximum not to exceed value of 75 mg/L.

Table 3-8. Summary of TSS data used in evaluating TSS and impairment condition of Bobtail Creek.

Source	Site Number	Site Name	Drainage Area (sq mi)	No. of Samples	Min mg/L	Max mg/L	Mean mg/L	Median mg/L
Bobtail Creek Data								
USFS		Bobtail Creek Near Mouth (includes sites Bobtail 1, Bobtail 2, and Bobtail Ck at River Road)	22	1131	0.002	14786	125.3	2
Reference Stream Data								
USGS	12303400	Ross Creek near Troy MT	24	19	1	4	1.9	2
USGS	12303430	Stanley Creek near Troy MT	13	19	1	3	1.7	1
USGS	12353400	Negro Gulch near Alberton MT	8	9	2	4	3.4	4
USGS	12370900	Teepee Creek near Polson MT	2	15	1	14	6.2	6
USGS	12374250	Mill Cr ab Bassoo Cr near Niarada MT	20	11	1	26	8.6	8
USGS	12375900	South Crow Creek near Ronan MT	8	16	1	26	4.5	2
USGS	12377150	Mission Cr ab Reservoir near St. Ignatius MT	12	22	1	75	8.3	3
USGS	12383500	Big Knife Creek near Arlee MT	7	12	2	38	8.1	4
USGS	12387450	Valley Creek near Arlee MT	15	15	1	24	6.6	4
USGS	12388400	Revais Cr below West Fork near Dixon MT	23	28	1	28	4.8	2
USGS	12388650	Camas Creek near Hot Springs MT	4	16	1	41	10.9	7
USGS	12389450	West Fork Thompson River near Thompson Falls, MT	36	4	1	4	2.5	2.5
Summary for All Reference Streams Combined			**NA**	**186**	**1**	**75**	**5.7**	**3**

Complete data in Appendix C

Bank Stability

The US Forest Service analyzed several Riparian Management Objectives (RMOs) (Section 3.4.2). From this analysis pool frequency, width-to-depth ratios, and riffle stability index targets were created. Another identified RMO was bank stability. Bank stabilities of less than 80% are considered impaired by the Inland Native Fish Strategy Standards (USFS, 1995). The proposed supplemental indicator value for bank stability is greater than or equal to 80%.

Macroinvertebrates

Macroinvertebrate data help to provide a better understanding of the cumulative and intermittent impacts that might have occurred over time in a stream, and they are a direct measure of the aquatic life beneficial use. Analytical methods used to interpret macroinvertebrate data are constantly evolving, based on new data and information offered from research. With this in mind, the macroinvertebrate supplemental indicator is intended to integrate multiple stressors and pollutants to provide an assessment of the overall aquatic life use condition. The macroinvertebrate targets are also intended to provide information regarding which pollutant(s) might be causing the impairment.

Macroinvertebrate data are typically organized according to a multimetric index of biological integrity (IBI), or a "multimetric index". In Montana the Mountain Index of Biological Integrity (IBI) (MDEQ, 1998) has been developed. Individual metrics (e.g. clinger taxa, percent EPT) are designed to indicate biological response to human-induced stressors. Scores are assigned to individual metrics, summed across several of them, and the total used to compare among samples or sampling sites. Three possible multimetric indices have been developed for Montana: 1) Mountain; 2) Foothill Valley and Plains (MFVP); and 3) Plains. The Mountain IBI was chosen for streams in the Bobtail TPA based on site characteristics, primarily elevation. MDEQ uses a scoring procedure with the maximum possible score is 100 percent. Total scores greater than 75 percent are considered within the range of anticipated natural variability and represent full support of their beneficial use (aquatic life). Additionally, data collected in 1991 (Section 3.4.2) shows that Bobtail Creek has the ability to reach the 75% criteria; therefore, a score representing full support (>75 percent) is proposed as the Mountain IBI target.

3.3.3 Uncertainty Associated with Targets and Supplemental Indicators

The targets and supplemental indicators were developed to represent desired conditions and achievement of water quality standards. However, a shortage of local reference data and the inherent variability in natural conditions in aquatic ecosystems combine to introduce a degree of uncertainty into the targets and indicators. As a result, reference conditions upon which the target thresholds were based may not accurately represent local potential, and thus targets may be difficult to achieve. In response, targets and supplemental indicators will be evaluated at least every five years (Section 7.0). This evaluation will include consideration of target suitability and could result in modification of the targets as more suitable reference data become available. Nevertheless, the target and supplemental indicator thresholds presented in this document are reasonable approximations of reference conditions based on the available data.

3.4 Current Water Quality Impairment Status for Bobtail Creek

The following section summarizes relevant data for Bobtail Creek.

3.4.1 Summary of the 303(d) List

The 2000 and 2002 Montana 303(d) lists reported that aquatic life and cold-water fishery beneficial uses were partially supported in Bobtail Creek due to bank erosion, siltation, turbidity, and other habitat alterations. The probable sources of the problems were listed as silviculture, logging road construction and maintenance, and “other”. The 303(d) status of Bobtail Creek is summarized in Table 3-9.

Table 3-9. 303(d) List Status for Bobtail Creek.

Year	Use Support Status	Probable Impaired Uses	Probable Causes of Impairment	Probable Sources of Impairment	Stream Miles Listed
1996	Not Listed	Not Listed	Not Listed	Not Listed	0
2000	Partial Support	Aquatic life support Cold water fishery	Bank Erosion, Siltation, Turbidity, Other habitat alterations	Silviculture, Logging road construction/maintenance, Other	10
2002	Partial Support	Aquatic life support Cold water fishery	Bank Erosion, Siltation, Turbidity, Other habitat alterations	Silviculture, Logging road construction/maintenance, Other	10

3.4.2 Target and Supplemental Indicator Data

As described in Section 3.3, a suite of targets representing applicable narrative water quality standards has been developed for listed streams in the Bobtail TPA. A review of available data for Bobtail Creek is provided below. Targets and supplemental indicators for which current data are available include: width-to-depth ratios, pool frequency, riffle stability index, Wolman pebble counts, McNeil core values, total suspended solids, bank erosion, and macroinvertebrates.

Width-to-Depth Ratios

The U.S. Forest Service measured width-to-depth ratios at eighteen locations (Figure 3-4) in the Bobtail TPA during the Pipestone EIS Riparian Management Objectives (RMO) assessment (USFS 2002). In two Rosgen B reaches the target of a range between 10 and 28 was not met, and in one Rosgen C reach the target of 10 to 21 was not met. The results of the RMO analysis are presented in Table 3-10.

Pool Frequency

The U.S. Forest Service measured pool frequency at eighteen locations (Figure 3-4) in the Bobtail TPA during the Pipestone EIS assessment (USFS, 2002). In stream reaches with a width of less than ten feet, three reaches did not meet the target of 96 pools per mile. In stream reaches of widths between ten and twenty feet, four reaches did not meet the target of 56 pools per mile. The only stream over twenty feet in width did not meet the target of 47 pools per mile. The results of this RMO analysis are presented in Table 3-9.

Riffle Stability Index

The U.S. Forest Service measured the riffle stability index at several locations (Figure 3-4) in the Bobtail TPA during the Pipestone EIS assessment (USFS, 2002). The indicator range of 45 to 75 RSI, which applies to Rosgen B streams, was not met in five of six reaches. The results of this analysis are presented in Table 3-10.

Table 3-10 Riparian Management Objectives Assessed in the Bobtail Creek Watershed.

Site	Rosgen Type	Bankfull Width (ft)	Pools per mile	LWD per Foot	% Bank Stability	Width/ Depth Ratio	Riffle Stability Index
1- Bobtail Cr.	B4	16.3	72	1/31	100	23	73
2- Bobtail Trb	A4	6.2	117	1/30	100	8.9	79
3- Bobtail Cr.	B4	18.8	88	0/240	100	28	85
4- Bobtail Cr.	B4	19	53	1/39	100	17	83
5- Bobtail Cr.	C4	10.8	64	1/21	92	18.6	90
7- Bobtail Cr.	B4	7.7	52	1/9	100	12	89
8- Terge Cr.	A4a+	2.5	330	1/10	100	8.9	88
9- Bobtail Cr.	B4a	5.5	377	0/50	100	11.2	87
10- Bobtail Cr.	E4b	9.8	79	1/200	74	7.3	
11- Bobtail Cr.	B4c	23.7	30	1/13	97	57	
12- Bobtail Cr.	C4	18.9	45	1/12	78	26	
13- Bobtail Cr.	B4c	10.3	Dry	-	-	26	
14- Bobtail Cr.	B4	17.0	15	1/26	69	18	
15- Bobtail Cr.	C4	12.0	66	1/120	100	12	
1- Bull Cr.	E6	4.2	176	1/8	05	6.6	
2- Bull Cr.	B4a	8.5	195	1/9	100	10.4	
6- Bull Cr.	B4	7.3	293	1/22	100	5.8	84
6a- Bull Cr.	G4	5.2	0	1/10	17	7.3	94

Shaded values do not meet target or indicator thresholds.

Wolman Pebble Counts - Percent Surface Substrate Fines < 2mm

Pebble counts have been conducted at numerous locations throughout the Bobtail Creek watershed and are used here to identify areas exhibiting excessive deposition of fine sediment. Pebble counts were performed by the USFS in 19 areas of Bobtail Creek in 1994, 1995 and 1997 (Figure 3-5). Reaches with the highest percentages of fine particles include reaches 5, 9, and 10 (Figure 3-5). Reach 5 (lower) and reach 10 do not meet the target of particles < 2 mm having a frequency of less than 20%.

Figure 3-4. U. S. Forest Service Riparian Management Objectives Sites.

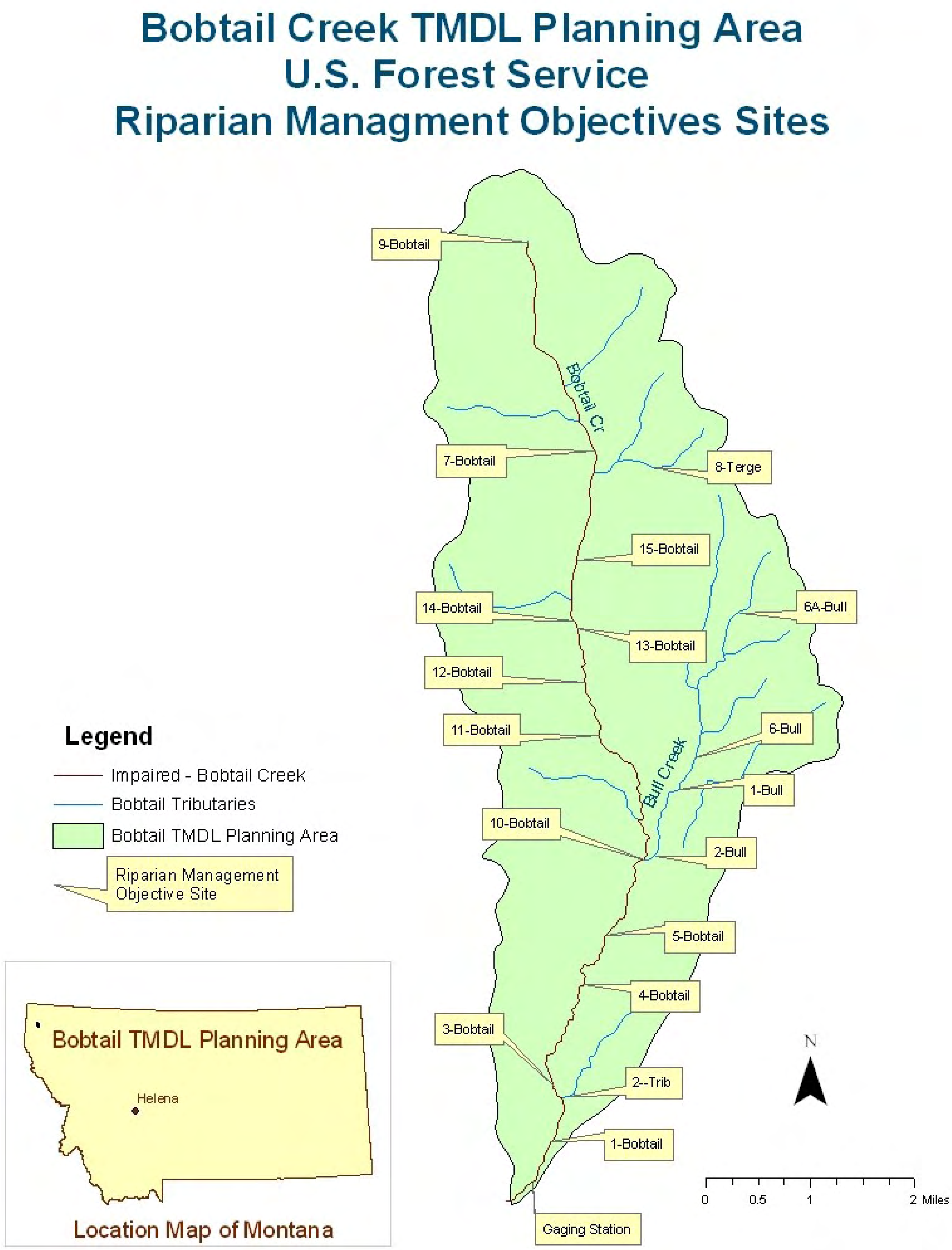
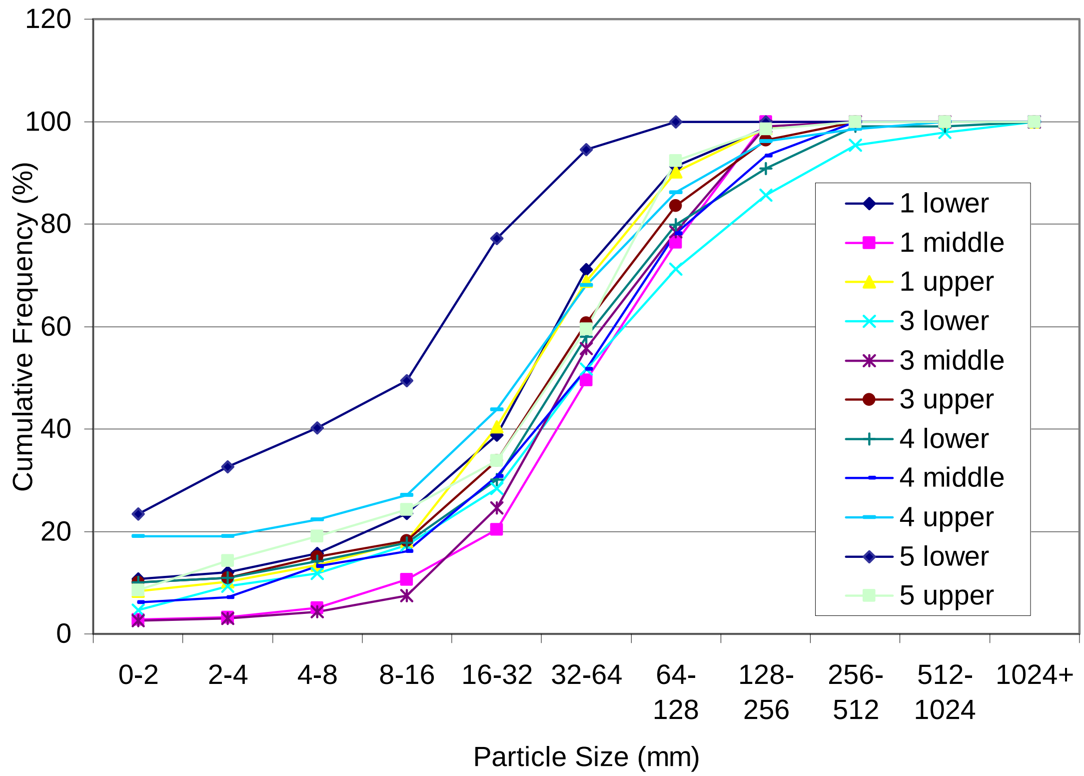
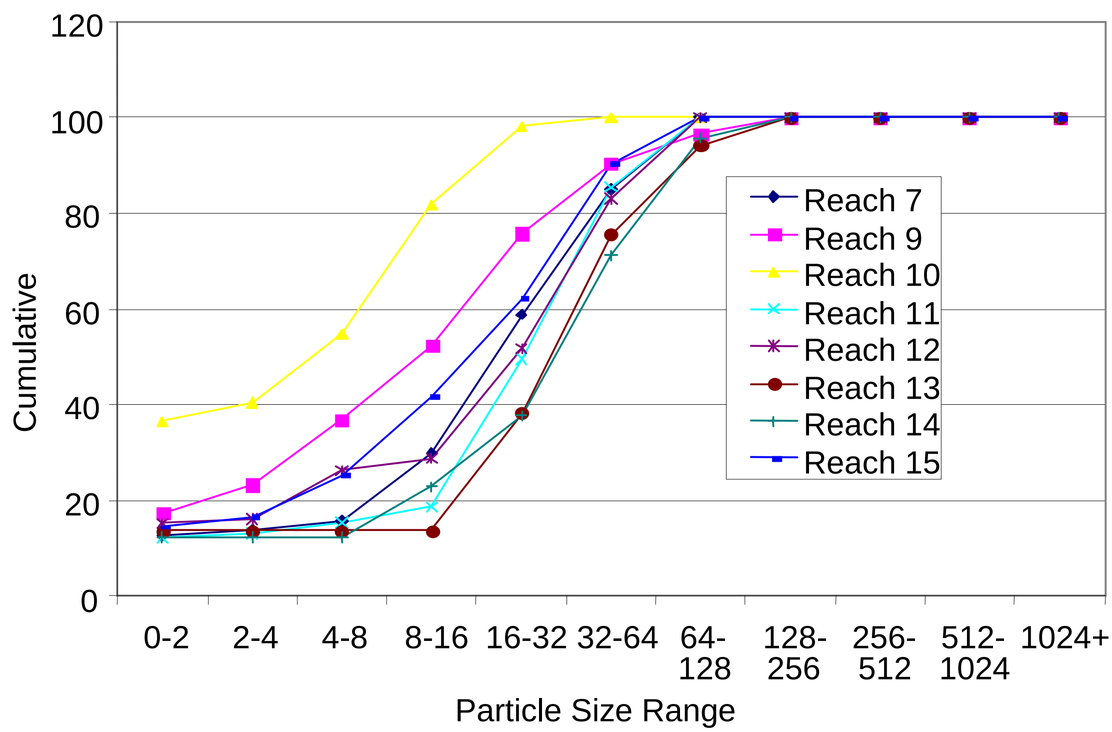


Figure 3-5. Pebble Count Results for Bobtail Creek Watershed.





McNeil Core Samples

The US Forest Service collected McNeil core samples from one location on Bobtail Creek in 1994, 2000, 2001, 2002 and 2003. The sample site is located approximately 0.6 miles upstream of the confluence with Bull Creek in the SE ¼ of Section 5, T31N, R31W (see stream core sample site, Figure 3-6). The 1994 sampling included three replicate samples from this site, while the 2000, 2001, 2002 and 2003 sampling included 10 replicate samples each. The McNeil core sampling results are summarized in Table 3-11, and the complete dataset is included in Appendix B.

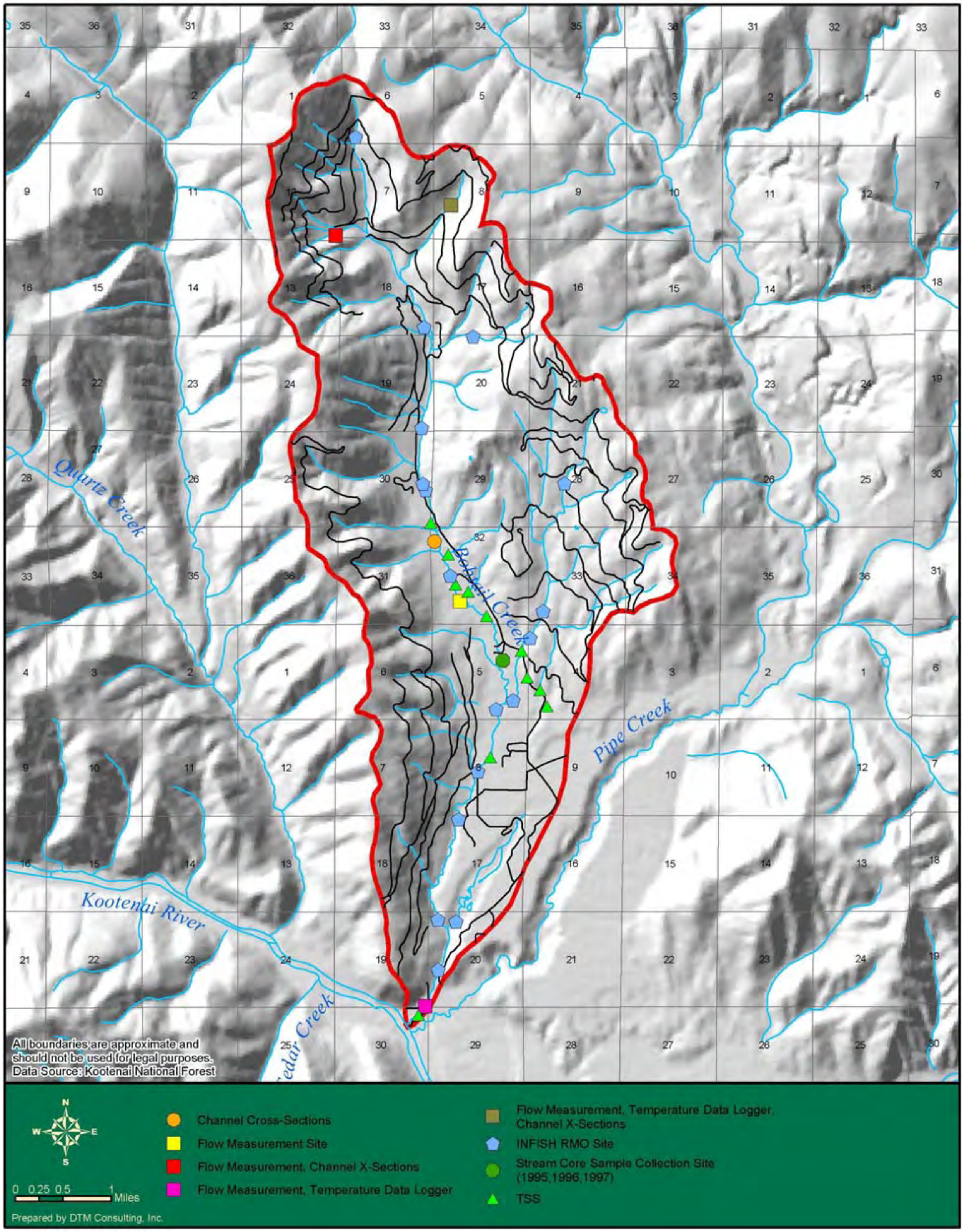
As shown in Table 3-11, a total of 43 core samples were collected between 1994 and 2003. The percentage of fine sediment particles (<6.35 mm in diameter) in these samples range from 15% to 57%. The average percent fines for each year were very consistent, with the annual averages ranging from 32.7% in 2002, to 34.9% in 1994. The average percent fines content for the entire database is 33.8%. This value is above the proposed target of 28%.

Table 3-11. Summary of Percent Fine Sediment in McNeil Core Samples on Bobtail Creek.

% Fine Sediment (<6.35mm) in Individual Replicate Samples											
Year	Replicate 1	Replicate 2	Replicate 3	Replicate 4	Replicate 5	Replicate 6	Replicate 7	Replicate 8	Replicate 9	Replicate 10	**Average**
1994	28.5%	40.7%	35.3%	na	na	na	na	na	na	Na	**34.9%**
2000	39%	41%	33%	40%	30%	25%	36%	30%	35%	39%	**34.8%**
2001	38%	30%	31%	34%	25%	33.7%	31%	40.8%	36%	31%	**33.1%**
2002	28%	40%	39%	25%	37%	24%	31%	28%	43%	32%	**32.7%**
2003	27%	38%	51%	26%	32%	57%	29%	26%	33%	15%	**33.4%**
									Overall Average		**33.8%**

All samples collected in NE¼ of Section 5, T31N, R31W (see Figure 3-6)
All samples collected by USFS
Complete database included in Appendix B

Figure 3-6. Bobtail Creek Watershed Sampling Sites.



Total Suspended Solids

The following evaluation of impairment conditions in Bobtail Creek, relative to TSS, involved numerous steps and multiple lines of evidence including:

1) Compilation and review of existing TSS and turbidity data from Bobtail Creek;
2) Comparison of Bobtail Creek TSS values to TSS values from other “least impaired” watersheds; and
3) Assessment of potential effects of TSS on aquatic life in Bobtail Creek.

Compilation of Existing TSS/Turbidity Data

As discussed in Section 2.0, the majority of hydrologic and water quality data available from Bobtail Creek drainage was collected by the USFS. The USFS has conducted frequent TSS monitoring in Bobtail Creek over the past several years, with daily TSS data collected near the mouth of Bobtail Creek for water years 2001 through 2003 (see data in Figure 2-6). Daily TSS samples were collected at a gauging station located in the SE¼ of Section 19 near the mouth of Bobtail Creek (Figure 3-6).

Table 3-12 provides yearly summaries of the daily TSS data collected near the mouth of Bobtail Creek. Maximum annual TSS values range from 104 mg/L in 2001 to 14,786 mg/L in 2002, while average annual values ranged from 3.9 mg/L in 2001 to 370 mg/L in 2002.

Table 3-12. Summary of 2001 through 2003 Daily TSS Data Collected Near the Mouth of Bobtail Creek.

Year	No. Samples	Min	Max	Mean	Median
2001	365	1.3	104	3.9	2.0
2002	365	1.0	14786	369.8	2.0
2003	365	1.1	313.7	7.8	2.5
2001-2003	1,095	1.0	14786	125.3	2.0

Year refers to water year, 10/01 through 9/30
All concentrations in mg/L
All data included in Appendix C

The extremely high TSS value of 14,786 mg/L occurred on April 11, 2002. This coincides with a period of elevated TSS during spring runoff with daily TSS measurements consistently greater than 1,000 mg/L from March 30 to April 18, 2002 and again from April 22 to April 26, 2002. TSS values decreased rapidly in the following days with TSS measured at 5.3 mg/L on April 30, 2002. As shown in Figure 2-6, this period of extremely high TSS corresponds to a period of higher than normal spring flows. Peak flows during this period exceeded 100 cfs while peak flows in April 2001 and 2003 failed to reach 30 cfs (Figure 2-6).

Results of a comprehensive TSS sampling event conducted by the USFS on February 23, 2002 provide a synopsis of spatial TSS concentration trends during a rain-on snow event (Table 3-13). As shown in Table 3-13, stream flow increased consistently with downstream direction, from 20 cfs to 50 cfs over a distance of approximately six miles (TSS sampling sites shown on Figure 3-

6). TSS concentrations (and loads) actually decreased from the upper site (72 mg/L at Harpers Bridge), to the next downstream site (26 mg/L at Wegners). TSS concentrations then increased steadily downstream from Wegners to a maximum of 74 mg/L at River Road near the mouth of Bobtail Creek. These TSS concentration and loading trends indicate one or more sources of sediment loading to Bobtail Creek are present upstream of Harpers Bridge (Section 30), with in-stream sediment deposition occurring between the Harpers and Wegner sampling locations. Likely sources include the area of damaged channel located in Section 30 and discussed in Section 4.0. Additional sediment loading sources exist downstream of Wegners as indicated by the steady increase in TSS concentrations and loads between this location and the mouth of Bobtail Creek. Source assessment is discussed more fully in Section 4.0.

Table 3-13. Results of February 23, 2003 TSS and Flow Monitoring During Rain – On –Snow for Main stem Sites.

Site	Location	Flow cfs	TSS mg/L	TSS Load tons/day
BC below Harpers Bridge	SE¼ Sec 30, T32N, R31W	20	72	3.9
BC at Wegner's	SW¼ Sec 32, T32N, R31W	25	26	1.75
BC below Red Rose Ranch	SE¼ Sec 32, T32N, R31W	30	34	2.75
BC at Brebner's	Mid Sec 8, T31N, R31W	45	70	8.5
BC at River Road	SE¼ Sec 19, T31N, R31W	50	74	10

Sites shown in upstream to downstream order
All data collected by USFS
cfs - cubic feet per second
Site locations shown on Figure 3-6
BC – Bobtail Creek

Extensive TSS data has been collected from Bobtail Creek over the last few years. This data indicates multiple sediment loading sources are present within the drainage, with TSS concentrations reaching extremely high concentrations during spring runoff and other high flow conditions. However, average and median TSS concentrations suggest that the elevated TSS concentrations are restricted to high flow events, with TSS concentrations much lower under typical flow conditions.

Comparison to TSS Values from Other "Least Impaired" Drainages

Following compilation and review of available data, the Bobtail Creek TSS data were compared to TSS data from similar drainages in western Montana. The purpose of this comparison was to assess TSS concentrations in Bobtail Creek in relation to other "least impaired" drainages as a measure of TSS-related impairment in Bobtail Creek.

Bobtail Creek differed from the reference streams in terms of the number and magnitude of extreme TSS values. The maximum TSS value recorded in Bobtail Creek, 14,786 mg/L, is almost 200 times more than the maximum value recorded in the reference drainages (Tables 3-8 and 3-12). Similarly, the average TSS value in Bobtail Creek, 125.3 mg/L, is significantly greater than the 5.7 mg/L average of all reference drainage data. As previously discussed, elevated TSS levels in Bobtail Creek coincide with periods of high flow such as spring runoff (Figure 2-6). These extreme high flow TSS peaks indicate significant sediment loading to the stream from disturbed lands within the drainage. Comparison of Bobtail Creek TSS concentrations to those from the reference streams (125.3 mg/L verses 5.7 mg/L for averages of the two datasets), as well as the shear magnitude of TSS concentrations in Bobtail Creek (up to 14,786 mg/L) provide clear evidence that Bobtail Creek is in fact impaired, at least on a periodic basis, due to TSS (Rowe et al., 2003).

Detailed review of the Bobtail Creek TSS data provides insight into the timing and duration of elevated TSS concentrations. Although the maximum and average TSS values are high, the median value was only 2.0 mg/L (Table 3-12). This means that half of the 1,131 TSS measurements taken from Bobtail Creek are less than 2.0 mg/L. The 75th percentile for the dataset is 6.2 mg/L meaning 75% of the TSS values are less than this. This trend of high TSS values during high flow conditions and relatively low TSS values during the majority of the year is evident in Figure 2-6. This information indicates that TSS may only act as a source of water quality impairment in Bobtail Creek during high flow periods.

The overall higher concentrations of TSS measured in Bobtail Creek compared to the 12 reference streams suggest that sediment loading in this watershed is elevated above least impaired conditions, primarily during spring runoff and other high flow events. While limited in duration, the magnitude of these elevated TSS episodes are believed to negatively impact the fishery and aquatic life in Bobtail Creek.

Assessment of TSS Effects on Biota

The impact of TSS on fish and aquatic life is related to the TSS concentration, the duration of the TSS episode, and the timing of the elevated TSS episode relative to life history stages of the aquatic organism. These relationships have been used to develop models to predict the severity of ill effects (SEV) on fish at different life history stages (Newcombe and Jenson, 1996). The SEV varies from behavioral effects such as avoidance to lethal effects. Based on the documented elevated TSS values in Bobtail Creek, effects of TSS on Bobtail Creek biota were estimated using the SEV. Although physical and biological conditions within Bobtail Creek deviate from certain model assumptions, the model does provide a qualitative assessment of water quality impairment from TSS (and thus turbidity). The SEV model is not intended as a quantitative analysis of TSS-related impairment in Bobtail Creek, but is presented to corroborate other evidence of impairment presented in this report, including the magnitude of periodic elevated TSS concentrations, comparisons to reference stream concentrations, and documented declines in fish populations. The SEV model is briefly summarized below and presented in more detail in Appendix D.

Multiple SEV models have been developed to determine TSS effects on aquatic life (Table 3-14). Because fish are more vulnerable at different periods of their life cycle, these models are typically applied for different portions of the year based on the presence of vulnerable life history stages. Of the four models, models 1 and 4 were selected for the Bobtail Creek analysis. These two models address a range of life history stages of salmonids (eggs, larvae, juvenile, and adult) and were developed for a relatively wide range of particle sizes. Based on information provided by Plum Creek (Plum Creek Timber Company, 2004) model 4 (for eggs and larvae) may not be valid for the fish found in Bobtail Creek, as the Bobtail fish bury their eggs in redds, and therefore those eggs may not be directly exposed to the effects of TSS.

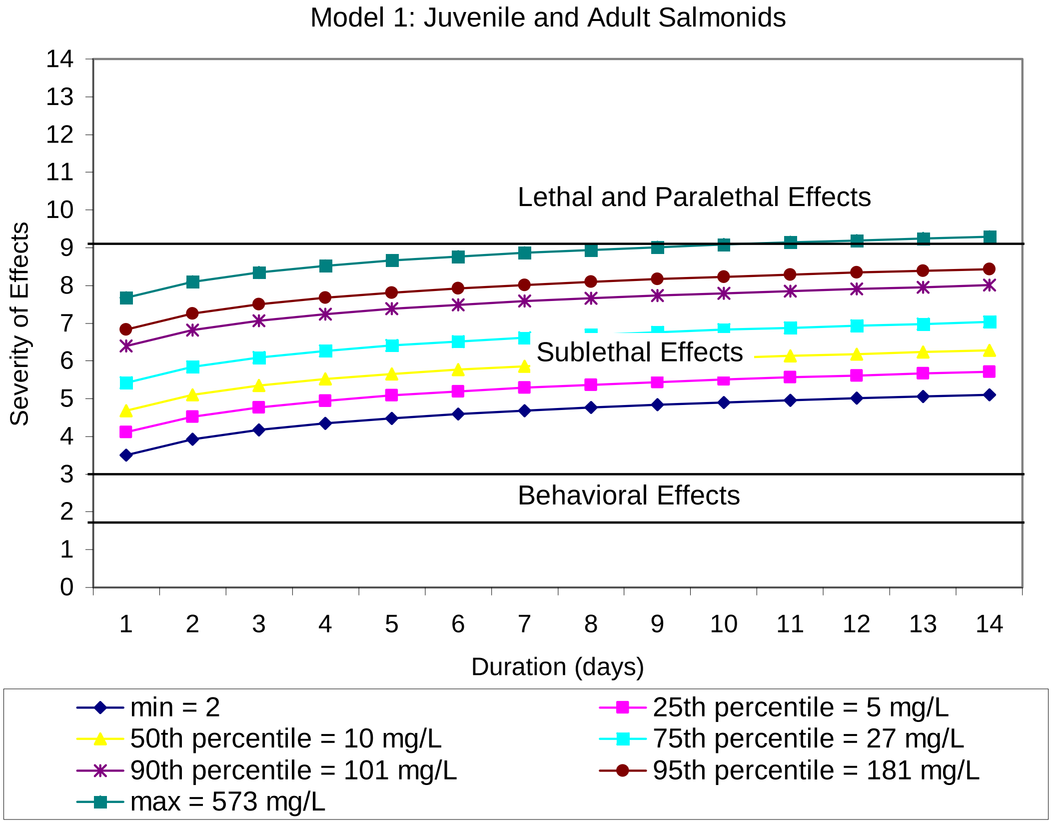
Table 3-14. Models Developed to Predict SEV for Different Life History Stages and Particle Sizes (Newcombe and Jenson 1996).

Model Number	Life History Stages and Particle Sizes	Model Information
1	Juvenile and adult salmonids; particle sizes 0.5-250 µm	SEV = 1.064+0.6068×LN(D)+0.7384×LN(C)
2	Adult salmonids; particle sizes 0.5-250 µm	SEV = 1.6814+0.4769×LN(D)+0.7565×LN(C)
3	Juvenile salmonids: particle sizes 0.5-75 µm	SEV = 0.7262+0.7034×LN(D)+0.7144×LN(C)
4	Eggs and larvae of salmonids and non-salmonids	SEV = 3.7456+1.0946×LN(D)+0.3117×LN(C)

D= duration of exposure in days; C=TSS concentration in mg/L

Based on the results of model 1 (Figure 3.7) SEV calculated for juvenile and adult salmonids based on TSS concentrations measured in Bobtail Creek experience sub-lethal but harmful effects within a few days for even low concentrations (5 mg/L) of TSS. Daily monitoring of TSS near the mouth of Bobtail Creek document high TSS values for the March to June period, even in drought years. TSS exceeded 5 mg/L and ranged as high as 14.6 mg/L for up to 18 days. Furthermore, the average TSS concentration occurring during spawning and incubation was greater than 11 mg/L. This concentration can lead to harmful impacts (increased coughing and respiration rate) to juvenile and adult salmonids in only 3 days of exposure (Appendix D). As pointed out by Rowe et al. (2003), discretion should be utilized when applying the SEV analysis and its associated models, as it can be inconsistent with other work.

Figure 3-7. Calculated SEV for Concentrations of TSS Sampled on Bobtail Creek for Hypothetical Durations Using Model 1 (Adults and Juvenile Salmonids).



Because timing of spawning and incubation for spring spawning species such as rainbow trout and westslope cutthroat trout typically coincide with the higher flows occurring during spring runoff, it is probable that a certain degree of para-lethal to lethal stress to eggs and larvae is unavoidable in most drainages, even with minimal development and disturbance. Still, the higher concentrations measured in Bobtail Creek, and the SEV values calculated, indicate an elevated risk for fish in Bobtail Creek during the more vulnerable life history stages.

The potential for TSS to impact early life history stages is further underscored by comparisons of TSS concentrations for various months (Figure 2-6). Most of the higher values occur from March to June, when eggs and larvae are within redds. Bobtail Creek samples demonstrated considerably higher concentrations of TSS than the reference streams combined.

Based on comparisons with regional reference streams, TSS in Bobtail Creek showed markedly higher peak concentrations. These concentrations, in conjunction with the SEV scores for juvenile and adult salmonid life stages, support the inclusion of TSS as a cause of impairment in Bobtail Creek. Based on the strong correlation between TSS and turbidity in Bobtail Creek as shown in Figure 3-3, this information also supports inclusion of turbidity as a source of impairment in Bobtail Creek.

Bank Stability

As described in Section 3.3.2, the supplemental indicator value for bank stability is >80 percent. Five of the study reaches do not meet these standards (Table 3-15). Unstable banks are an in-channel source of sediment. Furthermore, laterally migrating banks have the potential to increase width-to-depth ratios, further decreasing sediment transport capabilities. Note that relatively high levels of eroding bank were recorded in stream reaches experiencing channel instability (Section 30 and 32) following the 1997 ROS flood event.

Table 3-15. Bank Stability Values in the Bobtail Creek Watershed.

Site	Rosgen Type	Bankfull Width (ft)	% Bank Stability
1- Bobtail Cr.	B4	16.3	100
2- Bobtail Trb	A4	6.2	100
3- Bobtail Cr.	B4	18.8	100
4- Bobtail Cr.	B4	19	100
5- Bobtail Cr.	C4	10.8	92
7- Bobtail Cr.	B4	7.7	100
8- Terge Cr.	A4a+	2.5	100
9- Bobtail Cr.	B4a	5.5	100
10- Bobtail Cr.	E4b	9.8	74
11- Bobtail Cr.	B4c	23.7	97
12- Bobtail Cr.	C4	18.9	78
13- Bobtail Cr.	B4c	10.3	-
14- Bobtail Cr.	B4	17.0	69
15- Bobtail Cr.	C4	12.0	100
1- Bull Cr.	E6	4.2	05
2- Bull Cr.	B4a	8.5	100
6- Bull Cr.	B4	7.3	100
6a- Bull Cr.	G4	5.2	17
Current INFS Standards*	---	---	**>80%**

Shaded values do not meet supplemental indicator thresholds.

Macroinvertebrates

Macroinvertebrates were collected at one site by Plum Creek Timber Company (PCTC) in July 1991 and by the US Forest Service at a different site in October 2000 and August 2001. PCTC collected five replicate macroinvertebrate samples in the upper half of Bobtail Creek (SE¼ of Section 19, T32N, R31W) in July 1991 (Table 3-16). The Montana Mountain Macroinvertebrate Index of Biological Integrity (Mountain IBI) indicates full support of beneficial uses (Table 3-16). In all five samples, these taxa exceeded ecoregion criteria for biological integrity and full support of beneficial uses. These samples were collected above unstable reaches and before the 1997 flood event. These data provide baseline information and an internal reference that can be used in establishing numeric targets in the basin.

The USFS collected macroinvertebrate samples downstream of the PCTC sampling site (NE¼ Section 5, T31N, R31W) in October 2000 and August 2001 (Table 3-16). The USFS data show a greater level of impairment as compared to the 1991 PCTC data. There was a large decrease in the number of macroinvertebrates specialized in eating detrital materials. Detrital (allocthonous) materials include any dead plant material that falls into a stream or waterbody. Macroinvertebrates that specialize in consuming allocthonous materials are usually well represented in healthy streams (Barbour et al., 1999). Allocthonous materials also contribute to habitat diversity that increases the surface area for periphyton and allows other specialized invertebrates to exist in the same stream (Merritt and Cummins, 1978). A healthy well-developed mountain stream typically will retain a complete riparian zone. The riparian zone is the primary source of allocthonous material. A possible reason for the decline of shredder/scraper populations could be a decline in the riparian zone. Another possibility is the sampling technique used. Different sampling techniques will collect different macroinvertebrate populations. A third and more likely possibility is that sampling locations differed between Plum Creek and Forest Service sites, which along with a nine year delay between sampling events contributed to the disparity between samples. As previously noted (Section 2.9.2) the Plum Creek samples were collected in a forested reach of stream where the channel bed is composed of coarse gravel, while the USFS samples were taken downstream of agriculture, grazing, and residential development where the stream gradient is much lower and the substrate is much finer (Plum Creek Timber Company, 2004). One replicate in the USFS October 2000 sampling and the August 2001 sampling do not meet the target of a Mountain IBI of greater than 75 percent.

Table 3-16. Bobtail Creek Macroinvertebrate Sampling Results.

	Metric Guidelines*	Plum Creek Timber Company					US Forest Service			
Location		SE 1/4, SE 1/4, SE 1/4, S19, T32N, R31W					SE 1/4, NW 1/4, NE1/4, S5, T31N, R31W			
Date		7/25/1991	7/25/1991	7/25/1991	7/25/1991	7/25/1991	10/3/2000	10/3/2000	10/3/2000	8/30/2001
Replicate/ Sample Number		1	2	3	4	5	114572	114573	114574	118552
Taxa Richness	>28	30	32	29	31	33	33	34	29	28
EPT Richness	>19	25	26	24	23	28	24	22	15	17
Biotic Index	<3	3.69	3.45	2.76	2.89	3	3.2	3.7	5.05	3.07
% Dominant	<25	39.86	38.13	28.8	25.18	31.31	19.8	25.7	31.2	40.1
% Collectors	<60	42.7	40.61	27.87	28.57	30.8	42	22	63	38
% Scrapers + Shredders	>55	47.23	50.32	59.84	55	52.77	37	32	7	7
% EPT	>70	57.73	60.07	71.99	71.25	68.38	80.3	57.5	26.5	19.9
Mountain IBI**		0.76	0.76	0.95	0.90	0.81	0.86	0.76	0.38	0.24

* Mountain region metric guidelines established for Montana wadable streams
** Montana Mountain Macroinvertebrate Index of Biological Integrity
>0.75 indicates full support
0.25 - 0.75 indicates partial support
<0.24 indicates nonsupport

3.5 Bobtail Creek Water Quality Impairment Status Summary

The listed impairments for Bobtail Creek were summarized in **Tables 3-1 and 3-2.** The available data suggest that the stream, on the 2000 and 2002 303(d) lists, probably does not fully support its beneficial uses as a result of the pollutants that are included on the lists. TMDLs for these impairments are presented later in this document (Section 5.0). The primary pollutants of concern in these TMDLs are siltation and turbidity. For the purposes of this document, sediment is used to refer to a group of sediment-related pollutants including siltation, turbidity, bank erosion, and habitat alteration. Bobtail creek is impaired by sediment.

Based on review of existing information and results of various evaluations, current conditions support the contention that Bobtail Creek is impaired due to elevated turbidity (and total suspended sediment), siltation, and habitat alteration. The turbidity/TSS impairment is restricted primarily to high stream flow conditions associated with spring runoff and periodic rain-on-snow events. Comparison of fine sediment (<6.35mm) content in the Bobtail Creek streambed with that from nearby least impaired streams indicates that percent fine sediment in Bobtail Creek is elevated, and that these levels may inhibit fish propagation and survival during sensitive life stages. Basin-wide assessments conducted by the USFS documenting current watershed characteristics for various riparian management objectives (width-to-depth ratios, pool frequency, etc.) confirm that Bobtail Creek is impaired due to habitat alteration.

SECTION 4.0 SOURCE ASSESSMENT

Assessments and evaluations have been conducted in the Bobtail Creek watershed that provide information on the sources of impairment in Bobtail Creek. A substantial amount of the information used in this document was provided by the U. S. Forest Service (USFS) as part of the Kootenai National Forest Plan, the Inland Native Fish Strategy (INFS), and the Pipestone Environmental Impact Statement (EIS). Plum Creek Timber Company (PCTC) and the Bobtail Creek Watershed Group (BWG) provided additional information and data.

4.1 USFS Information

Management activities, planning, and stream assessments conducted by the USFS constitute the majority of the information available to evaluate sources of impairment in the Bobtail Creek watershed. USFS information was collected in preparation for the Pipestone EIS (USFS, 2002). This includes basin-level screening of potential risks based on land use practices in the basin, and stream assessments and TSS sampling throughout the watershed.

USFS Road Analysis

The Watershed and Fisheries National Forest Management Act (NFMA) Screen Process was developed to provide an estimate of the risk of sediment production and delivery based on characteristics of roads within a basin (USFS, 2002a). Specifically, it involves the calculation of several metrics based on basin-level road density, road density on sensitive land types, and the ratio of road crossings on sensitive land types to the miles of road on those types (Table 4-1). These scores are multiplied and compared to the appropriate criteria for wet areas (average precipitation > 30 inches/year) or dry areas (average precipitation < 30 inches/year). At an annual average of 30.3 inches/year in the Bobtail Creek watershed, Bobtail Creek scores as “non-functioning” in terms of road impact factor. This suggests that roads are a significant source of sediment to Bobtail Creek. Furthermore, the Pipestone DEIS (USFS, 2002) states that many roads in upper Bobtail Creek do not meet best management practices (BMPs).

USFS personnel have examined roads on National Forest Lands to determine sediment production and delivery risks (unpublished data). The road sediment delivery analysis (RSDA) included an inventory of Forest Service roads, assessment of the age and development history of the roads, road surface types and maintenance level, road management objectives, current and projected future road use, and degree of connectivity with streams including number an location of stream crossings. The evaluation identified seven road failures in the upper watershed, and two crossings with undersized culverts where water washed across the road and was eroding fill slopes.

Table 4-1. Results of Watershed and Fisheries NFMA Screening Process.

Data Type	Description	Bobtail Score (where applicable)
• Miles of road/mile^2	This attribute allows a quick analysis of the landscape changing processes that have taken place in the watershed.	5.81 = Severe
• Miles of road/mile^2 on sensitive land types	This attribute allows the analysis of the sediment generating potential of roads constructed in the following land types (322, 323, 357, 108).	4.4 = Severe
• Number of stream crossings on sensitive land types	This attribute will allow the analysis of the water quality and fisheries habitat degradation potential due to road/stream interactions.	1.5 = Moderate
• Road Impact Factor	This attribute attempts to integrate the potential effects the transportation network is having on watershed function. This attribute is produced from the multiplication of the scores received from the above screens.	38.35 = Non Functioning

USFS Analysis of Peak Flow and Relation to Eroding Banks

As part of the Pipestone EIS analysis in the Bobtail Creek watershed (USFS, 2002), USFS personnel have employed the equivalent clear-cut acres (ECA) model (USFS, 1991) to assess increases in peak flow due to timber harvest activities in the basin. In 2000, the Bobtail Creek drainage had an ECA of 2281 acres. Based on the model, which projects a 1% increase in peak flow per 215 ECAs, a resulting increase of peak flow of 10.6% is predicted. However, in the Final Pipestone EIS (USFS, 2004) a current peak flow increase of 10.8% was reported. Both of these values, 10.6% and 10.8%, are greater than the values the USFS suggests for stability (stable banks and stream bed). The USFS (2002), based on monitoring information from the adjacent Quartz Creek watershed, suggest that stability would be expected with water yields below the 7% to 9% level. Quartz Creek and Bobtail Creek watersheds are similar in geology so they are expected to function in similar manners. The peak flow increase of 10.6% likely leads to bank instability; therefore, contributes to the sediment source for Bobtail Creek.

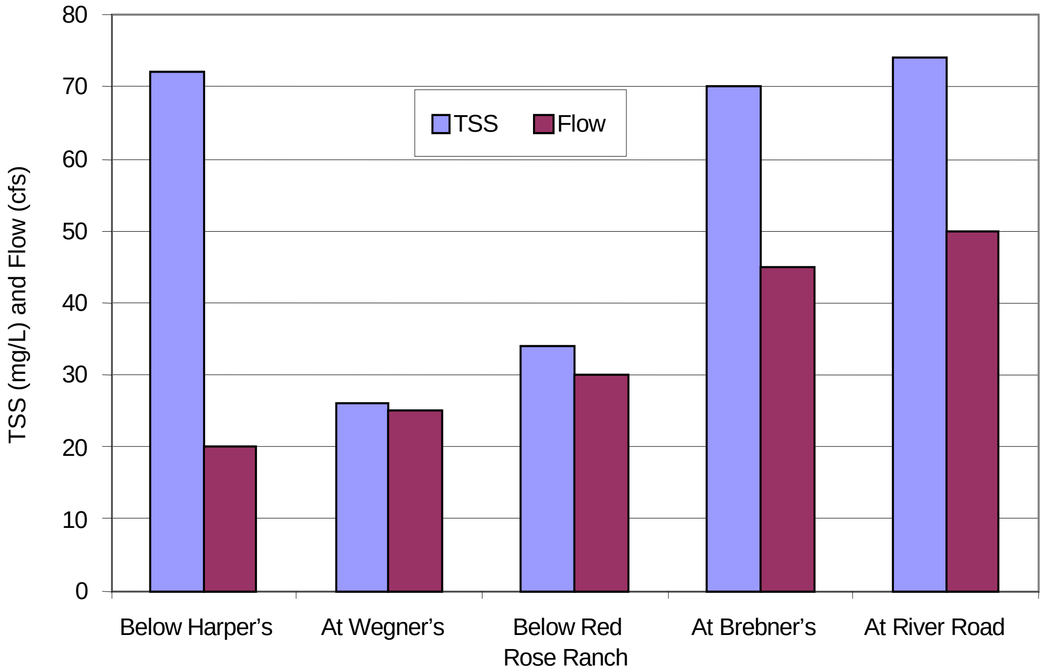
USFS TSS Sampling during a Rain-On-Snow (ROS) Event and Related Road Densities and Bank Erosion

TSS sampling conducted by the USFS during a ROS event on February 23, 2002 provides information regarding sources of suspended sediment in the Bobtail Creek basin. TSS samples on the main stem of Bobtail Creek ranged from 26 to 74 mg/L (Table 3-13, Figure 4-1). Flow consistently increased in a downstream direction, TSS did not (see decrease in TSS concentration between “Below Harper’s” and “At Wagner’s,” Figure 4-1). This underscores the concept of multiple sediment sources and the presence of sediment deposition within the Bobtail Creek channel. Sediment transport efficiency between the Harper’s property and Wegner’s property is likely limited by high width-to-depth-ratios in this wide and unstable reach, resulting in in-stream sediment deposition and the observed reduction if TSS concentrations (and loads).

There are two major potential sources of fine sediment above the highest sampling site on the main stem of Bobtail Creek. First, relatively high densities of roads and 19 stream crossings on sensitive land type 357 (Figure 2-2) could be a source. Second, this site was located immediately downstream of a highly unstable reach of stream on private land that had undergone channel reconstruction in the summer of 2001 and vegetation may not have recovered sufficiently to reduce sediment inputs. Because of this, concentrations of TSS at this location cannot be assumed to represent conditions in the forested headwaters upstream.

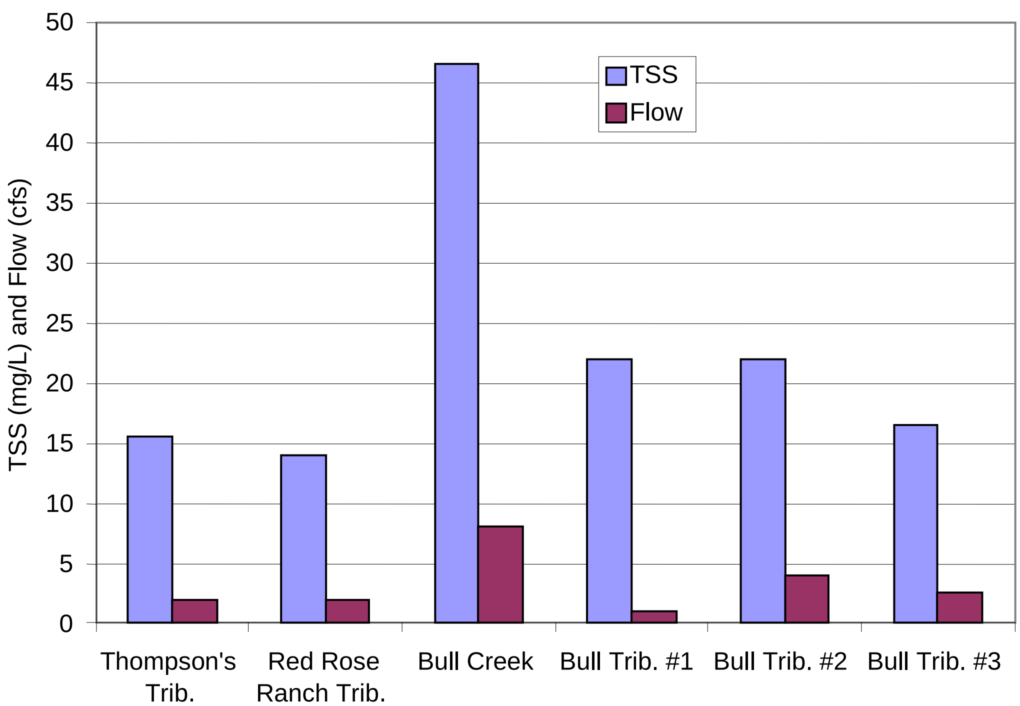
TSS concentrations measured on tributaries in the lower portions of the watershed indicate that Bull Creek is also a significant source of fine sediment to Bobtail Creek (Figure 4-2). The TSS concentration in Bull Creek at Bobtail Road was 47 mg/L, and the concentrations in three separate tributaries entering Bull Creek downstream of this site ranged from 16 to 22 mg/L (Appendix C). Bank erosion near the confluence of Bobtail Creek and Bull Creek may be a contributing source of sediment.

Figure 4-1. TSS Concentrations and Flow on Bobtail Creek During a ROS Event, February 23, 2002.



Presented in upstream (left) to downstream (right) order.

Figure 4-2. TSS and Flow Measured on Tributary Streams in the Bobtail Creek Watershed During the ROS Event, February 23, 2002.



Presented in upstream (left) to downstream (right) order.

4.2 Plum Creek Sediment Delivery Analysis

Plum Creek Timber Company conducted a road sediment delivery analysis on their holdings in May 2000 following protocol outlined in the Standards Methods for Conducting Watershed Analyses (Washington Forest Practices Board, 1997). The purpose of the analysis was to assess risks and identify actions to protect water quality on PCTC lands. The analysis results are summarized in Table 4-2 and monitoring sites shown on Figure 4-3.

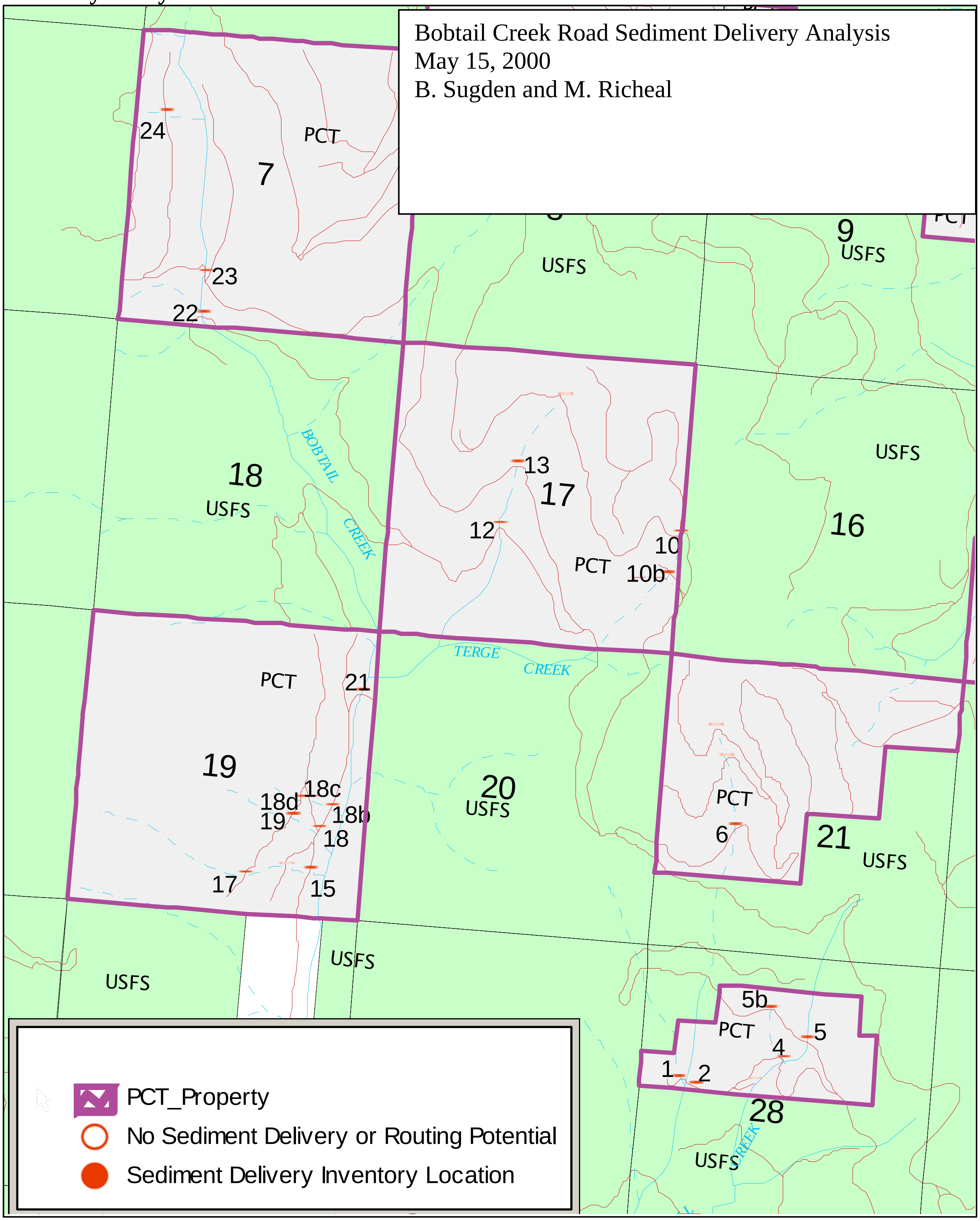
Based on this analysis, a total of 17.3 tons per year of sediment is delivered to streams in the Bobtail Creek watershed from Plum Creek roads. Sediment loading from road crossings varies from 0 to 3.3 tons per year. Additional information on the PCTC road sediment delivery analysis is provided in Appendix E.

Table 4-2. Bobtail Creek Road Sediment Delivery Analysis on PCTC Property (Sugden and Richeal 2000, Unpublished Data).

Location Code	Tread Delivery (tons/yr)	Cut slope Delivery (tons/yr)	Fill slope Delivery (tons/yr)	TOTAL *Total* *(tons/yr)*
6	2.4	0.9	0.0	3.3
15	2.0	0.1	0.0	2.1
24	1.4	0.1	0.0	1.5
10	0.9	0.3	0.0	1.1
13	0.5	0.6	0.0	1.1
22	1.0	0.1	0.0	1.1
21	1.0	0.1	0.0	1.0
5b	0.5	0.4	0.0	0.9
23	0.6	0.2	0.0	0.8
1	0.4	0.3	0.0	0.7
4	0.3	0.3	0.0	0.7
12	0.5	0.0	0.0	0.6
2	0.4	0.1	0.0	0.5
18	0.5	0.0	0.0	0.5
5	0.3	0.1	0.0	0.4
18b	0.3	0.0	0.0	0.4
17	0.1	0.1	0.0	0.2
18d	0.0	0.0	0.0	0.1
10b	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0
18c	0.0	0.0	0.0	0.0
Watershed Totals	13.2	3.9	0.2	17.3

PCTC road analysis methodology and data in Appendix E

Figure 4-3. Sites Evaluated by Plum Creek Timber Company in the Road Sediment Delivery Analysis.



4.3 Field Review of Residential Reaches – Eroding Banks

Bobtail Creek's problems, in part, stem from extreme erosion caused when the stream jumped out of its banks and ran down a skid road that a small-private landowner built adjacent to the stream when logging their property in the late 1980's. The diversion of the stream down this skid road first occurred during severe rain-on-snow events in the fall of 1990 and spring of 1991. MDEQ analyzed this situation in a warning letter submitted to the private landowner. Additional events in February 1996, spring 1997, and more recent floods have continued to erode this unstable reach, leading to extensive channel aggredation downstream (Plum Creek Timber, 2004).

In October 1999, the Bobtail Creek Watershed Group conducted field reviews of private holdings in unstable reaches in sections 29, 30, and 32 (T32N R31W) (Figure 2-4). Steve Wegner, a professional hydrologist with the USFS conducted these evaluations in conjunction with private property owners. These evaluations identified areas of eroding bank and channel instability in these reaches that contribute to sediment loading and reduced transport leading to siltation. Of considerable concern is a section where the stream left its historical channel and scoured an overflow channel 15 feet wide and 3 feet deep (Figure 4-4). This continues to act as a potential source of sediment loading to the stream. Other sources of sediment loading and habitat degradation from private land holdings include livestock grazing, private roads, and stream encroachment.

Figure 4-4. Area of Unstable Stream Reach.

4.4 Other Potential Sources

According to the USFS (2002), there is one known large bedload source area on Bobtail Creek in section T32N, R31W, Sections 30 and 32 (sites 12, 13 on Figure 3-4) on private property (mentioned in Section 4.3). The USFS (2002) also acknowledges that numerous road/stream crossing failures have been documented within this watershed in the past decade. County roads, pastures, and grazing are all potentially significant impacts in lower watershed and contribute to eroding banks and other sediment loading sources.

4.5 Source Assessment Uncertainty

As described above, an effort was made to identify all significant anthropogenic sources of sediment loading in the Bobtail Creek watershed. Although it is felt that this has resulted in sufficient information to reach the conclusions presented in this report, there are still some uncertainties regarding whether or not all of the significant sources have been identified, and regarding the quantification of sediment loads. The primary uncertainties are as follows:

- Bank erosion has not been thoroughly assessed in the Bobtail Creek watershed.
- The extent to which USFS roads, recognized in the upper drainage as not meeting BMP standard, are actively contributing sediment to the stream network is unknown.
- The extent to which past activities such as harvest and road building have affected Bobtail Creek watershed is unknown.
- The extent to which agriculture and private land development have affected the Bobtail Creek watershed is also unknown.

These uncertainties will be addressed by the proposed activities described in Section 8.0.

4.6 Source Assessment Summary

Based on available information and detailed analyses, primary sources of impairment include sediment yield from roads, and an area of unstable stream banks on private property within the middle portion of the drainage (Section 30). Sediment yield to Bobtail Creek from PCTC roads has been quantified as 17.3 tons/year. Results of Equivalent Clear-Cut Area analyses by the USFS indicate that increased water yield (peak flows) resulting from past timber harvesting in the drainage may contribute to stream channel instability and habitat-related impairment. Current management plans for the watershed should address many of these problem areas in Bobtail Creek drainage.

SECTION 5.0 TOTAL MAXIMUM DAILY LOAD, ALLOCATIONS, AND UNCERTAINTY

5.1 Total Maximum Daily Load

A TMDL is composed of the sum of individual waste load allocations (WLAs) for point sources, and load allocations (LAs) for nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between the pollutant loads and the quality of the receiving waterbody. Conceptually, this definition is denoted by the equation:

TMDL = WLAs + LAs + MOS

There are no point sources of sediment in the Bobtail Creek watershed; therefore, that variable can be removed from the equation. The primary human-caused sediment sources in the watershed appear to be forest roads and agriculture.

This TMDL definition is difficult to apply in a watershed such as Bobtail Creek where impairments are caused by nonpoint sources. One alternative often used for TMDL development in similar situations is to express the sediment TMDL as a percent reduction in loading. Therefore, the sediment TMDL for Bobtail Creek and its tributaries is expressed as percent reductions in TSS. The TMDL for TSS addresses turbidity as a cause of impairment due to the previously established correlation between TSS and turbidity (Section 3.3.2), and as the primary source of sediment loading to the stream, and also indirectly addresses siltation. The basic premise of this TMDL is that the targets will be achieved by reducing sediment loading (i.e., the TSS load) to the stream.

5.1.1 TMDL for Total Suspended Sediment (TSS)

This TMDL is developed for TSS. The average TSS concentration in Bobtail Creek for the 2000 through 2003 daily samples is 125 mg/L (Table 3-8). This compares to an average TSS value from 12 reference drainages of 5.7 mg/L. As described in Sections 3.3.2 and 3.4.2, the high average TSS concentration is contributed to high TSS values during high flow conditions. This is further exemplified in Figure 2-6, where high TSS values correspond to high flow events. Therefore, the TMDL for TSS is a 95% reduction in average TSS concentrations during high flow conditions.

This TMDL is intended to address the pollutant-related impairment conditions in Bobtail Creek. Allocations designed to meet these reductions are discussed below. The uncertainties with this are further discussed in Section 5.3.

5.2 Load Allocations

This section identifies allocations that support the TMDL developed for Bobtail Creek. The goal is to ensure that the water quality targets (Section 3.3.1) are met and, more importantly, that beneficial uses are restored and/or protected. The allocations all apply to nonpoint sources and are therefore defined as load allocations.

Waste load allocations are not required since there are no permitted point sources regulated under the National Pollutant Discharge Elimination System. However, NPDES/storm water discharge permits are required for land disturbance activities over one acre in size, often related to construction activities. These sources are addressed in the future development allocation (Section 5.2.5).

Assistance from all landowners will be needed to ensure protection of water quality because many of the allocations are based on voluntary implementation of management practices. If a landowner or set of landowners exceeds an allocation relative to their percentage of land ownership, then the risk of not meeting water quality targets is increased. Under these conditions, an additional burden could be placed on other landowners to compensate for the unexpected increase in impact/loading if Bobtail Creek is to meet water quality standards.

For Bobtail Creek, load allocations have been developed for identified sources of sediment loading, including runoff from roads and eroding banks (Table 5-1). These allocations address the primary sources or source categories, and are expressed as performance based allocations.

Table 5-1. Allocations for Identified Sediment Loading Sources in Bobtail Creek Watershed.

Source	Current Annual Estimated Load	Performance Based Load Allocation
Surface Erosion from Existing USFS Roads	50-70 tons/year	90% application of road best management practices.
Surface Erosion from Existing Plum Creek Timber Company Roads	17 tons/year	90% application of road best management practices.
Surface Erosion from Existing County and Other (non-PCTC) Roads	>2 tons/year	90% application of road best management practices.
Eroding Banks linked to Human Activities	Eroding banks documented as significant sediment loading source in Section 30, T 32N, R31W and other locations	75% reduction of bank erosion due to human causes such as grazing, agriculture, road crossings, hydraulic modifications on private and public lands.

Table 5-1. Allocations for Identified Sediment Loading Sources in Bobtail Creek Watershed.

Source	Current Annual Estimated Load	Performance Based Load Allocation
Mass Wasting from Timber Harvest or Other Activities	Not quantified	No loading from preventable mass wasting events.
Culverts	Not quantified	No loading from culvert failures where culverts are not up to best management practice standards or not maintained.
Future Development	Not quantified	No sediment loading increases other than potential minor predicted short-term increases associated with full implementation of applicable BMP standards.
Future Roads and Timber Harvest	Not quantified	No sediment loading increases other than potential minor predicted short-term increases associated with full implementation of applicable BMP standards.

5.2.1. Surface Erosion from Performance Based Roads Allocations

The allocation for surface erosion from roads applies to timber harvest roads as well as other forest roads, county roads, and private roads (Table 5-1). The 90% application of BMPs is used in recognition of achievable reductions from this source category and as a component of the margin of safety. The use of a 90% application of road BMPs is also important for the protection of tributary streams to avoid impairments in these streams. This road sediment allocation is also applied to individual landowners.

Both Plum Creek Timber Company (PCTC) and the U.S. Forest Service (USFS) have committed to decrease sediment delivery from roads on their respective properties in the Bobtail Creek watershed. Through their Native Fish Habitat Conservation Plan (PCTC, 2000), PCTC will implement a basin-wide program including road decommissioning, upgrading and maintenance of BMPs on logging roads on their property (Section 6.0). These activities are expected to significantly reduce sediment loading from PCTC roads in the next several years.

5.2.2 Eroding Banks Allocation

The allocation for sediment loading associated with eroding banks is expressed as a reduction in bank erosion in the lower reaches of Bobtail Creek and on Bull Creek or any stream where bank erosion can be controlled by using BMPs or reasonable land, soil and water conservation practices. During the INFS screening process, 5 reaches were identified with excessive percentages of eroding bank (Table 3-10). Unfortunately, the source assessment did not provide a good link between bank erosion and land use causes, although land use in these areas and funded restoration projects suggest a linkage between preventable bank erosion, riparian health, and grazing and other human activities. Where such linkages exist, it is assumed that the bank erosion can be reduced by as much as 75% via BMP implementation and the application of reasonable land, soil and water conservation practices. This 75% is consistent with the bank erosion allocation for similar sources in the Blackfoot Headwaters and Ninemile TMDL allocations (MDEQ, 2004a; MDEQ 2004b).

Although BMPs such as grazing management should be a primary focus, active channel restoration may be a desirable approach where passive restoration may require excessively long stream recovery times even with BMP implementation. BMP implementation and the application of reasonable land, soil, and water conservation practices will need to focus on grazing and other human impacts that are contributing to unstable bank conditions. Reasonable land, soil, and water conservation practices should include upstream reductions in peak flows and other contributing factors to downstream bank erosion. As mentioned in Section 4.0, the USFS recommends peak flow increases of <7-9% and the watershed is currently experiencing peak flow increases of 10.8%. Reducing peak flow increases will also help reach the eroding bank allocation. Peak flows are discussed further in Section 5.2.7.

5.2.3 Mass Wasting from Timber Harvest Activities or Other Development

Timber harvest activities and other development, including road building, have the potential to significantly contribute sediment to streams within the Bobtail Creek Watershed if measures are not taken to prevent this loading. An example includes avoiding certain types of timber harvest practices, including road building, in areas of sensitive land types. This allocation is set such that there should be no increase in loading where such loading is preventable via application of BMPs or other practices to prevent mass wasting.

5.2.4 Culvert Failures

The allocation for culvert failures is set at no loading from culverts that are not up to forestry BMP standards, which generally require passage of a 25-year storm event. This BMP standard is applied to all culverts, including existing culverts, culverts on private or county property, and any new culverts. The goal of this allocation is to ensure minimal preventable excess sediment loading from culvert failures under high flow conditions. The PCTC Native Fish Habitat Conservation Plan requires a higher storm event passage in some situations for new or upgraded crossings. INFS generally requires that the USFS use a 100-year flood design for culverts. To be consistent with the goals of this allocation, drainages with a high road density should be designed to meet higher standards such as a 50 or 100-year event to avoid a very large culvert failure loading risk when 25-year events occur. The Bobtail Creek watershed road density is 4.3 miles per square mile and is considered to be at high risk for water quality impairment (Table 5-2). Proper culvert size, placement and maintenance will help to alleviate problems from the high road densities. Culvert maintenance to ensure flow passage is also an important consideration, since a properly designed, but poorly maintained culvert, could fail during lower flow conditions.

5.2.5 Future Development

It is not reasonable to assume that there will be no future development in the Bobtail Creek watershed. An allocation is therefore required to account for potential future sediment loading.

This allocation proposes no sediment loading increases associated with future development other than potential minor, short-term increases that may be predicted and associated with full implementation of the applicable riparian best management practice (BMP) standards. Additionally, storm water permits should address no increase above natural conditions, except for temporary exceedances. Future development is further addressed in Section 5.2.7 and Table 5-3.

5.2.6 Future Roads and Timber Harvest

It is not reasonable to assume that there will be no future silviculture activities in the Bobtail Creek watershed. An allocation is therefore required to account for potential future sediment loading. This allocation proposes no future sediment loading increases associated with harvest and/or forest roads other than potential minor, short-term increases that may be predicted and associated with full implementation of applicable best management practice (BMP) standards. Future timber road development and future timber harvest are further addressed in Section 5.2.7 and Table 5-3.

5.2.7 Future Performance-Based Allocations

Future development and future roads and harvest can result in higher levels of bank instability. Bank instability is likely to result in higher sediment loads in the Bobtail Creek watershed. It is important to address these future activities and decrease the related bank erosion and resulting sediment loading.

Future development and future timber roads and harvest can result in riparian disturbance and reduced bank stability. Complete application and proper use of BMPs will help to minimize the potential sediment loading. It is recommended that there is full application of appropriate BMP standards related to development.

Bank erosion from future timber road development and timber harvest can also be the result of increased peak flows. It is recommended that there is a peak flow increase of no greater than 7-9% in the Bobtail Creek watershed (Section 5.2.2). Compliance with this indicator will help maintain a stable stream channel configuration and natural sediment transport. The ECA model and other land management tools can be used to evaluate future conditions within the watershed in meeting this indicator condition.

Culverts associated with timber roads and harvest also may contribute to future bank erosion. As specified in the Pipestone EIS (USFS, 2004), current plans call for removal of 30 stream crossings, 21 of which are located on sensitive land types. Culvert removal is intended to restore the Bobtail Creek flow regime to a more natural condition and reduce sediment accumulation upstream of culverts, and streambed scouring downstream of culverts due to increased flow velocities. Culvert removal will also address fish migration barrier problems that may be associated with the culverts.

Road decommissioning and the resulting decrease in road density may also decrease future bank erosion. The Bobtail Creek watershed has an existing road density of 4.3 miles per square mile

(USFS, 2004). This density is considered to be a high risk for water quality impairment. Table 5-2 provides a range of risk guidelines regarding road density (Johnson, as cited in EPA, 2004). The Pipestone EIS calls for decommissioning of 18 miles of roads, 11 miles of which occur on sensitive land types. According to the EIS, PCTC has also agreed to remove 1.5 miles of road. This will result in an estimated road density of 3.2 miles per square mile (USFS 2004). It is proposed that road densities move toward a decreased value with a goal of <1.5 miles per square mile in the Bobtail Creek watershed.

Table 5-2. Road Density Risk Ratings in Miles per Square Mile.

Risk	Kootenai National Forest[a]	Idaho Panhandle National Forest	Multi-Agency Bull Trout Screen	Columbia River Basin Final EIS[b]
Low	< 1.5	< 1.7	< 1.5	< 2.0 (proper function)
Moderate	1.5–3.5	1.7-4.7	1.5–3.0	2.0–3.0 (functioning at risk)
High	> 3.5	> 4.7	> 3.0	> 3.0 (non proper function)

[a]The values reported for the Kootenai National Forest represent the range of values for areas with mean annual precipitation of 20 to 40 inches (similar to the FTPA; see Section 2.1.1).
[b]The Columbia River Basin Final Environmental Impact Statement (CRB FEIS) reports low, moderate, and high in terms of proper functioning condition.

Table 5-3. Future Performance-Based Allocations.

Allocation	Source	Action	Rationale	Responsible Party
75 Percent Reduction in Future Bank Erosion	Future Development	No sediment loading increases other than potential minor predicted short-term increases associated with full implementation of applicable BMP standards.	Bank erosion from riparian disturbance will result in sediment loading. This can be minimized with the proper utilization of BMPs.	Private Landowners
	Future Roads and Timber Harvest	No sediment loading increases other than potential minor predicted short-term increases associated with full implementation of applicable BMP standards.	Bank erosion from riparian disturbance will result in sediment loading. This can be minimized with the proper utilization of BMPs.	USFS, Plum Creek Timber Company, private landowners
		Manage basin vegetation to result in an ECA leading to an estimated increase in peak flows of <7-9%	Increased water yield and peak flows increase the risks of channel instability and can increase pollutants of concern.	USFS, Plum Creek Timber Company, private landowners
		Culvert Removal.	Stream crossings promote sediment delivery and can limit fish movement.	USFS, Plum Creek Timber Company, private landowners
		Road decommissioning resulting in a reduction in road density.	Roads in the watershed have been identified as contributing sediment to Bobtail Creek.	USFS, Plum Creek Timber Company, private land owners

5.3 TMDL and Load Allocation Uncertainty

The analysis presented in this document assumes that the load reductions proposed for Bobtail Creek will enable it to meet target condition, and further assumes that meeting target conditions will ensure full support of all beneficial uses. To validate this assumption, implementation monitoring has been proposed in the monitoring plan in Section 7.0. This monitoring is intended to track progress toward meeting targets. If it looks like greater reductions in loading or improved performance is necessary to meet targets, then a new TMDL and/or allocations will be developed based on achievable reductions through application of reasonable land, soil, and water conservations practices. The linkage between meeting targets and supporting beneficial uses will also be monitored through the supplemental indicators described in Section 3.0, including TSS, bank erosion, and macroinvertebrates.

5.3.1 Margin of Safety

Applying a margin of safety is a required component of TMDL development. The margin of safety (MOS) accounts for the uncertainty about the pollutant loads and the quality of the receiving water and is intended to protect beneficial uses in the face of this uncertainty. 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 (USEPA, 1999). This plan addresses MOS in several ways:

- Multiple targets addressing physical channel conditions are developed to address excess fines and other impairments.
- The suite of proposed supplemental indicators, including biological indicators, used to help verify beneficial use support determinations.
- The proposed supplemental indicators may also provide an early warning method to identify pollutant-loading threats that may not otherwise be identified, if targets are not met.
- The WQRP presented in this document go beyond what is required by the EPA for TMDL development by including restoration and monitoring for non-pollutants such as habitat alteration. By doing so, the WQRP provides a holistic approach to water quality restoration and thus an additional MOS for beneficial use support.
- A large amount of data and assessment information were considered prior to finalizing any impairment determinations. Impairment determination were based on conservative assumptions that error on the side of keeping streams listed and developing TMDLs unless overwhelming evidence of use support was available.
- To be protective and proactive, TMDLs and subsequent restoration and monitoring were developed as part of this WQRP even though they were not required in all cases.
- Consideration of seasonality.
- The adaptive management approach evaluates target attainment and allows for refinement of load allocation, targets, and restoration strategies to ensure restoration of beneficial uses.
- The monitoring plan calls for evaluation of tributaries not on the 303(d) list that may contribute sediment to the Bobtail Creek Watershed.

5.3.2 Seasonality

Addressing seasonal variations is an important and required component of TMDL development. Throughout this plan, seasonality is an integral factor. Water quality and habitat parameters such as fine sediment, suspended sediment, turbidity, and macroinvertebrates are all recognized to have seasonal cycles.

Specific examples of how seasonality has been addressed include:

- Source assessment of sediment loading inherently incorporates runoff flows when erosion is greatest.

- Targets were developed with seasonality in mind: the % <6 fine sediment target data is collected in the summer, after flushing flows have passed; macroinvertebrate and supplemental indicator data is collected during the summer months when these biological communities most accurately reflect stream conditions.
- Throughout this document, the data reviewed cover a range of years, seasons, and geographic area within the Bobtail TPA.

SECTION 6.0
RESTORATION STRATEGY

It is important to note that elements of the following implementation strategy are strictly voluntary in nature. The only requirements are that MDEQ formally reevaluate this WQRP/TMDL in 5 years following implementation of this plan. Any data collected by stakeholders will serve to help make impairment decisions in the future.

Based on the current impairment conditions and impairment sources identified for Bobtail Creek drainage, a restoration strategy has been developed to guide restoration in the drainage and facilitate water quality improvement. Restoration requirements for Bobtail Creek are primarily associated with sediment loading from roads and unstable stream banks, and habitat impairment related to channel instability and poorly functioning culverts. Extensive restoration programs and obligations are already in place in the drainage, many of which address sediment loading from roads, poorly functioning culverts and aquatic habitat enhancement, through USFS and Plum Creek Timber Company land management programs. Therefore, this restoration strategy relies on these existing programs and obligations that are expected to result in attainment of restoration targets in the coming years. Additional restoration strategies are proposed for non-PCTC private lands to address potential problems related to roads, culverts and unstable stream channels on these lands. Several restoration activities and projects have already been completed (Figure 6-1).

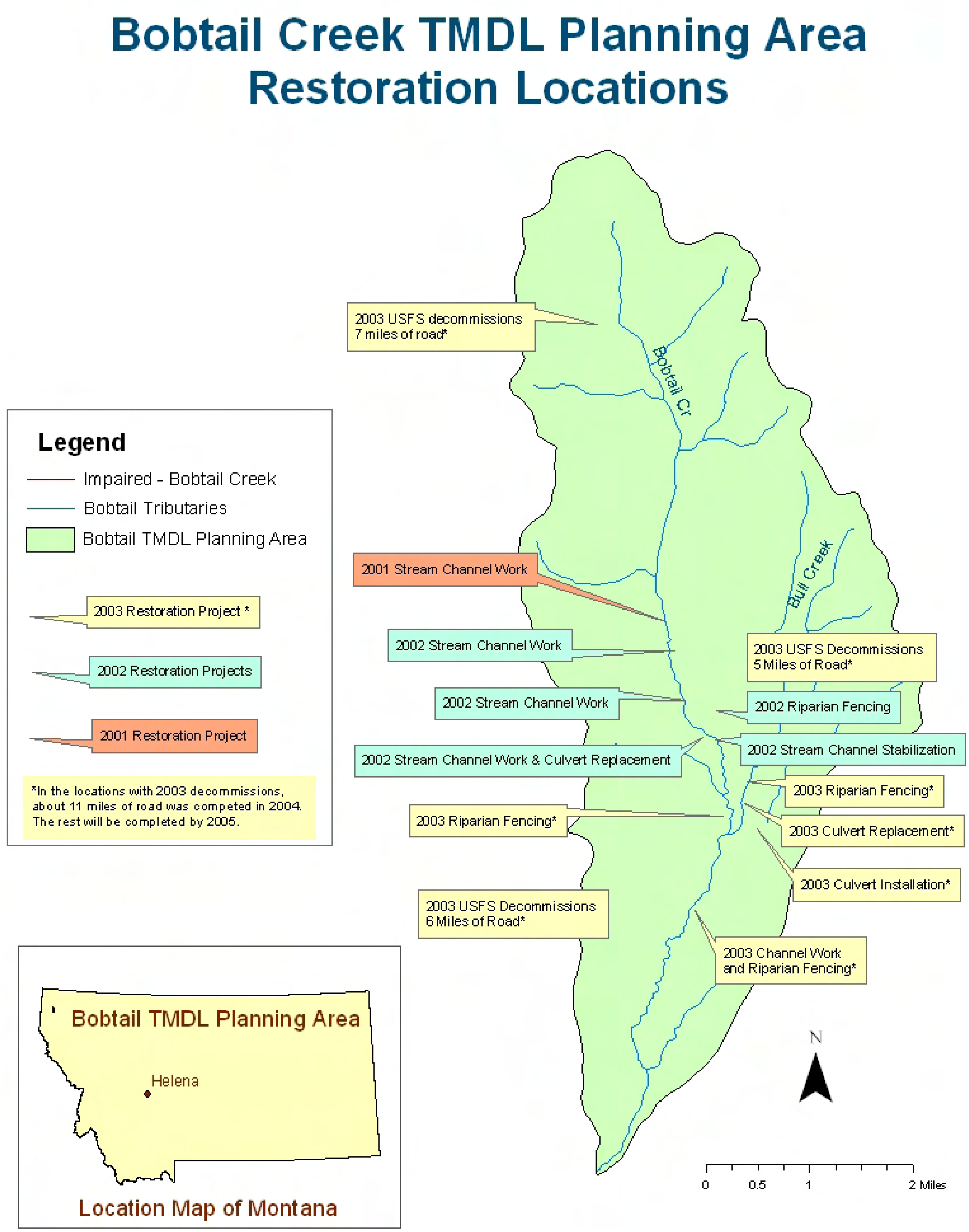
6.1 USFS Restoration Plans and Responsibilities

Restoration and management plans by the USFS constitute a significant component of the restoration strategy in Bobtail Creek. The following is a list of actions or management approach planned for this basin:

- The USFS plans on decommissioning several miles of existing forest roads in the drainage. Current plans include decommissioning 18 miles of road (USFS, 2004). Approximately 11 miles of these roads are located on sensitive land types, and therefore should decease sediment loading to Bobtail Creek and its tributaries.
- The USFS will oversee the removal of thirty stream crossings, 21 of which are on sensitive land types (USFS, 2004). Stream crossing and associated culvert removal will help restore the Bobtail Creek flow regime to a more natural condition, and reduce sediment accumulation upstream of culverts, and streambed scouring downstream of culverts due to increased flow velocities. Culvert removal will also address fish migration barrier problems that may be associated with the culverts.
- The USFS will continue their extensive monitoring program in Bobtail Creek drainage (Section 7.0). USFS monitoring will include geomorphic surveys at 18 locations, continuous stream flow and TSS monitoring, McNeil core sampling, and biological monitoring. These monitoring activities are scheduled to continue for at least 10 more years.

Additionally, it is recommended that the USFS manage timber harvesting on National Forest lands to limit water yield increases to less than 7-9% off of National Forest managed lands.

Figure 6-1 Restoration Projects in the Bobtail Creek Watershed.



6.2 Plum Creek Timber Company Restoration Plans and Responsibilities

Plum Creek Timber Company is responsible for implementation of a number of water quality and habitat restoration activities in Bobtail Creek drainage under their Native Fish Habitat Conservation Plan (NFHCP). Specific requirements of the NFHCP are as follows:

- Under the NFHCP, Plum Creek will be fully implementing Montana's Forestry Best Management Practices on their properties;
- Bobtail Creek is designated in the NFHCP as a High Priority Watershed. With this designation, Plum Creek will upgrade all roads to meet state BMP standards (with some specific enhancements) by the end of 2010. This work will include improving general road drainage, reducing the length of road draining to streams, and adding supplemental filtration (e.g., slash filter windrows, silt fences, etc.) where drainage feature outfalls discharge too close to streams for effective filtration;
- Where fish passage barriers exist, they will be corrected prior to 2010. This deadline may be extended if necessary to fully work out details with cost-share partners (e.g., USFS);
- New stream culvert installations will be designed to accommodate at a minimum the 50-year peak flow;
- Roads that Plum Creek does not require for forest management will be abandoned (reclaimed) by the end of 2010;
- All roads will be re-inspected for BMP condition every 5 years;
- Any new roads will be constructed to specific enhanced standards, such as gravel surfacing of the road running surface over stream crossings in highly erodible soils. Should potentially unstable landforms be identified on proposed roads, a geotechnical review will be conducted to ensure potential risk is minimized; and
- In addition to standard state Streamside Management Zone regulations, Plum Creek will be providing extra riparian protection along streams that contain channel migration zones. Riparian buffers must also be enhanced with additional leave trees when streamside roads inhibit recruitment on the opposite side of the stream.

Additionally, it is recommended that Plum Creek manage timber harvesting on their lands to limit water yield increases to less than 7 – 9% off of Plum Creek-owned lands.

6.3 Other Private Landowner Restoration Plans and Responsibilities

Many restoration activities have occurred on private lands within the Bobtail Creek watershed. Restoration activities along the privately owned reaches in the lower portions of the watershed will be the responsibility of private landowners; however, much of this will likely be accomplished with both financial and technical assistance from agencies and the Bobtail Creek Watershed Group. For example, the Natural Resource and Conservation Service is available to provide both technical assistance and grants for implementation of grazing management practices. Similarly, grants through the Montana MDEQ have been used to restore reaches of channel and are likely to be a source of these funds in the future. Finally, the Bobtail Creek Watershed Group has been effective in organizing landowners to cooperatively plant riparian vegetation and build fences.

The following are the specific tasks that may be completed by private landowners in conjunction with government agencies and the Bobtail Creek Watershed Group. It should be noted that most, if not all of these tasks would be undertaken on a voluntary basis.

- Implement riparian BMPs to restore riparian structure and function where impacted by private roads or stream encroachment.
- Restore channel stability in unstable stream reaches in sections 29, 30 and 32, T32N, R31W (see Section 2.8.1, 4.3). Of particular concern is restoration and stabilization of the stream segment where the stream recently overtopped its banks and cut a new 15-foot wide channel. Use of hard channel armoring, such as rock riprap should be avoided in these stream restoration efforts.
- Replace undersized or improperly functioning culverts.
- Assist in monitoring of water quality parameters.

Implementation of riparian BMPs and monitoring will be ongoing activities. Channel restoration will be largely contingent on acquisition of grant funds but should be completed within 5 years.

SECTION 7.0
MONITORING STRATEGY

It is important to note that elements of the following monitoring strategy are strictly voluntary in nature. The only requirements are that MDEQ formally reevaluate this WQRP/TMDL in 5 years following implementation of this plan. Any data collected by stakeholders will serve to help make impairment decisions in the future.

Water quality monitoring will be critical for evaluating future water quality trends in Bobtail Creek drainage and is a required component of TMDL development. Montana law (MCA 75-5-703(7)) states *"Once the control measures... have been implemented… the Department shall develop a monitoring program to assess the waters that are subject to the TMDL to determine whether compliance with water quality standards has been attained…*" TMDL-related monitoring is also necessary to provide information for determining if modifications of restoration targets, load allocations, or restoration strategies. This section outlines a monitoring strategy designed to provide the information necessary to meet these requirements. Much of the information and data requirements for TMDL implementation will be made available through ongoing USFS and Montana Department of Fish, Wildlife and Parks monitoring activities. Plum Creek Timber Company, the Bobtail Watershed Group, MDEQ, or other public and private entities may provide other sources of data and information.

7.1 Monitoring Plan

As part of the overall implementation strategy for this water quality protection plan, a water quality monitoring plan for the Bobtail Creek watershed is included to help meet the following six objectives:

1. Document water quality trends associated with future implementation efforts.
2. Monitor progress toward meeting water quality targets.
3. Fill existing data gaps throughout the watershed.
4. Conduct an adaptive management strategy to fulfill requirements of this WQRP.
5. Conduct a phased hydrologic study to fulfill the requirements of this WQRP.
6. Address all assumptions and uncertainties identified in this WQRP.

This monitoring plan will address the need to evaluate the progress toward meeting or protecting water quality standards and associated beneficial uses (Montana State Law (75-5-703(7) and (9)). The monitoring will also address the tracking of specific implementation efforts. It is anticipated that the stakeholders will help develop monitoring details and help pursue funding for monitoring and data evaluation. The Bobtail Creek Watershed Water Quality Protection Monitoring Plan includes the following:

- Continue the collection of data for targets and indicators.
- Conduct road sediment assessments and determine sediment loading from road erosion for the Bobtail Creek watershed.

- Conduct more in-depth bank erosion assessments and determine sediment loading from bank erosion within the Bobtail Creek watershed.
- Monitor the implementation of restoration actions. Monitoring activities should include tracking the effectiveness of BMPs on forest roads in meeting targets, and summarizing the length of road upgrades to BMP standards, length of decommissioned roads, and fish passage barriers corrected. Additionally riparian BMPs should also be tracked and analyzed for effectiveness.
- Monitor redds and/or populations of native salmonid species in Bobtail Creek.
- Collect new biological (macroinvertebrate and periphyton) data every year.
- Conduct RMO assessments at sites established by the Kootenai National Forest every 5 years.

7.2 Trend Monitoring of Target Variables

MDEQ is required by state law to monitor success of this TMDL and WQRP five years after implementation of control measures through the monitoring of target values. Many of these targets are scheduled to be monitored by the USFS. MDEQ acknowledges that schedules may change and the cost associated with this monitoring; therefore, it is suggested that that all stakeholders and land managers within the watershed work together to develop a effective monitoring program for the Bobtail watershed.

Width-to-Depth Ratios, Pool Frequency, and Riffle Stability Index

Stream channel geomorphic and fish habitat assessments should be continued at the established USFS sites to assess riparian management objectives (RMOs) defined in the Inland Native Fish Strategy (USFS, 1995). The surveys should be performed at the 18 RMO and Channel Cross-Section sites shown in Figure 3-4 and listed in Table 3-10, and include measurement of the following RMOs:

- Pools frequency;
- Large woody debris per foot;
- Percent bank stability;
- Width to depth ratio; and
- Riffle stability index.

Stream channel geomorphic analyses should occur at least once every five years.

Wolman Pebble Counts

Wolman Pebble Count sampling should occur on a five-year basis, as part of the stream channel geomorphic analysis at USFS established sites in the watershed. This data will aid in evaluation of future trends in particles < 2mm for comparison to the 20% or less target. Other sites on non-USFS lands should be considered.

McNeil Core Sampling

McNeil core sampling should occur on an annual basis at one site in NE¼ of Section 5, T31N, R31W (Figure 2-2). This data will aid in evaluation of future trends in fine sediment content (<6.35mm) in the streambed for comparison to the 28% or less target. Streambed sediment data will be required from multiple locations throughout the drainage to assess future compliance with the percent fines target. The USFS monitoring activities include annual McNeil core sampling at one location in lower Bobtail Creek. At least four additional McNeil core sampling locations should be added to the monitoring program, including one near the mouth of Bobtail Creek, two in upper Bobtail Creek, and one in Bull Creek drainage. The exact monitoring locations should coincide with areas of potential fish spawning habitat to ensure the intent of this restoration target (protection of salmonids during critical life stages) is met.

7.3 Trend Monitoring of Supplemental Indicators

Stream flow and TSS Monitoring

Daily stream flow and TSS data from site Bobtail 1 near the mouth of Bobtail Creek (Section 30, T31N, R31W) should continue to be collected. This information will be used for evaluating the hydrologic response to various natural and human influences in the drainage, as well as future trends in TSS levels.

Stream flow is calculated on a daily basis from continuous stream stage data and a stream stage/flow-rating curve. Actual flow measurements are recorded six to eight times per year to update the rating curve. TSS is measured daily with an ISCO automated sampler.

Bank Stability

As mentioned above, stream channel geomorphic analysis should be continued at established USFS sites to assess riparian management objectives (RMOs) defined in the Inland Native Fish Strategy (USFS, 1995). The surveys will be performed at the 18 RMO and Channel Cross-Section sites shown in Figure 3-4 and listed in Table 3-10, and include measurement of the following RMOs:

- Pools frequency;
- Large woody debris per foot;
- Percent bank stability;
- Width to depth ratio; and
- Riffle stability index.

Stream channel geomorphic analyses should occur at least once every five years.

Macroinvertebrates

The macroinvertebrate sampling should occur annually at one site in the NE¼ of Section 5, T31N, R31W (same location as stream core sampling site, Figure 2-2). Sample analyses will include the metrics shown in Table 3-16. Macroinvertebrate sampling should be performed at up to four additional sites corresponding to the McNeil core sampling sites recommended above to provide adequate coverage for assessing the watershed health and beneficial use attainment in the future.

7.4 Beneficial Use Linkage Indicators

Fish Population Monitoring

Montana Fish, Wildlife, and Parks is currently scheduled complete fish population surveys every two to three years. Fish populations will be monitored by two methods. First, redd counts will be conducted in the lower reaches of Bobtail Creek to evaluate the response of rainbow trout to decreased siltation of these spawning grounds. Second, resident fish will be sampled to assess fish population trends following implementation of restoration activities.

7.5 Condition Monitoring

For a stream channel to again become stable, it needs to be able to properly distribute its flow and sediment supply in order to maintain its dimension, pattern and profile without degrading or aggrading. Adjustments occur partially as a result of a change in the stream flow magnitude and/or timing, sediment supply and/or size, direct channel disturbance, and riparian vegetation changes (Rosgen, 1996). Management strategies and additional mitigations outlined in the restoration plan portion of this document would assist in the geomorphic recovery of these segments. It is important to note that “recovery” is defined as “potential for recovery” based on the reference conditions. Once this recovery is met, sediment loads are expected to reach their expected norm due to efficiency of the system. Putting a time limit on geomorphic recovery can be rather difficult. However, routine measurements of pool frequency, bank stability, and width/depth ratios can show trends over time. These trends can be used to make inferences towards the expected and desired evolutionary stage of the stream channel.

7.6 Reference Monitoring

As discussed in Sections 7.2 and 7.3, continued monitoring surrounding the water quality targets and supplemental indicators outlined in Section 3.3 is needed to further verify impairment status and achievement of full beneficial use support. In addition to monitoring and data collection of the target/indicator parameters outlined in Section 3.3, continued monitoring of those same parameters in reference streams is needed to help increase confidence that the targets and supplemental indicator values chosen best represent the narrative water quality standards.

MDEQ uses the reference condition to determine if narrative water quality standards are being achieved. The term “reference condition” is defined 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, reference condition reflects a waterbody’s greatest potential for water quality given historic land use activities.

MDEQ applies the reference condition approach for making beneficial use-support determinations for certain pollutants (such as sediment) that have specific narrative standards. All classes of waters are subject to the provision that there can be no increase above naturally occurring concentrations of sediment and settleable solids, oils, or floating solids sufficient to create a nuisance or render the water harmful, detrimental or injurious. These levels depend on site-specific factors, so the reference conditions approach is used.

Also, Montana water quality standards do not contain specific provisions addressing nutrients (nitrogen and phosphorous), or detrimental modifications of habitat or flow. However, these factors are known to adversely affect beneficial uses under certain conditions or combination of conditions. The reference conditions approach is used to determine if beneficial uses are supported when nutrients, flow or habitat modifications are present.

Waterbodies used to determine reference condition are not necessarily pristine or perfectly suited to giving the best possible support to all possible beneficial uses. Reference condition also does not reflect an effort to turn the clock back to conditions that may have existed before human settlement, but is intended to accommodate natural variations in biological communities, water chemistry, etc. due to climate, bedrock, soils, hydrology and other natural physiochemical differences. The intention is to differentiate between natural conditions and widespread or significant alterations of biology, chemistry or hydrogeomorphology due to human activity. Therefore, reference conditions should reflect minimum impacts from human activities. It attempts to identify the potential condition that could be attained (given historical land use) by the application of reasonable land, soil and water conservation practices. MDEQ realizes that presettlement water quality conditions usually are not attainable.

Comparison of conditions in a waterbody to reference waterbody conditions must be made during similar season and/or hydrologic conditions for both waters. For example, the TSS of a stream at base flow during the summer should not be compared to the TSS of reference condition that would occur during a runoff event in the spring. In addition, a comparison should not be made to the lowest or highest TSS values of a reference site, which represent the outer boundaries of reference conditions.

The following methods may be used to determine reference conditions:

Primary Approach

- Comparing conditions in a waterbody to baseline data from minimally impaired waterbodies that are in a nearby watershed or in the same region having similar geology, hydrology, morphology, and/or riparian habitat.
- Evaluating historical data relating to condition of the waterbody in the past.
- Comparing conditions in a waterbody to conditions in another portion of the same waterbody, such as an unimpaired segment of the same stream.

Secondary Approach

- Reviewing literature and studies (e.g. a review of studies of fish populations, etc.) that were conducted on similar waterbodies that are least impaired.
- Seeking expert opinion (e.g. expert opinion from a regional fisheries biologist who has a good understanding of the waterbody's fisheries health or potential).
- Applying quantitative modeling (e.g. applying sediment transport models to determine how much sediment is entering a stream based on land use information, etc.).

MDEQ uses the primary approach for determining reference condition if adequate regional reference data are available and uses the secondary approach to estimate reference condition when there are no regional data. MDEQ often uses more than one approach to determine reference condition, especially when regional reference condition data are sparse or nonexistent.

7.7 Data Gaps

The following data gaps have been identified during the TMDL development process and will be addressed by the Implementation Team:

- Macroinvertebrate Data: Macroinvertebrate data should be collected in additional reaches within the Bobtail Creek watershed. It is important to have a representation of the entire watershed.
- Surface erosion for existing roads in the Bobtail Creek watershed should be further assessed.
- Bank erosion in the Bobtail Creek watershed should be further assessed.

7.8 Adaptive Management Strategy

As monitoring data is obtained and evaluated, MDEQ in partnership with the stakeholders will adjust load allocations as necessary to meet targets, especially those targets associated with in-stream conditions. Additionally, targets could also be adjusted. These adjustments would take into account new technologies and information as they arise.

At the end of 5 years, an evaluation of BMP implementation, target compliance and beneficial use determinations will be made. At this time, recommendations would be made by MDEQ to ensure that the goals of this restoration plan are being met. If, at that time, any one goal or target is not being met, an evaluation would be made that would determine one or more of the following:

- Adjustments to land-use activities;
- Make changes to original targets; and
- Collect additional data and reevaluate next cycle.

To ensure reasonable and equitable decisions are made regarding future target and/or management adjustments, MDEQ would evaluate and compare both reference and TPA stream data collected under this WQRP with the data collected prior to the development of this plan.

Additionally, if at the 5-year evaluation period it is found that any or all of the streams within the Bobtail Creek TPA are fully supporting beneficial uses, steps would be taken to ensure that management practices and mitigation measures outlined in this WQRP would continue. While favorable management practices would be expected to continue, the level of monitoring outlined in this WQRP could be revised. At this time, the monitoring strategy could be scaled back in both the frequency and intensity. While reducing the monitoring program could take place under these circumstances, enough monitoring should continue to occur to ensure that full beneficial use support remains in place.

SECTION 8.0
PUBLIC INVOLVEMENT

The Bobtail Creek Watershed Group, Kootenai National Forest, the Lincoln Conservation District, Plum Creek Timber Company and other agencies and stakeholders contributed to the development of this plan.

Early in this project, the Bobtail Creek Watershed Group played an important role in water quality restoration planning in the Bobtail Creek watershed. In 2001, the Bobtail Creek Watershed Group worked in conjunction with Montana Watershed, Inc. for a Bobtail Creek watershed project utilizing Section 319 funding. This project included restoration work, funding for education programs, and early TMDL development work. A draft of a TMDL was completed in June 2002. In November 2003 a two-week stakeholder review and an internal MDEQ review were held on the first draft of the TMDL. It was determined that additional information was available and more work needed to be done to make this an acceptable TMDL.

This version of the TMDL and water quality restoration plan has a one-month public comment period from November 29, 2004 through December 27, 2004. A formal public meeting was held on December 8, 2004 at the Forest Service Office in Libby, Montana.

This final document reflects modifications made in response to the written and verbal comments received throughout the public comment period. The written comments and respective responses to those comments are provided in Appendix F.

Any future significant revisions to this plan or identification of water quality impairment conditions on future 303(d) lists will also undergo public review.

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