Water Quality Assessment and TMDLs for the Flathead River Headwaters Planning Area, Montana

Prepared by:
U.S. Environmental Protection Agency
Montana Operations Office,
Flathead National Forest,
and Tetra Tech, Inc.

Project Manager: Ron Steg

Contributing Authors:
Jason Gildea
Tina Laidlaw
Donna Pridmore
Ron Steg

Photos by Montana Fish, Wildlife, and Parks,
Flathead National Forest,
and Tetra Tech, Inc.

Prepared for the Montana Department of Environmental Quality

December 31, 2004

CONTENTS

TABLES

FIGURES

Executive Summary

The Flathead River Headwaters Total Maximum Daily Load (TMDL) Planning Area (TPA) drains approximately 4,369 square miles in northwestern Montana and Canada. Twelve stream segments and one reservoir in the Flathead River Headwaters TPA appeared on Montana's 1996 Clean Water Act section 303(d) list. The listed causes of impairment included flow alteration, other habitat alterations, nutrients, suspended solids, and siltation. Cold-water fish and aquatic life were the beneficial uses listed as impaired or threatened. Montana Department of Environmental Quality (MDEQ) revised the 303(d) list in 2002 using a new procedure, and two waters were removed from the list based on the revised listing procedure. A watershed-scale approach was used to evaluate beneficial uses in the following waters:

Big Creek
Challenge Creek
Granite Creek
Hungry Horse Reservoir
Lower Coal Creek
Morrison Creek
North Fork Coal Creek
Red Meadow Creek
South Fork Coal Creek
South Fork Flathead River
Sullivan Creek
Whale Creek

A summary of the way in which each of these waters has been addressed is provided in Table 1.

It has been determined that the cold-water fishery and aquatic life beneficial uses in Red Meadow Creek, Whale Creek, South Fork Coal Creek, North Fork Coal Creek, Granite Creek, and Morrison Creek are fully supported. These waters are not considered impaired due to sediment-related causes (siltation or suspended solids), and therefore no TMDLs are required. However, minor anthropogenic sediment sources were identified in Red Meadow, Whale, and Sullivan creeks. A Voluntary Water Quality Improvement Strategy is proposed to improve the overall watershed health in those three streams.

Although the available data do not support the conclusion presented in the 1996 303(d) list that North Fork Coal Creek is impaired due to nutrients, there is still some uncertainty because of limited data. Additional water quality data have been collected to address these uncertainties and will be evaluated to make a final determination. If it is found that anthropogenic sources of nutrients are not causing an impairment, documentation will be provided to the MDEQ so that the 303(d) list status of this water body can be changed in 2006 (when MDEQ is to propose the next 303(d) list). If, on the other hand, it is determined that anthropogenic sources of nutrients are causing impairment, a TMDL will be prepared.

The following waters were also considered in the analyses, but they are not addressed herein because they were found to be fully supporting on the 2002 303(d) list, all necessary TMDLs have already been completed, or the waters were not listed for a pollutant:

- South Fork Flathead River (flow and habitat alteration, no pollutants)
- Hungry Horse Reservoir (fully supporting on 2002 303(d) list)
- Big Creek (TMDL approved May 9, 2003)
- Challenge Creek (fully supporting on 2002 303(d) list)

Finally, unlike the populations in many of the other North Fork Flathead River tributaries, bull trout populations have failed to rebound in Lower Coal Creek. The cause of this impairment is unknown. The fact that the substrate conditions are slightly less than optimal, based on comparison with proposed target values, might or might not be contributing to this impairment. Other factors, such as physical habitat condition (e.g., large woody debris, number of pools, barriers, stream temperature) or high loads of sediment delivered to the stream from natural sources like eroding banks or the recent Moose Fire, could be the cause. Or, perhaps, a combination of factors are responsible. Given the uncertainty, a TMDL focusing on addressing all known anthropogenic sediment sources and further study to identify the cause(s) of the bull trout population decline is proposed herein.

Table 1. Summary of Required TMDL Elements for the Flathead River Headwaters TMDL Planning Area

Water Bodies, Pollutants of Concern, and Current Impairment Status	The following seven individual water body/pollutant combinations were addressed by demonstrating that they currently meet water quality standards (WQS): • Red Meadow Creek (listed for siltation, meeting WQS) • Whale Creek (listed for siltation, meeting WQS) • South Fork Coal Creek (listed for siltation, meeting WQS) • North Fork Coal Creek (listed for siltation and nutrients, meeting WQS for siltation, proposed plan to collect additional data regarding nutrients) • Granite Creek (listed for siltation, meeting WQS) • Skyland Creek (listed for siltation, meeting WQS) • Morrison Creek (listed for siltation, meeting WQS) A TMDL has been prepared for Lower Coal Creek (listed for siltation), which addresses the entire Coal Creek Watershed (including South Fork and North Fork Coal). Because a watershed-scale approach was taken, the following waters were also considered in the analyses. They were not addressed because they were found to be fully supporting on the 2002 303(d) list, all necessary TMDLs have already been completed, or the waters were not listed for a pollutant: • South Fork Flathead River (flow and habitat alteration, no pollutants) • Hungry Horse Reservoir (fully supporting on 2002 303(d) list) • Big Creek (TMDL approved May 9, 2003) • Challenge Creek (fully supporting on 2002 303(d) list)
Section 303(d)(1) or 303(d)(3) TMDL	303(d)(1) TMDL to address siltation in the Coal Creek watershed
Impaired Beneficial Uses	All waters appeared on the 1996 and/or 2002 303(d) lists for partial support, or threatened status, for the cold-water fishery and/or aquatic life beneficial uses.
Pollutant Sources	Sediment: Natural (e.g., fire, flood, bank erosion), and anthropogenic, associated with current or historical forest harvest and roads. Nutrients (North Fork only): Unknown at this time.
Target Development Strategies	• The current water quality impairment status of each of the waters originally listed on the 1996 303(d) list was evaluated using a weight-of-evidence approach with a suite of targets and supplemental indicators. • Targets for Coal Creek watershed include threshold values for McNeil Cores; substrate scores; percent surface fines smaller than 2 millimeters; and clinger richness.
TMDLs	Reduction in sediment loads from all known anthropogenic sediment sources (Coal Creek watershed only)
Allocation	Phased allocation, in which Phase I addresses the known anthropogenic sediment sources and Phase II provides for further study to address uncertainties (Coal Creek watershed only).
Restoration Strategies	• Water Quality Improvement Plan to address identified sediment sources in Red Meadow, Whale, and Sullivan creeks. • A phased restoration strategy is proposed for the Coal Creek watershed, in which Phase I addresses known anthropogenic sediment sources and additional studies are conducted to address uncertainties. Phase II is to be determined based on Phase I.
Margin of Safety	For the Coal Creek watershed, a margin of safety is provided by conservative assumptions and proposed additional studies to address uncertainties.
Seasonal Considerations	The focus of the Coal Creek watershed sediment TMDL is on annual sediment loading. There does not appear to be a seasonal critical condition that needs to be addressed.

1.0 INTRODUCTION

The Flathead River Headwaters Total Maximum Daily Load (TMDL) Planning Area (TPA) drains approximately 4,369 square miles in northwestern Montana and Canada (Figure 1-1). Twelve stream segments and one reservoir in the Flathead River Headwaters TPA appeared on Montana's 1996 Clean Water Act section 303(d) list, and the listing information is shown in Tables 1-1 and 1-2 (MDEQ, 1996). The causes of impairment include flow alteration, other habitat alterations, nutrients, suspended solids, and siltation. The Montana Department of Environmental Quality (MDEQ) revised the 303(d) list in 2002 using a new procedure. The updated 2002 303(d) listings are shown in Tables 1-1 and 1-2. Challenge Creek and Hungry Horse Reservoir were removed from the 2002 303(d) list on the basis of the revised listing procedure.

The purposes of this document are to provide an updated assessment of all waters within this TPA appearing on either the 1996 or 2002 303(d) list, to provide recommendations for future modifications to Montana's 303(d) list with respect to these water bodies, and to provide water quality improvement/restoration plans to address the significant anthropogenic sources of impairment identified through this process. The relevant physical, chemical, biological, and socioeconomic characteristics of the environment in which the subject water bodies exist are described in Section 2.0, Watershed Characterization. A summary and evaluation of all available water quality data and updated water quality impairment determinations are presented in Section 3.0, Water Quality Impairment Status. Section 4.0 includes a sediment TMDL for Coal Creek, including all the necessary TMDL components. Finally, a water quality improvement plan for Red Meadow, Whale, and Sullivan creeks is presented in Section 5.0.

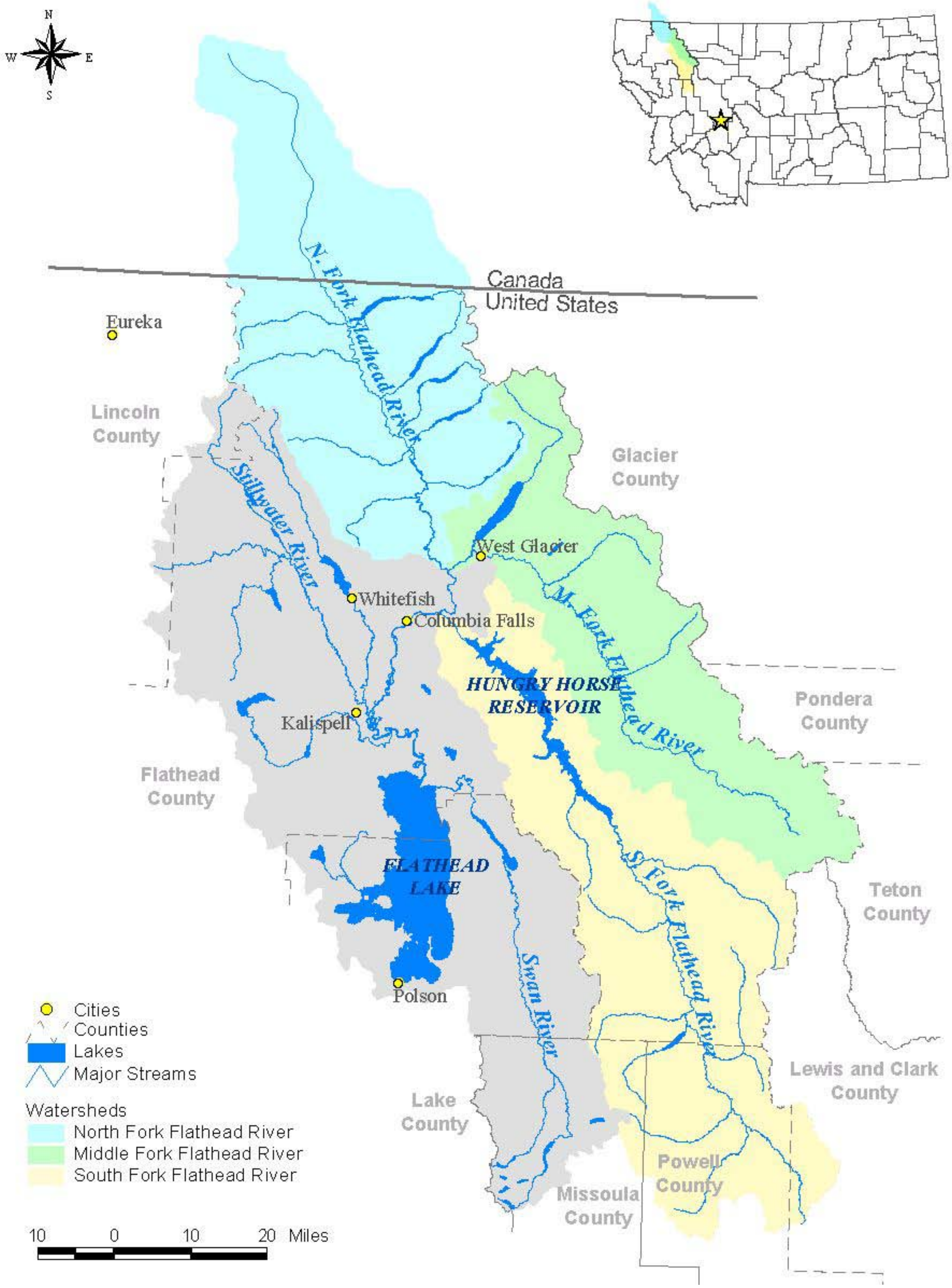


Figure 1-1. Location of the Flathead River Headwaters TPA.

Table 1-1. Impaired Streams Within the Flathead River Headwaters TPA on the 1996 and 2002 Montana 303(d) Lists

Watershed	Sub-Drainage and Water body No.	Use Class	Year Listed	Cold Water Fishery	Aquatic Life	Recreation (Swimmable)	Industry	Agriculture	Drinking Water
North Fork Flathead River	Big Creek MT76Q002-050	B1	1996	P	P	X	X	X	X
			2002	TMDL Completed					
	Red Meadow Creek MT76Q002-020	B1	1996	P	P	X	X	X	X
			2002	P	P	F	F	F	X
	Whale Creek MT76Q002-030	B1	1996	T	X	X	X	X	X
			2002	P	P	F	F	F	X
	South Fork Coal Creek MT76Q002-040	B1	1996	P	P	X	X	X	X
			2002	P	P	F	F	F	X
	Coal Creek MT76Q002-080	B1	1996	P	P	X	X	X	X
			2002	P	P	F	F	F	X
	North Fork Coal Creek MT76Q002-070	B1	1996	P	P	X	X	X	X
			2002	P	P	F	F	F	X
Middle Fork Flathead River	Granite Creek MT76I002-010	B1	1996	X	P	X	X	X	X
			2002	P	P	F	F	F	X
	Skyland Creek MT76I002-020	B1	1996	P	P	X	X	X	X
			2002	X	X	X	F	F	X
	Challenge Creek MT76I002-040	B1	1996	P	P	X	X	X	X
			2002	Not Listed					
	Morrison Creek MT76I002-050	B1	1996	P	P	X	X	X	X
			2002	P	P	F	F	F	X
South Fork Flathead River	South Fork Flathead River MT76J001-010	B1	1996	P	P	X	X	X	X
			2002	X	X	P	F	F	X
	Sullivan Creek MT76J003-010	B1	1996	P	P	X	X	X	X
			2002	X	X	F	F	F	X
	Hungry Horse Reservoir MT76J002-1	B1	1996	P	P	F	F	F	F
			2002	Not Listed					

Impairment Status Definitions for Table 1-1:

P = partial support of beneficial use.

F = full support of beneficial use.

T = threatened support of beneficial use.

X = sufficient credible data not available.

Table 1-2. Causes of Impairment in the Flathead River Headwaters TPA

Watershed	Sub-Drainage and Water body No.	Use Class	Year Listed	Probable Causes
North Fork Flathead River	Big Creek MT76LJ003-050	B1	1996	Habitat alter/siltation
			2002	TMDL completed
	Red Meadow Creek MT76Q002-020	B1	1996	Habitat alter/siltation
			2002	Habitat alter/siltation
	Whale Creek MT76Q002-030	B1	1996	Habitat alter/siltation
			2002	Habitat alter/siltation
	South Fork Coal Creek MT76Q002-040	B1	1996	Habitat alter/siltation
			2002	Habitat alter/siltation
	Coal Creek MT76Q002-080	B1	1996	Siltation
			2002	Siltation
	North Fork Coal Creek MT76Q002-070	B1	1996	Nutrients/siltation
			2002	Siltation
Middle Fork Flathead River	Granite Creek MT76I002-010	B1	1996	Habitat alter/ siltation/suspended solids
			2002	Siltation/bank erosion
	Skyland Creek MT76I002-020	B1	1996	Habitat alter/ siltation/suspended solids
			2002	No SCD
	Morrison Creek MT76I002-050	B1	1996	Habitat alter/siltation
			2002	Habitat alter/siltation
	Challenge Creek MT76I002-040	B1	1996	Habitat alter/siltation
			2002	Not Listed
South Fork Flathead River Below HHD	South Fork Flathead River MT76J001-010	B1	1996	Habitat alterations Flow alterations
			2002	Flow alterations
	Sullivan Creek MT76J003-010	B1	1996	Habitat alterations
			2002	No SCD
	Hungry Horse Reservoir MT76J002-1	B1	1996	Flow alterations siltation suspended solids
			2002	Not listed

Note: Alter= alternation (s): SCD= sufficient credible data.

2.0 WATERSHED CHARACTERIZATION

The intent of this section is to put the subject water bodies into the context of the watersheds in which they occur. This section should provide the reader with a general understanding of the environmental characteristics of the 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 Physical Characteristics

2.1.1 Climate

Weather stations at Polebridge (Station ID 246615), West Glacier (Station ID 248809), and Hungry Horse Dam (Station ID 244328) were used to characterize climatic conditions in the North Fork, Middle Fork, and South Fork Flathead rivers, respectively (Figure 2-1).

The weather variations for the entire Flathead Headwaters region are the result of the influence of maritime patterns from the Pacific Ocean. The general easterly flow by lower layers of the atmosphere common at this latitude of the Pacific Northwest is modified by the mountain complexes of western Montana and central Idaho. The high mountains in the Continental Divide, directly east of the Flathead region, form an effective barrier to severe, cold Artic patterns flowing south through Canada. The valleys experience many days with dense fog or low stratus cloud layers during the winter months due to radiational cooling of the dense, valley bottom air with relatively warmer Pacific-source air moving over the top.

Precipitation varies widely with season, elevation, and location. Sections of the higher portions of the North Fork of the Flathead have as much as 120 inches of mean annual precipitation. The greatest percentage of precipitation falls as snow during the winter months. The density of the mountain snowpack increases from about 20 percent water equivalency in early winter to about 35 percent in April. Average total precipitation and average annual snowfall for each of the three watersheds in the Flathead River Headwaters TMDL Planning Area (FTPA) are summarized in Table 2-1 and Table 2-2.

Figure 2-1. Distribution of NOAA climate monitoring stations within the FTPA.

Table 2-1. Average Total Precipitation at Selected Gages (inches)

Station	Month												Annual Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dev	
Polebridge	2.62	1.86	1.47	1.31	1.75	2.30	1.41	1.32	1.31	1.62	2.40	2.60	21.98
West Glacier	3.38	2.36	1.87	1.85	2.55	3.29	1.72	1.60	2.04	2.32	3.08	3.29	29.35
Hungry Horse Dam	3.53	2.61	2.31	2.29	2.80	3.43	1.78	1.79	2.28	2.89	3.72	3.67	33.10

Period of Record at Polebridge = 7/1/1948 to 7/31/2000.
Period of Record at West Glacier = 10/1/1949 to 12/31/2002.
Period of Record at Hungry Horse = 7/2/1948 to 12/31/2002.

Table 2-2. Average Total Snowfall at Selected Gages (inches)

Polebridge												
	Jan	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***
Ave. Total	31.4	17.7	10.9	3.4	0.5	0.3	0.0	0.0	0.2	2.8	15.8	24.9
Ave. Depth	19	22	19	5	0	0	0	0	0	0	3	11
Annual Mean Total = 107.8												
West Glacier												
	Jan	***Feb***	***Mar.***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***
Ave. Total	38.8	22.6	15.0	3.6	0.5	0.2	0.0	0.0	0.1	1.9	16.7	37.3
Ave. Depth	18	21	18	6	0	0	0	0	0	0	2	9
Annual Mean Total = 136.8												
Hungry Horse Dam												
	Jan	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***
Ave. Total	23.5	14.4	9.2	1.1	0.2	0.1	0.0	0.0	0.0	1.7	8.1	21.1
Ave. Depth	12	14	10	1	0	0	0	0	0	0	2	4
Annual Mean Total = 79.4												

Period of Record at Polebridge = 7/1/1948 to 7/31/2000.
Period of Record at West Glacier = 10/1/1949 to 12/31/2002.
Period of Record at Hungry Horse = 7/2/1948 to 12/31/2002.

2.1.2 Hydrology

2.1.2.1 Flow Data

The U.S. Geological Survey (USGS) National Water Information System (NWIS) online database lists 34 flow gages in the FTPA. There are 7 active flow gages with current and historical flow data (Table 2-3) and 27 inactive flow gages with historical data. The USGS active flow monitoring sites and the regional drainage pattern are displayed in Figure 2-2.

Flow between the monitoring stations at the Middle Fork Flathead River at West Glacier (1235700), the North Fork Flathead near Columbia Falls (12355500), and the South Fork Flathead above Twin Creek, above Hungry Horse Reservoir (12359800), are compared in Figure 2-3. On average, peak flows in the South Fork above Hungry Horse Reservoir arrive considerably earlier in the year than in the other two drainages in the FTPA. This difference is due to elevation and temperature differences in the South Fork Flathead River watershed (lower elevations, warmer temperatures), which cause snowmelt to occur earlier.

Water quality and quantity monitoring stations were maintained on the 303(d)-listed streams in the FTPA from the late 1970s through the mid-1990s. Flow characteristics extracted from the EPA Legacy STORET database for the 303(d) drainages are summarized in Table 2-4.

The regional drainage patterns are dendritic and controlled by the geologic structure of the surrounding mountain ranges. The Rocky Mountain Trench extends from southeast to northwest through the Mission and Flathead valleys, with extensional half-graben faults through the Swan, North Fork, South Fork, and Middle Fork valleys (Constenius, 1996). The region is deeply mantled by reworked glacial till and outwash, which mask the interactions between ground water and surface water.

Table 2-3. Active Flow Gages in the Flathead Headwaters TMDL Planning Area

Station ID	Station Name	Drainage Area (mi^2)
12355000	Flathead River at Flathead British Columbia	427
12355500	North Fork Flathead River near Columbia Falls, MT	1,548
12358500	Middle Fork Flathead River at West Glacier, MT	943
12359800	South Fork Flathead R above Twin Cr near Hungry Horse, MT	1,160
12362000	Hungry Horse Reservoir near Hungry Horse, MT	1,654
12362500	South Fork Flathead River near Columbia Falls, MT	1,663
12363000	Flathead River at Columbia Falls, MT	4,464

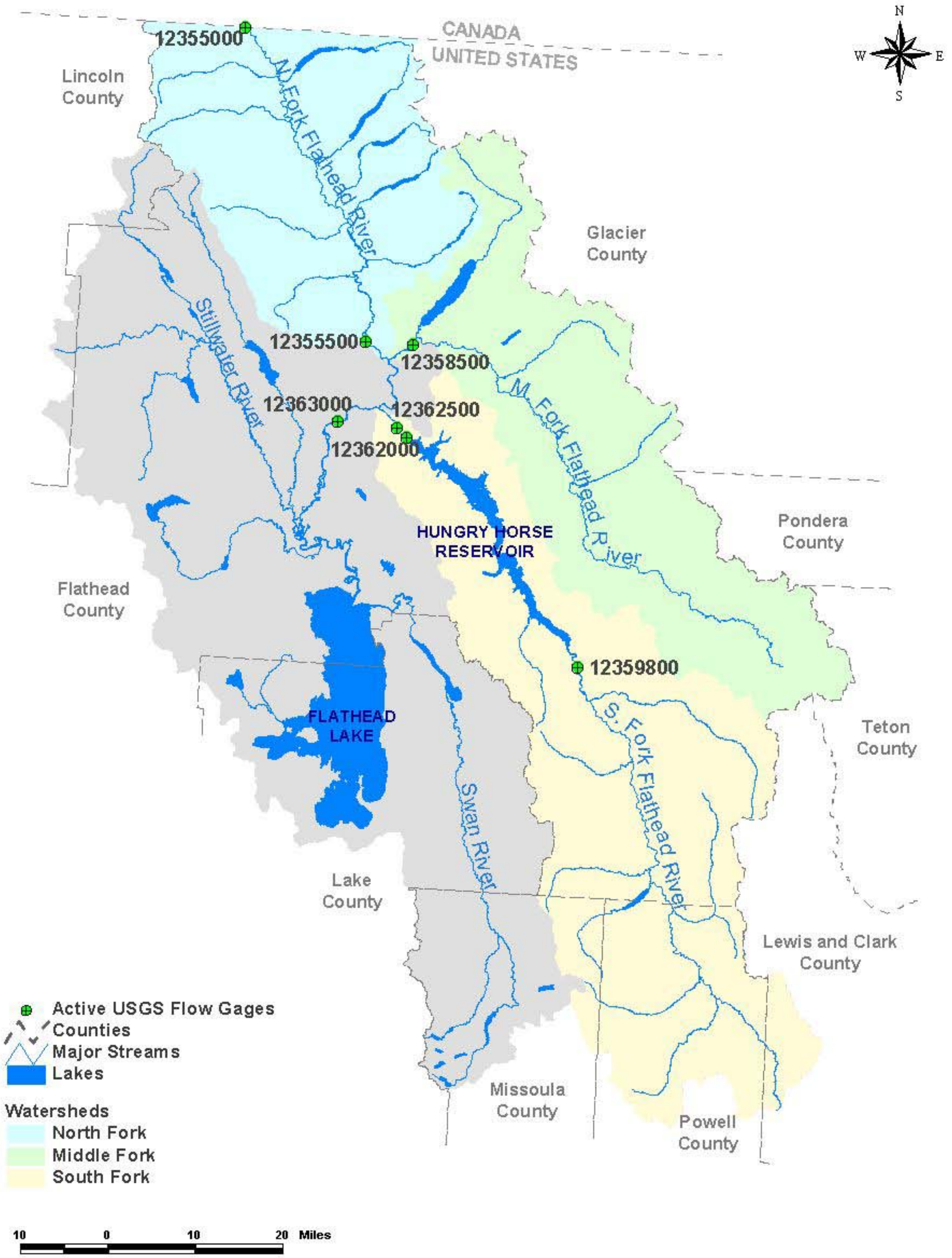


Figure 2-2. Active USGS flow monitoring stations within the FTPA.

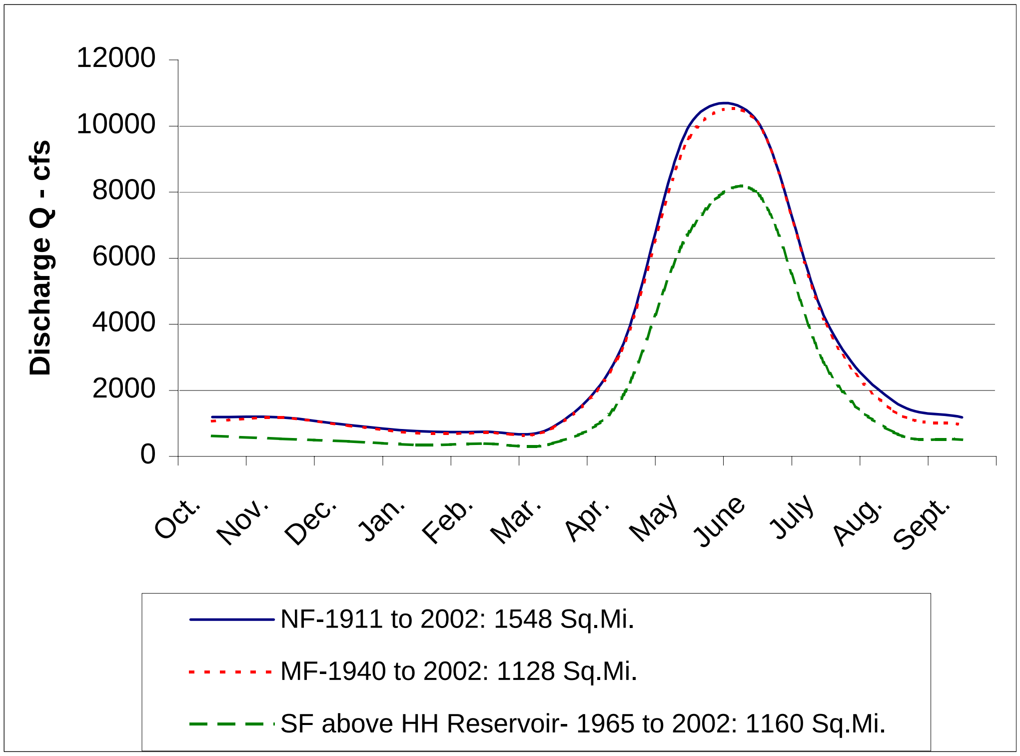


Figure 2-3. Historical average monthly flows at three USGS gaging stations on the Middle Fork, North Fork, and South Fork Flathead rivers.

Table 2-4. Summary Flow Characteristics of the 303(d)-Listed Streams

Drainage Name	FNF Station I.D.	Period of Record	Drainage Area (mi^2)	Main Stem Length (mi)	Average Gradient (%)	Average Sinuosity	Mean Annual "reported"[b] Q (cfs)	Peak "reported" Q (cfs)
Whale	FL7002 (lower)	1977 to 1994	64.1	21.3	26.1	1.02	261.2	1,189.0
Red Meadow	FL7003 (lower)	1978 to 1981	29.5	13.9	28.4	1.02	57.2	200.4
Upper Coal (N. Fork)	FL7009	1983 to 1995	23.4	9.0	36.3	1.01	110.4	494.0
South Fork Coal	FL7010	1983 to 1995	18.5	8.1	29.4	1.01	96.6	450.6
Lower Coal w/o Cyclone	FL7011	1983 to 1995	40.2	10.0	28.6	1.02	236.2	1,141.0
Granite (Challenge)[a]	FL6005	1987 to 1995	28.7	Confluence Challenge, Dodge to MF 8.2	25.5	1.02	16.4	129.6
Granite (Dodge)[a]	FL6012	1983 to 1995					8.8	60.0
Morrison	FL6006	1980	50.5	14.8	19.3	1.03	9.5	19.2
Skyland	FL6009	1980 to1993	8.3	5.5	19.5	1.02	16.5	80.2
Sullivan	FL4004	1978 to 1989	72.9	13.9	33.1	1.02	202.1	1,000.0

[a] The monitoring stations used for Granite are on the primary tributaries, Challenge and Dodge, which form Granite Creek at confluence. Granite Creek continues from the confluence south by southwest into the wilderness and on to the Middle Fork River.

[b] Discharge measurements were collected as "snapshots" during spring high flows and then sporadically throughout the water year; therefore, the average annual "reported" flows do not reflect actual channel capacity.

2.1.2.2 Stream Gradient

The valleys of the North and Middle forks in the FTPA flow through wide floodplains. Hungry Horse dam impounded the South Fork in 1949, flooding the lower valley reaches. Figure 2-4, Figure 2-5, and Figure 2-6 compare the gradients of the three major tributaries in the FTPA.

The average gradient for the Middle Fork is 16 to 20 feet per mile higher than the average gradients of the North and South Forks. The "headwaters" of the Middle Fork are the Continental Divide. The down-gradient direction is east to west, as opposed to the down-gradient directions of the North and South forks, which are north to south and south to north, respectively. The North and South forks parallel the Continental Divide, whereas the Middle Fork flows perpendicular to and from the Continental Divide.

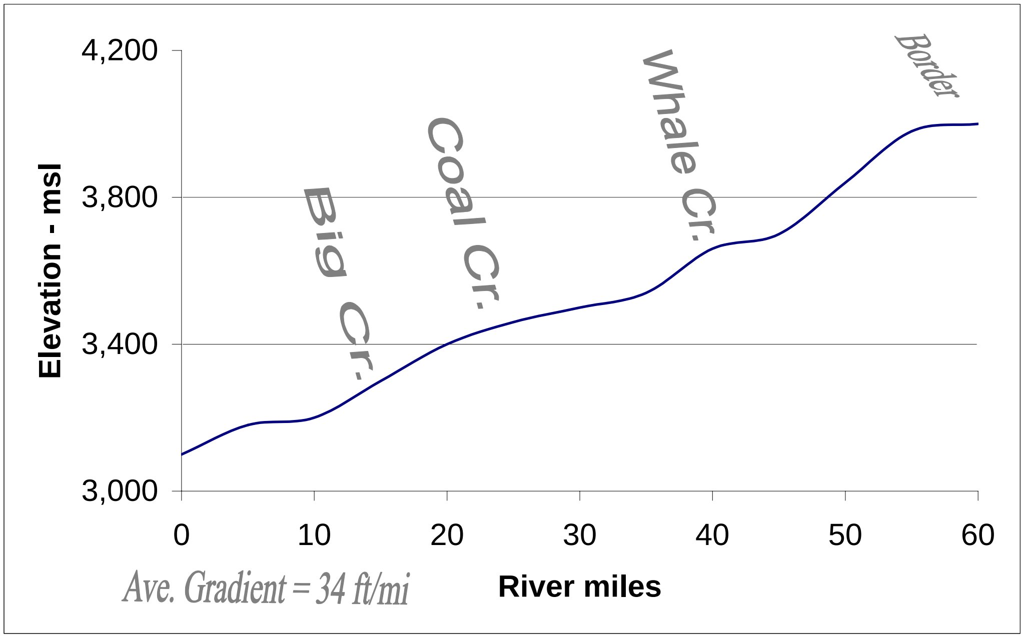


Figure 2-4. Profile of the North Fork Flathead River: International border to confluence with the Middle Fork Flathead River.

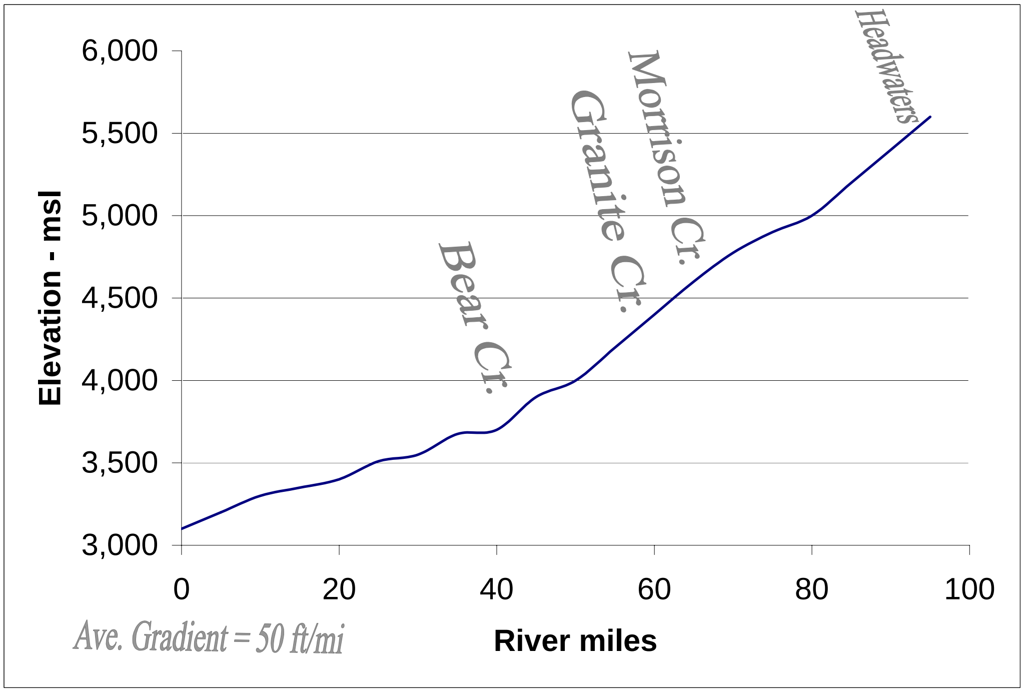


Figure 2-5. Profile of the Middle Fork Flathead River: Headwaters to confluence with the North Fork Flathead River.

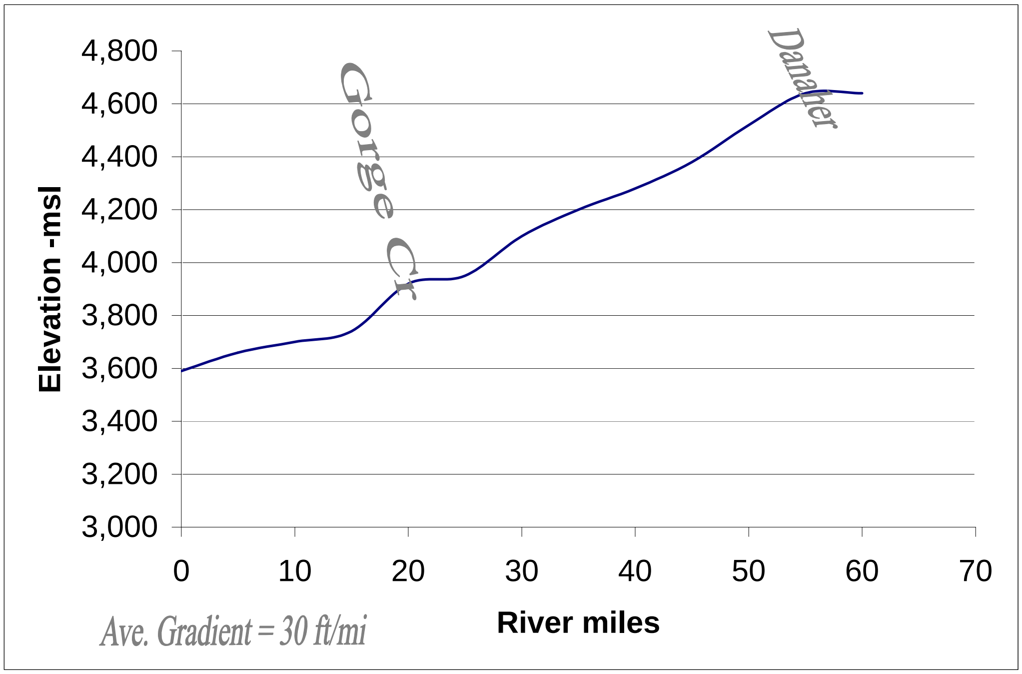


Figure 2-6. Profile of the South Fork Flathead River: Danaher to Hungry Horse Reservoir.

2.1.2.3 Significant Flood Events: 1964 and 1996

Extreme flood events can significantly alter the morphological characteristics of stream channels and can also affect the condition of the stream's floodplains and riparian corridors. In some cases, the resulting changes are evident many years after the events. Two such events have occurred in the FTPA, one in 1964 and one in 1996. Figure 2-7 illustrates these high-flow events as recorded by USGS in the three major rivers in the FTPA.

On June 7 and 8, 1964, the entire Flathead River watershed experienced rainfall varying from 3 to 16 inches over 40 hours. The rain fell on a deeper-than-normal snowpack, and the saturated snow and soil mantle provided the instrumental factors necessary to produce extreme runoff and flood conditions (Lundeen et al., 1964). The three forks of the Flathead each carried a record volume of runoff, although the South Fork River runoff was mitigated by significant storage capacity in Hungry Horse Reservoir. Lower valley areas were protected by Flathead Lake, which stored runoff from the North Fork, Middle Fork, and Swan rivers. All the main rivers were running at normal spring flow prior to the storm and were unable to carry all the surface runoff, producing flood flows in valley areas. Damages were most severe in the Middle Fork and South Fork areas, with lesser amounts along the North Fork and Swan rivers. Flathead Valley residents between Columbia Falls and Kalispell sustained extensive flood losses to crops, livestock, and homes. Resource damages to fisheries and watershed values along the main rivers and tributary streams occurred in the Flathead National Forest (FNF). Restoration of transportation facilities was the largest and most costly flood expense.

The Forest Service conducted surveys of flood damages immediately, dealing mainly with National Forest damages. The damages were classified into three types:

1. Loss of resources
2. Damage to developments
3. Loss or interruption of business

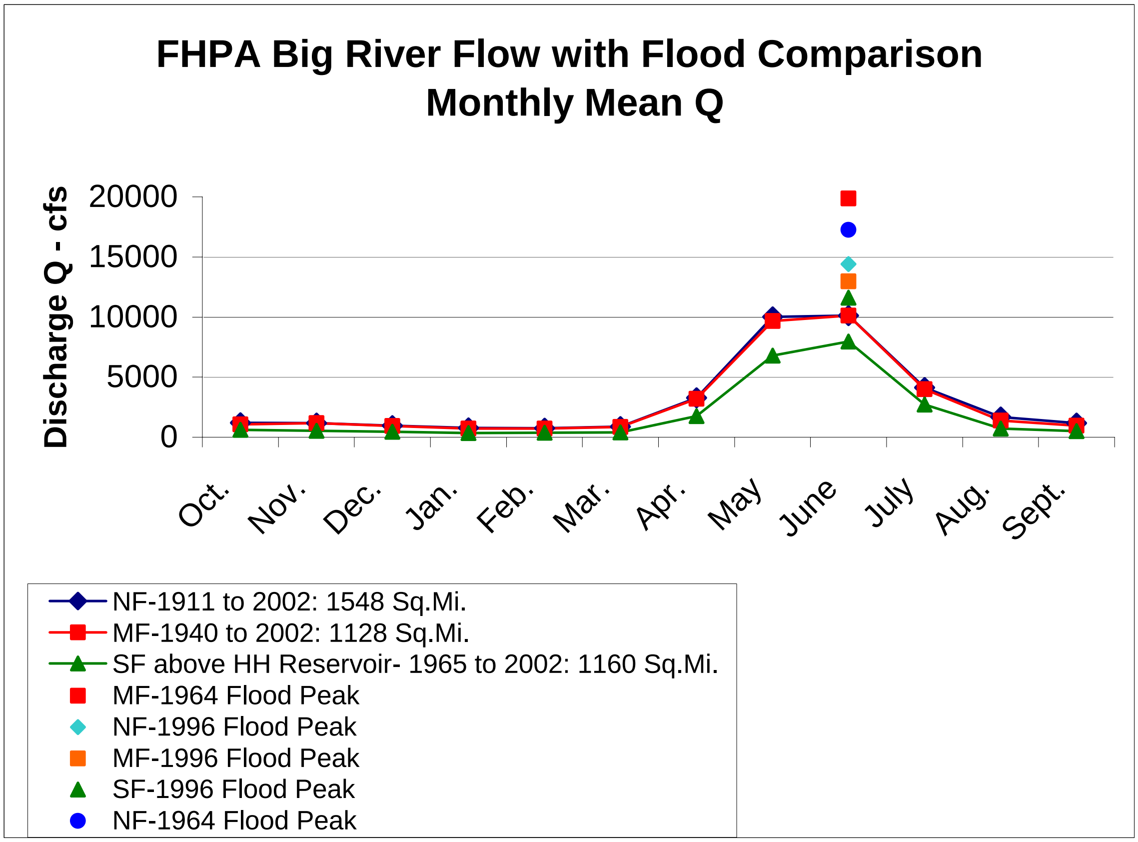


Figure 2-7. Mean monthly discharge in the North Fork, Middle Fork, and South Fork Flathead rivers compared to flood peaks in 1964 and 1996.

This summary addresses only the loss of resources that directly relate to watershed values, sedimentation, and fisheries habitat.

The FNF submitted a report to the Bureau of State Fisheries that summarized the flood damage to these forest resources. The damage to fisheries habitat was extensive on the east side of the FNF, particularly the Middle Fork. Above the mouth of Bear Creek, 45 miles of Middle Fork River bottom was scarred. Approximately 109 miles of tributary streams that contained spawning habitat were severely scarred. Skyland and Dickey creeks had washouts and slides that damaged roads. Marion Creek washed out the Essex Creek road. U.S. Highway 2 sustained major damage where it directly encroaches on the Middle Fork floodplain and was closed to all traffic for 2 months.

The South Fork River sustained severe flood damage to 60 miles of river bottom and approximately 104 miles of tributary streams, particularly in the Spotted Bear River, Upper and Lower Twin creeks, Blackbear Creek, and the White River. All the side drainage roads around Hungry Horse Reservoir required extensive maintenance after the storm and flood—culvert and ditch cleaning, debris removal, replacement of road surface material, and replacement of eroded fills. Bridges or approaches were washed out at Emery, Tiger, Margaret, Riverside, Murray, Deep, Logan, Dead Horse, Lower, and Upper Twin creeks.

The North Fork River scours every spring (Lundeen et al., 1964), but the flood damaged an additional 25 miles of tributary streams. The main North Fork road was washed out south of Big Creek where the river flows adjacent to the road. Bridge footings and approaches were washed out at Red Meadow, Whale, and Moose creeks. The Whale Creek road washed out for 500 feet at Ninko Creek, and the Whale Buttes bridge was damaged. The bridge was washed out on Coal Creek. On Big Creek, the Hallowat bridge washed out, the approaches and wingwalls were damaged at the Skookoleel bridge, and the Canyon Creek cutover was washed out.

The high floodwater velocity and force carried maximum sediment as a result of bank sluffing and undercutting, scouring old channels down to bedrock, and cutting new channels.

The flood event in 1996 resulted from a weather pattern similar to that which precipitated the 1964 flood event. A larger-than-normal snowpack was inundated by an early rainstorm that generated more runoff than channel capacity. Again, Hungry Horse Reservoir and Flathead Lake served as storage and prevented major damages.

2.1.3 Stream Types

The stream channels and valley bottoms in the FTPA represent the entire range of variability, from narrow V-shaped valleys with bedrock waterfalls to broad, flat valley bottoms with meandering streams in unconfined valleys. Valley forms and stream shape result in different sediment transport and deposition patterns. In uppermost reaches, the capacity to transport sediments exceeds sediment supply, so erosion is more common than deposition. In stream reaches that flatten and begin to meander, the capacity to transport sediments typically balances the amount of available sediments. A small change in water volume determines the occurrence of erosion or deposition. As stream gradients continue to flatten downstream, deposition is dominant over erosion, except when high peak flows occur to erode upper channel banks and transport the sediment downstream.

The Rosgen Stream Classification System (Rosgen, 1988) provides a method for categorizing streams according to their morphological characteristics. Morphological characteristics include factors such as channel gradient, sinuosity, width/depth ratio, dominant particle size of bed and bank materials, channel entrenchment, and channel confinement. A Rosgen Stream Type Classification (level 1) was developed for the FNF in 1999 using digital elevation models (DEMs). The computer models reliably identify only A, B, C, and E stream types. Rosgen stream types for the subject streams are listed in Table 2-5. Stream classification maps for each of the subject watersheds are presented in Figure 2-8, Figure 2-9, and, Figure 2-10.

Table 2-5. Rosgen Stream Classifications for the Flathead River Headwaters TMDL Planning Area

Watershed	Drainage Name	Drainage Area (mi^2)	Total Stream (mi)	Stream Density (mi/ mi^2)	Stream Type	Miles per Stream Type	Percent total stream miles
North Fork Flathead River	Red Meadow Creek	29.5	64.3	2.18	A	57.4	89.3
					B	2.30	3.58
					C	4.30	6.69
					E	0.20	0.31
	Whale Creek	64.1	109.7	1.71	A	96.2	87.7
					B	5.50	5.01
					C	6.80	6.19
					E	1.20	1.09
	South Fork Coal Creek	18.5	28.0	1.51	A	25.0	89.3
					B	1.50	5.37
					C	1.49	5.33
					E	0.00	0.00
	Upper Coal Creek (NF)	23.4	44.3	1.89	A	40.6	91.6
					B	1.39	3.14
					C	2.40	5.42
					E	0.00	0.00
	Lower Coal Creek w/o Cyclone	40.2	56.9	1.42	A	47.6	83.7
					B	5.90	10.4
					C	3.10	5.45
					E	0.40	0.70
Middle Fork Flathead River	Granite Creek	28.7	57.1	1.99	A	41.6	72.9
					B	5.3	9.2
					C	7.7	13.4
					E	2.6	4.5
	Skyland Creek	8.3	18.3	2.20	A	15.2	83.1
					B	1.9	10.3
					C	1.2	6.6
					E	0	0
	Morrison Creek	50.5	77.4	1.53	A	64.7	83.6
					B	8.5	11.0
					C	3.8	4.9
					E	0.4	0.5
South Fork Flathead River	Sullivan Creek	72.9	142.8	1.96	A	129.8	90.9
					B	5.6	3.9
					C	7.1	4.9
					E	0.2	0.3

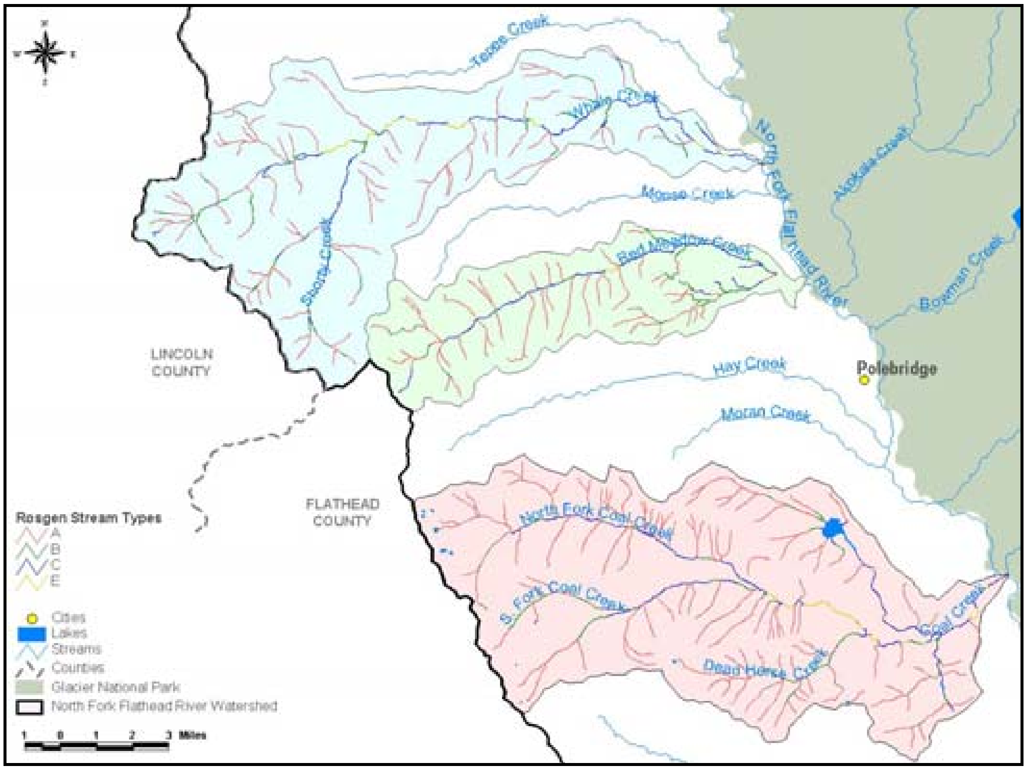


Figure 2-8. Rosgen stream types for selected watersheds in the North Fork Flathead River basin.

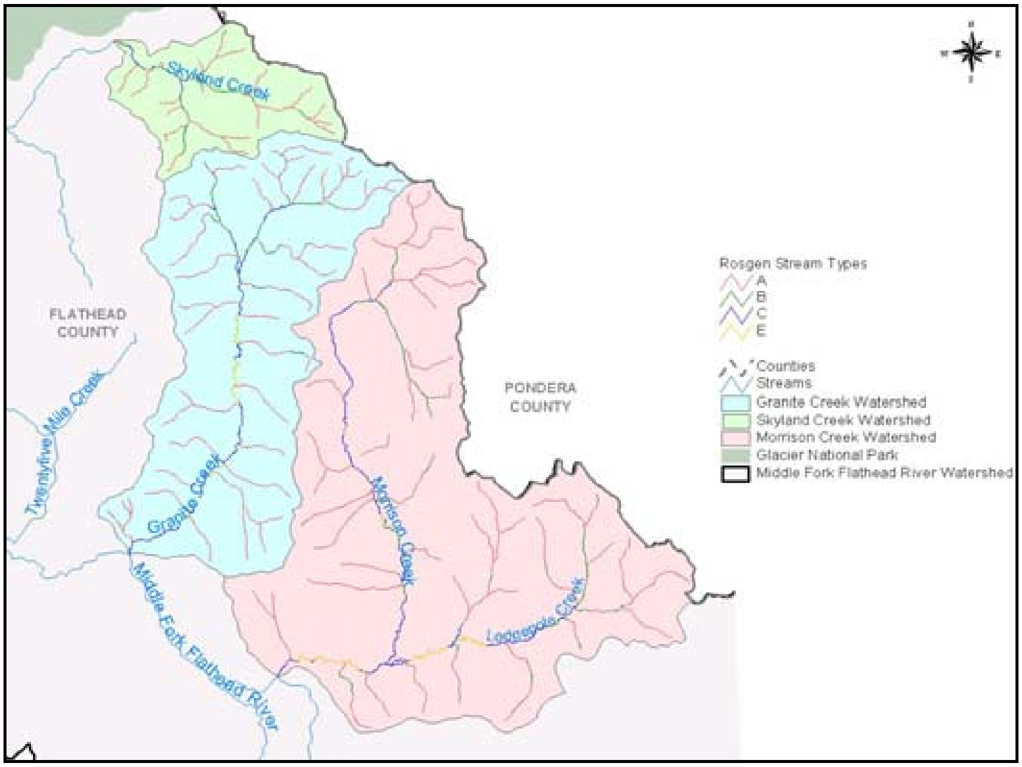


Figure 2-9. Rosgen stream types for selected watersheds in the Middle Fork Flathead River basin.

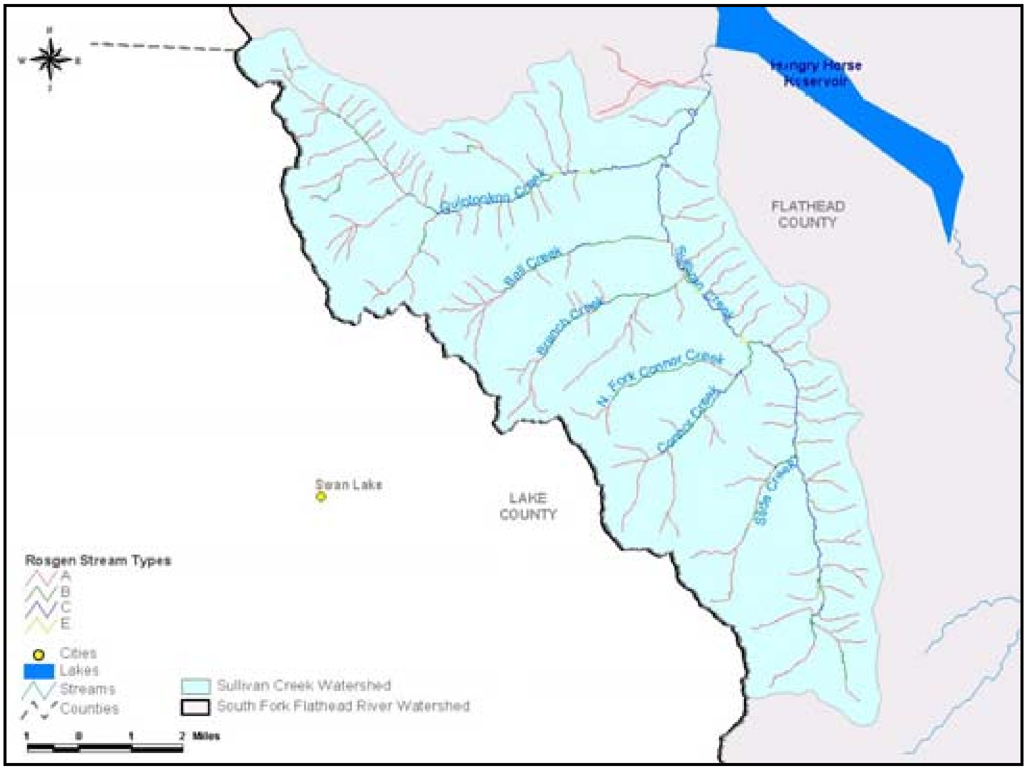


Figure 2-10. Rosgen stream types for selected watersheds in the South Fork Flathead River basin.

2.1.4 Topography

The FTPA is within the Northern Rocky Mountain Physiographic Province. There are five major mountain ranges and intervening narrow valleys. The mountain ranges are the Whitefish, Salish, Mission, Flathead, and Swan ranges. Elevations in the FTPA range from over 10,000 feet mean sea level (MSL) at some of the high mountain peaks to a low of approximately 3,000 feet MSL near the confluence of the three forks with the main stem of the Flathead River (Figure 2-11).

Figure 2-11. Shaded relief of the FTPA.

2.1.5 Geology

Surface geology in the North Fork Flathead River watersheds (Red Meadow Creek, Whale Creek, Coal Creek) is composed mostly of slightly metamorphosed sedimentary rocks (Belt supergroup) and associated tills (Smith, 2002) (Figure 2-12). These formations are relatively old, mostly Precambrian in age (Proterozoic era, 450–2,500 million years old). Pleistocene-aged glacial tills (1.8 million to 11,000 years old) from the last major glaciation fill the valleys. The Belt group consists mostly of alternating argillite and siltite beds with some quartzite (Harrison et al., 2000). These rocks are all slightly metamorphosed and therefore relatively hard (especially quartzite) and resistant to erosion. Dolomites and limestones are also common in the Belt group. Rocks generally weather to form silty soils that are neutral to slightly alkaline. Moving north in the North Fork watershed, sandstones and shales become more prevalent and make up the majority of the lower (downstream) Red Meadow Creek watershed. These rocks are not metamorphosed, and they are less resistant to weathering than the Belt group rocks. Whale Creek watershed is similar to Red Meadow Creek watershed, but also has a large percentage of older glacial and alluvial outwash near the mouth. Coal Creek is made up almost entirely of the Belt group rocks.

Geology in the Middle Fork Flathead River watershed is similar to that of the North Fork watershed. It is dominated by Belt group rocks, with some sandstones and shales in the southeastern portion of the watershed (Figure 2-13). Granite Creek and Skyland Creek watersheds are similar to other watersheds and are composed mostly of the older Belt group rocks. Morrison Creek watershed is dominated by the younger shales and sandstones.

The Sullivan Creek watershed, in the South Fork Flathead River watershed, has a geology that is similar to the North Fork watersheds and is composed mostly of slightly metamorphosed sedimentary rocks (Figure 2-14).

The effects of geology on watershed and sediment processes are discussed in more detail in Sections 2.1.6 (Landform Groups) and 2.1.8 (Soils).

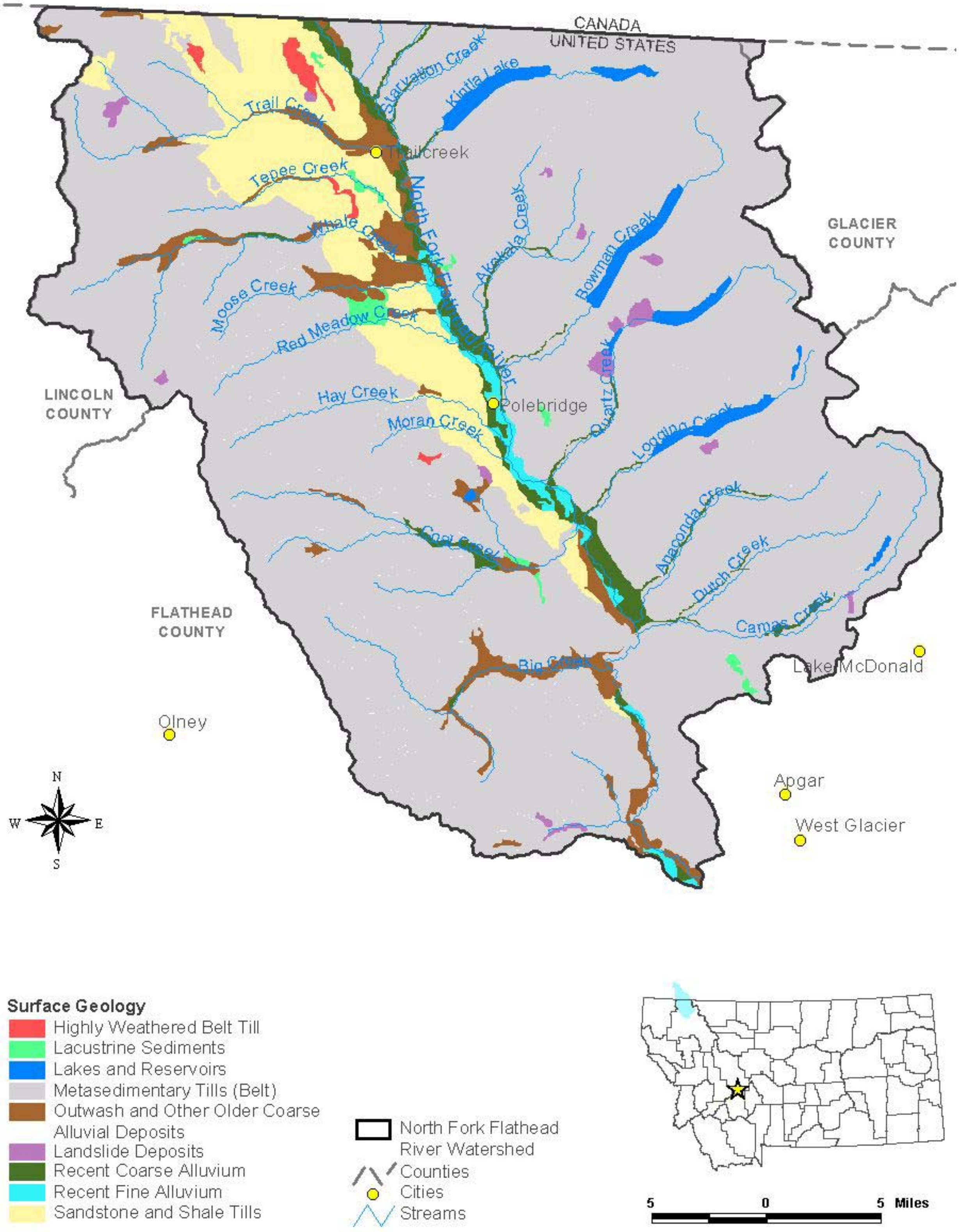


Figure 2-12. General geology of the North Fork Flathead River watershed.

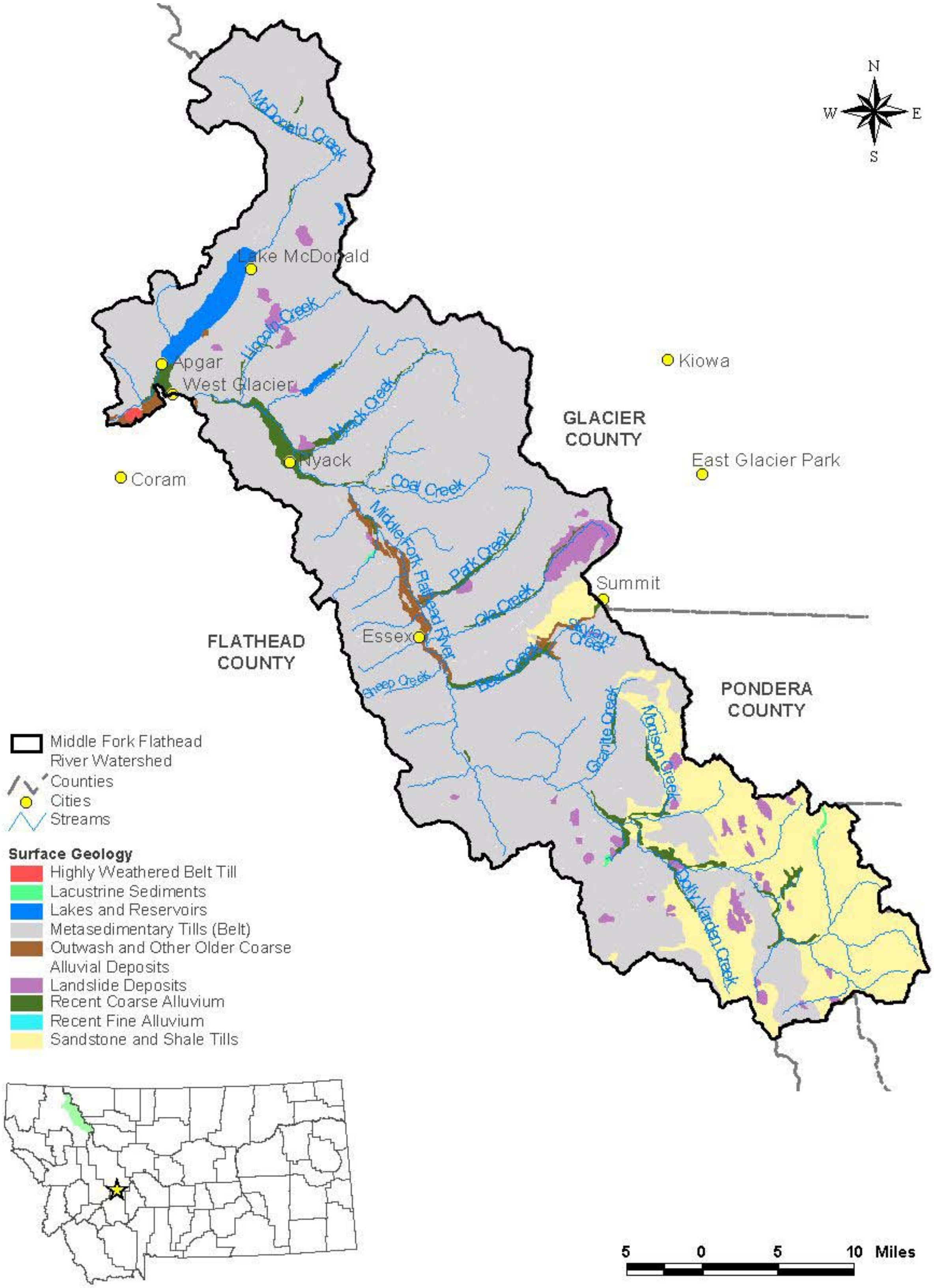


Figure 2-13. General geology of the Middle Fork Flathead River watershed.

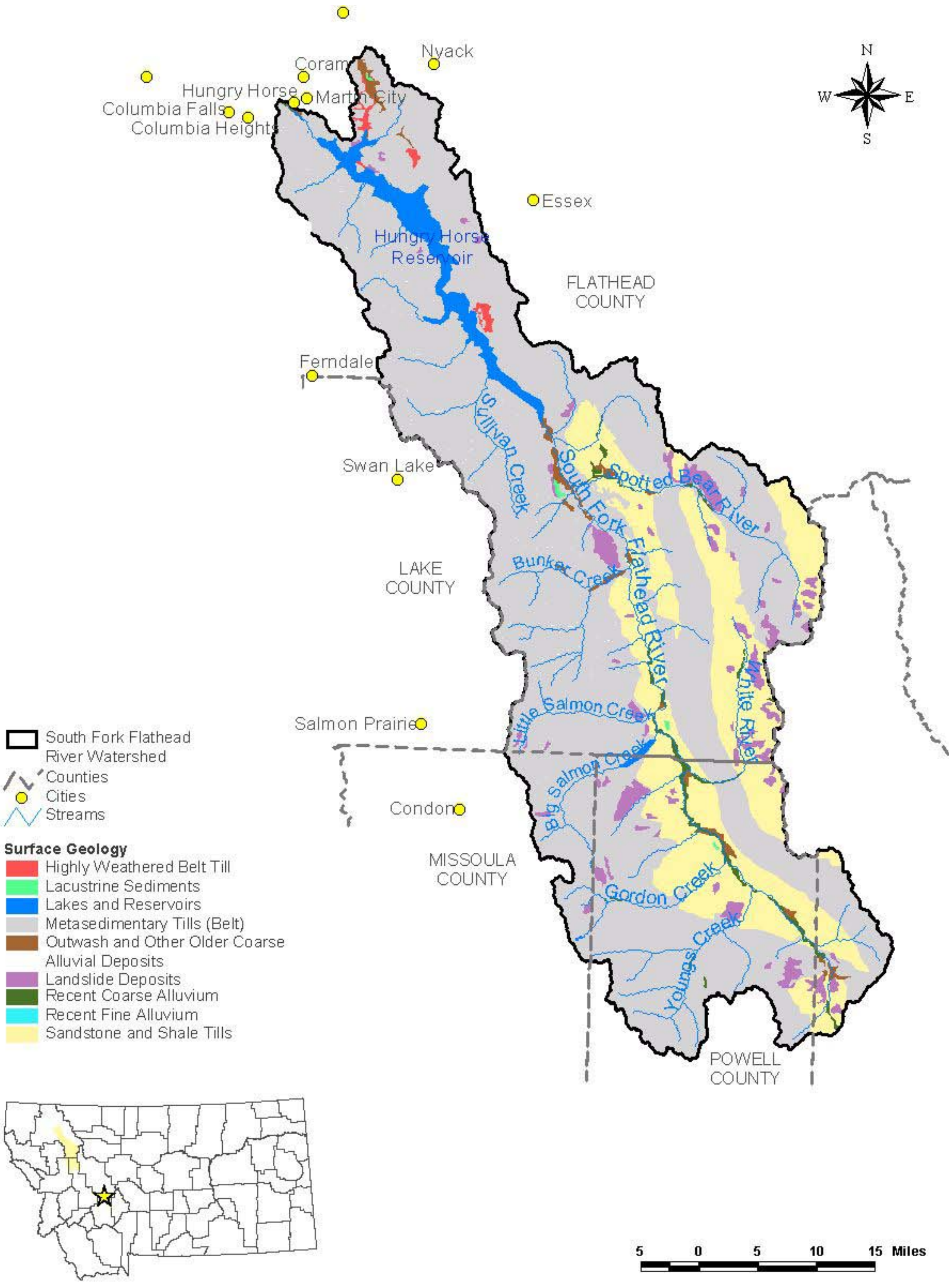


Figure 2-14. General geology of the South Fork Flathead River watershed.

2.1.6 Landform Groups

Landform and vegetation are the dominant physical features that affect watershed functions and processes. Landforms regulate how and where water flows across the landscape. Ford et al. (1997) described seven landform groups in the 303(d) listed watersheds in the FTPA: Valley Bottoms, Breaklands, Steep Alpine Glaciated Land, Glaciated Mountain Slopes, Mountain Slopes and Ridges, Mass Wasted and Colluvial Deposits, and Frost Shattered Mountain Ridges. Table 2-6 summarizes the landform groups for each watershed, and the groups are also shown in Figures 2-15 through 2-17. A description of each landform group is provided in Appendix A.

Table 2-6. Landform Groups in the Flathead River Headwaters TMDL Planning Area

Watershed	Watershed Name	Area	Valley Bottoms (VA)	Breaklands (BK)	Steep Alpine Glaciated (STGLM)	Glaciated Mount. slopes (GLMS)	Mountain Slopes Ridges (MSRI)	Mass Wasted Slopes (MWSL)	Frost Shattered Mountain Ridges (FSMR)
North Fork Flathead River	Red Meadow Creek	Acres	861	2,272	10,565	4,334	871	0	0
		%	4.6	12	55.9	22.9	4.6	0	0
	Whale Creek	Acres	3,450	3,595	27,027	6,119	653	148	0
		%	8.4	8.8	65.9	14.9	1.6	0.4	0
	South Fork Coal Creek	Acres	205	1,315	8,539	1,513	284	0	0
		%	1.7	11.1	72	12.8	2.4	0	0
	North Fork Coal Creek	Acres	353	1,902	11,223	1,176	293	0	0
		%	2.4	12.7	75.1	7.9	2	0	0
	Coal Creek, Lower	Acres	2,224	6,078	9,280	5,398	2,602	0	0
		%	8.6	23.6	36.1	21	10.1	0	0
Middle Fork Flathead River	Granite Creek	Acres	355	1,367	12,298	2,931	1,362	0	0
		%	1.9	7.5	67.2	16	7.4	0	0
	Skyland Creek	Acres	814	842	15,747	2,632	4,619	125	0
		%	3.3	3.4	63.6	10.6	18.6	0.5	0
	Morrison Creek	Acres	958	2,820	20,539	4,652	1,641	786	655
		%	3	8.8	64.1	14.5	5.1	2.5	2
South Fork Flathead River	South Fork Flathead River below HH dam	Acres	440	1,926	5,356	1,219	1,169	0	0
		%	4.3	18.6	51.8	11.8	11.3	0	0
	Sullivan Creek	Acres	0	9,935	27,265	5,961	3,491	0	0
		%	0	21.3	58.4	12.8	7.5	0	0

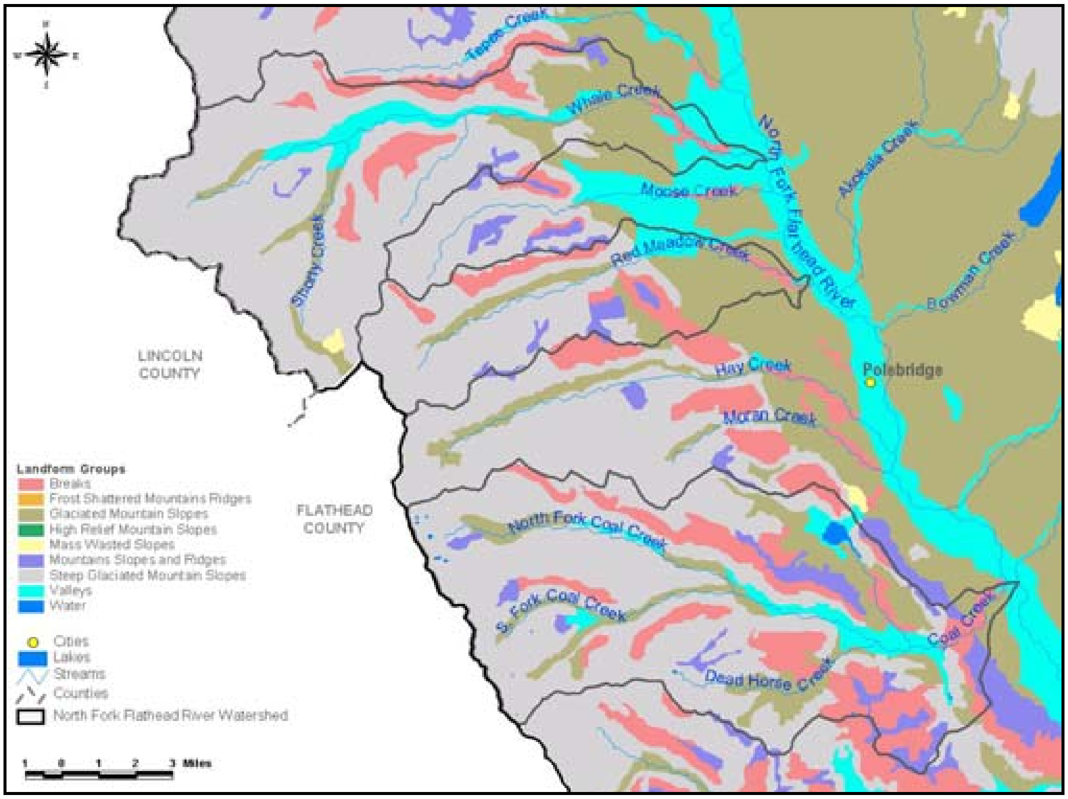


Figure 2-15. Landform groups for selected watersheds in the North Fork Flathead River basin.

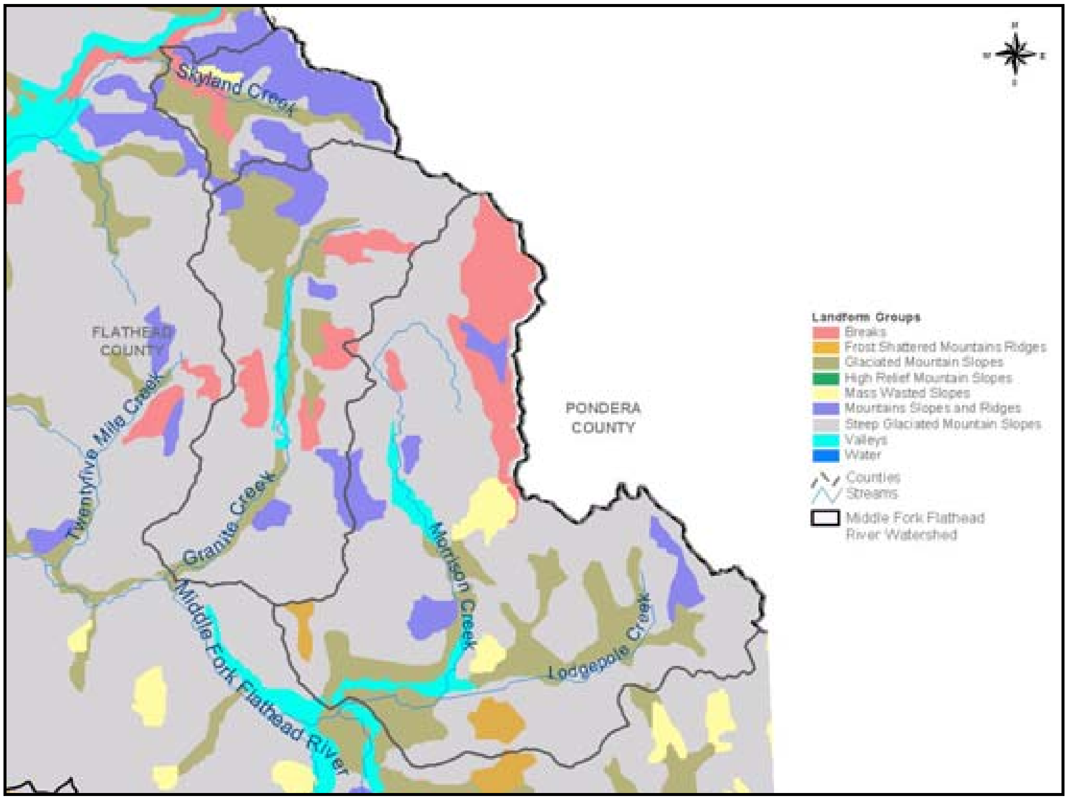


Figure 2-16. Landform groups for selected watersheds in the Middle Fork Flathead River basin.

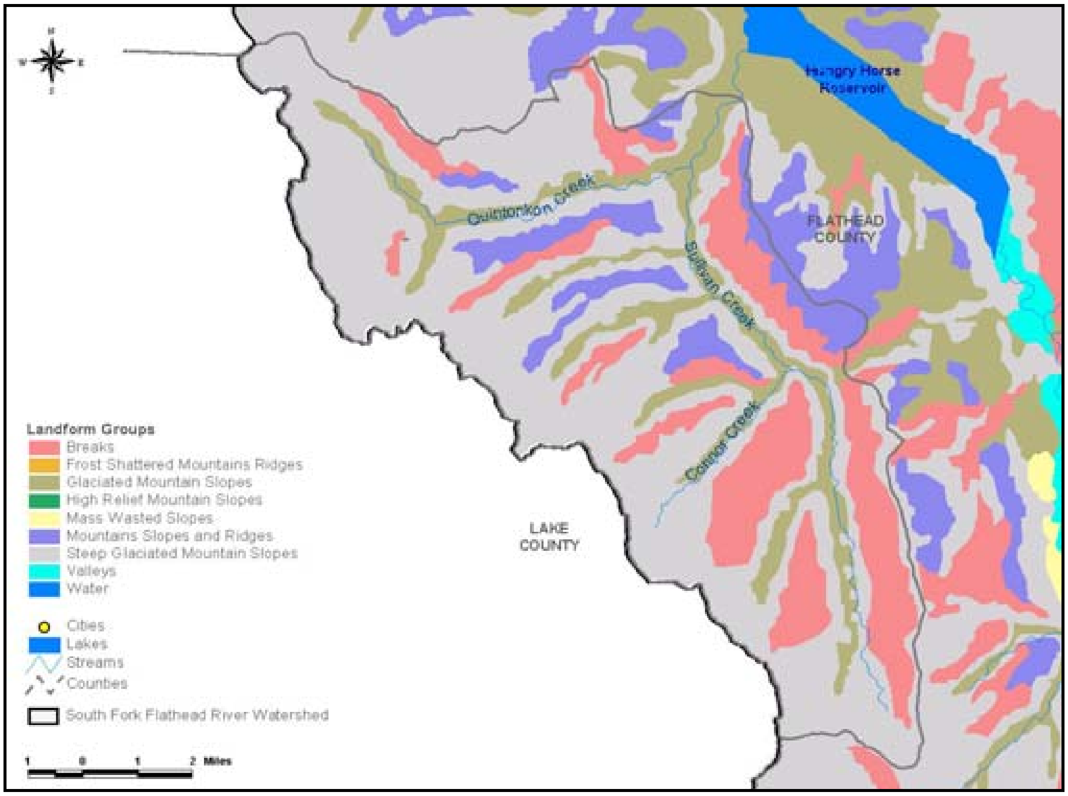


Figure 2-17. Landform groups for selected watersheds in the South Fork Flathead River basin.

2.1.7 Land Use and Land Cover

Land use and land cover for each of the three watersheds in the FTPA is summarized in Table 2-7 and shown in Figure 2-18. The land cover in the FTPA is predominately forested with intermittent grasslands and shrub complexes naturally formed by wildfire or by various configurations due to timber management. Less than 1 percent of the total FTPA is composed of developed lands (residential or commercial) or agricultural lands (e.g., row crops, pasture hay).

Table 2-7. Land Use/Land Cover in the FTPA (Source: USGS National Land Cover Dataset based on 1992 Landsat Thematic Mapper Imagery)

Cover Type	% of Watershed		
	North Fork	Middle Fork	South Fork
Open Water	1.77	1.61	2.26
Perennial Ice/Snow	0.19	0.13	0.05
Low Intensity Residential	0	0	0.01
High Intensity Residential	0	0	0
Commercial/Industrial	0.04	0.12	0.01
Bare Rock/Sand/Clay	4.33	5.44	3.23
Quarries/Strip Mines/Gravel	0	0	0
Transitional	0.84	0	0.19
Deciduous Forest	0.38	0.51	0.12
Evergreen Forest	75.89	75.62	80.06
Mixed Forest	0.01	0.07	0.1
Shrubland	9.79	9.45	6.28
Orchards/Vineyards/Others	0	0	0
Grassland/Herbaceous	6.03	6.65	7.6
Pasture/Hay	0.2	0.07	0
Row Crops	0	0	0
Small Grains	0	0	0
Fallow	0	0	0
Urban/Recreational Grasses	0	0	0
Woody Wetlands	0.42	0.31	0.1
Emergent Herb. Wetlands	0.1	0.02	0

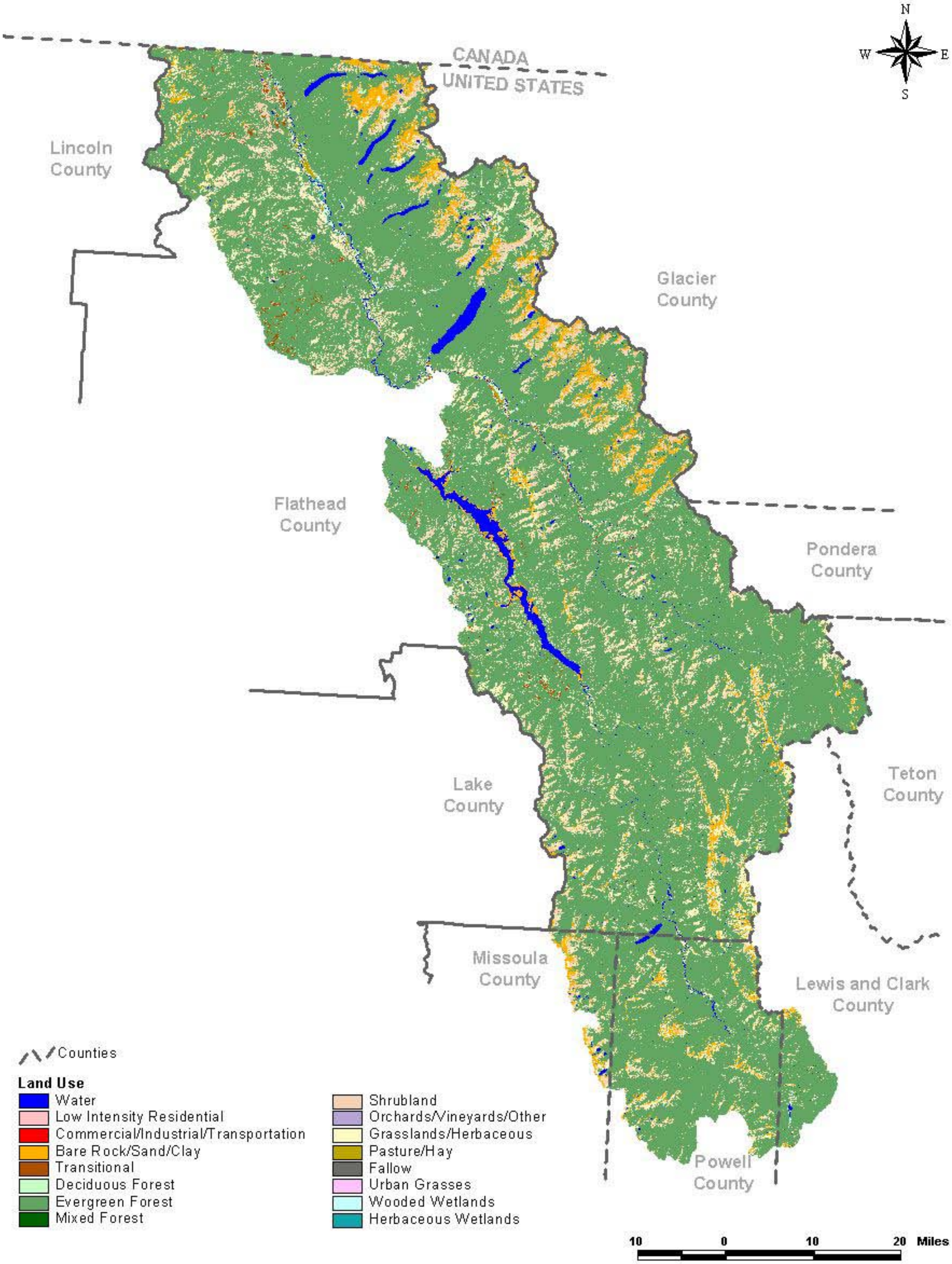


Figure 2-18. Land use/land cover in the FTPA.

2.1.8 Soils

2.1.8.1 Soil Map Units

Soils data and geographic information system (GIS) coverages from the Natural Resources Conservation Service (NRCS) were used to characterize soils in the FTPA. General soils data and map unit delineation for the United States are provided as part of the State Soil Geographic (STATSGO) database. The STATSGO data set was created to provide a general understanding of soils data to be used with large-scale analyses; small, site-specific analyses with STATSGO data are not appropriate. GIS coverages provide accurate locations for the soil map units at a scale of 1:250,000 (USDA, 1995). A map unit is composed of several soil series having similar properties. Identification fields in the GIS coverages can be linked to a database that provides information on chemical and physical soil characteristics. Figure 2-19 shows the general map unit boundaries in the FTPA, and the following sections summarize relevant physical soil data.

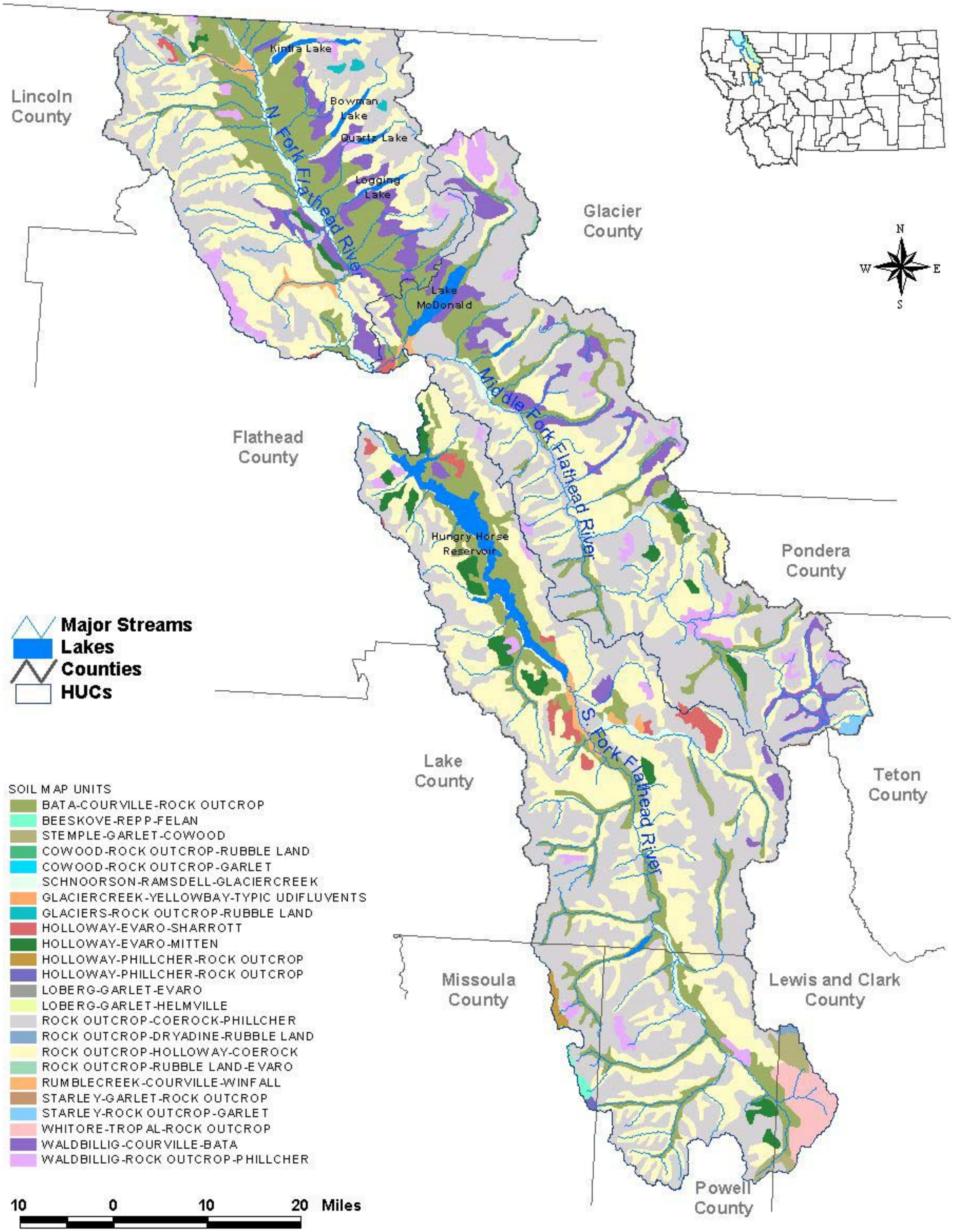


Figure 2-19. Major soil units in the FTPA.

2.1.8.2 Sediment Hazard Ranking

Erosion occurs infrequently on undisturbed forest soils in the FTPA because organic matter blankets the soil surface, reducing the impacts of precipitation and allowing water to gradually infiltrate into underlying soils. Below the organic layer, lower soil layers are high in organic matter, loose, porous, and water moves quickly through and into the root zone of vegetation. However, when management activities remove the protective organic layer over the soil or when surface soil layers are compacted, soil erosion occurs. The FNF developed the Sediment Hazard Ranking in an effort to evaluate the potential risk associated with delivery of eroded sediment from a given site to water associated with management activities. The Sediment Hazard ranking is based on a given site's erosion hazard and sediment delivery efficiency.

Erosion hazard ratings (slight, moderate, or severe) describe the relative susceptibility of exposed soil to erosion and are based on direct observation of erosion and soil properties. Sediment delivery efficiency (low, moderate, or high) rates the relative probability of eroded soil reaching a stream channel. The properties of landforms are the basis for the sediment delivery efficiency rating and are determined by observation and type of landform, slope, and distance between drainages.

A low ranking of sediment hazard indicates slight erosion hazard and low or moderate sediment delivery efficiency. A slight erosion rating is assigned to soil layers with loamy textures and either 35 percent to 85 percent content of angular rock fragments or 60 percent to 85 percent content of rounded rock fragments. Soils with parent geologic material of meta-sedimentary rocks have slight erosion hazard. Mountain ridges, moraines, kames, terraces or landslide deposits, alluvial fans, cirque headwalls, cirque basins, mid and upper portions of both mountain slopes and glaciated mountain slopes, and upper portions of trough walls are rated as low sediment delivery efficiency. Slopes are 10 percent to greater than 60 percent, and most eroded soil is deposited before reaching a drainage channel. Less than 10 percent of these landforms are close enough to drainage channels for eroded soil to enter a stream. A moderate sediment delivery efficiency rating is given to mid and upper trough walls, mid and lower portions of rolling and hilly glaciated mountain lobes, lower portions of mountain slope, and moraines. Slopes range from 10 percent to 60 percent. Streams have dendritic or parallel drainage patterns and are widely spaced. Approximately 10 percent to 40 percent of these landforms are close enough to a drainage channel for eroded soil to enter the stream channel.

A moderate ranking of sediment hazard indicates moderate erosion hazard and low to moderate sediment delivery efficiency or slight erosion hazard and high sediment delivery efficiency. Moderate erosion hazard is assigned to soils with loamy texture and either 15 percent to 35 percent content angular rock fragments or 15 percent to 60 percent content rounded rock fragments. Soil types formed in loess-influenced volcanic ash or in glacial till have moderate erosion hazard ratings. High sediment delivery efficiency is ranked for dissected mountain slopes, stream breaklands, stream bottoms, the lower portion of steep, glaciated mountain slopes, or themed and lower portions of trough walls. The dissected mountain slopes, stream breaklands, and lower portions of trough walls have slopes of 60 percent to 90 percent and eroded soil can travel a relatively long distance into drainage channels. The stream bottom landform is parallel to large streams, and soil erosion is close enough to the water body to become a sediment hazard. Approximately 10 percent to 100 percent of these landforms are close enough to a drainage channel for eroded soil to become sediment.

A high ranking of sediment hazard indicates moderate erosion hazard and a high sediment delivery efficiency OR a severe erosion hazard and a low, moderate, or high sediment delivery efficiency. Severe erosion hazard is assigned to soils with sandy textures or a loamy or clayey texture and less than 15 percent rock fragments, angular or rounded. Soils formed in lacustrine deposits, in sandy glacial outwash, or from material weathered out of granitic rocks have severe erosion hazard ratings.

Sediment hazard rankings are summarized in Table 2-8 and shown in Figure 2-20, Figure 2-21, and Figure 2-22.

Table 2-8. Summary of Sediment Hazard

Watershed	Drainage Name		High Sediment Hazard	Moderate Sediment Hazard	Low Sediment Hazard
North Fork Flathead River	Red Meadow	Acres	9,589	1,674	7,640
		%	51	9	40
	Whale Creek	Acres	211,435	3,952	15,590
		%	52	10	38
	South Fork Coal Creek	Acres	6,493	907	4,456
		%	55	8	38
	North Fork Coal Creek	Acres	8,142	363	6,441
		%	55	2	43
	Coal Creek Main Stem	Acres	13,230	3,989	8,496
		%	52	16	33
Middle Fork Flathead River	Granite Creek	Acres	7,342	2,778	8,213
		%	40	15	45
	Skyland Creek	Acres	1,833	743	2,753
		%	34	14	52
	Morrison Creek	Acres	13,355	7,019	11,936
		%	41	22	37
South Fork Flathead River	Sullivan Creek	Acres	27,980	2,170	16,502
		%	60	5	35

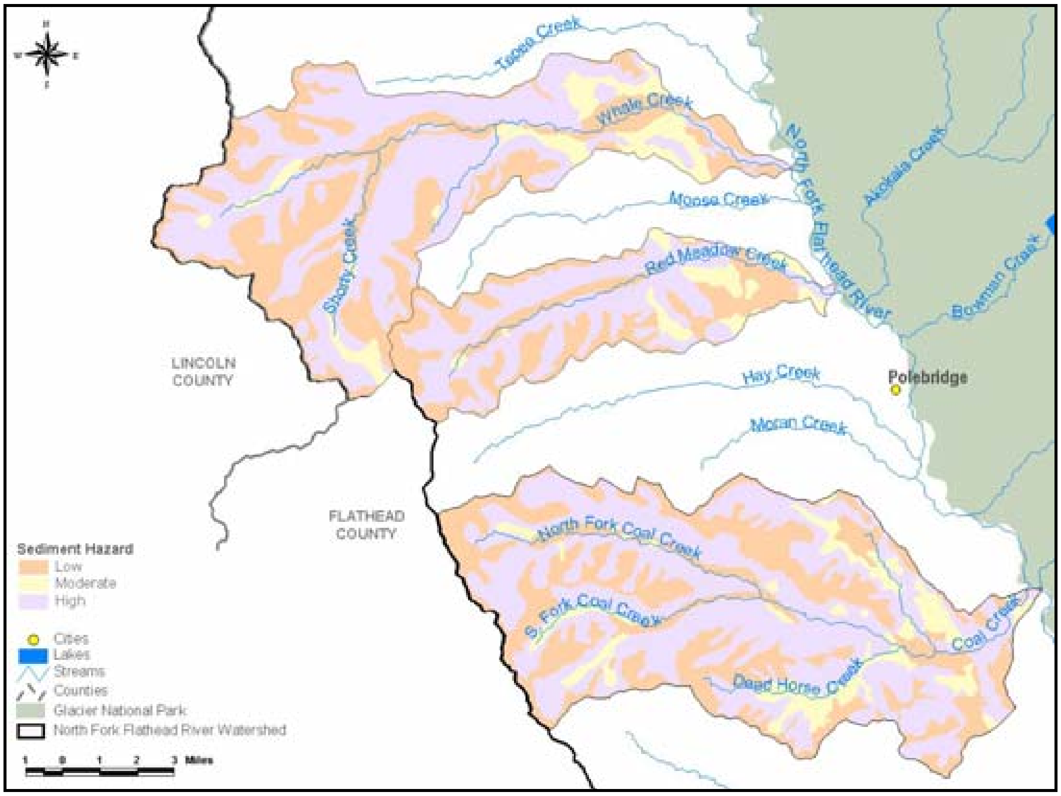


Figure 2-20. Sediment hazard ratings for selected watersheds in the North Fork Flathead River basin.

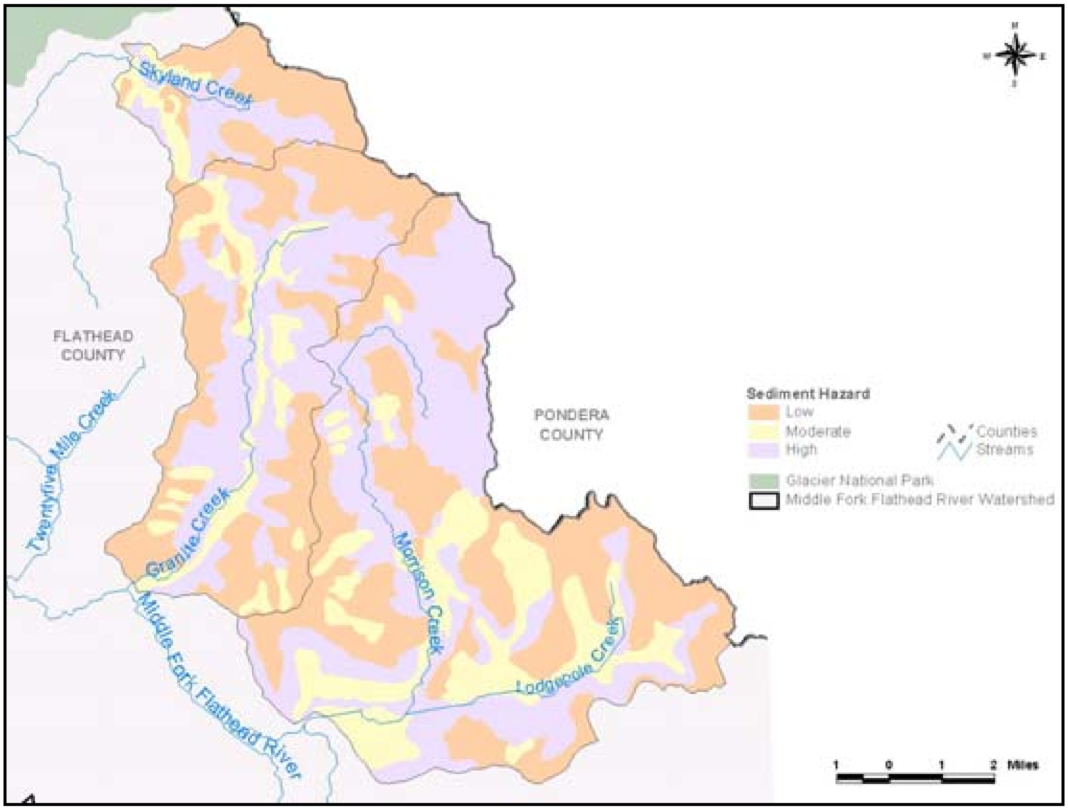


Figure 2-21. Sediment hazard ratings for selected watersheds in the Middle Fork Flathead River basin.

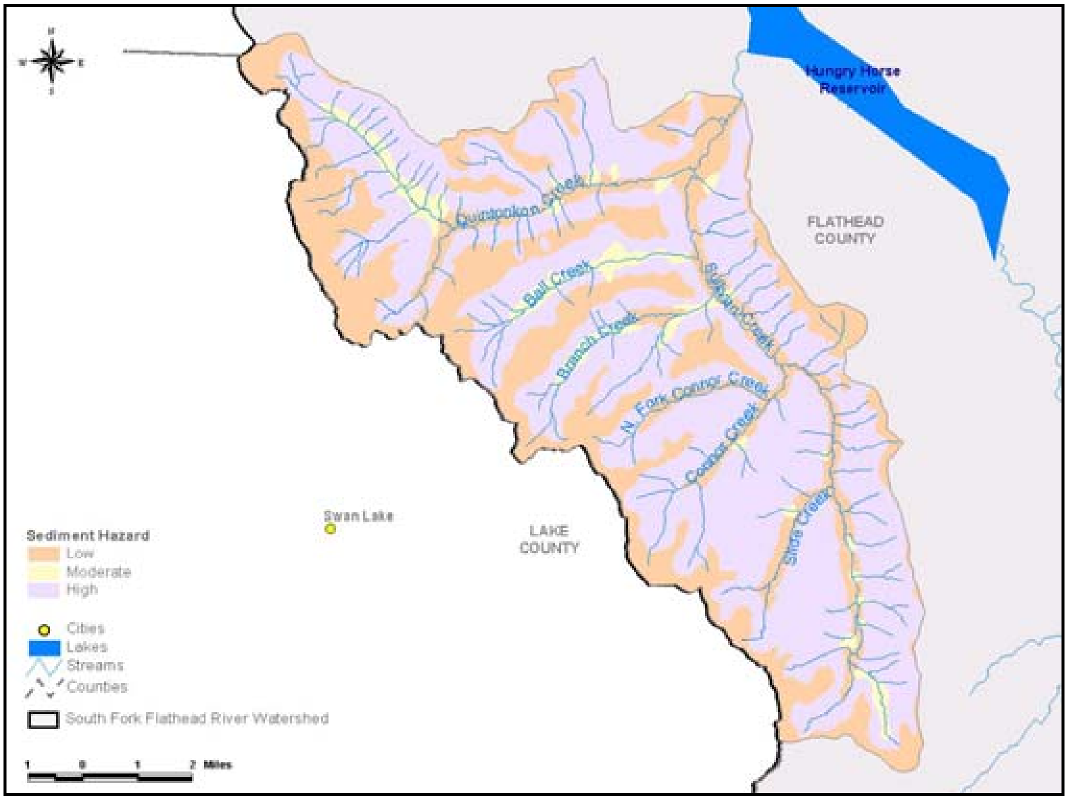


Figure 2-22. Sediment hazard ratings for selected watersheds in the South Fork Flathead River basin.

2.1.9 Forest Harvest History

Studies from throughout the United States have generally shown that forest harvesting on small watersheds increases the amount of annual streamflow, or annual water yield. For a given watershed, the amount of increase is generally proportional to the area of the watershed that is clear-cut. Thinnings and partial cuts are generally ineffective at changing annual water yields (Beschta and Platts, 1986). Typically the maximum water yield increase immediately follows harvest. Water yield increases will decline over time as regenerating trees and other vegetation reoccupy the site. For altered streamflow characteristics to return to pre-logging levels, more than 20 years might be required. Forest harvest activities have also been shown to directly increase erosion.

It should be noted that the relationship between harvest and water quality impacts is complex. Increased harvest intensity does not necessarily correlate with degraded water quality. Consideration of elevation, aspect, stand age, and hydrologic response is necessary to fully understand the potential for water quality impact associated with harvest. Nonetheless, there is sufficient information in the literature to indicate that forest harvest might affect water quality.

Data regarding “clear-cut” harvest trends in the FTPA were evaluated between 1960 and September 2003. Clear-cuts, as defined herein, include any areas in which FNF records exist for the following harvest activities: clearcut with reserves, group selection cuts, seed tree final cuts, seed tree final cuts with reserves, seed tree cuts, seed tree cuts with reserves, shelterwood final cuts, shelterwood final cuts with reserves, shelterwood removal cuts, shelterwood seed cuts, shelterwood seed cuts with reserves, single tree selection cuts, and stand clear-cut. Clear-cut harvests since 1960 are shown in Figure 2-23, Figure 2-24, and Figure 2-25 and are grouped as “intensive harvests.” Nonintensive harvests are also shown and consist of liberation, sanitation, salvage, and thinning cuts. Harvested land is discussed in further detail for each watershed in Section 3.0 as a supplemental indicator for determining sediment impairments.

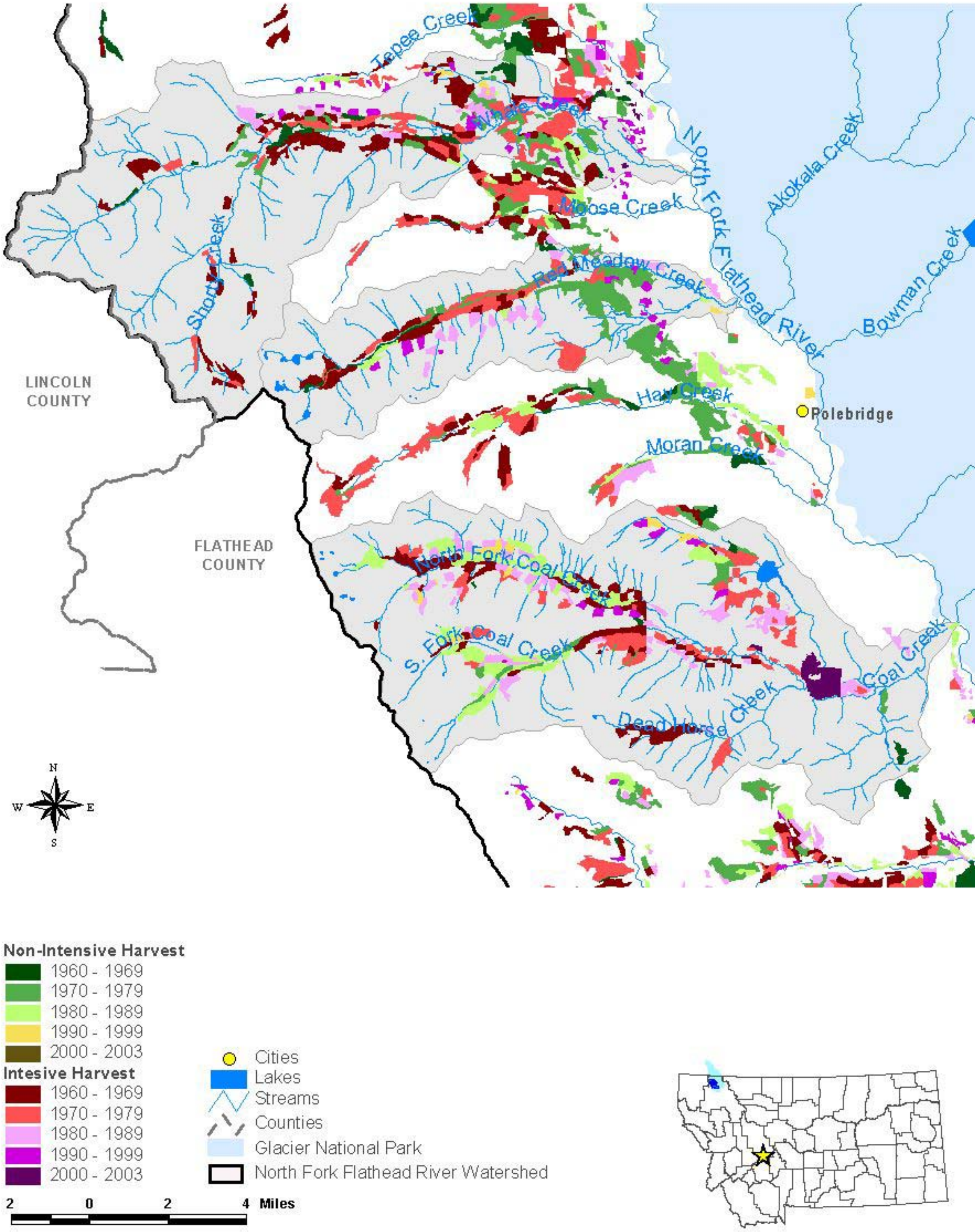


Figure 2-23. Harvest trends in selected watersheds in the North Fork Flathead River basin.

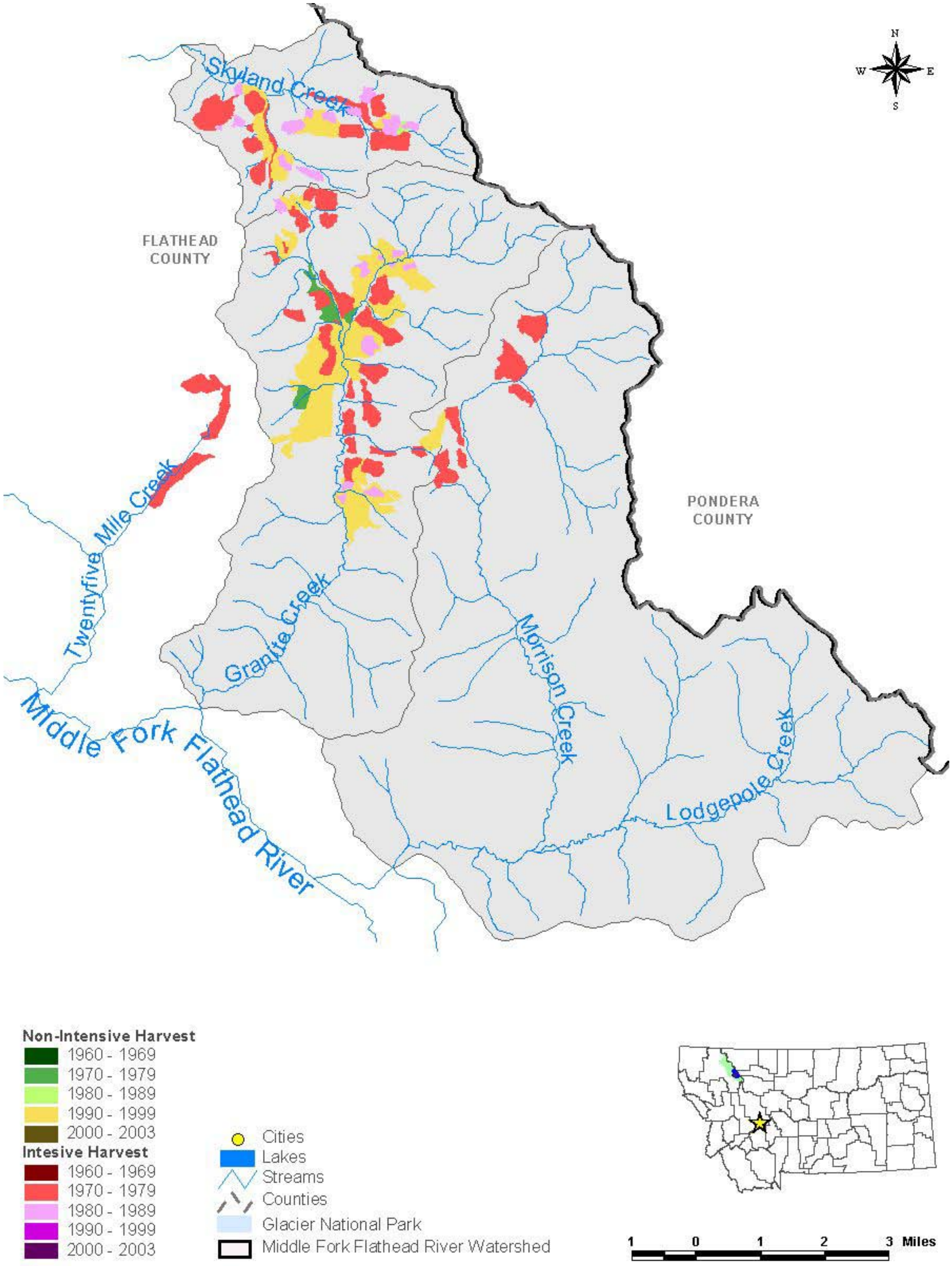


Figure 2-24. **Harvest trends in selected watersheds in the Middle Fork Flathead River basin.**

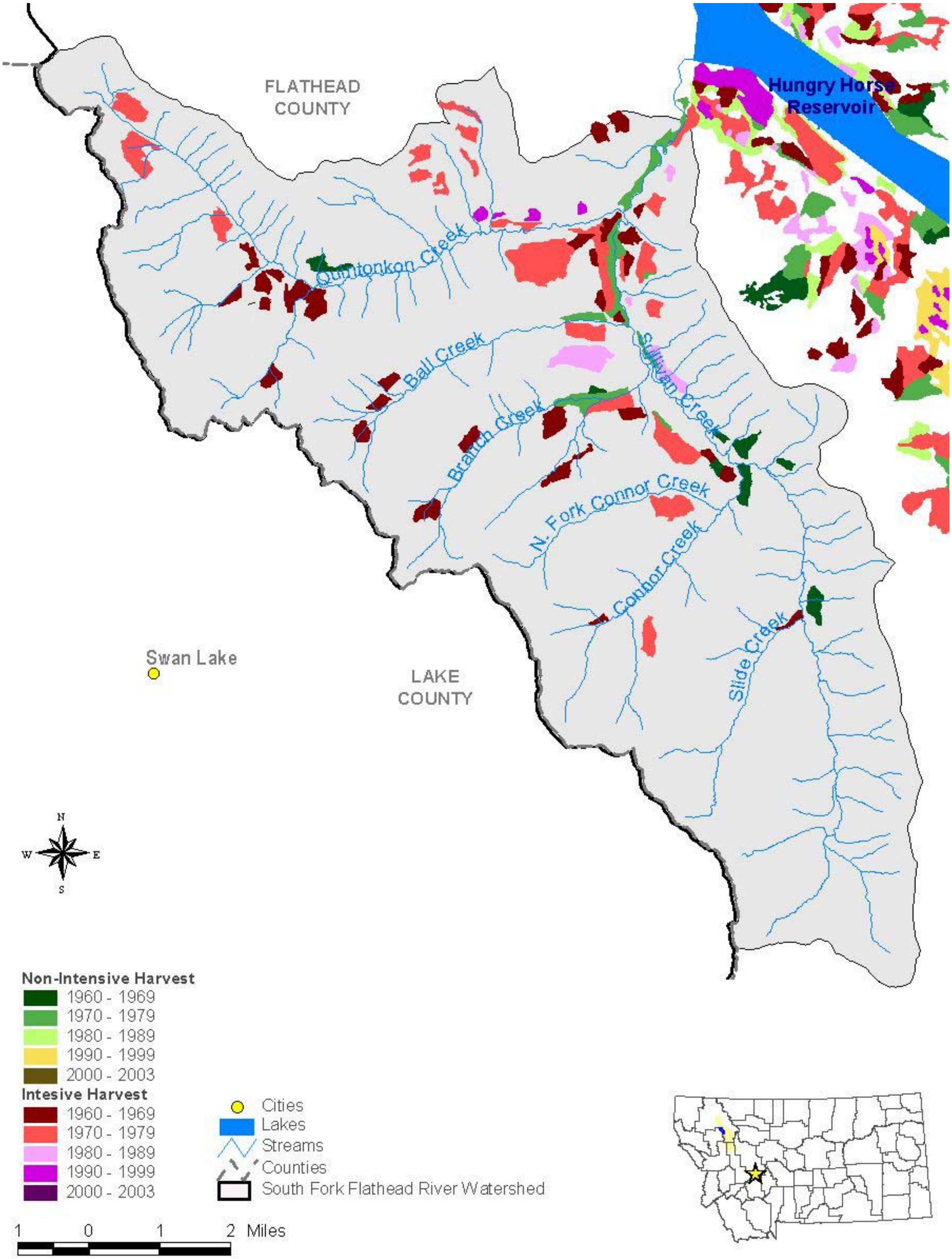


Figure 2-25. Harvest trends in selected watersheds in the South Fork Flathead River basin.

2.1.10 Fire History

Although forest fires are considered a natural phenomenon, they can result in soil erosion, soil nutrient loss, stream channel effects, and water yield effects. A wildfire has the potential to affect the characteristics of forest soils by reducing the soil aggregate stability, reducing permeability, increasing runoff and erosion, and reducing organic matter/nutrient status. These combined effects can cause the runoff following a storm event to increase significantly, increasing the overland flow available to initiate soil erosion, as either sheet or rill erosion. The potential for erosion increases with slope and burn severity. Burn severity is not considered directly in this analysis. Rather, burned areas are depicted in Figure 2-26, Figure 2-27, and Figure 2-28 to show areas that have burned and therefore might have functioned, or might be functioning, as natural sediment source areas. Fires are also discussed for each watershed in Section 3.0 as a supplemental indicator for determining sediment impairments

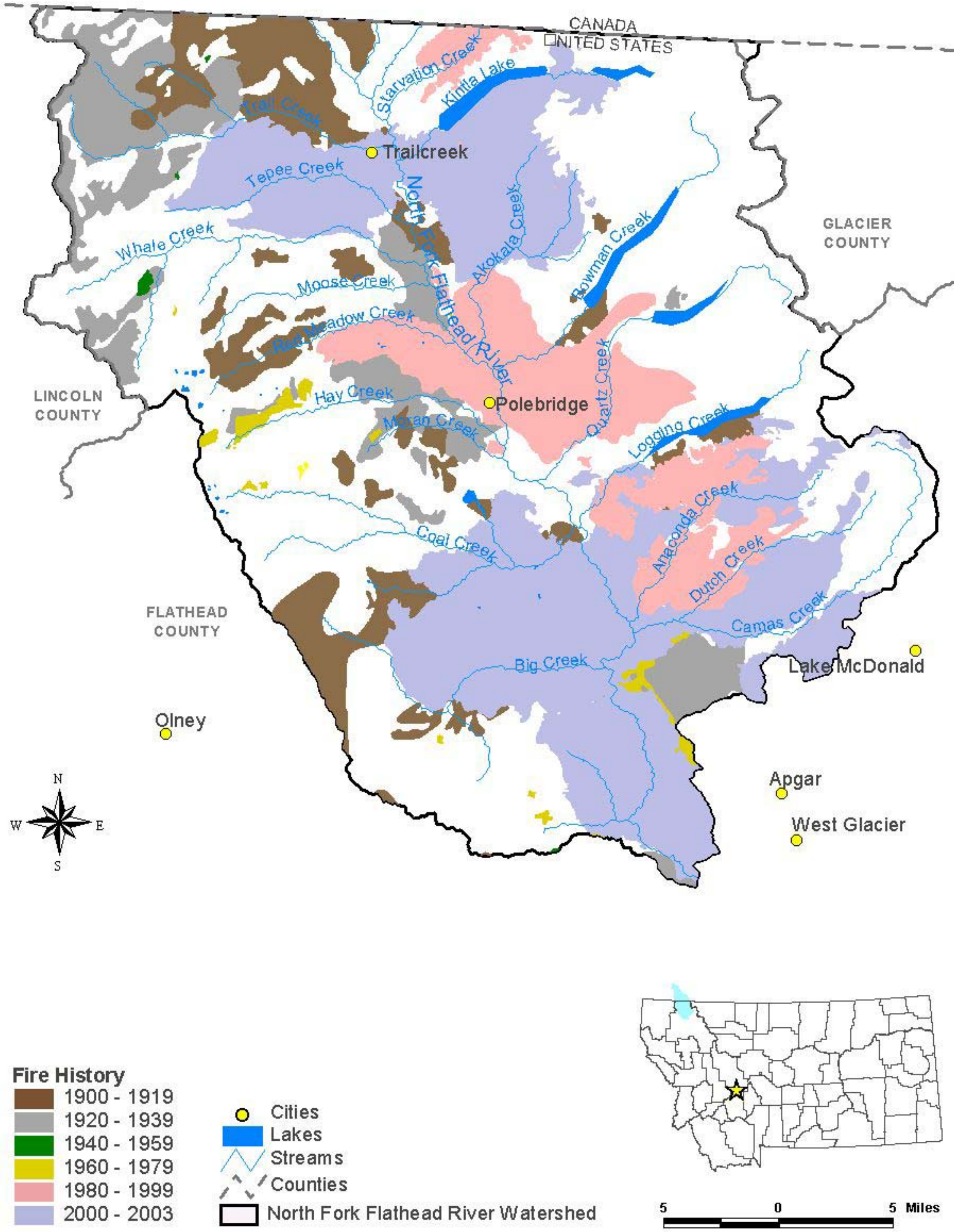


Figure 2-26. Fire history in the North Fork Flathead River watershed.

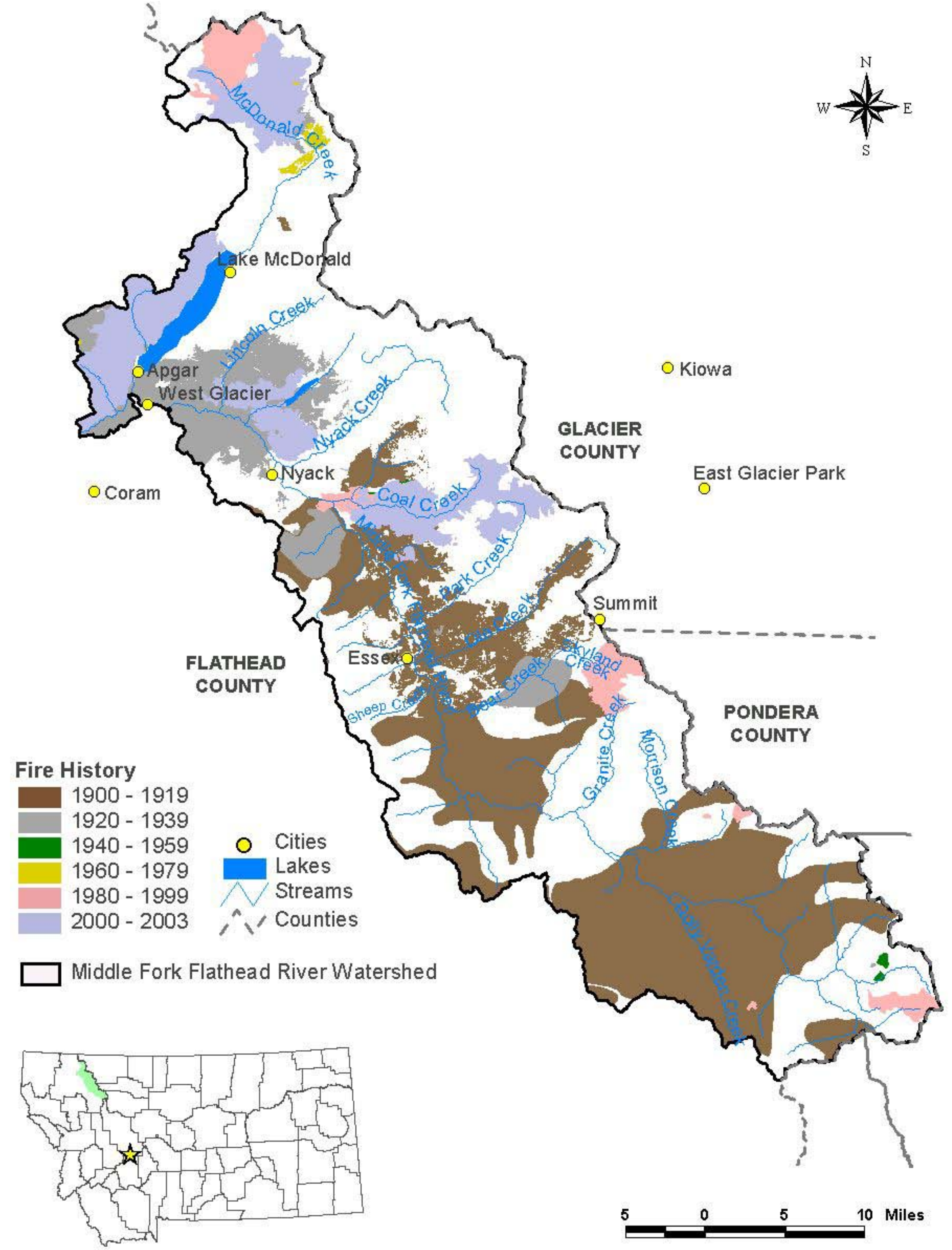


Figure 2-27. Fire history in the Middle Fork Flathead River watershed.

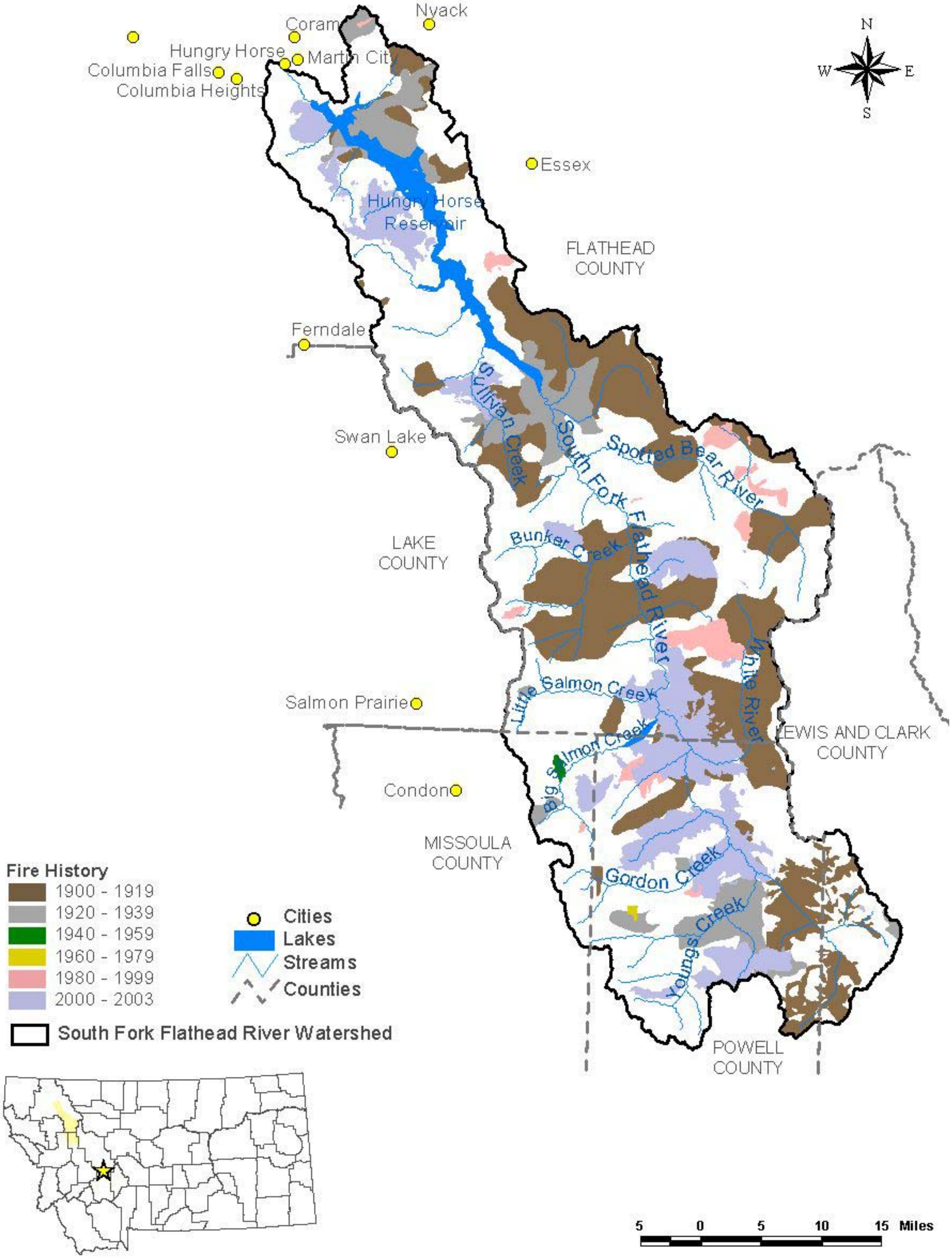


Figure 2-28. Fire history in the South Fork Flathead River watershed.

2.1.11 Forest Roads

Improperly designed roads can directly affect aquatic ecosystems. Roads fundamentally disrupt natural drainage patterns by diverting water and preventing water infiltration into soil. Roads can affect both the volume of water available as surface runoff and the efficiency with which water flows through a watershed. Roads can also contribute sediment to waterways from direct erosion on cut-and-fill slopes. In addition, improperly designed roads can increase the magnitude and frequency of mass failures and landslides. Adverse effects on natural hydrologic processes in roaded watersheds increase as road densities increase. Table 2-9 provides a range of risk guidelines regarding road density (Johnson, 2003). In general, road densities of less than 1.5 to 2.0 miles per square mile are thought to pose a low risk for water quality impairment.

Table 2-9. 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.

Road densities in the subject watersheds range between 0.12 to 1.69 miles per square mile (Table 2-10 and Figures 2-29 through 2-31). The highest road density in the FTPA is in Skyland Creek. All the road densities within the FTPA fall within the “Low” to “Moderate” risk categories.

Table 2-10. Road Densities in Selected Watersheds Within the FTPA

Watershed	Current Roads (miles)					Number of Road-Stream Crossings	Watershed Size (Sq Mi^2)	Road Density (mi/mi^2)	Historic Roads (miles)	
	Closed	Seasonal	Open Yearlong	Other	Total Road Miles				Historical (<1995)	De-commissioned (Since 1995)
North Fork										
Red Meadow Creek	20.3	7.3	4.2	1.6	33.4	58	30.1	1.11	8.9	1.7
Coal Creek	38.7	12.8	20.7	24.1	96.3	132	82.1	1.20		29.0
Whale Creek	22.3		17	4.2	43.5	58	64.1	0.68	12.8	19.6
Middle Fork										
Granite Creek	14.6	9.5			24.1	14	24.1	1.00		
Morrison Creek	6	0.1			6.1	4	50.5	0.12		
Skyland Creek	8.3	5.7			14.0	17	8.3	1.69		
South Fork										
Sullivan Creek	58.7		11.1		69.8	85	72.9	0.96		11.8

Note: Road density reflects current road conditions. Decommissioned and historical roads are not included in the road totals or road densities.

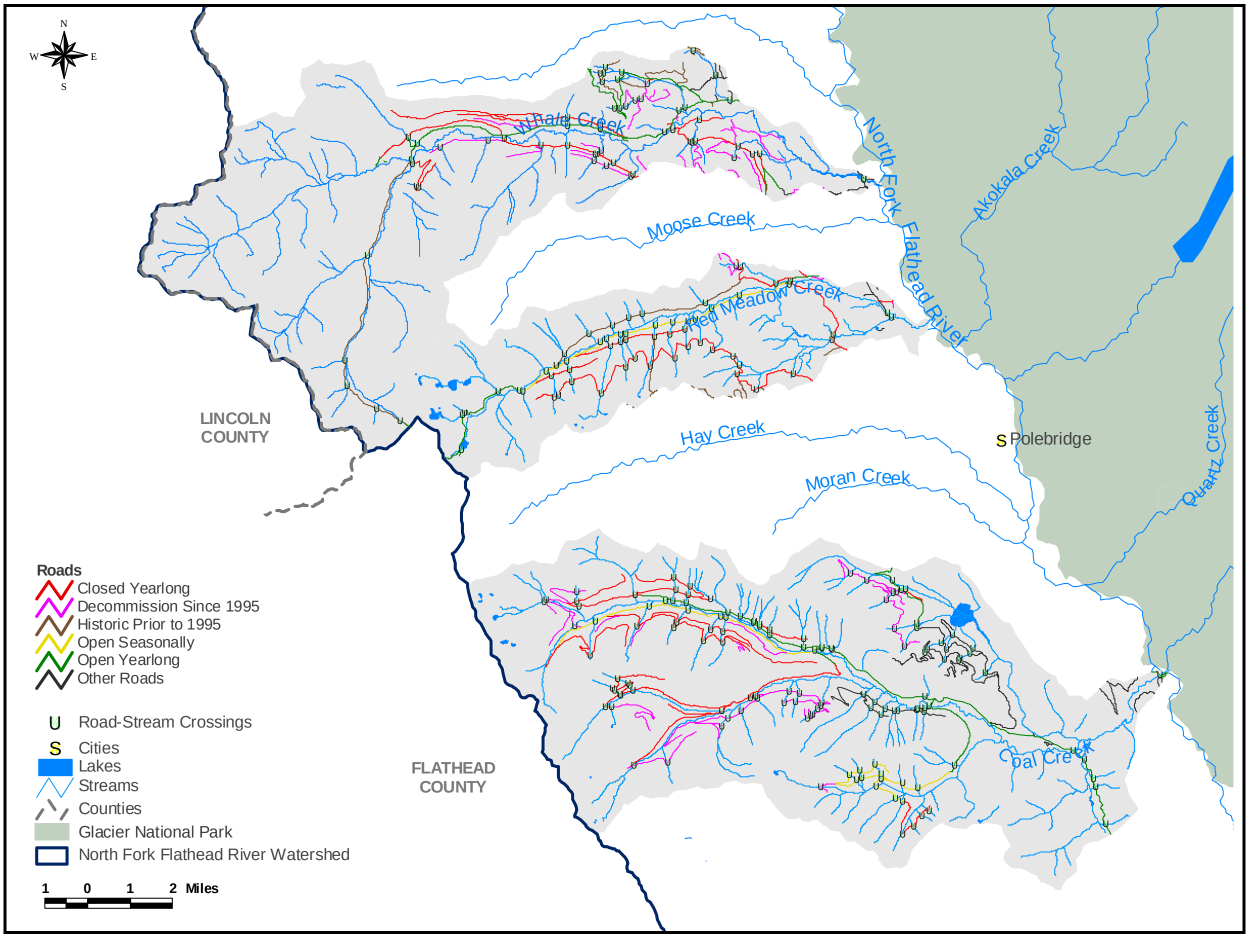


Figure 2-29. Roads and stream crossings in selected watersheds in the North Fork Flathead River basin.

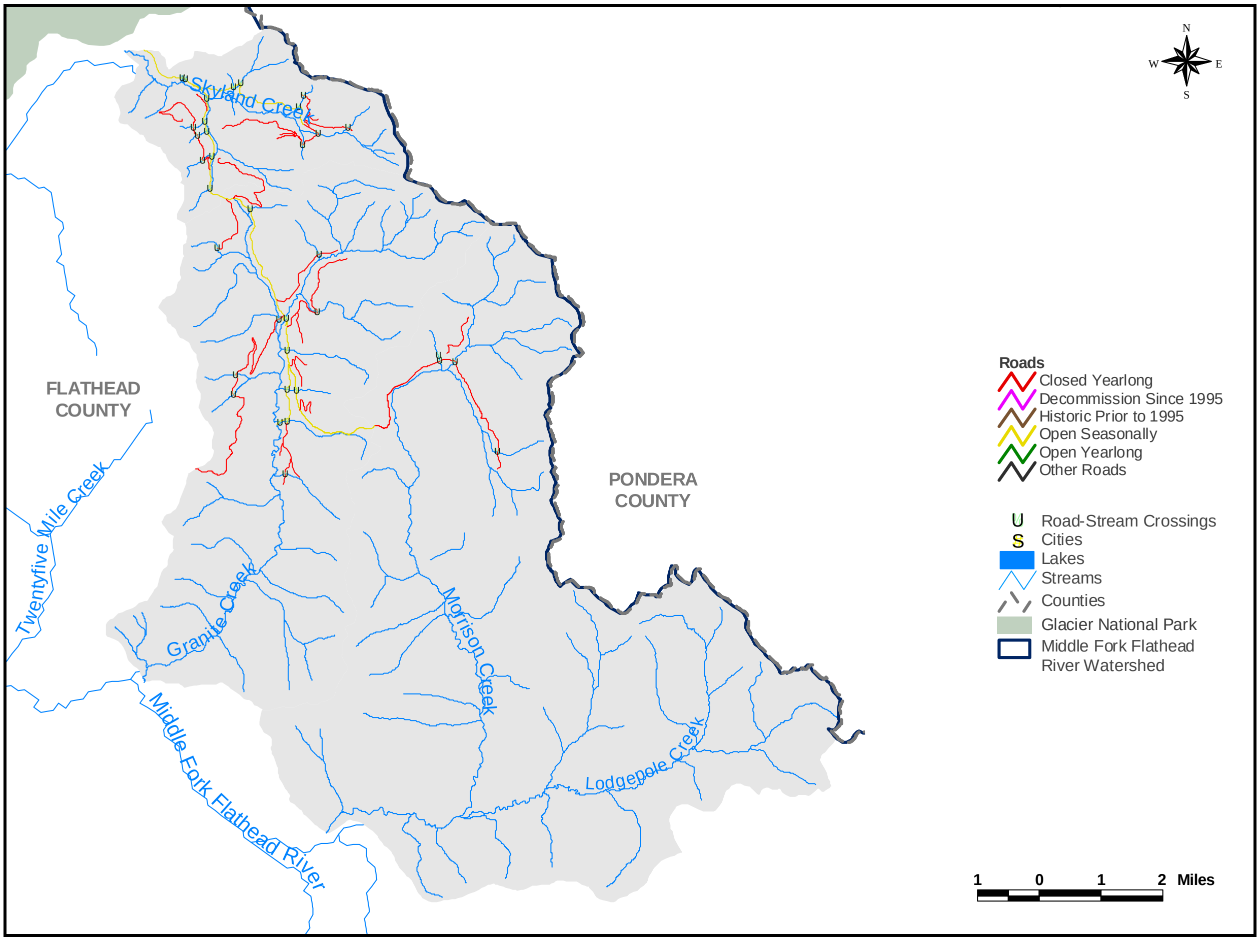


Figure 2-30. Roads and stream crossings in selected watersheds in the Middle Fork Flathead River basin.

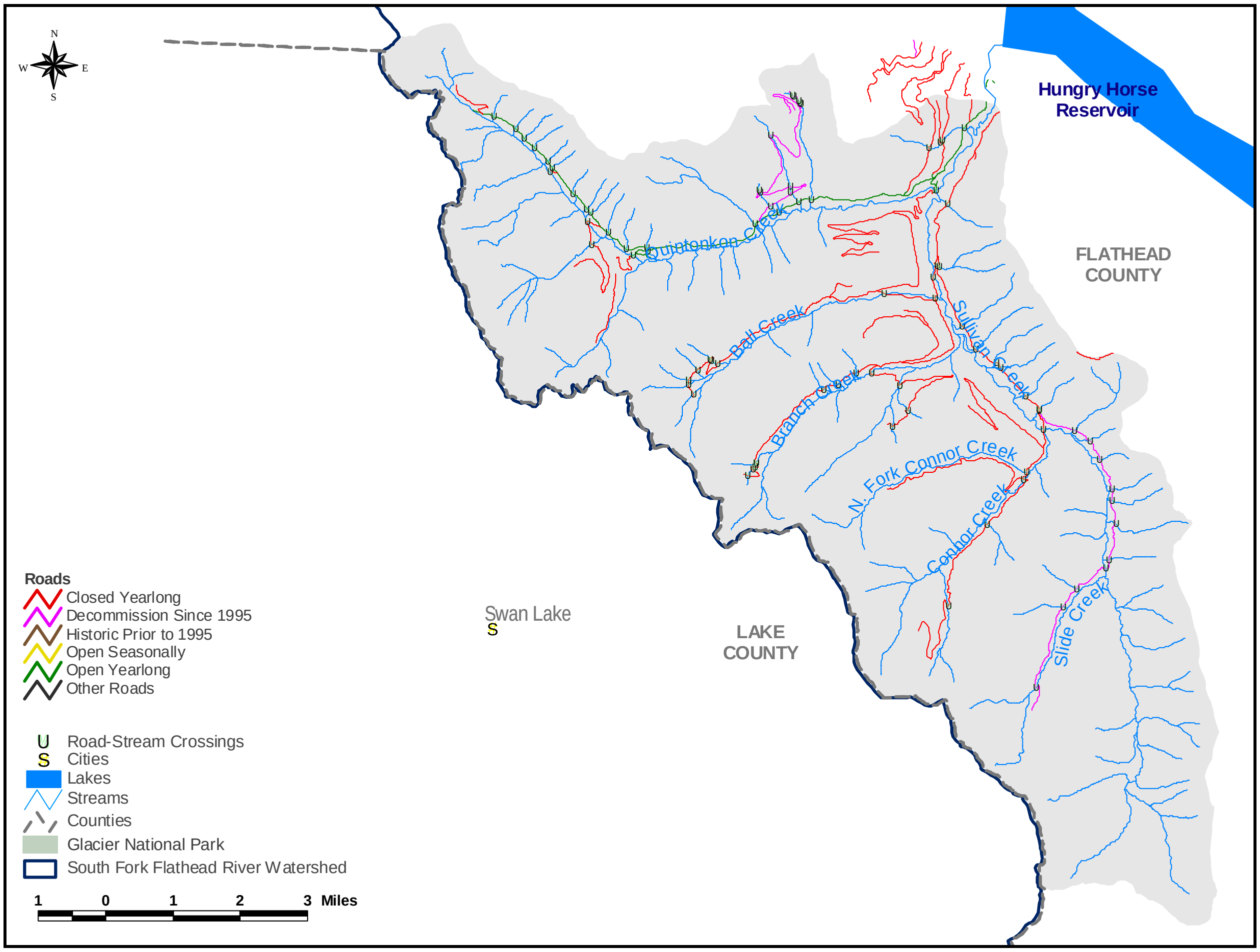


Figure 2-31. **Roads and stream crossings in selected watersheds in the South Fork Flathead River basin.**

2.2 Biological Characteristics

2.2.1 Threatened and Endangered Species

The federally threatened, endangered, and U.S. Forest Service (USFS) sensitive species known to occur within the FTPA are listed in Table 2-11.

Table 2-11. Federally Threatened, Endangered, and USFS Region 1 Sensitive Species in the FTPA

Species	Status[a]	SPECIES PRESENCE[b]					
		North Fork		Middle Fork		South Fork	
		Historic	Current	Historic	Current	Historic	Current
Bald Eagle	T	Y	Y	P	Y	Y	Y
Grizzly Bear	T	Y	Y	Y	Y	Y	Y
Gray Wolf	E	Y	Y	Y	Y	Y	Y
Canada Lynx	T	Y	Y	Y	Y	Y	Y
Bull Trout	T	Y	Y	Y	Y	Y	Y
Westslope Cutthroat Trout	S	Y	Y	Y	Y	Y	Y
Peregrine Falcon	S	P	UNK	P	UNK	Y	UNK
Flammulated Owl	S	Y	P	UNL	UNL	P	UNK
Harlequin Duck	S	Y	Y	Y	Y	Y	Y
Common Loon	S	Y	Y	Y	Y	Y	Y
Townsend's Big-eared Bat	S	P	P	P	P	P	P
Black-backed Woodpecker	S	Y	Y	P	P	P	P
Wolverine	S	Y	Y	Y	Y	Y	Y
Fisher	S	Y	Y	Y	P	Y	Y
Northern Goshawk	S	Y	Y	Y	Y	Y	Y
Northern Leopard Frog	S	UNK	UNK	UNL	UNL	UNL	UNL
Boreal Toad	S	Y	Y	Y	Y	Y	Y
Northern Bog Lemming	S	UNK	UNK	UNL	UNL	UNL	UNL

[a]T = Federally Threatened; E = Federally Endangered; S = Forest Service Region 1 listed as sensitive;
[b]Y = yes; N = no; P = probable occurrence based on presence of known habitat requirements; UNL = unlikely based on absence of known habitat requirements; UNK = unknown.

2.2.2 Fisheries

According to the 1996 and 2002 303(d) lists, the primary impaired beneficial uses are cold-water fishery support and aquatic life. Consequently, it is important to understand the current status of these beneficial uses.

Westslope cutthroat trout, bull trout, and mountain whitefish are the native game species found in the South, Middle, and North forks of the Flathead River and their tributaries (Deleray et al., 1999). Because bull trout were directly considered when MDEQ made water quality impairment determinations to support the 1996 and 2002 303(d) lists, and are also considered herein (Section 3.3.2.4) relative to TMDL supplemental indicators, bull trout are considered a primary indicator species for the support of the cold-water fishery beneficial use. Therefore, the remainder of this section is devoted to a summary of the available data regarding bull trout.

A number of waters in the FTPA have been designated “core” bull trout streams by Montana Fish, Wildlife, and Parks (MFWP) and “priority watershed” under INFISH (USDA Forest Service, 1995). Many of these streams were also listed as impaired on the 1996 and 2002 303(d) lists (Table 2-12).

Bull trout in the North and Middle forks of the Flathead watershed are considered one meta-population because Flathead Lake plays a major part in their life cycle. Most of the bull trout in this population spawn in headwater tributaries in the North and Middle forks. Juveniles rear in the tributaries for 1 to 3 years and then migrate to the Flathead River, and ultimately to Flathead Lake, to mature. As adults, they once again return to the tributaries for spawning. It is therefore impossible to consider trends in this bull trout population without considering the importance of the interconnected lake, river, and tributary system.

Flathead Lake has gone through a major change over the past two decades. Between 1965 and 1975 MFWP stocked mysis shrimp into three lakes with tributaries into Flathead Lake. By 1981, mysis had migrated into Flathead Lake. The mysis population peaked in 1986, and by 1987 only 330 kokanee salmon (major bull trout prey species) were found in McDonald Creek at the southwestern boundary of Glacier National Park. Kokanee salmon populations peaked from 26,000 to 11,800 between 1979 and 1985. No kokanee have been found on traditional spawning locations during recent surveys.

Lake trout and lake whitefish populations expanded as juveniles benefited from the mysis shrimp. The expansion of these species has resulted in a decline in bull trout. The mechanisms for the decline are not well understood. Because only a few bull trout have shown up in lake trout stomachs, competition among species and direct predation appear to be the most likely causes (USFS, Biological Assessment, 1998).

Since roughly 1980, MFWP has been monitoring the number of bull trout spawning sites (redds) in representative tributaries in the North and Middle Forks to estimate trends in escapement of adults from Flathead Lake into the upper watershed tributaries. A significant decline in redd numbers in all tributaries occurred during the 1990s. This widespread decline is thought to be a result of alteration in the trophic dynamics in Flathead Lake. However, bull trout eggs and juveniles were also subject to degraded habitat conditions in spawning tributaries. From 1992 to 1997, the number of bull trout redds remained relatively stable, but this level was considerably lower than that in the preceding 12-year period (70 percent below the average for the previous period). The 1998 through 2002 redd counts showed an increase over the previous 6 years, but they were still on average 45 percent below the pre-mysis levels. Although all tributaries in the watershed showed a decline in redd numbers in the early 1990s, individual streams have since responded with varied spawner abundances. For example, redd numbers in Coal Creek have continued to decline, hitting all-time lows of zero spawners in index reaches in some years. In the adjacent drainage, however, redd numbers in Big Creek have returned to the pre-mysis levels of the 1980’s. This difference suggests that habitat conditions within individual drainages might be affecting bull trout survival.

Bull trout in the South Fork above Hungry Horse Dam have been isolated from the rest of the Flathead Lake system since the dam was constructed in 1953. This population, therefore, is unaffected by conditions in Flathead Lake. In contrast to the North and Middle Fork population, this population has been stable or increasing following closure of bull trout angling, although bull trout redd counts have been conducted only in the South Fork for the past 10 years.

Bull trout and westslope cutthroat trout populations for individual streams are discussed in further detail in Section 3.0.

Table 2-12. Comparison of 303(d)-Listed Streams With Core and Priority Bull Trout Watersheds

Tributary Name	303(d) Listed	Core/Priority
Basin Creek		X
Bear Creek		X
Big Creek	X	X
Bowl Creek		X
Charlie Creek		X
Clack Creek		X
Coal Creek	X	X
Dolly Varden Creek		X
Granite Creek	X	
Lodgepole Creek	Wilderness tributary to Morrison above Middle Fork	X
Long Creek		X
Morrison Creek	X	X
Red Meadow Creek	X	X
Skyland Creek	X	
Shafer Creek		X
Strawberry Creek		X
Sullivan Creek	X	
Trail Creek (MF)		X
Trail Creek (NF)		X
Whale Creek	X	X

2.3 Cultural Characteristics

2.3.1 Population

The FTPA is an integral part of the public lands surrounding the Flathead Valley. The recreational opportunities on the public lands have made Flathead County one of the fastest growing counties in Montana. Hunting, hiking, swimming, boating, bird and animal watching, and skiing are just a few of the recreational activities afforded by public lands. However, the full-time residential population of the FTPA is very low. Based on 2000 Census Block data obtained from the Montana State Library (2001), the 2000 population of the FTPA was 2,278.

2.3.2 Land Ownership

The FTPA is largely under federal ownership, mainly the US Forest Service and the National Park Service. A summary of ownership by watershed is provided in Table 2-13 and Figure 2-32. Much of the South Fork Flathead River watershed is under the Wilderness Area designation (Bob Marshall and Great Bear wilderness areas).

Table 2-13. Land Ownership and Management by Drainage

Ownership	North Fork	Middle Fork	South Fork
National Park Service	46	48	0
US Forest Service	48	52	100
Montana Department of Natural Resources and Conservation	3	0	0
Private	3	1	0

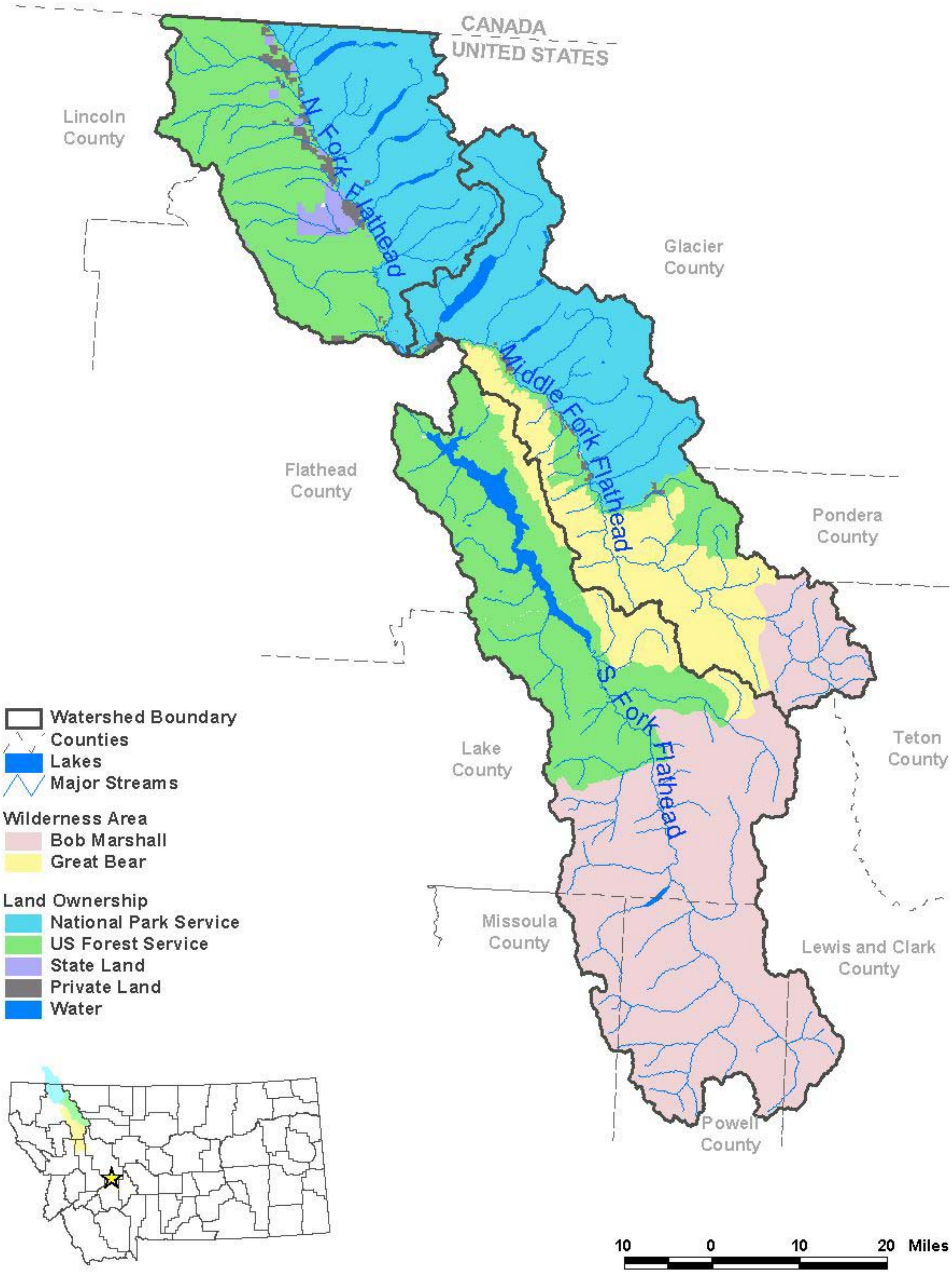


Figure 2-32. Land Ownership in the Flathead River Headwaters TPA.

3.0 WATER QUALITY IMPAIRMENT STATUS

This section first presents the status of all 303(d)-listed water bodies in the TPA (i.e., which water bodies are listed as impaired or threatened and for which pollutant). This information is followed by a summary of the 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 water body-by-water body review of available water quality data and an updated water quality impairment status determination for each listed water body.

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. As mentioned in Section 1.1, all necessary TMDLs must be completed for all pollutant water body combinations appearing on Montana's 1996 303(d) list. The 1996 303(d) list reported that Red Meadow Creek, Whale Creek, Big Creek, Coal Creek, South Fork Coal Creek, North Fork Coal Creek, Granite Creek, Skyland Creek, Challenge Creek, Morrison Creek, South Fork Flathead River, Sullivan Creek, and Hungry Horse Reservoir were impaired (Figure 3-1) (MDEQ, 1996). Listed causes of impairment for these water bodies included habitat alteration, flow alteration, bank erosion, nutrients, siltation, and suspended solids (Table 3-2). The most common impaired beneficial uses were cold-water fishery and aquatic life.

Habitat alteration, flow alteration, and bank erosion are considered "pollution," while siltation and suspended solids are considered "pollutants." It is EPA's position that TMDLs are required only for "pollutants" that are causing or contributing to water body impairments (Dodson, 2001). Therefore, because TMDLs are required only for pollutants and flow alteration, habitat alteration, and bank erosion are not pollutants, the focus of this document is on the sediment-related pollutants (siltation and suspended solids) and nutrients. Flow alteration, habitat alteration, and bank erosion might certainly constitute potential sources or causes of sediment related impairments, and while no TMDLs are established to specifically address these issues, they will be addressed as sources, as appropriate.

Table 3-1. Impaired Streams Within the Flathead River Headwaters TPA on the 1996 and 2002 Montana 303(d) Lists

Watershed	Sub-Drainage and Water body No.	Use Class	Year Listed	Cold-Water Fishery	Aquatic Life	Recreation (Swimmable)	Industry	Agriculture	Drinking Water
North Fork Flathead River	Big Creek MT76Q002-050	B1	1996	P	P	X	X	X	X
			2002	TMDL Completed					
	Red Meadow Creek MT76Q002-020	B1	1996	P	P	X	X	X	X
			2002	P	P	F	F	F	X
	Whale Creek MT76Q002-030	B1	1996	T	X	X	X	X	X
			2002	P	P	F	F	F	X
	South Fork Coal Creek MT76Q002-040	B1	1996	P	P	X	X	X	X
			2002	P	P	F	F	F	X
	Coal Creek MT76Q002-080	B1	1996	P	P	X	X	X	X
			2002	P	P	F	F	F	X
	North Fork Coal Creek MT76Q002-070	B1	1996	P	P	X	X	X	X
			2002	P	P	F	F	F	X
Middle Fork Flathead River	Granite Creek MT76I002-010	B1	1996	X	P	X	X	X	X
			2002	P	P	F	F	F	X
	Skyland Creek MT76I002-020	B1	1996	P	P	X	X	X	X
			2002	X	X	X	F	F	X
	Challenge Creek MT76I002-040	B1	1996	P	P	X	X	X	X
			2002	Fully Supporting					
	Morrison Creek MT76I002-050	B1	1996	P	P	X	X	X	X
			2002	P	P	F	F	F	X
South Fork Flathead River	South Fork Flathead River MT76J001-010	B1	1996	P	P	X	X	X	X
			2002	X	X	P	F	F	X
	Sullivan Creek MT76J003-010	B1	1996	P	P	X	X	X	X
			2002	X	X	F	F	F	X
	Hungry Horse Reservoir MT76J002-1	B1	1996	P	P	F	F	F	F
			2002	Fully Supporting					

Impairment Status Definitions for Table 3-1:

P = Partial support of Beneficial Use.

F = Full support of Beneficial Use.

T = Threatened support for Beneficial Use.

X = Sufficient Credible Data not available.

Table 3-2. Causes of Impairment in the Flathead River Headwaters TPA

Watershed	Sub-Drainage and Water body No.	Use Class	Year Listed	Probable Causes
North Fork Flathead River	Big Creek MT76LJ003-050	B1	1996	Habitat alter/siltation
			2002	TMDL completed
	Red Meadow Creek MT76Q002-020	B1	1996	Habitat alter/siltation
			2002	Habitat alter/siltation
	Whale Creek MT76Q002-030	B1	1996	Habitat alter/siltation
			2002	Habitat alter/siltation
	South Fork Coal Creek MT76Q002-040	B1	1996	Habitat alter/siltation
			2002	Habitat alter/siltation
	Coal Creek MT76Q002-080	B1	1996	Siltation
			2002	Siltation
	North Fork Coal Creek MT76Q002-070	B1	1996	Nutrients/siltation
			2002	Siltation
Middle Fork Flathead River	Granite Creek MT76I002-010	B1	1996	Habitat alter/ siltation/suspended solids
			2002	Siltation/bank erosion
	Skyland Creek MT76I002-020	B1	1996	Habitat alter/ siltation/suspended solids
			2002	No SCD
	Morrison Creek MT76I002-050	B1	1996	Habitat alter/siltation
			2002	Habitat alter/siltation
	Challenge Creek MT76I002-040	B1	1996	Habitat alter/siltation
			2002	Not Listed
South Fork Flathead River Below HHD	South Fork Flathead River MT76J001-010	B1	1996	Habitat alterations Flow alterations
			2002	Flow alterations
	Sullivan Creek MT76J003-010	B1	1996	Habitat alterations
			2002	No SCD
	Hungry Horse Reservoir MT76J002-1	B1	1996	Flow alterations siltation suspended solids
			2002	Not listed

Note: Alter= alternation (s): SCD= sufficient credible data.

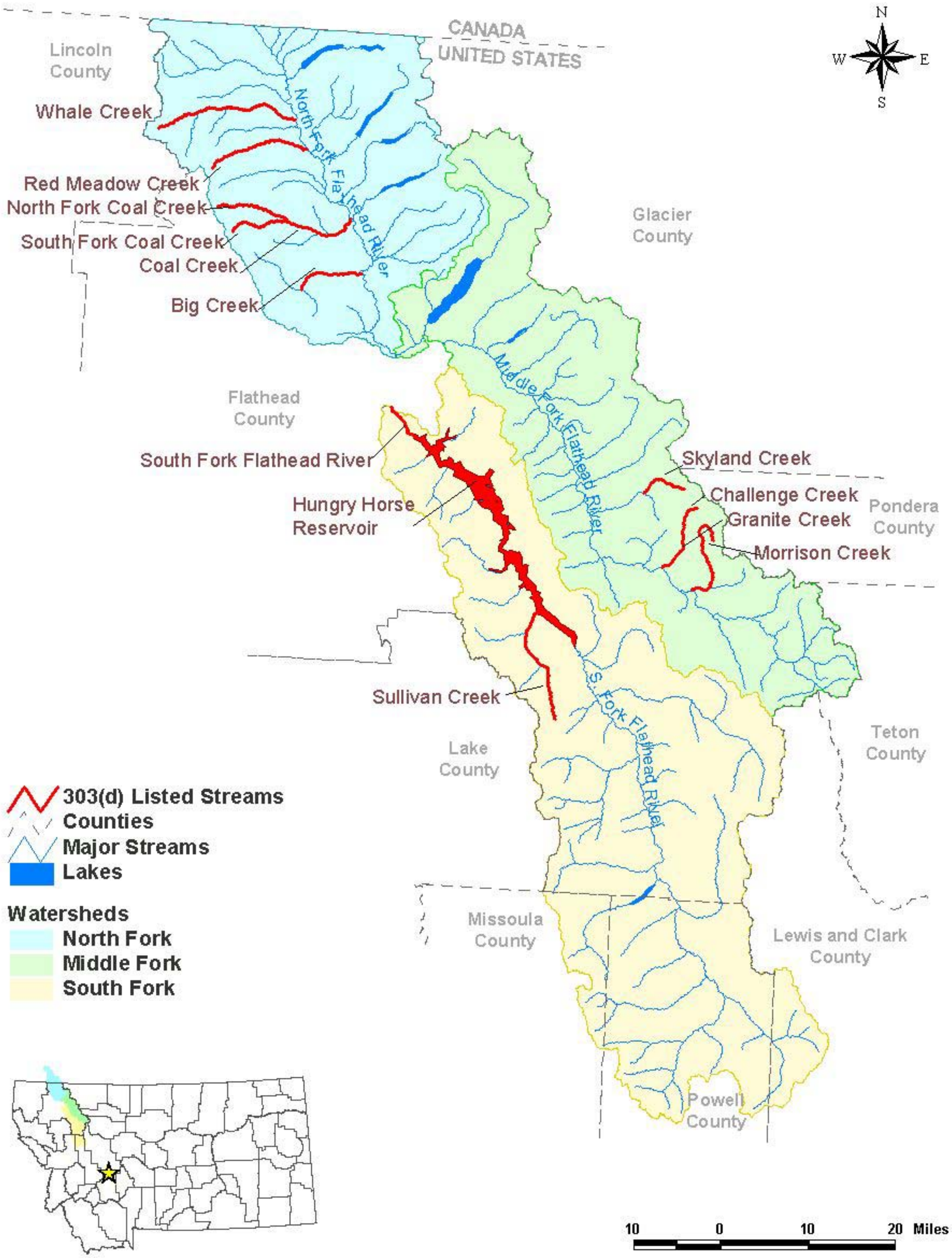


Figure 3-1. Location of the 303(d) listed streams.

3.2 Applicable Water Quality Standards

Water quality standards include the uses designated for a water body, the legally enforceable standards that ensure that the uses are supported, and a nondegradation policy that protects the high quality of a water body. The ultimate goal of this water quality assessment, 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. The pollutants addressed in this water quality assessment are sediment and nutrients. 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 use or group of uses to a water body based on the potential of the water body 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) to establish a classification system for all waters of the state that includes their present (when the act was originally written) and future 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 might not actually be used for a specific designated use (e.g., as a public drinking water supply); however, the quality of that water body must be maintained for that designated use. When natural conditions limit or preclude a designated use, permitted point source discharges or nonpoint source discharges may not make the natural conditions worse.

Modification of classifications or standards that would lower a water’s classification or standards (e.g., a change from B-1 to B-3) or removal of a designated use because of natural conditions may occur only if the water was originally misclassified. All such modifications must be approved by the BER and are undertaken through 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 may not be removed or made less stringent.

Descriptions of Montana’s surface water classifications and designated beneficial uses are presented in Table 3-3. All water bodies in the Flathead River Headwaters TPA are classified as B-1, except for the main stems of the North and Middle Forks of the Flathead River, which are classified as A-1.

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

Classification	Designated Uses
A-CLOSED	Waters classified A-Closed are to be maintained suitable for drinking, culinary and food processing purposes after simple disinfection.
A-1	**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	**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	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	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	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	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	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	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

Montana’s water quality standards include numeric and narrative criteria, as well as a nondegradation policy that currently applies to the numeric criteria.

Numeric surface water quality standards have been developed for many parameters to protect human health and aquatic life. These standards are in 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., lifelong) exposures as well as exposure 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 various durations of exposure. *Chronic* aquatic life standards are protective of long-term exposure to a parameter. The protection afforded by the chronic standards includes 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 MDEQ. Under no circumstance, however, 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 the water body.

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 that impair the beneficial uses of a water body. Uses can be impaired by toxic or harmful conditions (from one parameter 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 pollutants addressed in the Flathead River Headwaters TPA are summarized below.

3.2.2.1 Sediment

Sediment (coarse and fine bed sediment), siltation, and suspended solids are addressed through 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 water body’s greatest potential for water quality given current and historical land use activities where all reasonable land, soil, and water conservation practices have been applied. (See definitions in Table 3-4.)

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 as 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.

3.2.2.2 Nutrients

The term *nutrients* generally refers to the various forms of nitrogen and phosphorus found in a water body. Both nitrogen and phosphorus are necessary for aquatic life, and both elements are needed at some level in a water body to sustain life. The natural amount of nutrients in a water body varies depending on the type of system. A pristine mountain spring might have little to almost no nutrients, whereas a lowland, mature stream flowing through wetland areas might have naturally high nutrient concentrations. Most waters of Montana are protected from excessive nutrient concentrations by narrative standards. The exception is the Clark Fork River above the confluence with the Flathead River, where numeric water quality standards for total nitrogen (300 µg/L) and total phosphorus (20 µg/L upstream of the confluence with the Blackfoot River and 39 µg/L downstream of the confluence) as well as algal biomass measured as chlorophyll a (summer mean and maximum of 100 and 150 mg/m^2, respectively) have been established.

The narrative standards applicable to nutrients elsewhere in Montana are contained in the General Prohibitions of the surface water quality standards (ARM 17.30.637 et seq.). The prohibition against the creation of "conditions which produce undesirable aquatic life" is generally the most relevant to nutrients.

Nutrients generally do not pose a direct threat to the beneficial uses of a water body. However, excess nutrients can cause an undesirable abundance of plant and algae growth. This process is called eutrophication or organic enrichment, and it can have many effects on a stream or lake. One possible effect is low dissolved oxygen concentrations. Aquatic organisms require oxygen to live, and they can experience mortality and lowered reproduction rates with lowered dissolved oxygen concentrations. Montana has numeric criteria for dissolved oxygen concentrations, and they are discussed in Montana Water Quality Standards Circular WQB-7. The dissolved oxygen criteria are summarized in Table 3-5.

Table 3-5. Numeric Dissolved Oxygen Criteria.

Time Period	Early Life Stages[a] (mg/L)	Other Life Stages (mg/L)
30-Day Mean	NA	6.5
7-Day Mean	9.5 (6.5)	NA
7-Day Mean (min)	NA	5.0
1 Day Min	8.0 (5.0)	4.0

[a] These are water column concentrations recommended to achieve the required inter-gravel dissolved oxygen concentrations shown in parentheses. For species that have early life stages exposed directly to the water column, the figures in parentheses apply.
Source: MDEQ, 2004.

3.3 Water Quality Goals and 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. However, none of the pollutants of concern in the FTPA (i.e., siltation and nutrients) have established numeric water quality standards that can be directly applied as TMDL targets. Where targets are established for pollutants with only narrative standards, the target must be a water body-specific, measurable interpretation of the narrative standard.

In the case of the FTPA, 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 3-6 and 3-7). In consideration of the available data for the FTPA, 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 “natural” conditions. 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 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 3-6. Summary of the Proposed Sediment Targets and Supplemental Indicators for the Flathead TPA

Targets	**Threshold**
5-year Mean McNeil Core Percentage of Subsurface Fines < 6.35 mm	35%
5-year Mean Substrate Score	≥ 10
Percentage of Surface Fines < 2 mm	< 20%
Clinger Richness	≥ 14
Supplemental Indicators	**Recommended Value**
Juvenile Bull Trout and Westslope Cutthroat Trout Density	Documented increasing or stable trend
Bull Trout Redd Counts	Documented increasing or stable trend
Suspended Sediment Concentration Mean Suspended Sediment Concentration Mean Annual Maximum Suspended Sediment Concentration Maximum	3.2 ± 5.2 mg/L 14.6 mg/L 61.6 mg/L
Turbidity	High flow – 50 NTU instantaneous maximum Summer base flow – 10 NTU instantaneous maximum
Pfankuch Mass Wasting Score	“good”
Pfankuch Bank Vegetation Score	“good”
Pfankuch Cutting Score	“good”
Pfankuch Deposition Score	“good”
Montana Mountain Macroinvertebrate Index of Biological Integrity	> 75%
Percentage of Clinger Taxa	“High”
EPT Richness	≥ 22
Periphyton Siltation Index	< 20
Fire	Evaluated on a case-by-case basis
Equivalent Clear-Cut Acres	< 25%
Water Yield	< 10%
Roads	Evaluated on a case-by-case basis

Table 3-7. Summary of the Proposed Nutrient Targets and Supplemental Indicators for the Flathead TPA

Targets	**Threshold**
Benthic Chlorophyll-*a* (Median)	< 33 mg/m^2
EPA Ecoregion II, Total Phosphorus (Median)	< 0.01 mg/L
EPA Ecoregion II, TKN (Median)	< 0.05 mg/L
EPA Ecoregion II, Nitrate+Nitrite (NO_2/NO_3) (Median)	< 0.014 mg/L
EPA Ecoregion II, Total Nitrogen (Median)	< 0.12 mg/L
Supplemental Indicators	**Recommended Value**
Macroinvertebrate Hilsenhoff Biotic Index (HBI)	< 3.5
Montana Mountain Macroinvertebrate Index of Biological Integrity	> 75%
Dissolved Oxygen, 7-Day Mean	> 9.5 mg/L
Dissolved Oxygen, 1-Day Minimum	> 8.0 mg/L
EPA Ecoregion II, Chlorophyll-*a*, Water Column (Median)	< 1.08 µg/L
Fire	Evaluated on a case-by-case basis
Equivalent Clear-Cut Acres	< 25%
Water Yield	< 10%

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 3-2, 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? Might the exceedance be 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.

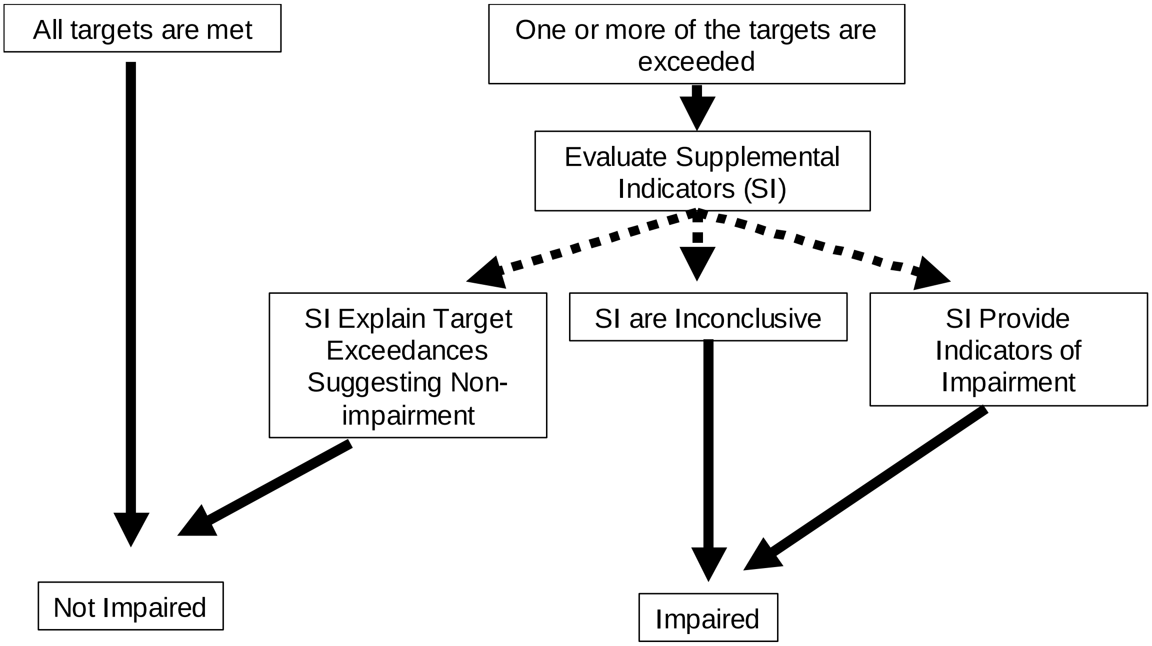


Figure 3-2. Weight-of-evidence approach for determining beneficial use impairments.

Targets and Supplemental Indicators 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 Tables 3-6 and 3-7 to measure compliance with water quality standards and achievement of full support of all applicable beneficial uses (Figure 3-3). 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. 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, or
- revisions to components of the TMDL are necessary.

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

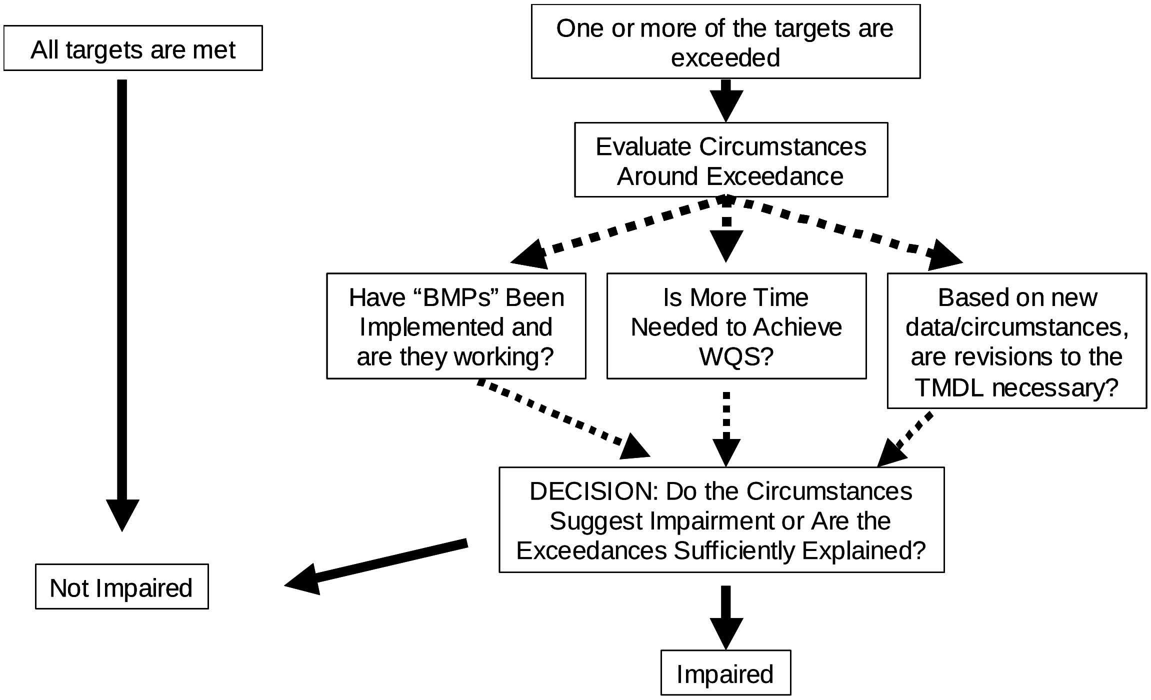


Figure 3-3. Methodology for determining compliance with water quality standards.

3.3.1 Sediment Targets

The proposed sediment targets include McNeil core substrate fines, substrate scores, pebble counts (percent surface fines), and macroinvertebrate metrics.

3.3.1.1 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.

Recommendations from the Flathead Basin Cooperative Forest Practice Study noted that fine sediment (< 6.35 millimeters) levels exceeding 35 percent threaten bull trout and westslope cutthroat trout embryo survival. This value is also similar to reference conditions described by Weaver and Fraley (31.7 ± 2.9) (Weaver and Fraley, 1991). A running 5-year average of 35 percent fines smaller than 6.35 millimeters is proposed as a target for the Flathead River Headwaters TPA.

A running average was selected for the McNeil core target to account for the year-to-year variability. Year to year variability appears to be a function of a number of both natural and potentially human-caused factors and ranges up to 20 percentage points based on the data that has been evaluated (see Table D-1 in Appendix D). It is thought that natural events such as flushing flows or low-flow periods may account for much of this variability. The running average target was proposed to account for this variability.

There are extensive McNeil core data for some streams (20+ years). The full period of record for all data was used to identify trends, variability, and long-term averages (See Appendix D). Trends, where identified, are discussed in the waterbody-by-waterbody discussions in Section 3.4. However, a McNeil core value from the early 1980s does not necessarily represent current conditions in any stream, and the purpose of this analysis is to determine if beneficial uses are currently impaired. Because of the dynamic nature of activities in the watershed, historic data, while useful, should not be used when making a current impairment determination. Therefore, data from the past five-years was chosen to represent “current conditions” in the watershed.

3.3.1.2 Substrate Scores

Since the early 1980s, MFWP has calculated substrate scores for many of the streams within the FTPA to provide an overall description of juvenile bull trout rearing habitat quality and observe trends over the period of record.

A detailed description of substrate scores is presented in the *Flathead Lake and River System Fisheries Status Report* (Deleray et al., 1999). In general, substrate scoring involves visually assessing the dominant and subdominant streambed substrate particles, along with embeddedness in a series of cells across transects. Surveyors assign a rank to both the dominant and subdominant particle size classes in each cell. They also rank the degree to which the dominant particle size is embedded. The three ranks are summed, yielding a single variable for each cell. All cells across each transect are averaged and a mean of all transects results in the substrate score.

Recommendations resulting from the *Flathead Basin Cooperative Forest Practices Study* observed that substrate scores of 10.0 or less “threatened” juvenile bull trout rearing capacity; at scores less than 9.0, rearing capacity was considered “impaired” (FBC 1991). A running five-year average score of ≥ 10.0 has been chosen as the target value for the FTPA. Similar to the McNeil core data (Section 3.3.1.1), the 5-year average substrate score target was selected to account for natural variability in the data and to ensure that current conditions are evaluated.

3.3.1.3 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 targets and supplemental indicators are 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.

Several biological indicators were considered for the FTPA. These indicators include the Mountain Index of Biological Integrity (IBI) (Bukantis, 1998), several individual biological metrics, and the relative stressor tolerance of dominant benthic and macroinvertebrate taxa. Many of these provide an indication of overall water quality, but do not specifically identify sediment as the cause of the impairment. Of the evaluated metrics, the *number of clinger taxa* provides the strongest indication of a sediment impairment. Clinger taxa have morphological and behavioral adaptations that allow individuals to maintain position on an object in the substrate even in the face of potentially shearing flows. These taxa are sensitive to fine sediments that fill interstitial spaces, one of the main niches. This metric is calculated as the number of clinger taxa in a sample, and decreases in the presence of stressors. A minimum of 14 clinger taxa are expected in unimpaired Montana streams, and this number is proposed as the target threshold value for streams in the FTPA (Bollman, 1998). Other biological metrics and indices are discussed as supplemental indicators in Section 3.3.2.

3.3.1.4 Surface Fines

Pebble counts provide an indication of the type and distribution of bed material (surface fines) in a stream. Streams naturally have a wide variety of bed material, however, streams with too much fine material can have lowered spawning rates for many fish species, especially salmonids. Too much fine material also degrades the habitat of aquatic invertebrates, and can cause a shift in the invertebrate population if conditions deteriorate from natural conditions. The state in which there is too much fine sediment in a streambed is often referred to as “embeddedness” or “siltation.” It is desirable (and usually natural in the FTPA) that streams have a low percentage of bed material smaller than 2 millimeters in diameter.

The Wolman pebble count method is one method for determining the amount of surface fines in a water body. Wolman pebble counts involve wading across a transect in a riffle section from bankfull to bankfull width. The field person places one foot in front of the other and, without looking down, selects a particle and measures the intermediate diameter of the rock. This information is recorded and the procedure followed until a minimum of 100 particles per transect are counted (Wolman, 1954). Pebble count data can be interpreted to compare median particle sizes between streams, evaluate the percentage of surface fines smaller than a specific size, and compare particle distributions between streams. Wolman pebble counts were collected at several sites within the FTPA in 2002 and 2003.

Threshold surface fine sediment values have not been fully developed by MDEQ. Recent work completed in the Boise National Forest in Idaho showed a strong correlation between the health of macroinvertebrate communities and the percent surface fines, where fine sediments are defined as all particles less than 2 millimeters in diameter. The most sensitive species were affected at 20 percent surface fines and a definite threshold was observed at 30 percent surface fines (Relyea, personal communication, April 28, 2004). The New Mexico Environmental Department has also established a percent surface fines target of less than 20 percent for TMDL development (NMED, 2002).

The percent surface fines provide a good measure of the siltation of a river system and, when combined with biological indicators and other measures, is a direct measure of stream bottom aquatic habitat. Although it is difficult to directly correlate the percent surface fines with loadings in mass per time, the Clean Water Act allows "other applicable measures" for the development of TMDLs, and percent surface fines have been used successfully in other TMDLs where stream bottom deposits, siltation, and aquatic life uses are the major issues of concern (USEPA, 1993; USEPA, 1998; USEPA, 1999). Based on these considerations, less than 20 percent surface fines (2 millimeters) is proposed as one of the TMDL target for the FTPA. A maximum not-to-exceed target threshold value was chosen for percent surface fines because there are no long-term surface fines data to evaluate natural variability. At the time of this report, surface fines data were only available for one or two years at each site.

Sediment Supplemental Indicators

As stated previously, the proposed supplemental indicators are not sufficiently reliable to be used alone as a measure of sediment impairment in the streams within the FTPA. These indicators are used as supplemental information, in combination with the targets, to provide better definition of potential sediment impairments.

3.3.1.5 Macroinvertebrates

Mutimetric Index

Macroinvertebrate data are typically organized according to a multimetric index of biological integrity (IBI). Individual metrics (e.g., clinger taxa, the 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 make comparisons 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 FTPA based on site characteristics, primarily elevation. The sites in the FTPA are located within the Northern Rockies ecoregion (Woods et al., 1999) and range in elevation from 4,000 to 6,000 feet. MDEQ uses a scoring procedure with a maximum possible score of 100 percent. Total scores *greater than 75 percent* are considered within the range of expected natural variability and represent full support of their beneficial use (aquatic life). A minimum score of 75 percent was therefore chosen as a supplemental indicator. Streams scoring between 25 percent and 75 percent are considered partially supporting their aquatic life uses and scores lower than 25 percent represent non-supported uses.

Individual Metrics

To date, the strongest candidate metric relating to possible sediment impacts is the number of clinger taxa (See Section 3.3.1.3). Additional metrics were collectively evaluated and used as supplemental information to assess overall stream condition. The *number of EPT taxa* is a metric describing the richness of mayflies (Ephemeroptera), stoneflies (Plecoptera), or caddisflies (Trichoptera) in a sample. Invertebrates that are members of these groups are generally understood to be sensitive to stressors in streams, whether physical, chemical, or biological. Consequently, they are less common in degraded streams. Metric values decrease in the presence of stressors. Bahls et al. (1992) determined that the average EPT taxa richness for mountain streams in Montana was 22 taxa. A minimum of 22 EPT taxa is proposed as a supplemental indicator in the FTPA. A *minimum* threshold value was chosen for EPT taxa because there are no long-term data to evaluate natural variability. At the time of this report, macroinvertebrate data were only available for one or two years at each site.

The *percentage of clinger taxa* in a sample is also proposed as a supplemental indicator. This metric is calculated as the number of individuals categorized as belonging to clinger taxa as a proportion of the total sample, and the value decreases in the presence of stressors. There are no values published in the scientific literature or other information on the expected percentage of clingers for the area. A high percentage of clingers suggests little impact from sediment. This metric, used in conjunction with the number of clinger taxa (Section 3.3.1.3), will provide supplemental information on the overall impacts of sediment.

Other individual macroinvertebrate metrics were evaluated based on their recognized response to certain stressors (Barbour, 1999). Continued research is needed to refine and document the diagnostic capabilities of these metrics and the response of individual species to specific pollutants. For that reason, the following metrics are included in the macroinvertebrate discussions to provide supporting information, but they are *not intended to be used as targets or supplemental indicators* for sediment impairments.

Percent tolerant taxa. The tolerance value designation is an estimate of the relative capacity of a taxon to survive and reproduce in the presence of stressors (for more discussion of tolerance values, see below). This metric is calculated as the number of tolerant taxa as a proportion of the total taxa richness in a sample, and it increases in the presence of stressors. A higher proportion of tolerant taxa suggests impacts to the biological condition. Since a threshold value for percent tolerant taxa has not been determined, this metric provides supplemental information regarding the possible impacts of other stressors.

Tolerance Values (TV) of the Dominant Taxa. The TV of the dominant taxa in a sample can also provide some indication of the presence of stressors at the site. Tolerance values for Montana benthic macroinvertebrate taxa were provided by Marshall and Kerans (2003 [draft]). Although the objectivity used in developing TVs is often unknown, the TVs of the dominant taxa were used as additional information to help interpret reach status. For each sampling site, the five dominant taxa in each sample and their associated stressor tolerance values were examined.

Hilsenhoff Biotic Index (HBI). The HBI is an abundance weighted index developed to assess impacts from organic pollution (Hilsenhoff 1987). Bahls et al. (1992) determined the average HBI value for mountain streams was less than 4. A conservative value of 3.5 is recommended for comparison.

3.3.1.6 Periphyton

MDEQ has collected periphyton samples at sites throughout the state for more than 15 years. Periphyton are recommended as an additional biological assemblage (USEPA, 1997, 2003) and diatoms, in particular, are considered useful water quality indicators because so much is known about the relative pollution tolerances of different taxa and the water quality preferences of common species (Bahls, 2003; Barbour et al., 1999). MDEQ uses several different diatom indices to assess stream condition.

Analysis of the periphyton data focused on the siltation index, which provides an indication of periphyton health with respect to sediment impact. The siltation index is the sum of the percent abundance of all species in the silt-tolerant diatom genera Navicula, Nitzschia, and Surirella. A high value (> 20.0) for this index indicates potential sediment impacts in mountain streams, and this was chosen as a supplemental indicator of impairment (Bahls, 2003). An annual not to exceed *maximum* supplemental indicator value was chosen because there are no long-term data to evaluate natural variability. At the time of this report, periphyton data were only available for one or two years at each site.

Summary findings from the periphyton data will provide additional information and could suggest the presence of other stressors. Both the siltation index and these summary findings will be used to derive conclusions regarding water quality at each site.

3.3.1.7 Pfankuch Ratings

The Pfankuch Stream Channel Stability rating was developed to "*systemize measurements and evaluations of the resistive capacity of mountain stream channels to the detachment of bed and bank materials and to provide information about the capacity of streams to adjust and recover from potential changes in flow and/or increases in sediment production*" (Pfankuch, 1978). This procedure uses a qualitative measurement with associated mathematical values to reflect stream conditions. The rating is based on 15 categories: 6 categories related to the bottom of the stream channel (the part of the channel covered by water yearlong), 5 related to the lower banks (covered by water only during spring runoff), and 4 related to the upper banks (covered by water only during flood stages). Prime fish habitat usually occurs in streams with a good rating.

The proposed supplemental indicators focus on two of the four categories related to the upper banks (i.e., mass wasting and vegetative bank protection), and two of the five categories related to the lower banks (i.e., cutting and deposition). These four categories are felt to provide the best information for interpretation of potential sediment impairments at selected sites within the FTPA. However, it should be noted that the results of these analyses do not differentiate between natural and anthropogenic causes. Also, the scores do not provide any indication of the natural potential of a stream (i.e., a stream's natural potential may only be "fair" for bank cutting). Pfankuch ratings are based on visual interpretation and, therefore, subject to observer bias. For these reasons, the ratings are considered supplemental indicators as opposed to targets and are used as supporting evidence of potential sediment impairments. In lieu of information that indicates the potential of a stream, a rating of "good" or better is proposed as an indicator value for the Pfankuch ratings.

> *Mass Wasting* provides a visual estimate of the degree to which mass wasting has occurred at a site or has the potential to occur in the future. Scores are assigned from 1 to 12, as defined in Table 3-8.
>
> *Vegetative Bank Protection* provides a visual estimate of vegetative density and the soil binding properties of the vegetation on the upper banks. As with Mass Wasting, scores are assigned from 1 to 12, as defined in Table 3-9.
>
> *Cutting* refers to the degree the lower bank the lower banks have eroded. Scores are assigned from 4 to16, as defined in Table 3-10.
>
> *Deposition* provides a visual estimate of the extent to which deposition has occurred on the lower banks. Scores are assigned from 4 to 16, as defined in Table 3-11.

Table 3-8. Mass Wasting Rating Description

Condition Description	Score	Rating
No evidence of past or future mass wasting	3	Excellent
Infrequent. Mostly healed over. Low future potential	6	Good
Frequent or large, causing sediment nearly yearlong	9	Fair
Frequent or large, causing sediment nearly yearlong or imminent danger of same	12	Poor

Table 3-9. Vegetative Bank Protection Description

Condition Description	Score	Rating
90%+ plant density. Vigor and variety suggests a deep dense soil binding root mass	3	Excellent
70–90% plant density. Fewer species or less vigor suggest less dense or deep root mass	6	Good
< 50–70% plant density. Lower vigor and fewer species for a shallow, discontinuous root mass	9	Fair
< 50% plant density. Less vigor and fewer species indicate poor, discontinuous, and shallow root mass	12	Poor

Table 3-10. Cutting Description

Condition Description	Score	Rating
Little or none. Infrequent Raw banks less than 6 inches	4	Excellent
Some, intermittently at outcurves and constrictions. Raw banks up to 12 inches	6	Good
Significant. Cuts 12-24 inches high. Root mat overhangs and sloughing evident	12	Fair
Almost continuous cuts, some over 24 inches high. Failure of overhangs frequent	16	Poor

Table 3-11. Deposition Description

Condition Description	Score	Rating
Little or no enlargement of channel or point bars	4	Excellent
Some new increase in bar formation, mostly from coarse gravels	8	Good
Moderate deposition of new gravel and coarse sands on old and some new bars	12	Fair
Extensive deposits of predominantly fine particles. Accelerated bar development	16	Poor

3.3.1.8 Fish Population

Fisheries are an important designated use in freshwater streams. Fish represent the higher trophic levels in streams and lakes. They serve as a surrogate for many physical and biological parameters such as adequate flow, spawning and rearing habitat, appropriate food sources, and proper environmental conditions.

MFWP has collected bull trout redd counts and juvenile bull trout and westslope cutthroat trout population estimates in many of the FTPA streams since the early 1980s (Deleray et al., 1999). Both redd counts and juvenile population densities provide a direct measure of the cold-water fishery beneficial use and therefore provide an important indicator of stream impairment. The proposed supplemental indicator is stable or increasing trends in redd counts and juvenile population densities.

Both the redd count and juvenile population density data are used with caution herein due to a number of complicating factors that have little to do with the condition of the spawning tributaries. As described in Section 2.2.2, migratory populations of bull trout, for example, have fluctuated due to food web changes in Flathead Lake. A major decline in redd counts in those tributaries contiguous with Flathead Lake (all North and Middle Fork tributaries) occurred in the 1990s as a result. In addition, fish populations might change due to effects outside of management control such as temperature, peak runoff, primary productivity, and competition from other fish species and invertebrate populations. For this reason, the proposed fisheries indicators must be used in combination with the full suite of targets to avoid misinterpretation.

3.3.1.9 Suspended Sediment Concentration

Considerable historical suspended sediment concentration data is available in several streams in the FTPA. These data have been evaluated and were considered as collaborative evidence in support of the water quality impairment status conclusions reached in Section 3.4.

Chepat Creek is a 3.4-mile long first-order tributary with a 1,112-acre watershed in the Upper Stillwater River Basin. The Montana Department of Natural Resources and Conservation (DNRC) (Mathieus, 2001) have collected flow and total suspended solids data in Chepat Creek annually since 1976 (n = 253). The catchment area of Chepat Creek has experienced only very minor timber harvest and contains few roads. The monitoring data from this water body are therefore considered baseline; that is, indicative of the water quality of an undisturbed watershed. The mean total suspended solids concentration for the period of record is 3.15 ± 5.83. The maximum reported value is 61.60 mg/L and the mean annual maximum is 14.56 mg/L. Theses values were chosen as supplemental indicators.

The above values are presented as metrics for comparison to the 303(d)-listed waters in the Flathead River Headwaters TPA. It is recognized herein that the Chepat Creek Basin is smaller than most of the subject basins within the FTPA. It is also recognized that the results for Chepat Creek are based on total suspended solids (TSS) concentrations as opposed to suspended solids concentration (SSC). SSC values have been shown to exceed TSS values in paired studies (Gray et. al., 2000). Therefore, comparison of the Flathead Headwaters SSC data with the Chepat Creek TSS data will result in a conservative comparison. However, these values are used only for *comparison purposes and as collaborating evidence* when combined with other more robust measures of sediment impairment.

3.3.1.10 Turbidity

Montana’s water quality standard for turbidity varies according to stream classification. The subject waters within the FTPA are all classified as B-1. For B-1 waters, the standard is no more than a 5 NTU (instantaneous) increase above naturally occurring turbidity. In the absence of sufficient data to characterize “naturally occurring turbidity,” it is not possible to directly apply this standard as a TMDL target.

As a result, although turbidity data are available they will be used only as collaborating evidence when combined with other more robust measures of sediment impairment. The State of Idaho’s standard to protect cold-water aquatic life will be used as the proposed supplemental indicator value. In accordance with Idaho’s Water Quality Standards and Wastewater Treatment Requirements (Section 58.01.02.250.02.e), turbidity below any applicable mixing zone should not be greater than 50 NTU (instantaneous). This value will be applied to high flow events or during the time of annual runoff. Some evidence suggests that detrimental effects on biota can occur with turbidity as low as 10 NTU. The State of Idaho therefore has recommended that chronic turbidity not exceed 10 NTU during summer base flow. To be conservative, both of these values are applied as instantaneous maximum supplemental indicators in the Flathead River Headwaters Planning Area.

3.3.1.11 Sediment Sources

The FTPA is sparsely populated and relatively remote with substantial areas under the protection of the National Park Service or Wilderness Designation. Therefore, it is not appropriate to assume that deviations from the targets and/or supplemental indicators are necessarily a result of human actions. Consideration of sources, therefore, is important given that TMDLs are necessary only for impairments caused by anthropogenic sources.

The FNF conducted a detailed sediment source assessment in 2002 and 2003 focusing on the identification of active sediment sources associated with their past and current management activities and road networks (Appendix B). A GIS and aerial photography assessment was conducted to identify managed areas with the potential for erosion and sediment delivery to streams. This was followed by site reconnaissance visits to verify the results of the remote investigation in roughly 50 percent of the areas considered potential source areas.

Several indicators were chosen to describe the impact of potential sources of sediment in the FTPA. Each indicator is described below in more detail.

> ***Fire.*** Fire is a common occurrence in the western Montana landscape and it can be the cause of impaired beneficial uses in a stream. A burned landscape can result in increased water yield, increased sediment runoff, and increased organic loading, and it can cause changes to the stream channel (log jams, increased woody debris). In the TMDL process, it is important to understand the fire history of a watershed as it relates to measured in-stream data. In-stream data, such as data on macroinvertebrates or percent fines data, can indicate an impairment that is completely due to natural sources, such as fire. Because of this, the fire history is described in the source assessment section for each watershed to provide a better understanding of natural sources of sediment.
>
> ***Equivalent Clear-Cut Acres.*** The impact of forest harvest was evaluated for each watershed by calculating the equivalent clear-cut acreage (ECA). ECA is an estimate of the cumulative effect of multiple years of forest crown removal (including both harvest and fire), and is calculated by considering the timing, amount, and location of cut acres in the watershed. In general, an ECA of greater than 25 percent suggests a potential for increased water and sediment yield (Jones and Grant, 1996). Region 1 of the Forest Service also suggests that watersheds with an ECA greater than 25 percent are at risk for having detrimental increased water yields (Bengeyfield, personal comm., June 11, 2004). FNF calculated ECAs for the spring of 2004 using a modified WATSED model.
>
> ***Water Yield.*** An increase in water yield can lead to increased flows, higher bank erosion rates, more scouring, and sediment imbalances in a stream. The Montana DNRC calculated water yields using a modified version of WATSED for six watersheds in the FTPA: Coal Creek, Lower Coal Creek, Cyclone Creek, Dead Horse Creek, Upper Coal Creek, and South Fork Coal Creek (FNF, 2004). In general, water yield increases greater than 10 percent in Rosgen “C” type channels indicate that increased sediment yield and channel altering flows might be present. Increases in water yield generally have less impact on A and B stream types (see section 2.1.3 for an explanation of stream types) because of their gradient and channel dimensions.
>
> ***Roads.*** The FNF crew completed driving and walking surveys on all open, closed, and decommissioned roads in the 303(d)-listed watersheds. Roads were evaluated to determine the condition and number of road/stream crossings, and the number of road miles in need of best management practices (BMPs). Total road miles within 125 feet of the stream, total road miles within 300 feet of the stream, and road density were then evaluated in a geographic information system (GIS). Road density was compared to the Forest Service rankings described in Table 2-9. As a supplemental indicator, roads were evaluated on a case-by-case basis for each 303(d) listed watershed to determine potential effects.

These supplemental indicators have been proposed to assist in verifying water quality impairment determinations. No water quality goals or endpoints involving sources are proposed. A detailed consideration of sources is provided in Section 4.0 for those waters described as impaired in Section 3.4.

3.3.2 Nutrient Targets

The proposed nutrient targets reflect EPA's nutrient criteria and benthic chlorophyll-*a* for Nutrient Ecoregion II (Western Forested Mountain) streams.

3.3.2.1 EPA Ecoregion Nutrient Criteria

EPA has proposed nutrient criteria for ecoregions throughout the United States. Criteria for Nutrient Ecoregion II (Western Forested Mountains) are proposed here as targets for North Fork Coal Creek (USEPA, 2000). Recommendations are for median total phosphorus, total nitrogen, nitrate plus nitrite, and total Kjeldahl nitrogen (TKN) concentrations, and are proposed here as 5-year median targets for the North Fork Coal Creek (Table 3-12).

Table 3-12. Nutrient Concentration Targets for the North Fork Coal Creek

Nutrient Parameter	Threshold Value
Total Phosphorus	< 0.01 mg/L
Total Nitrogen	< 0.12 mg/L
Nitrate+Nitrite (NO_2/NO_3)	< 0.014 mg/L
Total Kjeldahl Nitrogen (TKN)	< 0.05 mg/L

3.3.2.2 Benthic Chlorophyll-*a*

Benthic algae (also known as *periphyton*) are found growing on substrate surfaces in streams, unlike free-floating organisms found in the water column (phytoplankton). Benthic algae data help to provide a better understanding of the cumulative and intermittent impacts that may have occurred over time in a stream, and are useful for determining whether impairments due to nutrients are present. EPA has proposed benthic algae criteria for Nutrient Ecoregion II streams (Western Forested Mountains) based on the measured amount of chlorophyll-a (in milligrams) divided by the total substrate area (in square meters). The EPA's proposed criterion, based on the 25th percentile of an ecoregional dataset, is a median value of less than 33 mg/m^2. A value of less than 33 mg/m^2 is proposed as a target.

3.3.3 Nutrient Supplemental Indicators

The proposed supplemental indicators are not sufficiently reliable to be used alone as a measure of nutrient impairment in the streams within the FTPA. These indicators are used as supplemental information, in combination with the targets, to provide better definition to potential nutrient impairments.

3.3.3.1 Hilsenhoff Biotic Index

The HBI is an abundance-weighted macroinvertebrate index developed to assess impacts from organic pollution and associated low dissolved oxygen in streams (Hilsenhoff, 1987). The index assesses the tolerance value and abundance of various macroinvertebrates with specific sensitivities to organic loading. A low index score indicates good water quality with no indication of organic enrichment. A high HBI score suggests that long-term low dissolved oxygen concentrations are present, usually due to organic loading. Bahls et al. (1992) determined that the average HBI value for reference Montana mountain streams was less than 4. Bollman (2002, 2003) has also applied the HBI index to various streams through out northwest Montana to assess the presence of organic loading. A conservative maximum value of 3.5 is recommended for comparison.

3.3.3.2 Mountain IBI

Macroinvertebrate data are typically organized according to a multimetric index of biological integrity (IBI). 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 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 FTPA based on site characteristics, primarily elevation. The sites in the FTPA are located within the Northern Rockies ecoregion (Woods et al., 1999) and range in elevation from 4,000 to 6,000 feet. MDEQ uses a scoring procedure with a maximum possible score of 100 percent. Total scores *greater than 75 percent* are considered within the range of expected natural variability and represent full support of their beneficial use (aquatic life). This score is proposed as a supplemental indicator for streams in the FTPA. Streams scoring between 25 percent and 75 percent are considered partially supporting their aquatic life uses and scores lower than 25 percent represent unsupported uses.

3.3.3.3 Water Column Chlorophyll-*a*

EPA has proposed water column chlorophyll-*a* concentrations as part of the ecoregional nutrient criteria. Concentrations are measured as the amount of chlorophyll-*a* in the water column, and can provide an indication of the amount of algal biomass in the stream. High chlorophyll-*a* concentrations suggest that there is an excessive amount of algae in a stream, which further suggests that excessive organic loading is present. Water column chlorophyll-*a* is referred to as a *response variable* as opposed to a direct nutrient measurement and, as such, is included as a supplemental indicator. EPA (2000) suggested that median water column chlorophyll-*a* values for Western Forested Mountain streams should not exceed 1.08 µg/L. This is proposed as a supplemental indicator for the North Fork Coal Creek.

3.3.3.4 Dissolved Oxygen

Nutrients generally do not pose a direct threat to the beneficial uses of a water body. However, excess nutrients can cause an undesirable abundance of plant and algae growth. This process is called eutrophication or organic enrichment. Organic enrichment can have many effects on a stream or lake. One possible effect is low dissolved oxygen concentrations. Aquatic organisms require oxygen to live and they can experience lowered reproduction rates and mortality with lower dissolved oxygen concentrations.

MDEQ’s numeric dissolved oxygen criteria are shown in Table 3-13, and are proposed as supplemental indicators for the determination of nutrient impairments (MDEQ, 2004). Because North Fork Coal Creek is used by several species of fish for spawning (including bull trout), the more stringent water column criteria are proposed to ensure that inter-gravel dissolved oxygen concentrations are met.

Table 3-13. Numeric Dissolved Oxygen Criteria.

Time Period	Early Life Stages[a]	Other Life Stages[b]
30-Day Mean (mg/L)	NA	6.5
7-Day Mean (mg/L)	9.5	NA
7-Day Mean (minimum) (mg/L)	NA	5.0
1-Day Minimum (mg/L)	8.0	4.0

[a] Dissolved oxygen criteria applicable when early life stages are present.
[B] Dissolved oxygen criteria applicable when early life stages are not present.

3.3.3.5 Nutrient Sources

As with sediment, it is not appropriate to assume that deviations from the targets and/or other supplemental indicators are necessarily a result of man's actions. Consideration of sources, therefore, is important given that TMDLs are necessary only for nutrient impairments that have anthropogenic causes. Three indicators were chosen: Fire, Equivalent Clear-Cut Acres (ECA), and Water Yield. Fires have the potential to directly increase inorganic nutrient loading to a stream by converting organic matter to soluble, inorganic nutrients. ECA also captures the effects of fire, and therefore is included as a supplemental indicator. Furthermore, clear-cuts and increased water yield can result in increased nutrient concentrations in a stream (Hauer et al., 1991). Each of those supplemental indicators is discussed in more detail in Section 3.3.2.7.

3.4 Current Water Quality Impairment Status

This section presents summaries and evaluations of all available water quality data for waters appearing on Montana's 1996 and 2002 303(d) lists. The weight-of-evidence approach described above in Section 3.3, using a suite of targets and supplemental indicators, has been applied to verify each of the water quality impairments listed in 1996 and 2002. This section provides supporting documentation for each water body within each of the three major drainages.

3.4.1 North Fork Flathead River Watershed

The North Fork Flathead River watershed (which lies within both Canada and the United States) spans 997,176 acres, or 1,558 square miles (Figure 3-4). The North Fork Flathead River flows for 53.8 miles in Canada and 54.2 miles in the United States for a total of 108 river miles. The Canadian portion of the drainage spans 375,919 acres or 593 square miles. The U.S. portion of the drainage spans 617,598 acres or 965 square miles.

To paraphrase from Stanford (2000), the North Fork differs substantially from the Middle Fork, South Fork, and the main stem of the Flathead River. The North Fork flows through a broad alluvial valley with braided and anastomosed channels and expansive floodplains. The North Fork primarily drains lands underlain by Precambrian Belt series bedrocks. The North Fork river corridor offers nearly intact ecological connectivity. Biota are able to migrate longitudinally from headwaters to the confluence with the Middle Fork and on to Flathead Lake. The expansive floodplains of the river link the channel to the uplands and foster movements between Glacier National Park and the Whitefish Range.

Streams listed as impaired on Montana's 303(d) list in the North Fork Flathead River watershed are Big Creek, Red Meadow Creek, Whale Creek, the South Fork Coal Creek, North Fork Coal Creek, and Lower Coal Creek – Main stem.

3.4.1.1 Big Creek

The cold-water fishery and aquatic life beneficial uses in Big Creek were listed as impaired on the 1996 303(d) list. The FNF completed a Watershed Restoration Plan for Big Creek, including all necessary TMDLs. EPA approved the TMDL for Big Creek on May 9, 2003. As a result, Big Creek is not discussed further herein.

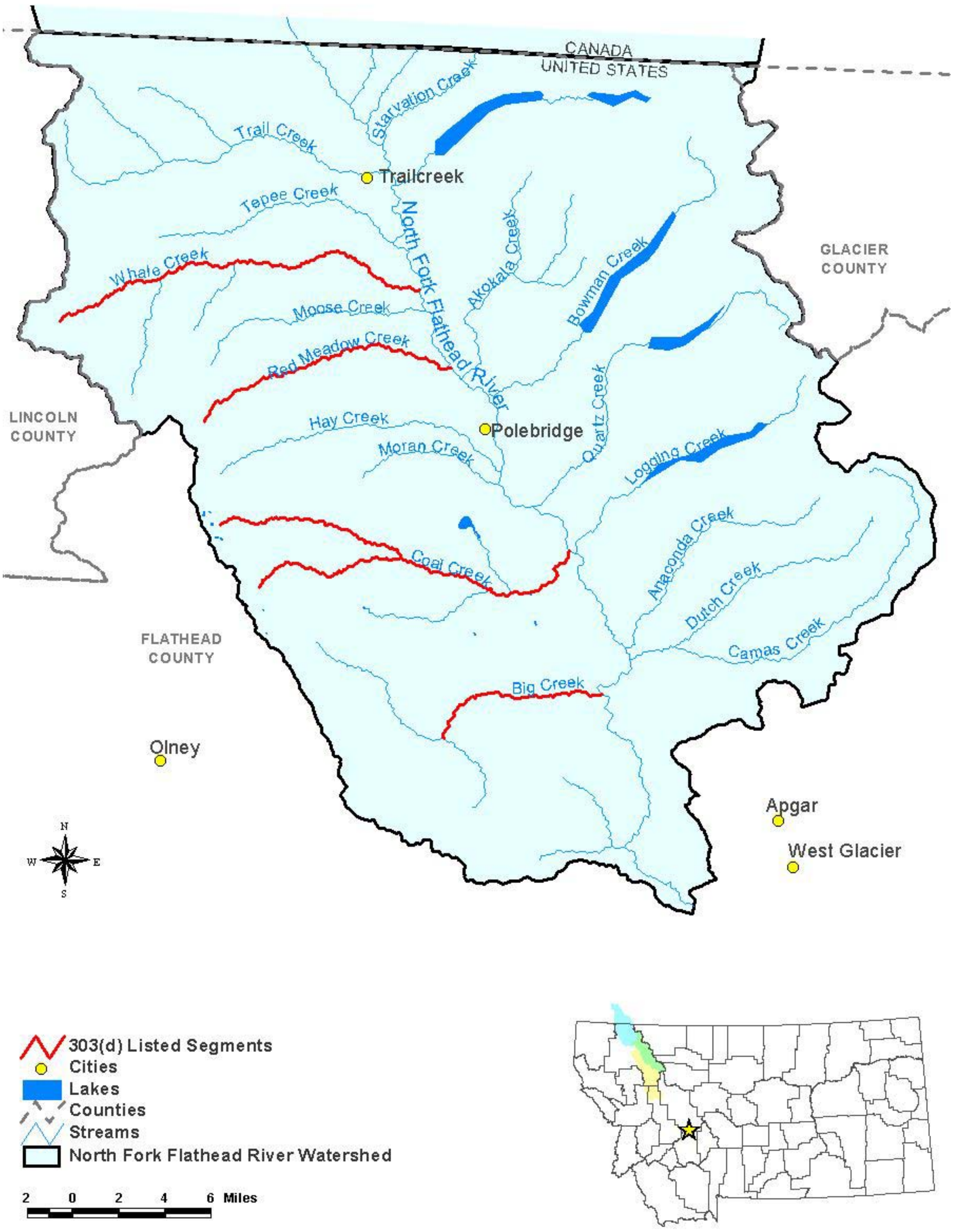


Figure 3-4. North Fork Flathead River watershed.

3.4.1.2 Red Meadow Creek

Red Meadow Creek is a second-order tributary flowing approximately 12 miles from its origin at Red Meadow Lake to its confluence with the North Fork Flathead River (Figure 3-5). The total watershed area covers roughly 30 square miles. The cold-water fishery and aquatic life beneficial uses were listed as impaired by habitat alterations and siltation on both the 1996 and 2002 303(d) lists. The basis for the 1996 listing is unknown. According to MDEQ's Assessment Record Sheet (Chesnut, 1999), the 2002 listing was based primarily on the results of a 1989 MDEQ stream assessment conducted in two reaches of Red Meadow Creek. For the headwaters reach, MDEQ concluded the following:

> *"…large amount of debris in channel, especially cut logs. Excessive sediment accumulation in pools behind debris jams. Scouring is also present. The channel has undergone migration due to debris. Several jams large enough to prevent fish passage. Impairments most likely due to logging operation. There is also litter from recreation users near the upper end."*

MDEQ's Assessment Record Sheet also cited a decline in fish populations since 1983. It should be noted that MDEQ's 1989 stream assessment was conducted 1 year after the Red Bench Fire occurred in the lower reaches of this watershed, reflecting a large amount of large woody debris following the fire (Deleray et al., 1999). Because of the fire, MDEQ noted that it was difficult to attribute sediment-related impairments in the lower reaches of Red Meadow Creek to anthropogenic sources.

A review of the available data is presented below. Available data include substrate scores, McNeil cores, Pfankuch ratings, pebble counts, sources (fires, harvest, roads), macroinvertebrates, and fish population estimates. The SSC and turbidity data are outdated and are too limited in number to be useful, and therefore, they are not considered further.

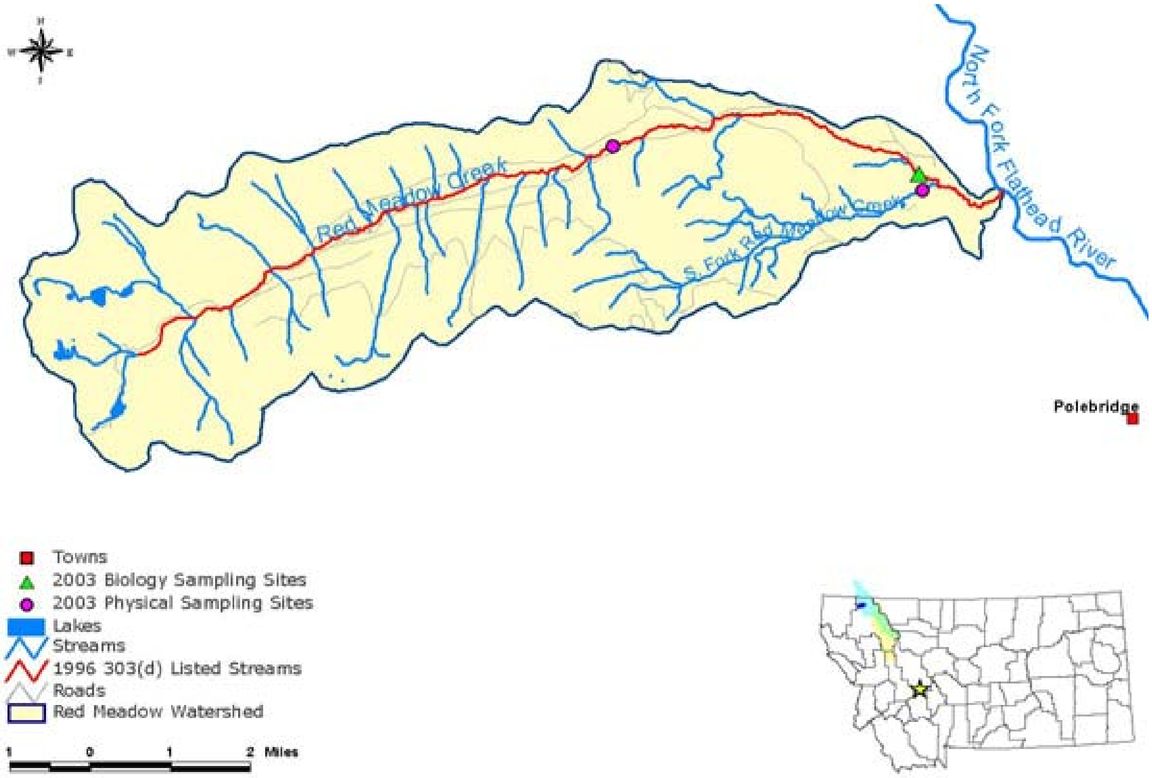


Figure 3-5. Red Meadow Creek watershed.

McNeil Core

MFWP collected McNeil core samples in Red Meadow Creek in 1988 and 1989 (Weaver et al., 2003). A mean value of 40.1 percent fines smaller than 6.35 mm was reported. As in the 1989 MDEQ field assessment, the data were collected soon after the Red Bench Fire. No conclusions can be reached regarding this target in the absence of recent data.

Substrate Scores

Substrate scores were calculated based on MFWP stream surveys conducted from 1988 through 2002 (Deleray, et al., 1999). From 1998 to 2002, the mean substrate score was 11.9, indicating good juvenile bull trout rearing habitat quality. The mean substrate score for the period of record (1984–2002) was also 11.9.

Pebble Counts

Pebble counts were conducted at two sites: one on the South Fork of Red Meadow Creek on July 10, 2003, and one on the main stem of Red Meadow Creek on July 8, 2003. The percent surface fines smaller than 2 millimeters at the South Fork and main-stem sites were 18.75 percent and 12.71 percent, respectively. Both values are below the 20 percent target, and suggest no impairment from siltation.

Macroinvertebrates

Macroinvertebrate sampling was performed at one site on Red Meadow Creek in August 2003. The number of clinger taxa (23) was above the target of 14, which suggests that sediment impacts were not present. The Mountain IBI was 81, which is above the 75 percent recommended value to be considered fully supporting aquatic life beneficial uses. There were a high number of EPT taxa (27) and a high percentage of clinger taxa (69 percent). Other supporting metrics also suggest that no water quality impairments were present. No tolerant taxa were found in the sample. The HBI score was 2.63, which is below the recommended value of 3.5. The five most dominant taxa (*Heterlimnius, Arctopsyche grandis, Drunella doddsi*, *Epeorus deceptivus*,and *Baetis tricaudatus*) had low tolerance values and are sensitive to pollution. The entire suite of macroinvertebrate metrics suggests that the site on Red Meadow Creek shows no evidence of siltation or any other water quality problems.

Fish Population

MFWP conducted electrofishing surveys between 1983 and 2002 in Red Meadow Creek (Deleray et al., 2003). Densities of bull trout 1 year old or more have declined from a high of 5.9 per 100 square meters in 1983 to 0.16 per 100 square meters in 1995 (Figure 3-6). Bull trout redd counts (1980-2000) also showed a declining trend. However, declines in the bull trout population may be due to changes in the Flathead Lake ecosystem, and do not necessarily indicate beneficial use impairment (see Section 2.2.2). Westslope cutthroat trout populations fluctuated over the same period of record, but unlike the bull trout, showed no overall trend (Figure 3-6). This indicates that the cause of the declining bull trout population is not similarly affecting the westslope cutthroat trout population.

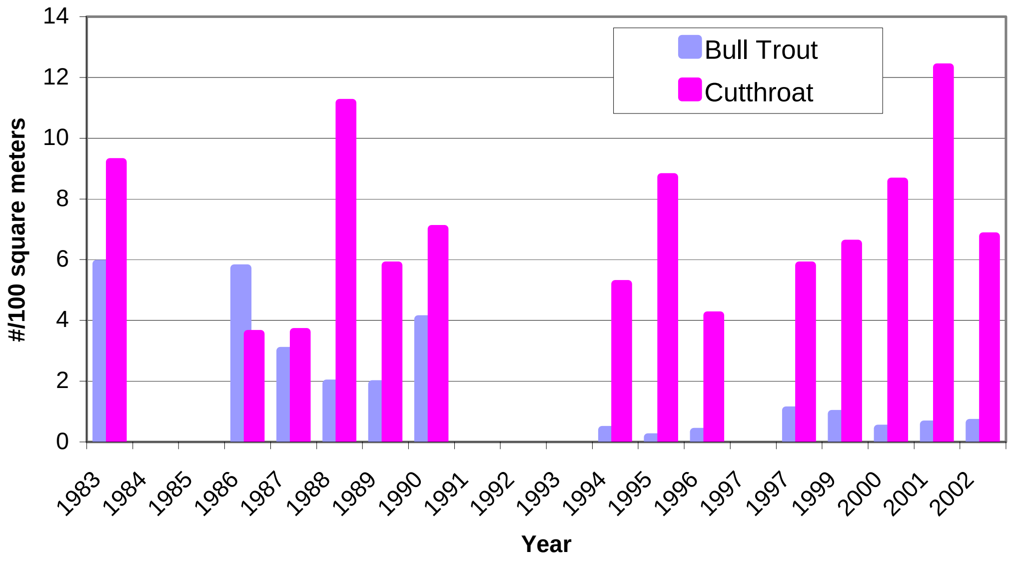


Figure 3-6. Age 1 and older bull trout and Westslope cutthroat trout densities in Red Meadow Creek.

Pfankuch Ratings

Pfankuch ratings were estimated at three locations along an approximately 1,000-foot-long reach of Red Meadow Creek on July 9, 2003. The three ratings were averaged to provide a single value for each of the four Pfankuch categories listed in Table 3-14. Although these results are based on visual observation and are therefore qualitative, they suggest that the stream banks are in relatively good shape (i.e., good and excellent scores for mass wasting and cutting) with excellent vegetative bank protection. Deposition of fine material along the lower banks is minor.

Table 3-14. Selected Pfankuch Ratings for Red Meadow Creek

Pfankuch Category	Score	Rating
Mass Wasting	4	Good
Vegetative Bank Protection	2.67	Excellent
Cutting	8	Good
Deposition	6	Good

Sources

As shown in Figure 2-26, approximately 24 percent of the watershed burned in 1988 in the Red Bench Fire. There have been no significant fires in Red Meadow Creek since then. Since 1960, clear-cut harvest has occurred in approximately 13 percent of the watershed. Clear-cut harvest trends have declined substantially since 1960, with the last harvest occurring in 1990 when 1.5 percent of the watershed was clear-cut. The calculated equivalent clear-cut acreage (ECA) for 2004 is 12.2 percent

The FNF identified active upland erosion areas during a source assessment survey conducted in 2003 (Appendix B). Total road density in the Red Meadow watershed is 1.1 miles/square mile, and a total of 76 road/stream crossings were identified and evaluated (FNF, 2003). None were considered at risk of failure. Nine miles of roads are in need of BMPs or upgrading. Most of this road length (8 miles) is a stretch of the main access road (Road 115), which needs improved drainage at first-order stream crossings and more ditch relief culverts to reduce sediment. One mile of Road 115A might be contributing sediment, and it is in need of grading, ditch relief, water bars, and culvert maintenance. Almost half the roads in the watershed are located within 125 feet of a stream channel (14.6 out of 33.4 miles). Although road density is fairly low, it appears that roads are contributing some sediment to streams.

Red Meadow Creek Water Quality Impairment Summary

Red Meadow Creek was listed on the 1996 and 2002 303(d) lists as impaired because of siltation and habitat alterations. Aquatic life and cold-water fishery beneficial uses were the listed impaired beneficial uses.

It appears that beneficial uses are not currently impaired by siltation in Red Meadow Creek. The target and supplemental indicator values are met for all parameters except McNeil cores and bull trout populations. Based on the FNF's source assessment survey, there are some actively eroding sediment sources in the Red Meadow Creek watershed; however, no evidence exists of sediment-caused impairment in the macroinvertebrate data. Macroinvertebrate scores indicate that the aquatic life beneficial uses are not impaired, and the high clinger values suggest that there are no aquatic life impairments associated with sediment. Neither the substrate scores nor the percent surface fines suggest sediment impairment. Finally, none of the visual estimates of mass wasting, vegetative bank protection, bank cutting, and lower bank deposition suggest sediment-related water quality impairments.

Although the mean McNeil core value (40.1 percent subsurface fines smaller than 6.35 millimeters) exceeds the target, the McNeil cores were collected roughly 14 years ago (two samples), soon after a fire that burned 24 percent of the watershed. Therefore, the McNeil core data are not considered valid for making current beneficial use impairment determinations. The decline in bull trout redd counts and juvenile population cannot necessarily be attributed to water quality conditions in Red Meadow Creek because of the possible influences of Flathead Lake on the bull trout population. The fact that juvenile cutthroat populations have not declined over the same period of record suggests that habitat conditions in Red Meadow Creek are good.

Table 3-15. Comparison of Available Data with the Proposed Targets and Supplemental Indicators for Red Meadow Creek

Targets	**Threshold**	**Available Data**
5-year Mean McNeil Core Percent Subsurface Fines < 6.35 mm	35%	40.1%*
5-year Mean Substrate Scores	≥ 10	11.9
Percent Surface Fines < 2 mm	< 20%	12.7%
Clinger Richness	≥ 14	23
Supplemental Indicators	**Recommended Value**	**Available Data**
Juvenile Bull Trout and Westslope Cutthroat Trout Density	Documented increasing or stable trend	Stable (Cutthroat) Decline (Bull)
Bull Trout Redd Counts	Documented increasing or stable trend	Decline
SSC Mean SSC Mean Annual Maximum SSC Maximum	3.2 ± 5.2 14.6 61.6	NA
Turbidity	High flow – 50 NTU instantaneous maximum Summer base flow – 10 NTU	NA
Pfankuch Mass Wasting Score	“good”	Good
Pfankuch Bank Vegetation Score	“good”	Excellent
Pfankuch Cutting Score	“good”	Good
Pfankuch Deposition Score	“good”	Good
Montana Mountain Macroinvertebrate Index of Biological Integrity	> 75%	81%
Percentage of Clinger Taxa	“high”	69%
EPT Richness	≥ 22	27
Periphyton Siltation Index	< 20	NA
Fire	Evaluated on a case-by-case basis	Year: 1988 % Burned: 24
Equivalent Clear-Cut Acres	< 25%	12.2%
Water Yield	< 10%	NA
Roads	Evaluated on a case-by-case basis	Some roads in need of BMPs

**Historical data from 1988/1989*

3.4.1.3 Whale Creek

Whale Creek is a third-order tributary of the North Fork Flathead River flowing 21 miles from the headwaters to the mouth (Figure 3-7). The total watershed area covers approximately 78 square miles. The cold-water fishery beneficial use was listed as threatened on the 1996 303(d) list because of habitat alterations and siltation. The basis for the 1996 listing is unknown. Cold-water fishery and aquatic life beneficial uses were listed as impaired on the 2002 303(d) list because of habitat alterations and siltation. According to MDEQ's Assessment Record Sheet (Chestnut, 1999), the 2002 listing was based primarily on the results of a 1989 MDEQ stream assessment that indicated that the impaired reach extends from the headwaters to the confluence with Shorty Creek, and

"Sedimentation problems, stream braiding, cut logs in channel all attribute to impairment. Improper logging procedures are most likely cause of the problems."

A review of the available data is presented below. Available data include substrate scores, McNeil cores, Pfankuch ratings, pebble counts, sources (fires, harvest, roads), macroinvertebrates, suspended sediment concentration data, turbidity data, and fish population estimates.

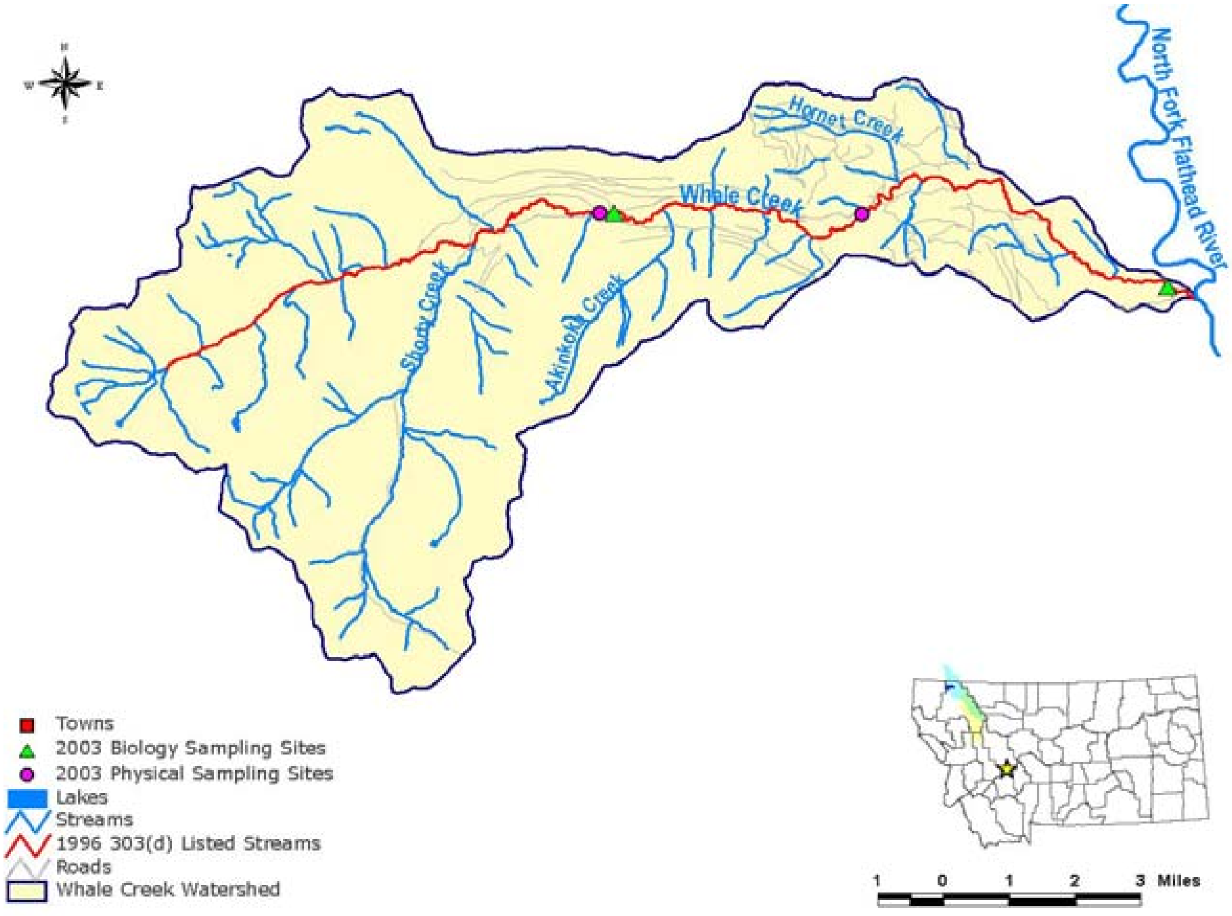


Figure 3-7. Whale Creek watershed.

McNeil Core

MFWP collected McNeil core samples in Whale Creek between 1981 and 2001 (Weaver et al., 2003). The mean value for the past 5 years is 31.3 percent fines smaller than 6.35 millimeters. In 2001, the McNeil core value was 31.6 percent and the maximum for the past 5 years is 31.9. All of these values are below the proposed target.

Substrate Scores

Substrate scores were calculated based on MFWP stream surveys conducted in 1988 through 2002 (Deleray et al., 1999). From 1998 to 2002, the mean substrate score was 12.2, indicating good juvenile bull trout rearing habitat quality. The mean substrate score for the period of record was 11.8.

Pebble Counts

Pebble counts were conducted in two reaches (at three locations in each reach – upper, cross section, and lower) in Whale Creek in 2003. Whale Creek reach #1 is the downstream reach near the confluence with Hornet Creek (Figure 3-7). The percent surface fines smaller than 2 millimeters at reach #1 were 11 percent (upper), 27 percent (cross section), and 19 percent (lower). The average percent surface fines for this reach was 19 percent, which is below the proposed target of 20 percent.

Whale Creek reach #2 just upstream of the confluence with Akinkoka Creek (Figure 3-7). The percent surface fines smaller than 2 millimeters at reach #2 were 21.6 percent (upper), 13.3 percent (cross section), and 15.7 percent (lower). The average percent surface fines for this reach was 16.9 percent, which is below the proposed target of 20 percent.

Overall, the percent surface fines in Whale Creek suggest that the stream is not impaired because of siltation.

Macroinvertebrates

Macroinvertebrates were collected at two sites in Whale Creek in August 2003 (Figure 3-7). Organisms at the upstream site suggest cold, clean water and little anthropogenic influences (Bollman, 2003b). The number of clinger taxa (20) was above the target of 14, which suggests that sediment impacts were not present. Also, the Mountain IBI score (81) and percentage of clingers (70) were greater than the recommended values. Both suggest good water quality with no impairment from sediment. Only the number of EPT taxa (20) was slightly lower than the indicator value. Other supporting metrics also suggest that no water quality impairments were present. The sample was dominated by sensitive taxa, and the HBI score (2.41) was lower than the recommended value of 3.5. The five most dominant taxa (*Rhithrogena, Eukiefferiella Brehmi Gr., Drunella doddsi, Epeorus deceptivus,* and *Epeorus grandis*) all had low tolerance values and are intolerant to pollution. Overall, the data suggest that aquatic life at the upstream site on Whale Creek is not impaired because of sediment.

Macroinvertebrates were also collected at a downstream site in Whale Creek near the North Fork Road Bridge. Clinger data (16 taxa, 89 percent of the sample) indicated that sediment was not a cause of impairment at this site. However, the Mountain IBI score (57) is below the 75 percent supplemental indicator, suggesting that some sort of stressor might be present. The number of EPT taxa was also slightly lower than expected (18 taxa). One possible explanation for this is the 2003 fires in the lower Whale Creek watershed. Sampling occurred immediately after the fires, and the macroinvertebrate population may reflect post-fire impacts. Other supporting metrics suggest that no water quality impairments were present. The HBI score was good (2.45). Of the five most dominant taxa (*Simulium, Epeorus deceptivus, Rhithrogena, Prosimulium,* and *Drunella doddsi*), three are very sensitive to pollution. It was noted in the field notes and in the taxonomic analysis that this site was dominated by blackfly larvae (48 percent), which resulted in a decreased overall index score due to their relative abundance and pollution tolerant characteristics. Bollman (2003b) noted that given the clustering of blackfly larvae, a "large number can compromise the availability of substrate space for other clingers." Geology at this site is also significantly different from the upstream site, and is composed of glacial outwash and alluvium as opposed to the older Belt Rocks. These factors, along with the 2003 fires, could explain the decreased IBI score.

Overall, it appears that aquatic life at the downstream site on Whale Creek might be slightly impaired because of natural causes. Sediment does not appear to be a cause of impairment.

Fisheries Data

Bull trout redd counts between 1980 and 1997 in Whale Creek suggest a declining trend (Weaver et al., 2003) (Figure 3-8). Redd count declines in the early 1990s are thought to reflect the overall trend in the North and Middle Fork Flathead River watersheds due to changes in the Flathead Lake ecosystem and food chain (see Section 2.2.2). However, redd counts show an increasing trend from 1998 to 2002, and indicate a recent rebound in the bull trout population. This may be partially due to the fact that bull trout were listed as a threatened species during this time period, and harvest became illegal, or could be a function of improving habitat/water quality conditions in this stream. Unlike the redds, juvenile bull trout populations have fluctuated and showed no overall trend during the same time period (Figure 3-9).

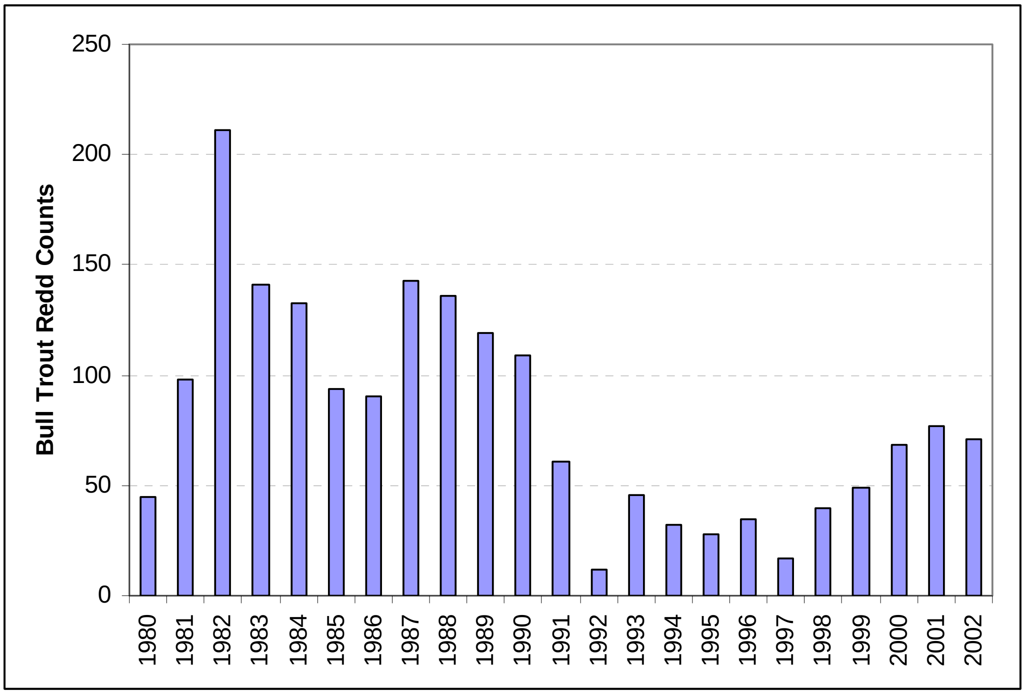


Figure 3-8. Bull trout redd counts in Whale Creek.

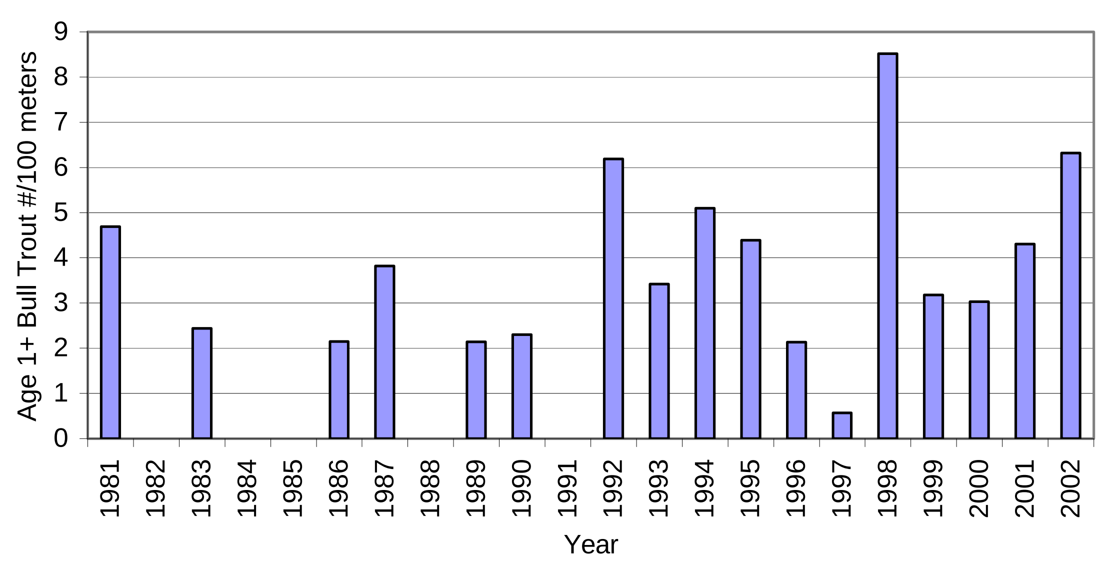


Figure 3-9. Age 1 and older bull trout densities in Whale Creek.

Pfankuch Ratings

Pfankuch ratings were estimated at six locations in Whale Creek between 1976 and 2003. A summary of the four Pfankuch indicators is provided in Table 3-16. Good to excellent mass wasting and vegetative protection was observed in 2003. Some bank cutting and sediment deposition was also noted in 2003.

Table 3-16. Pfankuch Ratings for Segments of Whale Creek

Stream Segment	Year	Mass Wasting	Vegetative Bank Protection	Cutting	Deposition
RM 8.8	1976	Excellent	Good	Fair/Good	Fair
RM 8.8	1979	Excellent	Good	Fair/Good	Good
RM 12.1	1976	Excellent	Good	Excellent	Excellent
RM 12.1	1979	Excellent	Excellent	Excellent	Good
RM 7.0	1994	Poor	Good	Fair	Good
Whale1-UL	2003	Good	Excellent	Fair/Good	Fair
Whale1-CS	2003	Good	Excellent	Fair/Good	Fair
Whale1-LL	2003	Good	Excellent	Fair/Good	Good

RM= river mile.

Suspended Sediment Concentration

Suspended sediment concentration (SSC) data were collected in Whale Creek on nearly an annual basis between 1978 and 1994 (n = 221). In general, samples were collected to capture spring runoff (in April, May, and June) as well as base flow conditions (in July, August, September, October, and November). However, the frequency of sampling varied from year to year.

The absence of current SSC data prohibits the use of the older data for making a current impairment determination. However, the data are useful in evaluating long-term trends and in making historical comparisons with other streams in the FTPA. The mean for the period of record, mean annual maximum, and maximum reported values are presented in Table 3-17. The mean SSC concentration was below the range for the supplemental indicator mean concentration. The mean annual maximum was similar (but slightly higher) to the supplemental indicator value and the maximum value was higher than the supplemental indicator value. It is expected that Whale Creek should have slightly higher sediment concentrations because the watershed is much larger than Chepat Creek. Nonetheless, the maximum values were exceeded.

Table 3-17. Comparison of Available SSC Data for Whale Creek with the Supplemental Indicator Values

SSC Metric	Observed Value (mg/L)	Indicator Value for Comparison (mg/L)
Mean (mg/L)	4.03	3.15 ± 5.83
Mean Annual Maximum (mg/L)	21.29	14.56
Maximum (mg/L)	97.80	61.60

Turbidity

Turbidity data were collected in Whale Creek for roughly the same period of record as the SSC data (1978–1994, n = 192). As with the SSC data, a lack of current data prohibits the use of the older data for making a current impairment determination, but the data are useful in evaluating long-term and historical trends. The mean turbidity for the period of record is 1.21 NTU and the median is 0.90 NTU. The maximum recorded value was 17 NTU in May 1987. The average and median turbidity values are well below the proposed target of 10 NTU during summer base flow. The turbidity data suggest that sediment is not impairing beneficial uses in Whale Creek.

Sources

There was a 32-acre fire in the Shorty Creek watershed in 1973 and much of the lower (downstream) watershed burned in the 2003 fires (4,802 acres, 12 percent). The large burned area from the 2003 fires will most likely contribute natural amounts of increased sediment to Whale Creek over the next several years.

Since 1960, clear-cut harvest occurred on approximately 4,800 acres (16 percent) of the Whale Creek watershed (FNF, 2003). The most recent clear-cut occurred in 2000. On average, approximately 171 acres were clear-cut per year between 1960 and 2003. Clear-cut acreage was higher during the 1960s and 1970s, and has tapered off from 1980 through 2003. The calculated equivalent clear-cut acreage (ECA) for 2004 is 14 percent, which is below the indicator value of 25 percent. Overall, clear-cut land does not appear to be a significant source of sediment.

In 2003, the FNF identified several areas where roads are contributing sediment to Whale Creek or its tributaries: 8 out of 84 road/stream crossings are at risk for failure, mostly on Route 589 in the Shorty

Creek watershed (FNF, 2003); 11 closed and 10 open road miles need improved BMPs to reduce sediment delivery, and several culverts were found to be contributing sediment; and 27 out of 44 road miles are within 125 feet of a stream (30 miles within 300 feet). However, half the roads in the Whale Creek watershed are closed (22 out of 44 miles), and the road density is very low (0.68 miles/square mile).

Whale Creek Water Quality Impairment Summary

Whale Creek was listed on the 1996 and 2002 303(d) lists as impaired because of habitat alterations and siltation. Aquatic life and cold-water fisheries were the listed impaired beneficial uses. The previous sections reviewed the available data for making a refined impairment determination, and those data are summarized below and in Table 3-18.

Overall, it appears that siltation is not currently impairing beneficial uses in Whale Creek. None of the target values were exceeded. McNeil core and substrate scores were collected at one site over multiple years, and both sets of data indicate good substrate conditions. Good substrate conditions were also noted in the percent surface fines at two different sites. There is no indication of sediment impairment in the macroinvertebrate data, as the number of clinger taxa was high (more than 14) at two sites in Whale Creek. Because none of the targets were exceeded, beneficial uses in Whale Creek are not considered impaired because of sediment or siltation.

The supplemental indicators generally support this conclusion. Macroinvertebrate data suggest that healthy, complex systems were present at the upstream site and there was no indication of impairment from any pollutants. An unknown stressor appears to be affecting macroinvertebrates at the downstream site (low IBI score), but individual metrics suggest that sediment and siltation are not the cause of the impairment. Bull trout redds declined from 1987 to 1997. However, counts have increased every year since 1998, and the declines noted in the mid 1990s coincide with the documented changes to the bull trout fishery connected to Flathead Lake. Although the turbidity data are old, they do not suggest water quality impairment due to siltation. Data from the Pfankuch surveys indicated little mass wasting and good riparian conditions were present, with some sediment deposition and bank cutting observed. Potential sources exist throughout the watershed (fire, clear-cuts, roads); however, the ECA indicator was not exceeded.

Table 3-18. Comparison of Available Data with the Proposed Targets and Supplemental Indicators for Whale Creek

Targets	**Threshold**	**Upper Whale**	**Lower Whale**
5-year Mean McNeil Core Percent Subsurface Fines < 6.35 mm	35%	31.3%	
5-year Mean Substrate Scores	≥ 10	12.2	
Percent Surface Fines < 2 mm	< 20%	19%	17%
Clinger Richness	≥ 14	20	16
Supplemental Indicators	**Recommended Value**	**Upper Whale**	**Lower Whale**
Juvenile Bull Trout and Westslope Cutthroat Trout Density	Documented increasing or stable trend	NA (Cutthroat) Stable (Bull)	
Bull Trout Redd Counts	Documented increasing or stable trend	Increasing Since 1998	
SSC Mean SSC Mean Annual Maximum SSC Maximum	3.2 ± 5.2 mg/L 14.6 mg/L 61.6 mg/L	4.0 mg/L 21.3 mg/L 97.8 mg/L	
Pfankuch Mass Wasting Score	“good”	Good	NA
Pfankuch Bank Vegetation Score	“good”	Excellent	NA
Pfankuch Cutting Score	“good”	Fair/Good	NA
Pfankuch Deposition Score	“good”	Fair/Good	NA
Turbidity	High flow – 50 NTU instantaneous max Summer base flow – 10 NTU	Mean – 1.21 Median – 0.90 Max – 17.0	
Montana Mountain Macroinvertebrate Index of Biological Integrity	> 75%	81	57
Percentage of Clinger Taxa	“high”	70%	89%
EPT Richness	≥ 22	20	18
Periphyton Siltation Index	< 20	NA	NA
Fire	Evaluated on a case-by-case basis	No recent fires	Year: 2003 % Burned: 12
Equivalent Clear-Cut Acres	< 25%	14%	
Water Yield	< 10%	NA	
Roads	Evaluated on a case-by-case basis	Some roads in need of BMPs	

3.4.1.4 South Fork of Coal Creek

South Fork Coal Creek flows approximately 9 miles from the headwaters to the confluence with Coal Creek, encompassing an area of 18.5 square miles. Aquatic life and cold-water fishery beneficial uses were listed as impaired on the 1996 303(d) list. Other habitat alterations and siltation were the listed causes of impairment. The same listing appeared on the 2002 303(d) list, as well as riparian degradation. According to MDEQ's Data Assessment Record Sheet, the basis for the 2002 303(d) listing include declining bull trout densities between 1989 and 1998, habitat alteration and bank erosion associated with historical logging activities, and observed substrate fines greater than 35 percent in 2 of 10 McNeil core samples (Phillips, 2000).

A review of the available data is presented below. The available data include suspended sediment concentration, turbidity data, substrate scores, McNeil cores, Pfankuch ratings, pebble counts, sources (fires, harvest, roads), macroinvertebrates, and fish population estimates.

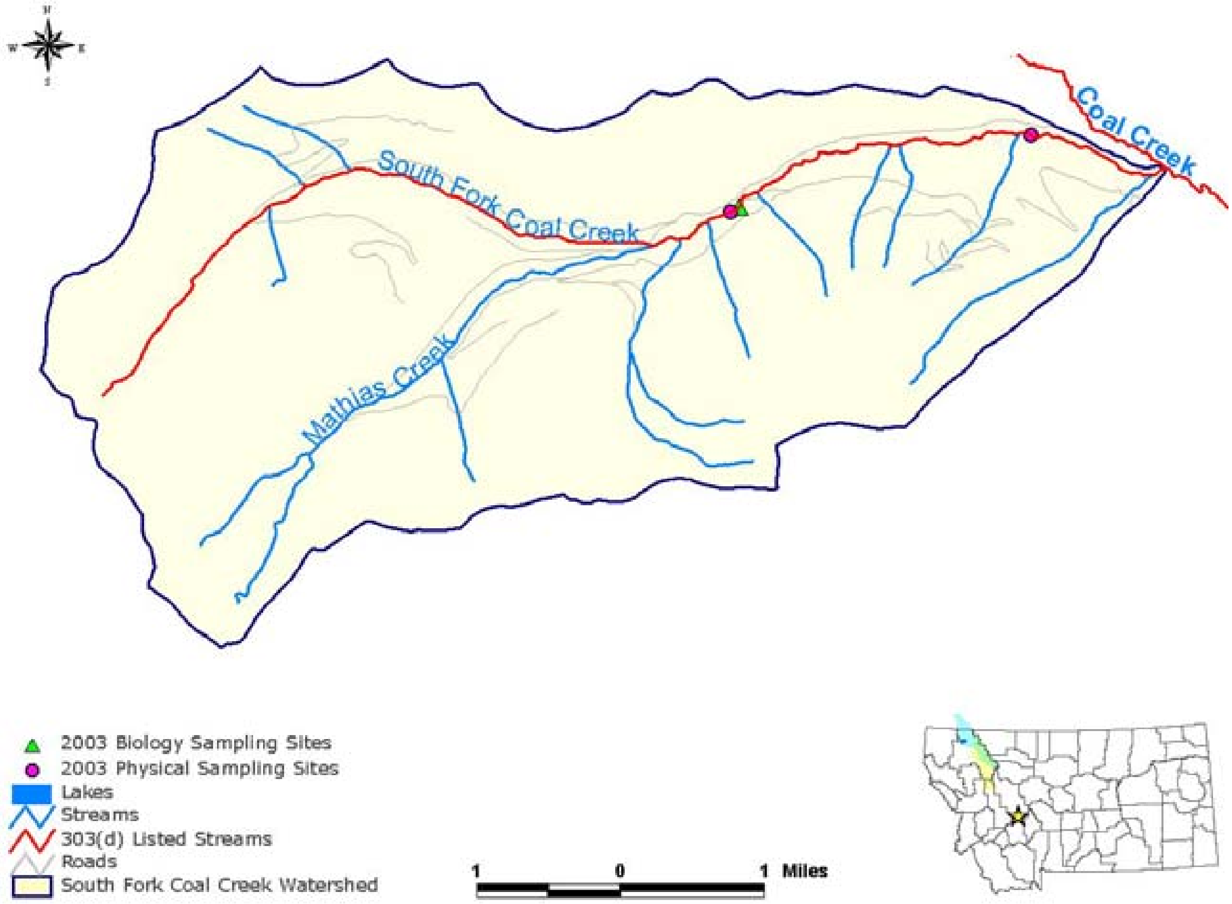


Figure 3-10. South Fork Coal Creek watershed.

McNeil Core

MFWP collected McNeil core samples in South Fork Coal Creek between 1985 and 2001 (Weaver et al., 2003). The mean value for the past 5 years is 30.2 percent fines smaller than 6.35 millimeters. In 2001, the percent fines smaller than 6.35 millimeters was reported at 30.9 percent, and the maximum for the past 5 years is 30.9 percent. All these values are below the proposed target.

Substrate Scores

Substrate scores were calculated based on MFWP stream surveys conducted from 1985 through 2002 (Deleray et al., 1999). The mean substrate score for the past 5 years (1998-2002) was 12.7, indicating good juvenile bull trout rearing habitat quality (greater than 10). The mean score for the entire period of record was 12.2.

Pebble Counts

Pebble counts were collected from one reach on the South Fork Coal Creek in 2003 (at three sites within each reach). The percent surface fines smaller than 2 millimeters were 12.6 percent (upper), 11.3 percent (cross section), and 4.7 percent (lower). All three figures are lower than the proposed target of 20 percent. The data suggest that siltation is not impairing beneficial uses at this site.

Macroinvertebrates

One macroinvertebrate sample was collected in the South Fork Coal Creek in August 2003. Clinger data (19 taxa, 66 percent of the sample) suggest that sediment was not a cause of impairment at this site. The Mountain IBI was 87, which indicates that aquatic life beneficial uses were fully supported. However, the number of EPT taxa (21) was slightly below the recommended value of 22.

Other supporting macroinvertebrate metrics also suggest that no water quality impairments were present. The HBI score was 2.25, which is lower than the recommended value of 3.5. All of the five most dominant taxa (*Drunella doddsi, Baetis tricaudatus, Rhithrogena, Epeorus grandis*,and *Epeorus deceptivus*), are sensitive to pollution. Overall, the data suggest that aquatic life beneficial uses were fully supported.

Fisheries Data

MFWP conducted electrofishing surveys from 1985 through 2002 (Deleray et al., 1999). Densities of bull trout 1 year and older have fluctuated throughout the period of record, ranging from a high of 5.91 per 100 square meters in 1985 to a low of 0.16 per 100 square meters in 1998 (Figure 3-11). Like other Flathead River headwater streams, bull trout densities were lowest during the mid 1990s, and have generally been increasing since 1998. During the same period, the more resident westslope cutthroat populations showed a relatively similar trend in densities of fish 1 year and older. Bull trout redd counts were conducted in 1980, 1981, 1982, 1986, 1991, 1992, 1997, and 2000. Redd counts show a declining trend from a high of 24 in 1981 to 1 in 2000. It is not known whether the redd count declines reflect the overall trend in the North and Middle Fork Flathead River watersheds due to changes in the Flathead Lake ecosystem and food chain, or are a result of factors within the South Fork Coal Creek watershed.

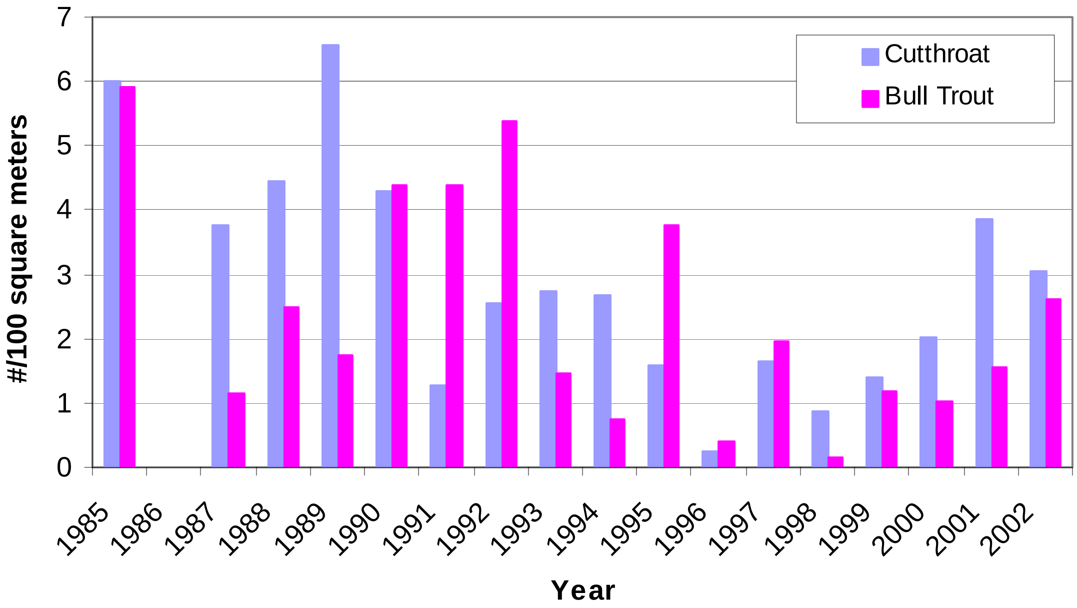


Figure 3-11. Age 1 and older bull trout and Westslope cutthroat trout densities in South Fork Coal Creek.

Pfankuch Ratings

Pfankuch ratings were estimated at several sites in the South Fork Coal Creek between 1976 and 2003. A summary of the findings is shown in Table 3-19. Recent data (collected in 2003) suggests that vegetative bank protection and sediment deposition were good or better at all sites surveyed. Some sites were ranked “fair” for bank cutting or mass wasting, but there was no indication as to the cause of the fair ratings. Historic data (1976 to 1985) indicates that conditions may have been worse in the past, having more fair or poor ratings, especially in the 1985 survey.

Table 3-19. Pfankuch Ratings for Segments of South Fork Coal Creek

Stream Segment	Year	Mass Wasting	Vegetative Bank Protection	Cutting	Deposition
RM 1.0	1976	Good	Good	Good	Excellent/Good
RM 4.2	1976	Good	Good	Good	Excellent
RM 7.2	1976	Excellent	Good	Excellent	Excellent
RM 4.2	1979	Excellent	Excellent	Excellent	Good
RM 0.3	1985	Poor	Fair	Fair/Poor	Fair
RM 1.1	1985	Good	Good	Good	Excellent/Good
RM 1.5	1985	Good	Good	Good/Fair	Good
RM 2.3	1985	Good	Good	Fair/Good	Good
RM 3.0	1985	Fair	Fair	Poor	Fair/Poor
RM 3.2	1985	Good/Fair	Fair	Good/Fair	Good
RM 4.0	1985	Fair	Fair	Fair/Good	Fair
RM 5.2	1985	Poor	Poor	Good/Fair	Poor
RM 6.8	1985	Fair	Fair	Good/Fair	Excellent/Good
Profile #1 LL	2003	Excellent	Excellent	Good/Fair	Excellent
Profile #1 CS	2003	Excellent	Excellent	Excellent	Excellent
Profile #1 UL	2003	Excellent	Excellent	Excellent	Good
Profile #2 LL	2003	Fair	Good	Fair	Good
Profile #2 CS	2003	Excellent	Good	Fair	Good
Profile #2 UL	2003	Good	Excellent	Good/Fair	Excellent
Mathias Creek	1976	Excellent	Good	Good	Excellent

RM= river mile.

Suspended Sediment Concentration

Suspended sediment concentration (SSC) data were collected in the South Fork Coal Creek almost yearly between 1983 and 1995 (n = 190). In general, samples were collected to capture spring runoff (in April, May, and June) as well as base flow conditions (in July, August, September, October, and November). However, the frequency of sampling varied from year to year.

The absence of current SSC data prohibits the use of these data for making a current impairment determination. However, the data are useful in evaluating long-term trends and in making historical comparisons with other streams in the FTPA. The mean for the period of record, mean annual maximum, and maximum reported values are presented in Table 3-20. All values are below the proposed indicator values, indicating that suspended sediment was not likely contributing to sediment impairment in South Fork Coal Creek prior to the end of the period of record in 1995.

Table 3-20. Comparison of Available SSC Data for South Fork Coal Creek with the Supplemental Indicator Values

SSC Metric	Observed Value (mg/L)	Indicator Value for Comparison (mg/L)
Mean (mg/L)	2.83	3.15 ± 5.83
Mean Annual Maximum (mg/L)	10.8	14.56
Maximum (mg/L)	31.2	61.60

Turbidity

Turbidity data were collected in South Fork Coal Creek for roughly the same period of record as for the SSC data (1983–1995, n = 190). As with the SSC data, a lack of current data prohibits the use of the older data for making a current impairment determination, but the data are useful in evaluating long-term and historical trends.

The mean turbidity for the period of record is 1.06 NTU and the median is 0.80 NTU. The maximum recorded value was 15 NTU in May 1984. The average and median turbidity values are well below the proposed summer base flow target of 10 NTU. The turbidity data suggest that sediment was not impairing beneficial uses in the South Fork Coal Creek during the period of record. More current information is not available.

Sources

There have been no recent fires in the South Fork of Coal Creek. The last recorded major fire occurred in 1910, when 893 acres burned.

Since 1955, 743 acres (6 percent) have been clear-cut in the South Fork watershed, and no clear-cutting has occurred since 1991. The calculated equivalent clear-cut acreage for 2004 is 4.3 percent, which is below the proposed indicator of 25 percent. An analysis by the Montana DNRC indicated that water yields are only 2.5 percent greater than naturally occurring yields (Nelson, personal communication March 11, 2004). Overall, harvested land does not appear to be a significant source of sediment.

Road density in the South Fork Coal Creek watershed is very low (0.82 miles/square mile), and almost all of the roads are closed yearlong. The FNF survey found that several road-stream crossings are at risk of failure, and several miles of roads are in need of BMPs. MFWP also identified several potential sources of sediment in the South Fork watershed. Skid trails and heavy equipment operation have caused increased erosion in the Mathias Creek watershed (MFWP, 2004), and portions of the South Fork have been straightened and channelized from past logging activities. Overall, it appears that some sediment from anthropogenic sources is reaching the South Fork of Coal Creek.

South Fork Coal Creek Water Quality Impairment Summary

The South Fork of Coal Creek was listed on the 1996 and 2002 303(d) lists as impaired because of siltation and habitat alterations. Riparian degradation was also a listed impairment on the 2002 303(d) list. Aquatic life and fishery beneficial uses were listed as impaired. A summary of the available data is presented below and in Table 3-21.

It appears that siltation is not currently impairing beneficial uses in the South Fork of Coal Creek. None of the target values were exceeded. McNeil core and substrate scores were collected at one site over multiple years, and both sets of data indicate good substrate conditions. Good substrate conditions were also noted in the percent surface fines at three different sites. There was no indication of sediment impairment in the macroinvertebrate data, as the number of clinger taxa was high (more than 14). Because none of the targets were exceeded, beneficial uses in the South Fork of Coal Creek are not considered impaired because of sediment or siltation.

Supplemental indicators generally support this conclusion. Macroinvertebrate data suggest that healthy, complex systems were present with no indication of impairment from any pollutants (high IBI score). The available fisheries data suggest that the bull trout population declined in the mid 1990s and then showed an improving trend starting in 1998. Although the SSC and turbidity data are old, they do not suggest water quality impairment due to siltation. Surveys found that there are several road and road-stream crossings potentially contributing sediment to the stream; however, there is no evidence of stream impairment. Clear-cut land is most likely not a major source of sediment, because only a small percentage of the watershed has historically been clear-cut, and none since 1991. The ECA and water yield supplemental indicators suggest no impairment from clear-cut areas.

Table 3-21. Comparison of Available Data to the Proposed Targets and Supplemental Indicators for South Fork Coal Creek.

Targets	Threshold	Available Data
5-year Mean McNeil Core Percent Subsurface Fines < 6.35 mm	35%	30.2%
5-year Mean Substrate Scores	≥ 10	12.7
Percent Surface Fines < 2 mm	< 20%	9.54%
Clinger Richness	≥ 14	19
Supplemental Indicators	**Recommended Value**	**Available Data**
Juvenile Bull Trout and Westslope Cutthroat Trout Density	Documented increasing or stable trend	Increasing Since 1998 (Cutthroat) Increasing Since 1998 (Bull)
Bull Trout Redd Counts	Documented increasing or stable trend	Decline
SSC Mean SSC Mean Annual Maximum SSC Maximum	3.2 ± 5.2 mg/L 14.6 mg/L 61.6 mg/L	2.83 mg/L 10.8 mg/L 31.2 mg/L
Pfankuch Mass Wasting Score	"good"	Excellent
Pfankuch Bank Vegetation Score	"good"	Excellent
Pfankuch Cutting Score	"good"	Good
Pfankuch Deposition Score	"good"	Good
Turbidity	High Flow – 50 NTU instantaneous maximum Summer base flow – 10 NTU	Mean – 1.1 NTU Median – 0.8 NTU Max – 15 NTU
Montana Mountain Macroinvertebrate Index of Biological Integrity	> 75%	87%
Percentage of Clinger Taxa	"high"	66%
EPT Richness	≥ 22	21
Periphyton Siltation Index	< 20	NA
Fire	Evaluated on a case-by-case basis	No recent fires
Equivalent Clear-Cut Acres	< 25%	4%
Water Yield	< 10%	2.5%
Roads	Evaluated on a case-by-case basis	Some roads in need of BMPs

3.4.1.5 North Fork Coal Creek: Siltation

The North Fork Coal Creek watershed covers approximately 23.2 square miles (14,895 acres), all of which is in the FNF. It was listed on the 1996 303(d) list as impaired because of siltation and nutrients. The basis for the 1996 listing is unknown. Cold-water fishery and aquatic life beneficial uses were listed on the 2002 303(d) list as impaired as a result of siltation. Nutrients were not listed as a cause of impairment on the 2002 303(d) list. According to MDEQ's Data Assessment Record, a significant decline in bull trout since 1990, along with indications of sedimentation problems in the watershed, is the primary basis for the 2002 303(d) listing (Suplee, 1999a).

A review of the available sediment and siltation data is provided below. Available data include suspended sediment concentration, turbidity data, substrate scores, McNeil cores, Pfankuch ratings, pebble counts, sources (fires, harvest, roads), macroinvertebrates, and fish population estimates. Nutrient data are discussed in Section 3.4.1.6.

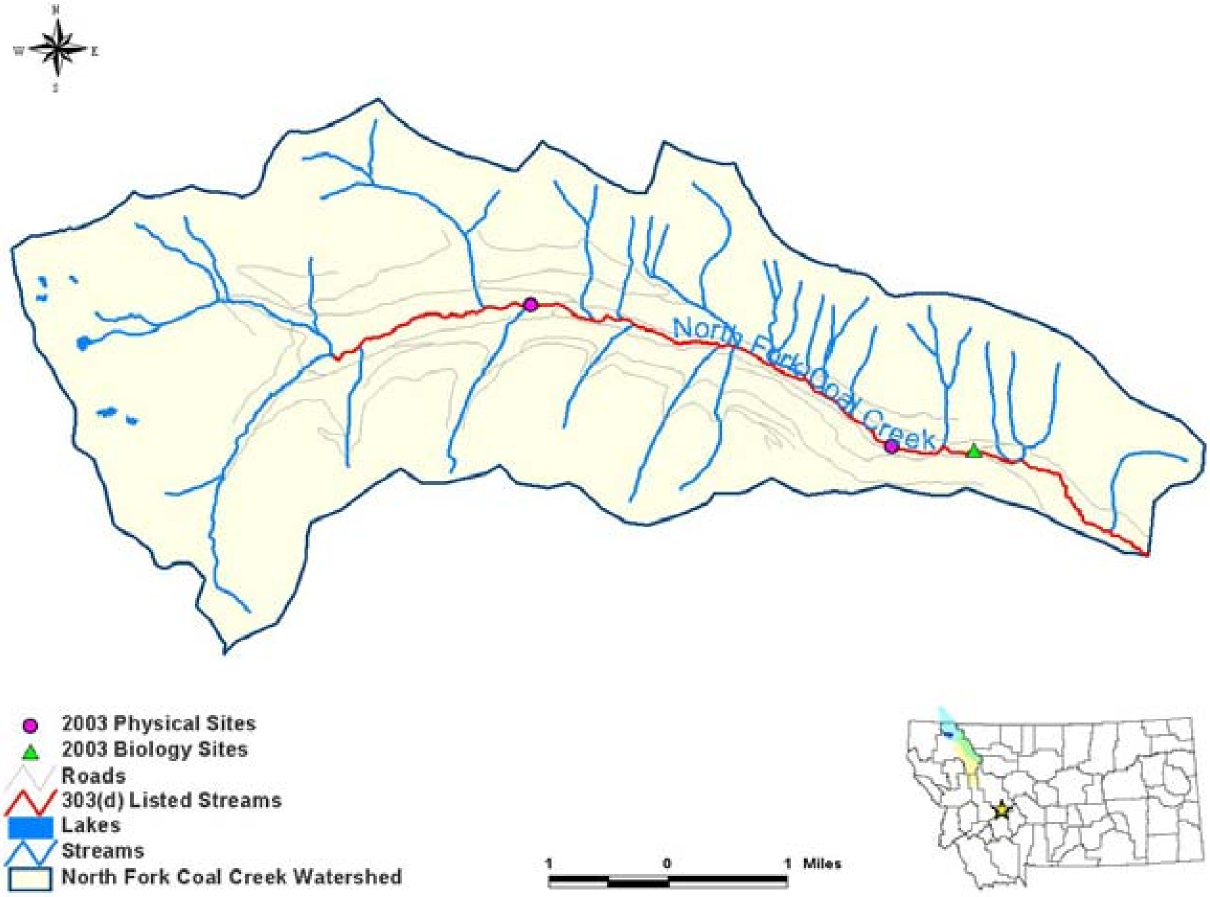


Figure 3-12. North Fork Coal Creek watershed.

McNeil Core

MFWP collected McNeil core samples in the North Fork between 1985 and 2001 (Weaver et al., 2003). The mean value for the past 5 years in the North Fork was 31.0, indicating good substrate conditions. The maximum value for the past 5 years was 31.8.

Substrate Scores

Substrate scores were calculated for the North Fork Coal Creek based on MFWP stream surveys conducted from 1984 through 2002 (Deleray et al., 1999). The mean substrate score for 1998 through 2002 was 13.7. This score indicates good juvenile bull trout rearing habitat quality. Over the entire period of record, the mean substrate score was 13.3.

Pebble Counts

Pebble counts were collected from two reaches on the North Fork Coal Creek in 2003. The percent surface fines smaller than 2 millimeters at the upper reach were 7.9 percent (lower), 9.4 percent (cross section), and 2.8 percent (upper). At the lower North Fork reach, the percent surface fines smaller than 2 millimeters were 14.4 percent (lower), 7.6 percent (cross section), and 19.3 percent (upper). All values were below the supplemental indicator of 20 percent.

Macroinvertebrates

Macroinvertebrate data were collected at one site on the North Fork of Coal Creek in August 2003 (Figure 3-12). There was no indication of water quality impairment at this site. The number of clinger taxa was high (25 taxa, 80 percent), which indicates no impact on the macroinvertebrate community from siltation. Both the number of EPT taxa (27) and Mountain IBI (90 percent) were above the recommended supplemental indicators. The HBI score was 2.18 (i.e., no apparent nutrient or sediment influences). All five of the most dominant taxa are intolerant to pollution (*Rhithrogena, Heterlimnius Epeorus grandis,, Epeorus deceptivus,*and *Parapsyche elsis*). The entire suite of macroinvertebrate metrics suggests that aquatic life beneficial uses are not impaired because of siltation in the North Fork of Coal Creek.

Fish Population

MFWP conducted electrofishing surveys between 1982 and 2002 in North Fork Coal Creek (Deleray et al., 2003). Densities of bull trout 1 year old or more have declined from a high of 4.9 per 100 square meters in 1989 to 0.08 per 100 square meters in 1997 (Figure 3-13). The numbers have remained low since 1997. During the same period, westslope cutthroat populations appeared to have an increasing trend. This indicates that the cause of the declining bull trout population is not similarly affecting the westslope cutthroat trout population. No redd data were available for North Fork Coal Creek. Declines in the bull trout population may be due to changes in the Flathead Lake ecosystem, and do not necessarily indicate beneficial use impairment (see Section 2.2.2).

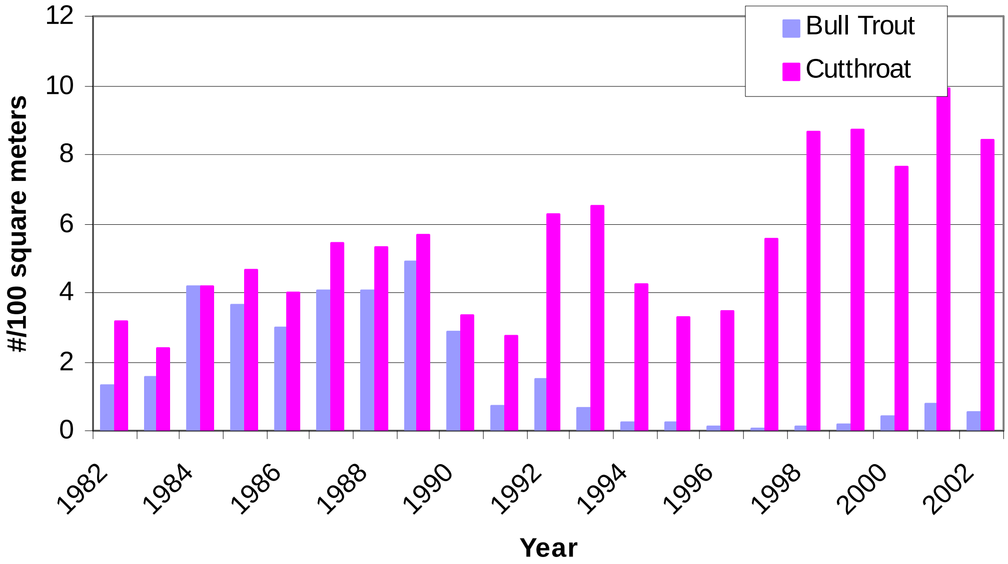


Figure 3-13. Age 1 and older bull trout and Westslope cutthroat trout densities in North Fork Coal Creek.

Pfankuch Ratings

Pfankuch ratings were estimated at several sites in the North Fork Coal Creek watershed between 1976 and 2003. A summary of the findings is shown in Table 3-22. The most recent samples (2003) show few problems relating to mass wasting, vegetative bank protection, and deposition. However, significant bank cutting (fair/good rating) was observed at several sites.

Suspended Sediment Concentration

Suspended sediment concentration (SSC) data were collected in the North Fork Coal Creek almost yearly between 1982 and 1995 (n = 215). In general, samples were collected to capture spring runoff (in April, May, and June) as well as base flow conditions (in July, August, September, October, and November). However, the frequency of sampling varied from year to year.

The absence of current SSC data prohibits the use of the older data for making a current impairment determination. However, the data are useful in evaluating long-term trends and in making historical comparisons with other streams in the TPA. The mean for the period of record, mean annual maximum, mean annual load, and maximum reported values are presented in Table 3-23. All three values were within an acceptable range of the reference data. The data suggest that sediment concentrations in the North Fork Coal Creek were generally similar to reference conditions during the period of record. More current information is unavailable.

Table 3-22. Pfankuch Ratings for Segments of North Fork Coal Creek

Stream Segment	Year	Mass Wasting	Vegetative Bank Protection	Cutting	Deposition
RM 12.18	1976	Excellent	Good	Good	Excellent
RM 16.19	1976	Good	Good	Fair/Good	Good/Excellent
RM 18.57	1976	Good	Good	Good	Excellent
RM 20.22	1976	Excellent	Excellent	Fair/Good	Good/Excellent
RM 12.18	1979	Excellent	Fair	Fair/Good	Excellent
RM 16.19	1979	Excellent	Fair	Fair/Good	Good
RM 18.57	1979	Excellent	Excellent	Excellent	Excellent
RM 20.22	1979	Excellent	Good	Fair/Good	Good
RM 9.47	1985	Good	Good	Fair/Good	Good
RM 9.72	1985	Poor	Fair	Poor	Good/Fair
RM 9.95	1985	Poor	Fair	Poor	Fair
RM 10.26	1985	Poor	Good	Fair	Good
RM 10.42	1985	Fair/Poor	Fair	Fair	Good/Fair
RM 10.91	1985	Poor	Poor	Fair/Good	Poor
RM 11.69	1985	Poor	Good	Fair	Fair
RM 12.84	1985	Good	Fair	Fair/Good	Good
RM 15.11	1985	Fair	Poor	Fair/Poor	Fair
Profile #1 UL	2003	Good	Good	Fair/Good	Fair
Profile #1 CS	2003	Good	Excellent	Fair/Good	Good
Profile #1 LL	2003	Excellent	Good	Fair/Good	Good
Profile #2 UL	2003	Fair	Good	Fair	Good
Profile #2 CS	2003	Excellent	Excellent	Excellent	Excellent
Profile #2 LL	2003	Good	Excellent	Fair	Good

RM = river mile.

Table 3-23. Comparison of Available SSC Data for North Fork Coal Creek with the Supplemental Indicators.

SSC Metric	Observed Value (mg/L)	Indicator Value for Comparison (mg/L)
Mean (mg/L)	3.73	3.15 ± 5.83
Mean Annual Maximum (mg/L)	19.56	14.56
Maximum (mg/L)	40.60	61.60

Turbidity

Turbidity data were collected in the North Fork for roughly the same period of record as for the SSC data (1982–1995, n = 213). As with the SSC data, a lack of current data prohibits the use of the older data for making a current impairment determination, but the data are useful in evaluating long-term and historical trends.

The mean turbidity for the period of record is 1.17 NTU and the median is 0.85 NTU. The maximum recorded value was 8 NTU in May 1984. None of the values exceed the proposed target of 10 NTU during summer base flow. The data suggest that sediment was not impairing beneficial uses during the period of record. More current data are not available.

Sources

There have been few recent fires in the North Fork watershed. One fire occurred in 1988, burning approximately 100 acres, and another fire occurred in 1970, burning approximately 160 acres. No fires have occurred in the North Fork since 1988.

Since 1960, 822 acres of land have been clear-cut (6 percent of the total watershed). The last clear-cut occurred in 1990, when 125 acres were cut. The ECA for the watershed was 6.7, which indicates that harvested land is not likely a major source of sediment. The percent water yield increase was also low (3.2 percent). Some riparian harvests have occurred historically, and MFWP noted that this activity has caused increased bank erosion in the stream (MFWP, 2004). No streamside management zone was created at the time of the riparian harvests.

The FNF survey found that several roads in the North Fork of Coal Creek (Roads 5270 and 5278) have plugged culverts, sediment slumps, and actively eroding surfaces. Road density is relatively high in the North Fork of Coal Creek compared to other watersheds in the planning area (1.6 miles per square mile) (see Section 2.1.11). Within the entire Coal Creek watershed, the survey indicated that some heavily traveled roads require ditch drainage improvements, and approximately 17 miles of bermed, closed roads need additional BMPs. (FNF, 2003).

North Fork Coal Creek Water Quality Impairment Summary: Sediment/Siltation

The North Fork of Coal Creek was listed on the 1996 and 2002 303(d) lists as having impaired aquatic life and fishery beneficial uses. The causes of impairment listed in 1996 were siltation and nutrients. A summary of the sediment related data is presented below and in Table 3-24. Nutrient impairments are discussed in Section 3.4.1.6.

It appears that siltation is not currently impairing beneficial uses in the North Fork of Coal Creek. None of the target values were exceeded. McNeil core and substrate scores were collected at one site over multiple years, and both sets of data indicate good substrate conditions. Good substrate conditions were also noted in the percent surface fines at two different sites. There is no indication of sediment impairment in the macroinvertebrate data: the number of clinger taxa was high (greater than 14). Because none of the targets were exceeded, beneficial uses in the North Fork of Coal Creek are not impaired because of sediment or siltation.

Supplemental indicators generally supported this conclusion. Macroinvertebrate data suggest that healthy, complex systems were present at the upstream site and there is no indication of impairment from any pollutants (high IBI score). Westslope cutthroat trout densities appear to be increasing over the period of record, and turbidity and SSC historically do not suggest sediment impairments. Pfankuch surveys found good physical stream conditions, and road density, ECA, and water yield were low (good). Although data indicate that bull trout populations are declining in North Fork Coal Creek, the cause of the decline is unknown, and the cause of impairment does not appear to be similarly affecting the westslope cutthroat trout population. Some potential road sources of sediment were identified in the watershed; however, there does not appear to be an effect on beneficial uses.

Table 3-24. Comparison of Available Data with the Proposed Targets and Supplemental Indicators for North Fork Coal Creek (Sediment)

Targets	Threshold	Available Data
5-year Mean McNeil Core Percent Subsurface Fines < 6.35 mm	35%	31.0%
5-year Mean Substrate Scores	≥ 10	13.7
Percent Surface Fines < 2 mm	< 20%	6.7% and 13.7%
Clinger Richness	≥ 14	25
Supplemental Indicators	**Recommended Value**	**Available Data**
Juvenile Bull Trout and Westslope Cutthroat Trout Density	Documented increasing or stable trend	Cutthroat: increasing Bull: decline
Bull Trout Redd Counts	Documented increasing or stable trend	NA
SSC Mean SSC Mean Annual Maximum SSC Maximum	3.2 ± 5.2 mg/L 14.6 mg/L 61.6 mg/L	3.7 mg/L 19.6 mg/L 40.6 mg/L
Turbidity	High flow – 50 NTU instantaneous maximum Summer base flow – 10 NTU	Mean: 1.17 NTU Median: 0.85 NTU Maximum: 8.0 NTU
Pfankuch Mass Wasting Score	"good"	Good
Pfankuch Bank Vegetation Score	"good"	Good
Pfankuch Cutting Score	"good"	Fair/Good
Pfankuch Deposition Score	"good"	Good
Montana Mountain Macroinvertebrate Index of Biological Integrity	> 75%	90
Percentage of Clinger Taxa	"high"	80%
EPT Richness	≥ 22	27
Periphyton Siltation Index	< 20	NA
Fire	Evaluated on a case-by-case basis	Year: 1988 Acres: 96
Equivalent Clear-Cut Acres	< 25%	6.7%
Water Yield	< 10%	3.2%
Roads	Evaluated on a case-by-case basis	Some roads in need of BMPs

3.4.1.6 North Fork Coal Creek: Nutrients

As stated previously, the North Fork Coal Creek also appeared on the 1996 303(d) list for nutrients. A general watershed overview of the North Fork Coal Creek watershed is presented in Section 3.4.1.5. A review of the available nutrient data is provided below. The available data include nutrient concentrations, dissolved oxygen concentrations, macroinvertebrates, and sources (fires, harvest, roads).

Nutrient Concentrations

Nutrient data were collected at one site in the North Fork Coal Creek between 1982 and 1987. The frequency of sampling and type of parameters sampled varied from year to year. The absence of current data limits the use in making a current impairment determination. However, the data are useful for evaluating historical trends. Table 3-25 shows that phosphorus concentrations were below the proposed indicator, however, some nitrate (and nitrate/nitrate) concentrations exceeded the proposed indicators. It should be noted that nutrient concentrations could reflect inaccuracies in data collection and analysis, as field and laboratory methods have significantly improved since 1987.

A study conducted by Hauer and Hill (1997) found that total phosphorus (TP) loads in lower Coal Creek were higher than loads in similarly sized watersheds; however, there was no indication that loads were impairing beneficial uses. The maximum TP concentration in the North Fork Coal Creek over a 2-year period (1994–1995) was 0.014 mg/L, which is slightly above the target. However, the age of the data limits their use in making impairment determinations.

Table 3-25. Nutrient Data and Comparison with the Targets

Parameter	Count	Mean (mg/L)	Median (mg/L)	Max (mg/L)	Target (mg/L)
Nitrate	9	0.06	0.05	0.19	NA
Nitrite	1	0.0002	0.0002	0.0002	NA
Nitrate + Nitrite	1	0.031	0.031	0.031	0.014
Total Nitrogen	NA	NA	NA	NA	0.12
Total Phosphorus	3	0.0047	0.004	0.0067	0.01

Benthic Algae

No data have been collected.

Macroinvertebrates

Macroinvertebrate data were collected at one site on the North Fork of Coal Creek in August 2003. The HBI score was 2.18, indicating no apparent impairment from nutrients. Also, the Mountain IBI score was very high (90 percent), which indicates that there were no overall impairments present in the North Fork of Coal Creek.

Dissolved Oxygen

Dissolved oxygen data were collected at one site on the North Fork Coal Creek between 1982 and 1987 (n = 84). The mean concentration over the time period was 10.3, which is above the target of 9.5, and suggests the nutrients were not impairing aquatic life or fish communities. The minimum concentration was 8.0, which also suggests that dissolved oxygen concentrations were not impairing beneficial uses.

Sources

There have been few recent fires in the North Fork watershed. One fire occurred in 1988, burning approximately 100 acres, and another fire occurred in 1970, burning approximately 160 acres. No fires have occurred in the North Fork since 1988. Since 1960, 822 acres of land have been clear-cut (6 percent of the total watershed). The last clear-cut occurred in 1990, when 125 acres were cut. The ECA for the watershed was 6.7, which indicates that harvested land is not a major source of sediment. The percent water yield increase was also low (3.2 percent). Overall, it does not appear that fire, increased water yield, or increased sediment loading has significantly contributed to nutrient impairments in the North Fork of Coal Creek.

No other potential sources of nutrients have been identified in the North Fork Coal Creek watershed. Aside from roads, there is no development, and no potential for nutrient loadings related to human activities (such as wastewater systems, agriculture, fertilizers). Moreover, streams in heavily forested mountain systems in northwestern Montana tend to be nutrient poor, as most nutrients are tied up in organic matter and forest litter.

North Fork Coal Creek Water Quality Impairment Summary: Nutrients

The North Fork of Coal Creek was listed on the 1996 303(d) list as having impaired aquatic life and cold-water fishery beneficial uses. The causes of impairment were siltation and nutrients. A summary of the nutrient data is presented below and in Table 3-26.

In light of available data, it does not appear that nutrients are impairing beneficial uses in the North Fork of Coal Creek. Macroinvertebrate data indicate that excellent aquatic life communities are present (high IBI score) with no indication of nutrient impairment (low HBI score). Also, westslope cutthroat trout densities are high and increasing, indicating that no water quality impairments are present. None of the recent biological data indicate impairments of any kind in the North Fork of Coal Creek. Also, there are virtually no anthropogenic sources of nutrients (such as wastewater treatment, agriculture, fertilizers) in the watershed. The ECA and water yield for the watershed is low, and suggest that fires and clear-cuts have not impaired beneficial uses.

The overall lack of sources, combined with the excellent recent data on macroinvertebrate communities, suggests that the North Fork of Coal Creek is not impaired because of nutrients. However, additional data are necessary to verify this conclusion (refer to Section 4.4 for details regarding proposed monitoring).

Table 3-26. Comparison of Available Data with the Proposed Targets and Supplemental Indicators for North Fork Coal Creek (Nutrients)

Targets	Threshold	Available Data
Benthic Algae (Median)	< 33 mg/m^2	NA
EPA Ecoregion II, Total Phosphorus (Median)	< 0.01 mg/L	0.004 (No recent data)
EPA Ecoregion II, TKN (Median)	< 0.05 mg/L	NA
EPA Ecoregion II, Nitrate+Nitrite (NO_2/NO_3) (Median)	< 0.014 mg/L	0.031 (No recent data)
EPA Ecoregion II, Total Nitrogen (Median)	< 0.12 mg/L	NA
Supplemental Indicators	**Recommended Value**	**Available Data**
Macroinvertebrate Hilsenhoff Biotic Index (HBI)	< 3.5	2.18
EPA Ecoregion II, Chlorophyll- *a*, Water Column (Median)	< 1.08	NA
Dissolved Oxygen, 7-Day Mean	> 9.5	10.3 (No recent data)
Dissolved Oxygen, 1-Day Minimum	> 8.0	8.0 (No recent data)
Fire	Evaluated on a case-by-case basis	Year: 1988 Acres: 96
Equivalent Clear-Cut Acres	< 25%	6.7%
Water Yield	< 10%	3.2%

3.4.1.7 Lower Coal Creek

Coal Creek is a third-order tributary of the North Fork Flathead River flowing 18 miles from the headwaters to the mouth (Figure 3-14). The total watershed area covers approximately 82 square miles. Primary tributaries include South Fork Coal Creek, Deadhorse Creek, and Cyclone Creek. The reach downstream of the confluence with the North and South Forks is referred to as “Lower Coal Creek,” and will be referred to as such herein. Most of Lower Coal Creek flows through the Coal Creek State Forest.

Cold-water fishery and aquatic life beneficial uses in Lower Coal Creek were listed on both the 1996 and 2002 303(d) lists as impaired because of siltation. No information is available regarding the basis for the 1996 listing of Lower Coal Creek. According to MDEQ’s Data Assessment Record, sedimentation, embeddedness, bank erosion, and logging activities are the primary basis for the 2002 303(d) listing (Suplee, 1999b).

A review of the available data is provided below. The available data include substrate scores, McNeil cores, Pfankuch ratings, pebble counts, sources (fires, harvests, roads), macroinvertebrates, and fish population estimates.

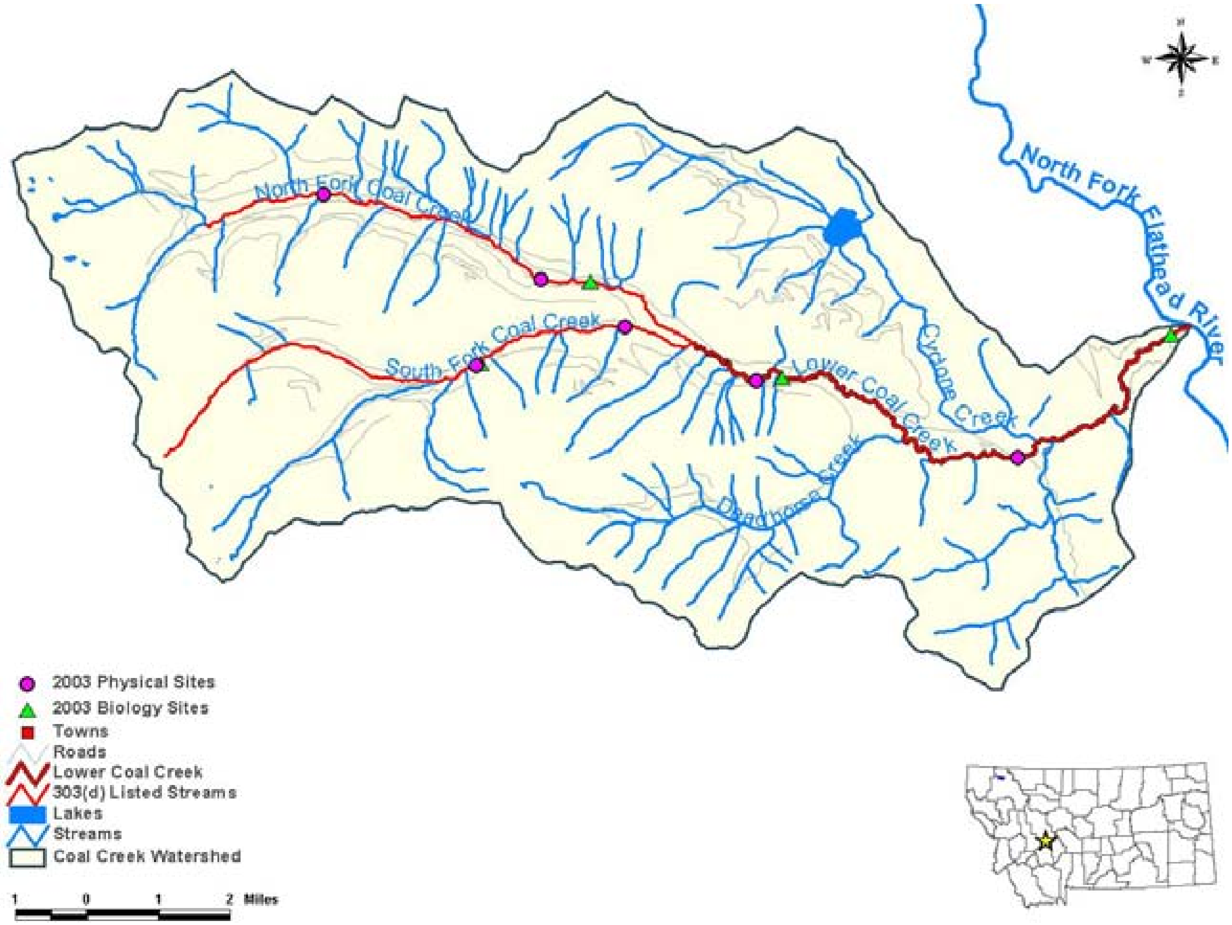


Figure 3-14. Coal Creek watershed.

McNeil Core

MFWP collected McNeil core samples in the lower segment of Coal Creek between 1981 and 2001 (Weaver et al., 2003). A summary of the data is presented in Figure 3-15. The mean McNeil core value for the past 5 years in Lower Coal Creek is 37.1 percent fines smaller than 6.35 millimeters. In 2001, the percent fines smaller than 6.35 millimeters was reported to be 37.6 percent, and the maximum for the past 5 years was 37.6 percent.

Bull trout redd counts and densities were relatively high throughout the 1980s and early 1990s (see the subsection below on fish population and Figure 3-16). During this period, McNeil core values regularly exceeded the target value, with a maximum McNeil core value of 42.1 occurring in 1990 (Figure 3-16). This information suggests that functional bull trout populations existed in Lower Coal Creek with McNeil core values as high as 42.1. Furthermore, there does not appear to be a visible trend in the McNeil core data over time, or a correlation between bull trout redd counts and the McNeil core values (Figure 3-16). The only visible trend is the fact that the year-to-year variability in McNeil cores has decreased since 1995 (Figure 3-15). This, however, is not unique to Lower Coal Creek. As shown in Figure 3-17, the year-to-year variability in many of the tributaries within the Flathead Headwaters has decreased similarly. Unlike Lower Coal Creek, however, in these other tributaries have seen their bull trout redd counts increase in recent years.

Although the mean McNeil cores exceed the target, there is no definitive indication that high percentages of subsurface fines are impairing bull trout populations in Lower Coal Creek or that the high values are necessarily a result of human activities. The extent to which the minor (+2.1 percent) exceedance of this threshold value is or was the cause of bull trout impairment is unknown.

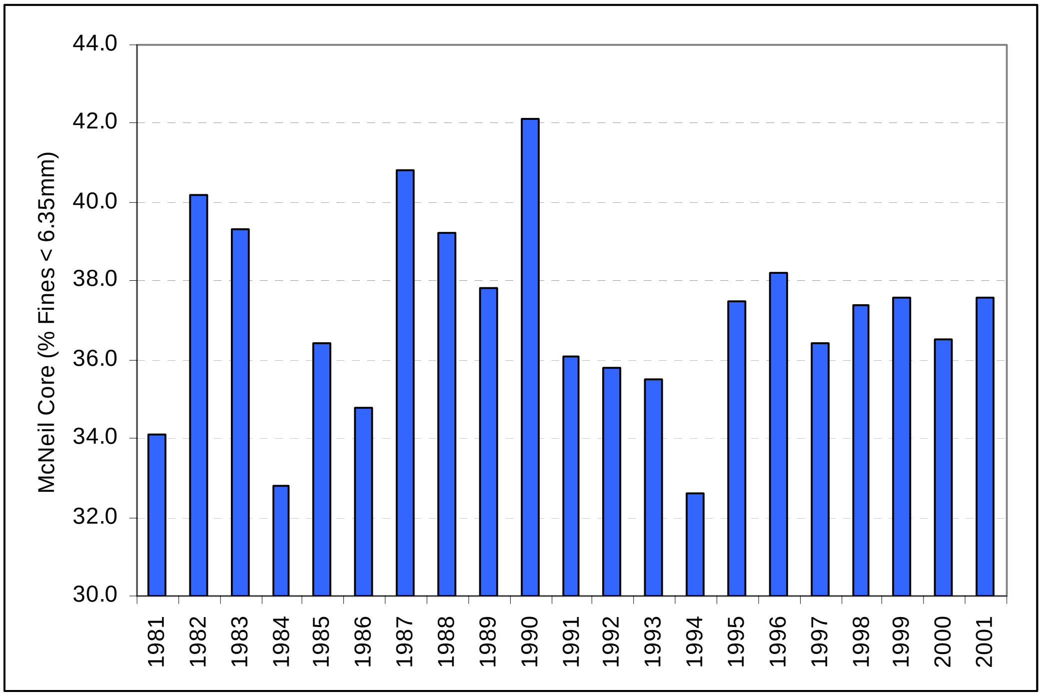


Figure 3-15. McNeil core values for Lower Coal Creek.

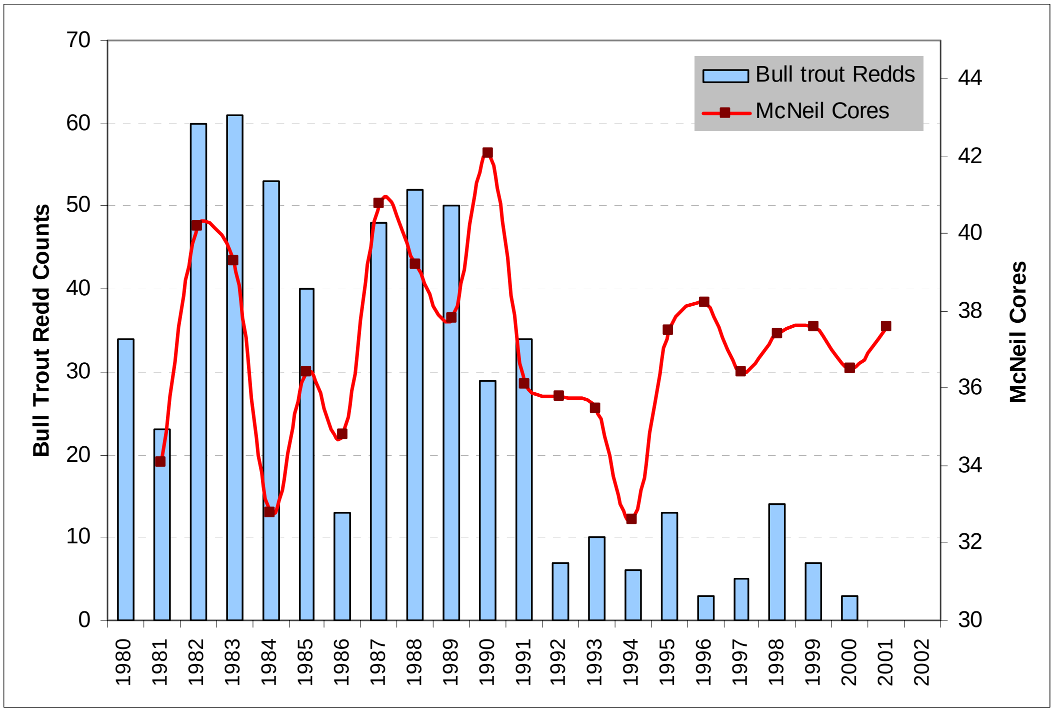


Figure 3-16. McNeil core and bull trout redd count trends in Lower Coal Creek.

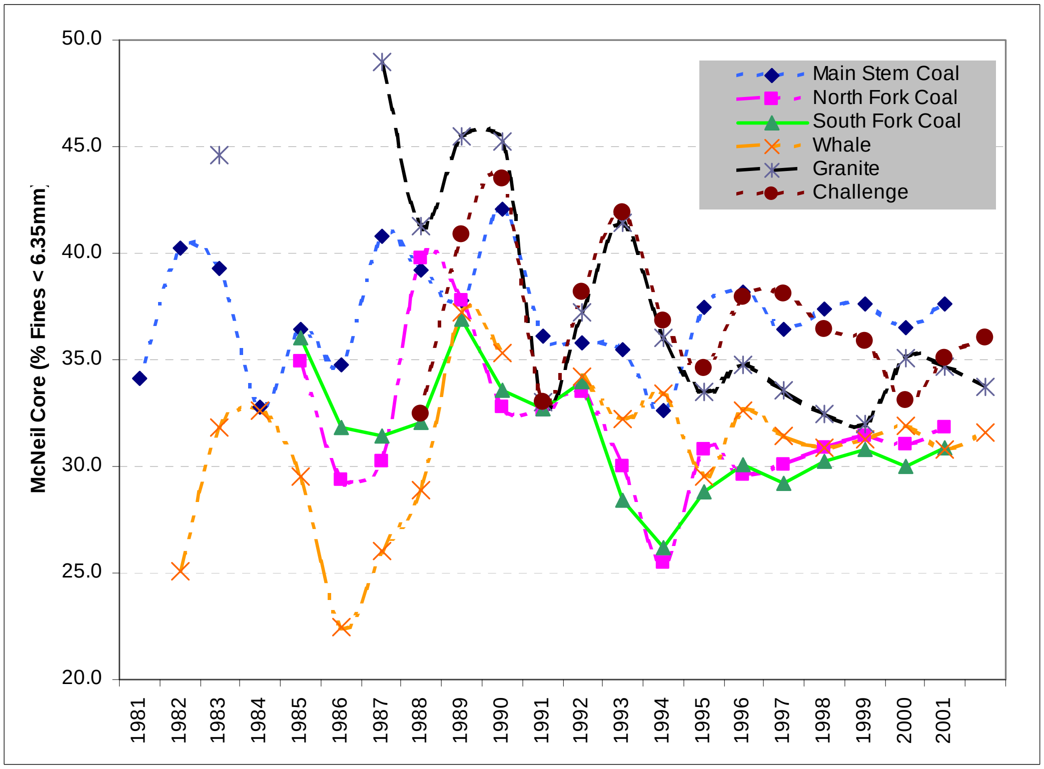


Figure 3-17. McNeil core values at six sites in the Flathead River Headwaters TPA.

Substrate Scores

Substrate scores were calculated for Lower Coal Creek based on MFWP stream surveys conducted in 1984 through 2002 (Deleray et al., 1999). The 5-year mean substrate score was 9.9, which is slightly lower than the target. The mean value for the entire period of record was 10.4. Overall, the 5-year mean substrate score is only slightly lower than the target, which itself is a conservative indicator that suggests that a threatened condition might be present.

Pebble Counts

Pebble counts were collected from two reaches on Lower Coal Creek. All of the pebble counts on the lower segments of Coal Creek slightly exceeded the proposed target of 20 percent. At the upstream reach, the percent surface fines smaller than 2 millimeters were 22.1 percent (upper), 20.2 percent (cross section), and 22.9 percent (lower). One pebble count was performed on the lower site (22.9 percent). Although the 20 percent threshold is exceeded at several sites, the exceedance is minor, and the 20 percent target is a conservative value that suggests that a threatened condition might be present. Other studies suggest that a percent surface fines indicator of 30 percent is more appropriate for making sediment impairment decisions.

Macroinvertebrates

Macroinvertebrate data were collected at two sites on Lower Coal Creek in August 2003 (Figure 3-14). The data are summarized below.

Lower Coal Creek at Deadhorse Creek (Upstream)

Macroinvertebrates at the upstream Lower Coal Creek site were similar to those on the North Fork site. EPT taxa (23), clinger taxa (23), and clinger percent (71 percent) were all high, indicating good water quality with no evidence of siltation. The Mountain IBI score was very high (90 percent) and did not indicate any water quality impairments. The HBI score was 2.64 (i.e., no apparent nutrient or sediment influences). All five of the most dominant taxa (*Epeorus deceptivus, Baetis tricaudatus, Heterlimnius, Cinygmula, Eclipidrilus*) are intolerant to pollution. The entire suite of macroinvertebrate metrics suggests that aquatic life beneficial uses are not impaired because of siltation at the Deadhorse Creek site.

Lower Coal Creek at North Fork Road near the Mouth (Downstream)

Data from the downstream Lower Coal Creek site indicate that aquatic life was not impaired because of sediment. The number of clinger taxa (16) and percentage of clingers (83 percent) were both high, indicating good water quality with no evidence of siltation. The Montana Mountain IBI score was 86 percent, which is considered fully supporting aquatic life beneficial uses. One tolerant taxon was found (0.6 percent of the total sample), but this alone does not suggest a water quality impairment. The number of EPT taxa (19) was slightly lower than the recommended value. The HBI score was 2.79 (i.e., no apparent nutrient or sediment influences). All five of the most dominant taxa (*Glossosoma, Drunella doddsi, Simulium, Epeorus deceptivus, Baetis tricaudatus*) are intolerant to pollution. Overall, the macroinvertebrate data do not suggest a water quality impairment because of siltation.

Fish Population

Historically, the Coal Creek watershed supported one of the most productive bull trout populations in the Flathead River watershed. MFWP conducted electrofishing surveys from 1982 through 2002 in Lower Coal Creek (Deleray et al., 1999). Densities of bull trout 1 year old and older have declined throughout the period of record (Figure 3-18). Bull trout redd counts have also declined over the same period of record (Figure 3-19). It is not known whether the bull trout declines reflect the overall trend in the North and Middle Fork Flathead River watersheds due to changes to the Flathead Lake ecosystem and food chain, or are a result of conditions within the Coal Creek watershed.

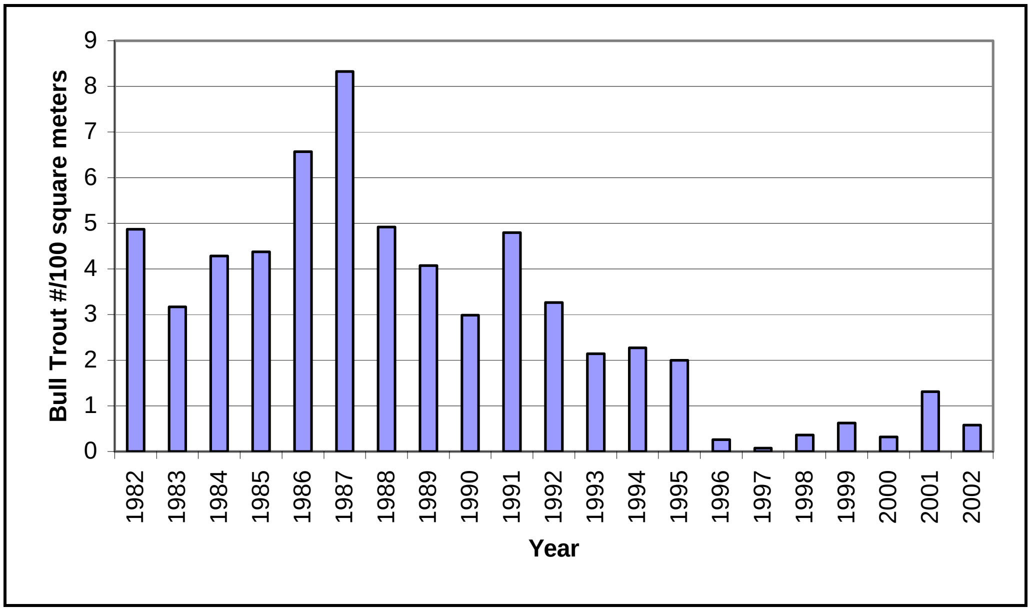


Figure 3-18. Age 1 and older bull trout densities in Lower Coal Creek.

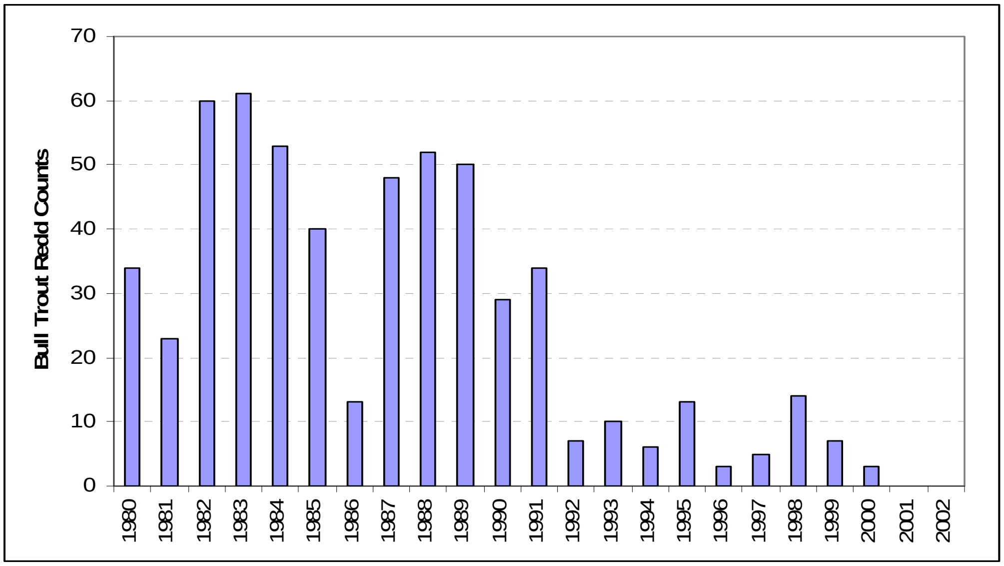


Figure 3-19. Bull trout redd counts in Lower Coal Creek.

Pfankuch Ratings

Pfankuch ratings were estimated at several sites in the Coal Creek watershed between 1976 and 2003. A summary of the findings is shown in Table 3-27. In 2003, Lower Coal Creek had excessive deposition at one site and significant bank cutting at most of the sites. Overall, the data suggest that bank cutting might be a source of sediment in the lower segments of Coal Creek. However, there is no information to suggest that this is necessarily a result of human activities. It may or may not be a natural phenomenon (see Section 4.1).

Table 3-27. Pfankuch Ratings for Segments of Lower Coal Creek

Stream Segment	Year	Mass Wasting	Vegetative Bank Protection	Cutting	Deposition
RM 0.294	1976	Good	Good	Good/Fair	Excellent
RM 8.492	1976	Excellent	Excellent	Excellent	Excellent
RM 0.294	1979	Excellent	Fair	Fair	Excellent
RM 8.49	1979	Excellent	Excellent	Excellent	
RM 8.44	1985	Good	Good	Good/Fair	Excellent/Good
RM 8.68	1985	Good	Good	Fair	Fair
RM 8.53	1994	Good	Excellent	Good/Fair	Excellent
RM 7.92	1997	Excellent	Good	Fair	Fair
Profile #1 UL	2003	Good	Good	Fair	Poor
Profile #1 CS	2003	Excellent	Good	Good/Fair	Fair
Profile #1 LL	2003	Excellent	Excellent	Good/Fair	Poor
Profile #2 CS	2003	Excellent	Good	Fair	Good

RM = river mile.

Suspended Sediment Concentration

No data have been collected.

Turbidity

No data have been collected.

Sources

A detailed source assessment for the entire Coal Creek watershed is presented in Section 4.1. A summary is presented in the following paragraphs to facilitate the use of this information in the context of the weight-of-evidence determination of water quality impairment.

Almost 30 percent of the Coal Creek watershed (14,938 acres) burned in the 2001 Moose Fire, mostly in the lower third of the watershed from the confluence of Dead Horse Creek downstream to the mouth. Much of the Dead Horse Creek and Cyclone Creek watersheds also burned in that fire. The Forest Service Water Erosion Prediction Model (WEPP-Disturbed) estimated that 53,000 tons of sediment would enter streams in the Coal Creek watershed in 2003 because of the Moose Fire (3.6 tons sediment/acre). However, the model assumes that average rainfall fell in the Coal Creek watershed in 2002 and 2003. This was not the case, as both 2002 and 2003 were extremely dry years. Forest service personnel estimated that less than one ton of sediment per acre of land was actually delivered to streams in 2003 (Sirucek, personal communication, September 20, 2004). The amount of sediment eroded because of the fire will continue to decrease in the future as vegetation reestablishes and soils stabilize.

Since 1954, 4,809 acres of land have been clear-cut (9 percent of the total watershed), with an average of 94 acres of land cut per year. The most recent clear-cut occurred in 2000, when 512 acres were cut from the Coal Creek State Forest. The ECA for the Coal Creek watershed is 18 percent, which is lower than the proposed supplemental indicator of 25 percent. This ECA value is heavily influenced by fire, a natural occurrence, and is higher than expected largely because of the 2001 Moose Fire. Water yield increase (7.0 percent above natural) was also lower than the proposed supplemental indicator. Pre-fire water yield for the entire Coal Creek watershed was 2.5 percent.

The WEPP-Disturbed model estimated that 34 tons of sediment reached Coal Creek in 2003 because of historical harvest activities. However, is it recognized that much more sediment may have been contributed in the past. These historical harvest loads may be contributing to the high percentage of fine material in the stream substrate as identified by the McNeil core and substrate sampling.

The FNF survey found that 10 road sites are actively contributing sediment to stream channels in the Coal Creek watershed. The WEPP-Roads model estimated that these roads contribute approximately one-half ton of sediment per year. Other roads were identified as needing BMPs; however, none of these appeared to be contributing sediment directly to a stream channel. The road density in the Coal Creek watershed is relatively low (1.17 miles/square mile), and is rated fully functioning using Forest Service criteria. It should be noted that road conditions have greatly improved in the FNF over the past several years, and historical roads and historical road building activities may have contributed a much greater load of sediment to streams in the past. This historical sediment load may be contributing to the high percentage of fine material in the stream substrate as identified by the McNeil core and substrate sampling.

MFWP found that the lower segment of Coal Creek was a major depositional area, with high amounts of large woody debris (partially from the Moose Fire) retaining pockets of sediment (MFWP, 2004). An imbalance of large woody debris (LWD) was noted in this survey, where some segments appeared to have too much and others not enough. Channelization, historical riparian clear-cuts, and a lack of streamside management zone were also noted in various sections of Coal Creek. This was verified by FNF personnel, who suggested that channel alterations in association with large woody debris distribution could be impairing the fishery beneficial use in Coal Creek (Stevens and Sirucek, personal communications, June 23, 2004). Bank erosion sites were also noted during this survey, although not all streams were surveyed. Approximately 697 tons of sediment per year come from the identified bank erosion sites. Bank erosion loads are most likely much higher than estimated because of the incomplete survey.

Overall, there appears to be very few current anthropogenic sources of sediment in the Coal Creek watershed. However, current sediment sources may not be the cause of the high percentage of fine substrate material observed in Coal Creek. Historical sources, such as roads, road building, and harvests, may have contributed much more sediment in the past than is currently observed today. Because in-stream sediment can move slowly through a system, the conditions observed today may be a result of historic natural and anthropogenic sediment loading.

Lower Coal Creek Water Quality Impairment Summary

The available data for Lower Coal Creek are compared with the proposed thresholds and supplemental indicators in Table 3-28. As stated in Section 3.3, the approach for the FTPA is to evaluate a suite of targets and supplemental indicators to make beneficial use determinations. When one or more of the targets 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 the lower segment of Coal Creek, three out of the four targets were exceeded (McNeil cores, substrate scores, and percent surface fines).

When examined in the absence of the supplemental indicators or without examining all of the available evidence, the targets in Lower Coal Creek clearly suggest water quality impairment associated with sediment. The McNeil core, substrate score, and percent surface fines all suggest impairment associated with sediment. Further, bull trout densities and red counts have declined substantially in Lower Coal Creek, and counts have not rebounded in recent years as they have in the other North Fork Flathead Basin tributaries.

However, more than 20 years of McNeil core and substrate score data are available for Lower Coal Creek, and no trends are apparent over that time period. Bull trout redd counts and densities from 1980 to 1991 show that high bull trout densities existed with historical McNeil core values as high as 42.1 and substrate scores as low as 9.6. Did slightly high subsurface substrate fines (as measured by McNeil cores) cause the decline in bull trout in Lower Coal Creek? The information suggests that that bull trout populations historically were not affected by high amounts of subsurface fine sediment (>35 percent McNeil core) in Lower Coal Creek, and it does not appear that the substrate condition caused the observed decline in bull trout. It is possible that bull trout declines were not caused by sediment, but by some other stressor (or combination of stressors), such as the overall decline in the Flathead Lake bull trout meta-population (see Section 2.2.2), temperature, or habitat alterations.

It is possible that substrate conditions are currently preventing the bull trout population in Lower Coal Creek from rebounding, but examination of the available data does not provide a black-and-white answer. The percent surface fines and macroinvertebrate data provide additional information regarding the situation. The surface fines proposed threshold value (20 percent), a conservative value that suggests beneficial uses might be threatened by sediment, is barely exceeded in Coal Creek. Other information suggests that macroinvertebrate populations are impaired when the percent surface fines reaches 30 percent (see Section 3.3.1). In the case of Coal Creek, macroinvertebrate data were collected at the same time as the surface fines data. The macroinvertebrate data showed that excellent communities were present at both sites in Coal Creek, and at the two sites in the North and South Forks. This information shows that healthy macroinvertebrate populations existed with percent surface fines data as high as 22.9 percent, and suggests that percent surface fines are not impairing beneficial uses. Also, out of all of the macroinvertebrate data collected in the Flathead River Headwaters TPA, the four best Mountain IBI scores were found in the Coal Creek watershed. Clinger taxa were high at all four sites in the Coal Creek watershed, and did not indicate any impairment because of sediment or siltation. These data support the conclusion that *aquatic life beneficial uses are not impaired because of current sediment conditions* in Lower Coal Creek.

It appears that aquatic life health (as evaluated by various macroinvertebrate metrics) is not impaired in Lower Coal Creek. The cold-water fishery, however, is currently impaired. Bull trout populations have failed to rebound in Lower Coal Creek as they have in many of the other North Fork Flathead tributaries. The cause of this impairment is unknown. The fact that the substrate conditions are slightly less than optimal based on comparison with the proposed threshold values may or may not be contributing to this impairment. Other factors such as temperature, physical habitat condition (e.g., large woody debris, number of pools, barriers, stream temperature) or high loads of sediment delivered to the stream from natural sources such as eroding banks or the recent Moose Fire may be the cause. Or, perhaps, it is a combination of factors, including historical sediment loading that has not moved through the system. Given this uncertainty, a TMDL focusing on addressing all known anthropogenic sediment sources has been prepared and is presented in Section 4.0. A plan for a future study to identify the cause(s) of the bull trout population decline has been prepared and is also presented in Section 4.0.

Table 3-28. Comparison of Available Data with the Proposed Targets and Supplemental Indicators for Lower Coal Creek

Targets	Threshold	Upper	Lower
5-year Mean McNeil Core Percent Subsurface Fines < 6.35 mm	35%	37.1%	
5-year Mean Substrate Scores	≥ 10	9.9	
Percent Surface Fines < 2 mm	< 20%	21.7%	22.9%
Clinger Richness	≥ 14	23	16
Supplemental Indicators	**Recommended Value**	**Upper**	**Lower**
Juvenile Bull Trout and Westslope Cutthroat Trout Density	Documented increasing or stable trend	Cutthroat: NA Bull: Decline	
Bull Trout Redd Counts	Documented increasing or stable trend	Decline	
SSC Mean SSC Mean Annual Maximum SSC Maximum	3.2 ± 5.2 mg/L 14.6 mg/L 61.6 mg/L	NA	
Turbidity	High flow – 50 NTU instantaneous maximum Summer base flow – 10 NTU	NA	
Pfankuch Mass Wasting Score	“good”	Excellent	
Pfankuch Bank Vegetation Score	“good”	Good	
Pfankuch Cutting Score	“good”	Fair	
Pfankuch Deposition Score	“good”	Fair	
Montana Mountain Macroinvertebrate Index of Biological Integrity	> 75%	90	86
Percentage of Clinger Taxa	“high”	71	83
EPT Richness	≥ 22	23	19
Periphyton Siltation Index	< 20	NA	
Fire	Evaluated on a case-by-case basis	Year: 2001 Acres: 14,938 % Burned: 30	
Equivalent Clear-Cut Acres	< 25%	18%	
Water Yield	< 10%	7.0% (2.5%)[1]	
Roads	Evaluated on a case-by-case basis	Some roads in need of BMPs	

[1] Pre-Moose Fire water yield.

3.4.2 Middle Fork Flathead River Watershed

The Middle Fork Flathead River watershed encompasses 723,161 acres (1,130 square miles) of land in Flathead County, Montana (Figure 3-20). The Middle Fork Flathead River flows southeast to northwest for 55 miles from the continental divide to the confluence with the North Fork Flathead River, eventually flowing into Flathead Lake. Approximately half of the watershed is in Glacier National Park. With the Bob Marshall Wilderness (90,441 acres) and Great Bear Wilderness Area (212,104 acres), almost the entire watershed is federally protected.

Montana's 1996 303(d) list showed four streams in the Middle Fork Flathead River watershed as impaired: Challenge Creek, Granite Creek, Skyland Creek, and Morrison Creek. Aquatic life and/or fishery beneficial uses were listed as impaired because of habitat alterations and siltation in all four streams. Skyland Creek and Granite Creek were also listed as impaired because of suspended solids in 1996. MDEQ reported on the 2002 303(d) list that Challenge Creek fully supported all beneficial uses, and no TMDLs were required at that time. Granite Creek was listed for siltation and bank erosion on the 2002 303(d) list, MDEQ did not have sufficient credible data for Skyland Creek. Morrison Creek was listed for habitat alterations and siltation.

3.4.2.1 Challenge Creek

Challenge Creek is a first-order tributary flowing approximately 4.3 miles from its origin to its confluence with Granite Creek. The cold-water fishery and aquatic life beneficial uses in Challenge Creek were listed on the 1996 303(d) list as impaired because of habitat alteration and siltation. The basis for the 1996 listing is unknown. In 2002, MDEQ removed Challenge Creek from the 303(d) list and indicated that it was "fully supporting" its designated uses based on the following explanation:

> *"There are no indications of impairments to the stream. Some logging has been done, but there are no overwhelming impacts. Sedimentation appears to be natural. Chemistry and fish data give no indication of a problem."*

Challenge Creek has been removed from the 303(d) list. Since it has been demonstrated that Challenge Creek is fully supporting its beneficial uses, no TMDL is necessary.

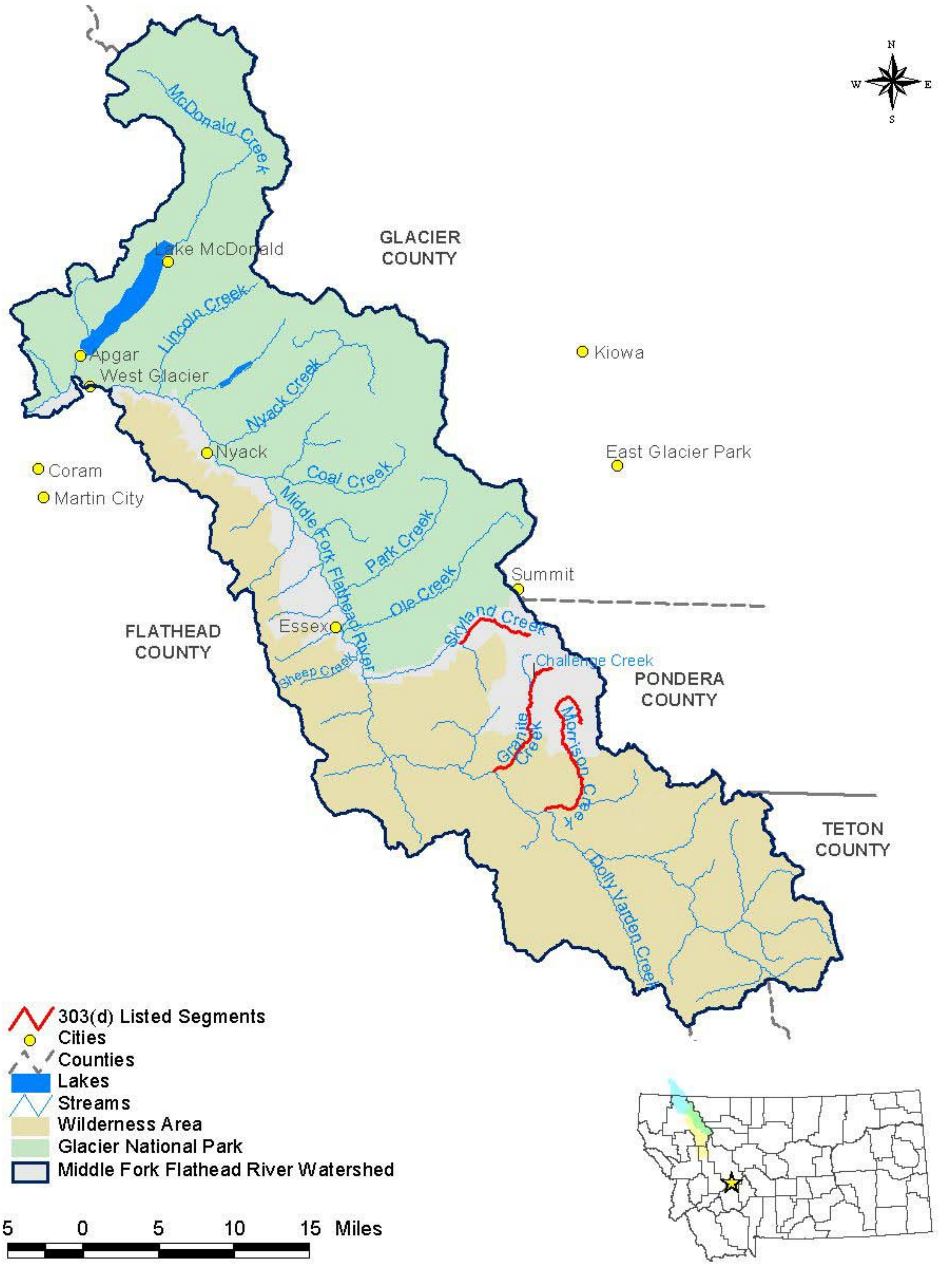


Figure 3-20. Middle Fork Flathead River watershed.

3.4.2.2 Granite Creek

Granite Creek is a second order tributary flowing approximately 8.2 miles from its origin at the confluence of Dodge and Challenge creeks to its confluence with the Middle Fork Flathead River (Figure 3-21). The total watershed area is 18,339 acres (28.7 square miles), one third of which is in the Great Bear Wilderness Area. Because of the Wilderness Area, sampling efforts have focused on the upstream portion of Granite Creek in the FNF. It is assumed that there are few to no anthropogenic sources in the Wilderness Area. Based on field observations, portions of Granite Creek are intermittent in the headwaters region (Laidlaw, 2003).

The aquatic life beneficial use in Granite Creek was listed on the 1996 303(d) list as impaired because of habitat alterations, suspended solids, and siltation. The basis for the 1996 listing is unknown. Bank erosion, other habitat alterations, siltation, and fish habitat degradation were the causes of impairment cited on the 2002 303(d) list; cold water fishery and aquatic life beneficial uses were listed as impaired. According to MDEQ's Assessment Record Sheet, the 2002 listing was based primarily on a 1991 Forest Service report citing moderate impairment *"because of excessive sedimentation from logging road runoff and past silviculture"* (Chestnut 2000). MDEQ's Assessment Record Sheet also cited a decline in bull trout populations.

A review of the available data is provided below. The available data include substrate scores, McNeil cores, Pfankuch ratings, pebble counts, sources (fires, harvest, roads), macroinvertebrates, and fish population estimates. SSC and turbidity data from Challenge and Dodge creeks are also discussed in this section because these streams are the main headwater tributaries to Granite Creek.

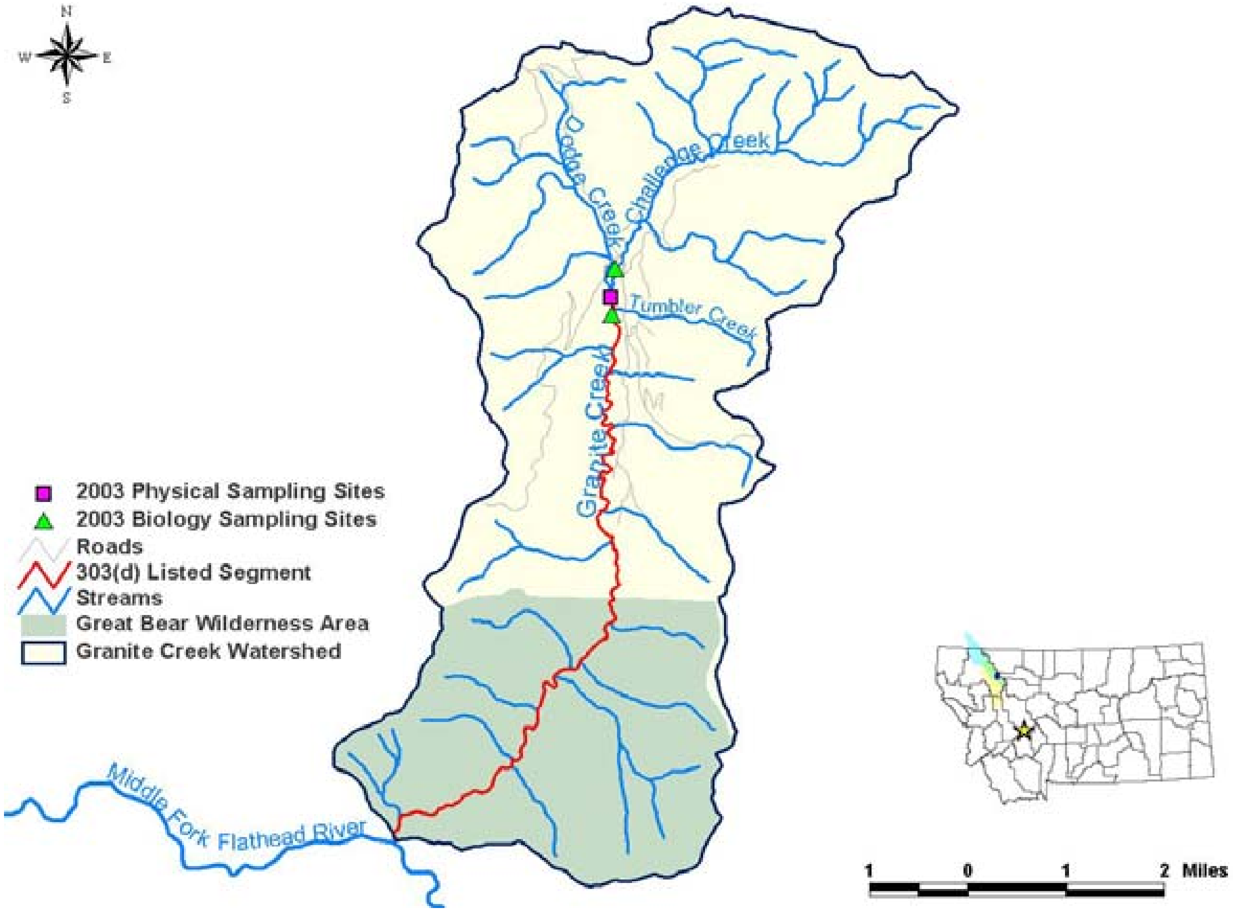


Figure 3-21. Granite Creek watershed.

McNeil Core

MFWP collected McNeil core samples in Granite Creek in 1982 and in 1986 through 2001 (Weaver et al., 2003). The mean from 1997 to 2001 was 33.6, which is below the target of 35 percent. There is also a decreasing trend in the McNeil core data from 1986 through 2001. The maximum value recorded for the past five years is 35.1, and the most current data (2001) indicates a value of 33.7 percent fines.

Substrate Scores

Substrate scores were calculated based on MFWP stream surveys conducted in 2001 and 2002 (Deleray et al., 1999). The mean substrate score for the period of record was 11.5, indicating good juvenile bull trout rearing habitat quality.

Pebble Counts

Pebble counts were collected from one reach in the Granite Creek watershed in 2003. The percent fines smaller than 2 millimeters were 24.8 percent (upper), 18.2 percent (cross section), and 10.4 percent (lower). The average for the reach was 17.8, which is below the supplemental indicator of 20 percent. The data suggest that surface fines are not impairing beneficial uses in Granite Creek.

Macroinvertebrates

Macroinvertebrates were collected at one site on Granite Creek in August 2003. Clinger taxa (15) and percent clingers (77 percent) suggest good water quality with no evidence of siltation. The Mountain IBI score (81 percent) indicates that the aquatic life beneficial uses are not impaired, although the number of EPT taxa (19) was slightly lower than the supplemental indicator. Other supporting metrics suggest that no water quality impairments were present. The HBI score was 1.85, which is lower than the recommended value of 3.5. The dominant taxa were *Drunella doddsi, Yoraperla, Baetis tricaudatus, Epeorus deceptivus,* and *Heterlimnius,* and all had low tolerance values and are sensitive to pollution. In general, the macroinvertebrate data suggest that aquatic life beneficial uses in Granite Creek are not impaired because of siltation.

Macroinvertebrates were also collected in Challenge Creek in August 2003. Data are presented here as supplemental information for Granite Creek, because Challenge Creek is a major headwaters tributary to Granite Creek, and is likely to reflect water quality in Granite Creek. Macroinvertebrate populations at this site were very similar to Granite Creek's. The number of Clinger taxa (18) and clinger percent (70 percent) suggest good water quality with no evidence of siltation. The Mountain IBI score was 86 percent and did not indicate a water quality impairment. As in Granite Creek, the number of EPT taxa (20) was below the recommended supplemental indicator. Other supporting metrics indicated good water quality. The HBI score was 2.65, which is lower than the recommended value of 3.5 (i.e., no apparent nutrient or sediment influences). The majority of the most dominant taxa (*Drunella doddsi, Rhithrogena, Zapada columbiana, Brachycentrus americanus*) are intolerant to pollution. In general, the macroinvertebrate data suggest that the aquatic life beneficial use of Challenge Creek is not impaired because of siltation.

Fish Population

MFWP conducted bull trout redd count surveys from 1980 through 2002 (Weaver et al., 2003). Counts ranged from 47 in 1984 to a low of 4 in 1996, and generally declined from 1986 to 1996 (Figure 3-22). However, redd counts appear to be increasing again from 1997 to the present. It is possible that the declining redd count trend reflects the overall trend in the North and Middle Fork Flathead River watersheds due to changes in the Flathead Lake ecosystem and food chain.

MFWP began conducting juvenile population surveys on Granite Creek in 2001 and 2002. The bull trout densities in 2001 and 2002 were 5.99 juveniles per 100 square meters and 4.13 juveniles per 100 square meters, respectively. Unfortunately, in the absence of a longer period of record, it is not possible to use the population data to evaluate trends.

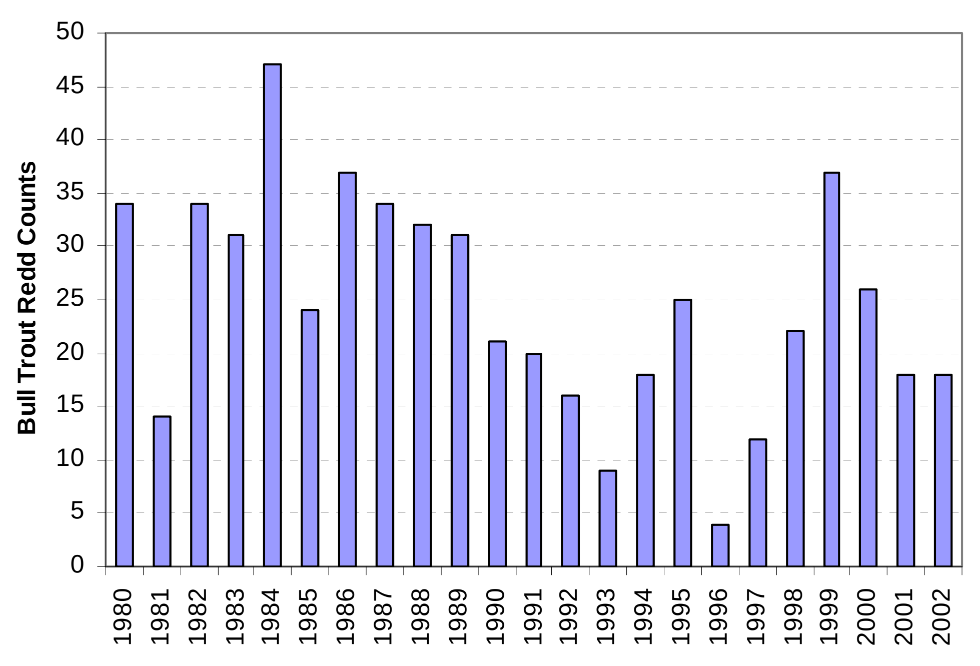


Figure 3-22. Bull trout redd counts for Granite Creek.

Pfankuch Ratings

Stream channel stability ratings were completed at one site in Granite Creek in 2003. No other historical data are available for Granite Creek. However, historical ratings are available for Challenge Creek and Dodge Creek, and are included in Appendix C. Indications of mass wasting, bank erosion, and deposition were noted at the Granite Creek reach in 2003 (Table 3-29). However, streams in the Middle Fork Flathead River watershed (i.e., Granite Creek, Skyland Creek, Morrison Creek) tend to have greater rates of erosion because of bedrock geology. Sandstones and shales in the region are more erodible than the metamorphic rocks and soils, and therefore the maximum natural potential of the stream channel is most likely only good or fair for the evaluated parameters.

Table 3-29. Pfankuch Ratings for Segments of Granite Creek.

Stream Segment	Year	Mass Wasting	Vegetative Bank Protection	Cutting	Deposition
Profile #1 UL	2003	Fair	Good	Fair	Fair
Profile #1 CS	2003	Good	Good	Fair	Fair
Profile #1 LL	2003	Fair	Good	Fair	Fair

RM = river mile.

Suspended Sediment Concentration

No suspended sediment concentration data exist for the main stem of Granite Creek; however, suspended sediment concentration (SSC) data were collected in Challenge and Dodge creeks, the two primary headwater tributaries, from year to year between 1980 and 1995 (n = 146 for Challenge and 144 for Dodge). In general, samples were collected to capture spring runoff (in April, May, and June) as well as base flow conditions (in July, August, September, October, and November). However, the frequency of sampling varied from year to year.

The absence of current SSC data and data from the main stem of Granite Creek prohibits the use of the older data in making a current impairment determination. However, the data are useful in evaluating long-term trends and in making historical comparisons with other streams in the TPA. The mean for the period of record, mean annual maximum, and maximum reported values are presented in Tables 3-30 and 3-31. All values are below the proposed supplemental indicators.

Table 3-30. Comparison of Available SSC Data for Challenge Creek with the Supplemental Indicator Values

SSC Metric	Observed Value (mg/L)	Indicator Value for Comparison (mg/L)
Mean (mg/L)	3.37	3.15 ± 5.83
Mean Annual Maximum (mg/L)	13.48	14.56
Maximum (mg/L)	37.10	61.60

Table 3-31. Comparison of Available SSC Data for Dodge Creek with the Supplemental Indicator Values

SSC Metric	Observed Value (mg/L)	Indicator Value for Comparison (mg/L)
Mean (mg/L)	2.57	3.15 ± 5.83
Mean Annual Maximum (mg/L)	8.69	14.56
Maximum (mg/L)	24.42	61.60

Turbidity

No turbidity data are available for Granite Creek; however, turbidity data were collected in Challenge Creek for approximately the same period of record as the SSC data (1980–1995, n = 149). As with the SSC data, a lack of current data prohibits the use of the older data in making a current impairment determination, but they are useful in evaluating long-term and historical trends.

The mean turbidity in Challenge Creek for the period of record is 1.79 NTU and the median is 0.99 NTU. The maximum recorded value was 17 NTU in May 1987. These data do not suggest that Challenge Creek, one of the primary headwaters tributaries, was likely contributing to potential sediment impairment in Granite Creek.

Sources

In 1998 a large fire burned 2,230 acres of land (12 percent) in the headwaters region of the Granite Creek watershed. Most of this was in the Dodge Creek drainage and in the lower portion of the Challenge Creek drainage. Prior to 1998, no other major fires had occurred in the watershed since 1919. The large burned area will most likely contribute increased amounts of sediment and will increase water yield to Granite Creek for several more years.

Since 1960, clear-cutting has occurred on 1,167 acres of land (6 percent), with the most recent clear-cut occurring in 1987. The harvests occurred during two major time periods: 1970–1975 and 1984–1987. No other clear-cutting has occurred. However, the FNF sources report indicates that the stream channel occupies a wide alluvial valley that has experienced historical riparian harvests (FNF, 2003). Historic timber management units are well vegetated and the historical haul roads are bermed or gated to prevent traffic. The ECA for 2004 is 14.6 percent, which is below the supplemental indicator of 25 percent. Overall, clear-cut land does not appear to be a significant source of sediment.

The lower Granite Creek watershed is part of the Great Bear Wilderness Area, and therefore has no sediment contributions from roads. Upper Granite Creek has roads that are either closed year long or only open seasonally. The FNF survey found that 2 out of 16 road-stream crossings were at risk of failure (FNF, 2003). In addition, 18 out of 24.1 miles of roads are in need of BMPs or upgrading. Only 1.5 miles of roads are within 125 feet of a stream. Overall road density is low (1.0 mile per square mile) and the FNF survey concluded that roads were not a major source of sediment to Granite Creek. However, it appears that roads in the headwaters region area an anthropogenic source of sediment.

Granite Creek Water Quality Impairment Summary

Granite Creek was listed on the 1996 303(d) list as impaired because of habitat alteration, siltation, and suspended solids. Bank erosion, other habitat alterations, fish habitat degradation, and siltation were the listed causes of impairment on the 2002 303(d) list. The impaired beneficial uses were aquatic life and fisheries. A summary of the data for Granite Creek is presented below and in Table 3-32.

Overall, it appears that siltation and suspended solids are not currently impairing beneficial uses in Granite Creek. None of the target values were exceeded. McNeil core and substrate scores were collected at one site over multiple years, and both sets of data indicate good substrate conditions. Good substrate conditions were also noted in the surface fines data. There is no indication of sediment impairment in the macroinvertebrate data, as the number of clinger taxa was high (greater than 14). Because none of the targets were exceeded, it can be concluded that beneficial uses in Granite Creek are not impaired by sediment or siltation.

The supplemental indicators generally support this conclusion. Macroinvertebrate data suggest that healthy, complex systems were present and there was no indication of impairment from any pollutants (high IBI score). The available fisheries data suggest that the bull trout population, after declining in the 1990s, is now rebounding. The cause of the decline is unknown, but it coincides with the documented changes to the bull trout fishery connected to Flathead Lake. ECA (15 percent) was less than the proposed indicator and the road density was low. Twelve percent of the watershed burned in 1998, and likely has contributed increased natural sediment and water yield to the system. However, any effects from the fire do not appear to be impairing beneficial uses.

Table 3-32. Comparison of Available Data with the Proposed Targets and Supplemental Indicators for Granite Creek

Targets	Threshold	Available Data
5-year Mean McNeil Core Percent Subsurface Fines < 6.35 mm	35%	33.6%
5-Year Mean Substrate Scores	≥ 10	11.5
Percent Surface Fines < 2 mm	< 20%	17.8%
Clinger Richness	≥ 14	15
Supplemental Indicators	**Recommended Value**	**Available Data**
Juvenile Bull Trout and Westslope Cutthroat Trout Density	Documented increasing or stable trend	NA NA
Bull Trout Redd Counts	Documented increasing or stable trend	Fluctuating, but Stable Trend
SSC Mean SSC Mean Annual Maximum SSC Maximum	± 5.2 mg/L 14.6 mg/L 61.6 mg/L	NA
Turbidity	High flow – 50 NTU instantaneous maximum Summer base flow – 10 NTU	NA
Pfankuch Mass Wasting Score	"good"	Fair
Pfankuch Bank Vegetation Score	"good"	Good
Pfankuch Cutting Score	"good"	Fair
Pfankuch Deposition Score	"good"	Fair
Montana Mountain Macroinvertebrate Index of Biological Integrity	> 75%	81
Percentage of Clinger Taxa	"high"	77%
EPT Richness	≥ 22	19
Periphyton Siltation Index	< 20	NA
Fire	Evaluated on a case-by-case basis	Year: 1998 Acres: 2230 % Burned: 12
Equivalent Clear-Cut Acres	< 25%	14.6%
Water Yield	< 10%	NA
Roads	Evaluated on a case-by-case basis	Some roads in need of BMPs

3.4.2.3 Skyland Creek

Skyland Creek is a second-order tributary flowing approximately 5.5 miles from its origin to the confluence with Bear Creek (Figure 3-23). It is a small, high-altitude stream that historically has not been managed as a bull trout fishery. The total watershed area is 5,343 acres (8.3 square miles), all of which is in the FNF. In 1998, 75 percent of the watershed burned, and most data collected since then reflect the impacts of the large burned area.

The cold-water fishery and aquatic life beneficial uses in Skyland Creek were listed on the 1996 303(d) list as impaired as a result of habitat alteration, suspended solids, and siltation. The basis for the 1996 listing is unknown. MDEQ lacked sufficient credible data to include this water body on the 2002 303(d) list. As a result, reassessment sampling was completed for Skyland Creek in August 2002.

A review of the available data is provided below. The available data include Pfankuch ratings, a pebble count, channel dimensions, sources (fires, harvest, roads), SSC concentrations, turbidity data, macroinvertebrates, periphyton, water chemistry, and riparian assessments.

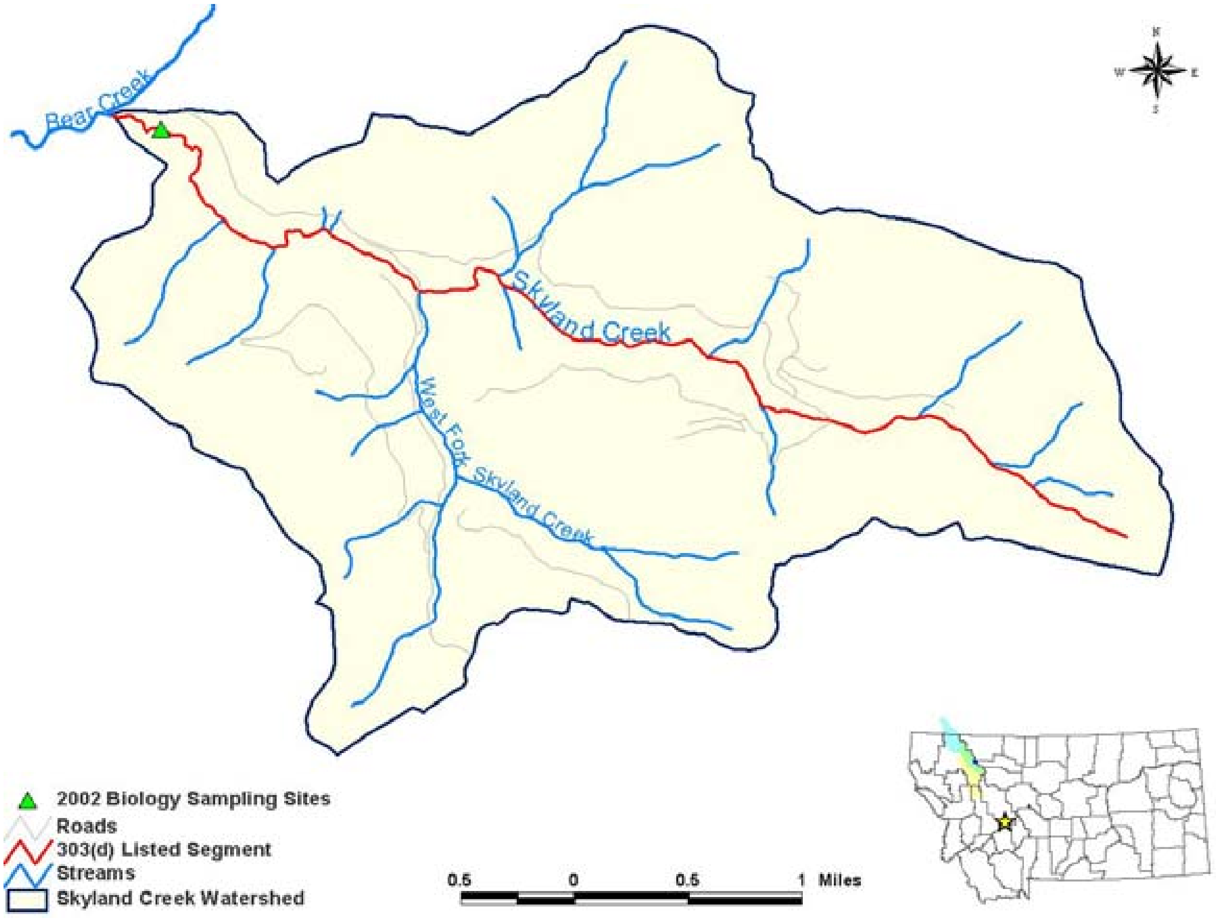


Figure 3-23. Skyland Creek watershed.

McNeil Core

No McNeil core samples have been collected.

Substrate Scores

No substrate samples have been collected.

Pebble Counts

One pebble count was completed on Skyland Creek in 2002. The percent fines smaller than 2 millimeters was 5.71 percent, indicating that siltation is not impairing beneficial uses.

Macroinvertebrates

Macroinvertebrates were collected at one site on Skyland Creek in August of 2002. The number of clinger taxa (13) was slightly below the target, and the percentage of clinger taxa was relatively low (39 percent). These data indicate that a sediment stressor might be present. The macroinvertebrate supplemental indicators did not meet recommended values as well. The Mountain IBI score was 71 percent, which suggests that aquatic biota are slightly impaired. In addition, the number of EPT taxa (18) was below the proposed supplemental indicator value.

Other supporting macroinvertebrate metrics suggest that there were no impairments in the biological community. The five most dominant taxa (*Baetis tricaudatus, Orthocladius sp., Epeorus deceptivus, Drunella coloradensis,* and *Zapada Oregonensis Gr.)* are intolerant to pollution. The HBI score was 2.47, which is lower than the recommended value of 3.5. It should also be noted that Bollman (2003b) concluded that “in-stream habitats were diverse and available,” and “the functional composition of the assemblage included all expected groups in appropriate proportions.”

Periphyton

Periphyton were collected at one site in Skyland Creek in August 2002. The siltation index (3.55) was below the supplemental indicator of 20, and did not indicate impacts from sediment. Bahls (2003) noted that *“The dominant diatom at this site was Encyonema silesiacum, which is somewhat tolerant of organic pollution. A large percentage of this species indicated moderate impairment here. The pollution index also indicated minor impairment from organic loading. Diatom species richness, equitability, and diversity were also low and indicated minor impairment.”* Bahls concluded that a moderate impairment, probably from organic enrichment, was present at this site. However, these results may be explained (and somewhat expected) because of the 1998 fire. Increased organic loading from the 1998 fire may be the source of moderate impairment of the periphyton communities in Skyland Creek. Soils this region also have naturally high nutrient concentrations, and potentially explain the organic loading.

Fish Population

No fish data have been collected.

Pfankuch Ratings

Pfankuch ratings were estimated at multiple locations along Skyland Creek in the 1980s and in 1998, and the data are summarized in Table 3-33. In the absence of recent data, it is not possible to take full advantage of this supplemental indicator.

Table 3-33. Pfankuch Ratings for Segments of Skyland Creek

Stream Segment	Year	Mass Wasting	Vegetative Bank Protection	Cutting	Deposition
RM 1.95	1980	Fair	Fair	Good/Fair	Good/Fair
RM 2.11	1980	Good	Good	Good/Fair	Good
RM 2.39	1980	Good	Good	Good/Fair	Excellent
RM 2.59	1980	Excellent	Excellent	Fair	Fair
RM 2.69	1980	Excellent	Excellent	Fair	Good
RM 3.03	1980	Excellent	Excellent	Good/Fair	Fair
RM 3.83	1980	Fair	Excellent	Poor	Good
RM 4.26	1980	Excellent	Excellent	Good/Fair	Good
RM Unknown	1981	Poor	Good	Fair/Poor	Fair
RM 2.13	1987	Good	Good	Fair	Good/Fair
RM 2.36	1987	Excellent	Poor	Excellent	Excellent
RM 2.69	1987	Excellent	Good	Good	Excellent
RM 4.15	1987	Fair	Good	Good/Fair	Fair
RM 4.57	1987	Fair	Good	Good	Good
RM 4.04	1998	Good	Excellent	Good/Fair	Good

RM = river mile.

Suspended Sediment Concentration

Suspended sediment concentration (SSC) data were collected in Skyland Creek on nearly an annual basis between 1980 and 1993 (n = 292). In general, samples were collected to capture spring runoff (in April, May, and June) as well as base flow conditions (in July, August, September, October, and November). However, the frequency of sampling varied from year to year.

The absence of current SSC data prohibits the use of the older data in making a current impairment determination. However, the older data is useful in evaluating long-term trends and in making historical comparisons with other streams in the TPA. The mean for the period of record, mean annual maximum, and maximum reported values are presented in Table 3-34. In general, these values do not suggest water quality impairment associated with sediment, since concentrations were below the supplemental indicator values.

Table 3-34. Comparison of Available SSC Data for Skyland Creek with the Supplemental Indicator Values

SSC Metric	Observed Value (mg/L)	Indicator Value for Comparison (mg/L)
Mean (mg/L)	2.21	3.15 ± 5.83
Mean Annual Maximum (mg/L)	7.87	14.56
Maximum (mg/L)	14.00	61.60

Turbidity

Turbidity data were collected in Skyland Creek for approximately the same period of record as for the SSC data (1980–1993, n = 296). As with the SSC data, a lack of current data prohibits the use of for the older data in making a current impairment determination, but the older data are useful in evaluating long-term and historical trends.

The mean turbidity for the period of record is 1.47 NTU and the median is 0.91 NTU. The maximum recorded value was 48 NTU in May 1987. Although the data are old, they do not exceed the supplemental indictor values.

Riparian Assessment

A Natural Resources Conservation Service (NRCS) Visual Riparian Assessment was completed in 2002 (MDEQ, 2002). The overall score was 85.5 percent, indicative of good riparian condition. The only disturbance found in the watershed was a lack of large riparian trees, which was attributed to flooding and fire.

Sources

More than 75 percent of the Skyland Creek watershed burned in the 1998 Challenge Fire (4,038 acres). Almost the entire headwaters region of Skyland Creek burned in this fire, from the confluence of the West Fork Skyland Creek upstream. The large burned area has most likely contributed increased sediment loads to Skyland Creek, as well as increased nutrient loads and unstable channel conditions. NRCS and EPA field assessments noted that much of the riparian area was burned, and there is currently a lack of shade and large woody debris around the channel. All field data collected since 1998 may reflect the impacts of this fire.

Since 1960, 879 acres of land have been clear-cut (16 percent). This occurred during two time periods – 1970 to 1972 and 1984 to 1986. No clear-cuts have occurred since 1986. The calculated ECA for 2004 is 9.2 percent. Because there are no recent clear-cuts and the ECA is below the supplemental indicator, clear-cut land does not appear to be a significant source of sediment.

The FNF found that roads are not a significant source of sediment in Skyland Creek (FNF, 2003). More than half of the roads are closed yearlong, and the remaining roads are only open seasonally. No road-stream crossings are at risk of failure, and all roads have had full BMPs implemented. Only 2.3 miles of roads are within 125 feet of a stream.

Skyland Creek Water Quality Impairment Summary

The cold-water fishery and aquatic life beneficial uses in Skyland Creek were listed on the 1996 303(d) list as impaired because of habitat alteration, siltation, and suspended solids. The basis for the 1996 listing is unknown. MDEQ lacked sufficient credible data to include this water body on the 2002 303(d) list. As a result, reassessment sampling was completed for Skyland Creek in August 2002. The data for Skyland Creek are summarized below and in Table 3-35.

It appears that siltation and suspended solids are not impairing beneficial uses in Skyland Creek. No siltation was evident in the surface fines data. Although the number of clinger taxa was slightly lower than the target value, Bollman (2003) noted that taxa richness was good and did not indicate a sediment impairment. Information for the other targets (McNeil cores and substrate scores) was not available.

Supplemental indicators generally suggested good conditions relative to sediment and siltation. The periphyton siltation index was low, which indicates that the algae community is not impacted by excessive sediment. Bollman (2003) reported that the macroinvertebrate community was “excellent” and Skyland Creek had “unpolluted water” with no indication of sediment deposition. IBI scores, clinger taxa, and EPT taxa were all slightly lower than recommended values. However, the cause may simply be due to watershed conditions (high elevation, low flow, drought) or the effects of the 1998 fire (increased water yield, sediment loads, nutrient loads; watershed disturbance). This theory is supported by the periphyton data, which suggested that excessive nutrient loading is present, most likely due to the 1998 fire.

Because of the 1998 Challenge fire, it is difficult to differentiate fire-related sediment impairments from those associated with other potential anthropogenic sources. However, the FNF and MDEQ found no major anthropogenic sediment sources during the 2002 and 2003 surveys. Historically, a small percentage of the watershed has been clear-cut, but no land has been clear-cut for the past 18 years. All roads have full BMP measures implemented, and the Forest Service found no indication of failing road-stream crossings. The lack of sources in the Skyland Creek watershed suggests that any impacts found in the stream are due to natural sources. This, in combination with the good percent surface fines, clinger richness, Pfankuch ratings, and low periphyton siltation index, indicates that Skyland Creek is not impaired because of siltation or sediment.

However, the macroinvertebrate and periphyton data do suggest that a slight aquatic life impairment is present, most likely due to nutrients. This is explained and somewhat expected because of the 1998 fire and subsequent increased nutrient loading. The impairment is most likely due to natural sources (fire) and not anthropogenic sediment loading.

Table 3-35. Comparison of Available Data with the Proposed Targets and Supplemental Indicators for Skyland Creek

Targets	Threshold	Available Data
5-year Mean McNeil Core Percent Subsurface Fines < 6.35 mm	35%	NA
5-year Mean Substrate Scores	≥ 10	NA
Percent Surface Fines < 2 mm	< 20%	5.7%
Clinger Richness	≥ 14	13
Supplemental Indicators	**Recommended Value**	**Available Data**
Juvenile Bull Trout and Westslope Cutthroat Trout Density	Documented increasing or stable trend	NA
Bull Trout Redd Counts	Documented increasing or stable trend	NA
SSC Mean SSC Mean Annual Maximum SSC Maximum	± 5.2 mg/L 14.6 mg/L 61.6 mg/L	NA
Turbidity	High flow – 50 NTU instantaneous maximum Summer base flow – 10 NTU	NA
Pfankuch Mass Wasting Score	"good"	Good
Pfankuch Bank Vegetation Score	"good"	Excellent
Pfankuch Cutting Score	"good"	Good/Fair
Pfankuch Deposition Score	"good"	Good
Montana Mountain Macroinvertebrate Index of Biological Integrity	> 75%	71%
Percentage of Clinger Taxa	"high"	39%
EPT Richness	≥ 22	18
Periphyton Siltation Index	< 20	3.6
Fire	Evaluated on a case-by-case basis	Year: 1998 Acres: 4038 % Burned: 76
Equivalent Clear-Cut Acres	< 25%	9.2%
Water Yield	< 10%	NA
Roads	Evaluated on a case-by-case basis	No significant road sources
Riparian Assessment	> 75%	86%

3.4.2.4 Morrison Creek

Morrison Creek is a third-order tributary flowing approximately 14.8 miles from its origin to the confluence with the Middle Fork of the Flathead River (Figure 3-24). The total watershed area is 32,324 acres (50.5 square miles), the lower half of which is in the Great Bear Wilderness Area. All of the land in the watershed is federally owned (the Wilderness Area and FNF). Because of access constraints and the lack of potential anthropogenic sources in the Wilderness Area, sampling efforts have focused on Morrison Creek upstream of the confluence of Lodgepole Creek in the FNF.

The cold-water fishery and aquatic life beneficial uses in Morrison Creek were listed on both the 1996 and 2002 303(d) lists as impaired because of habitat alteration and siltation. The basis for the 1996 listing is unknown. According to MDEQ’s Assessment Record Sheet, the 2002 listing was based primarily on the results of a 1989 MDEQ stream assessment (MDEQ, 2002).

A review of the available data is provided below. The available data include substrate scores, McNeil cores, Pfankuch ratings, pebble counts, sources (fires, harvest, roads), macroinvertebrates, and fish population estimates.

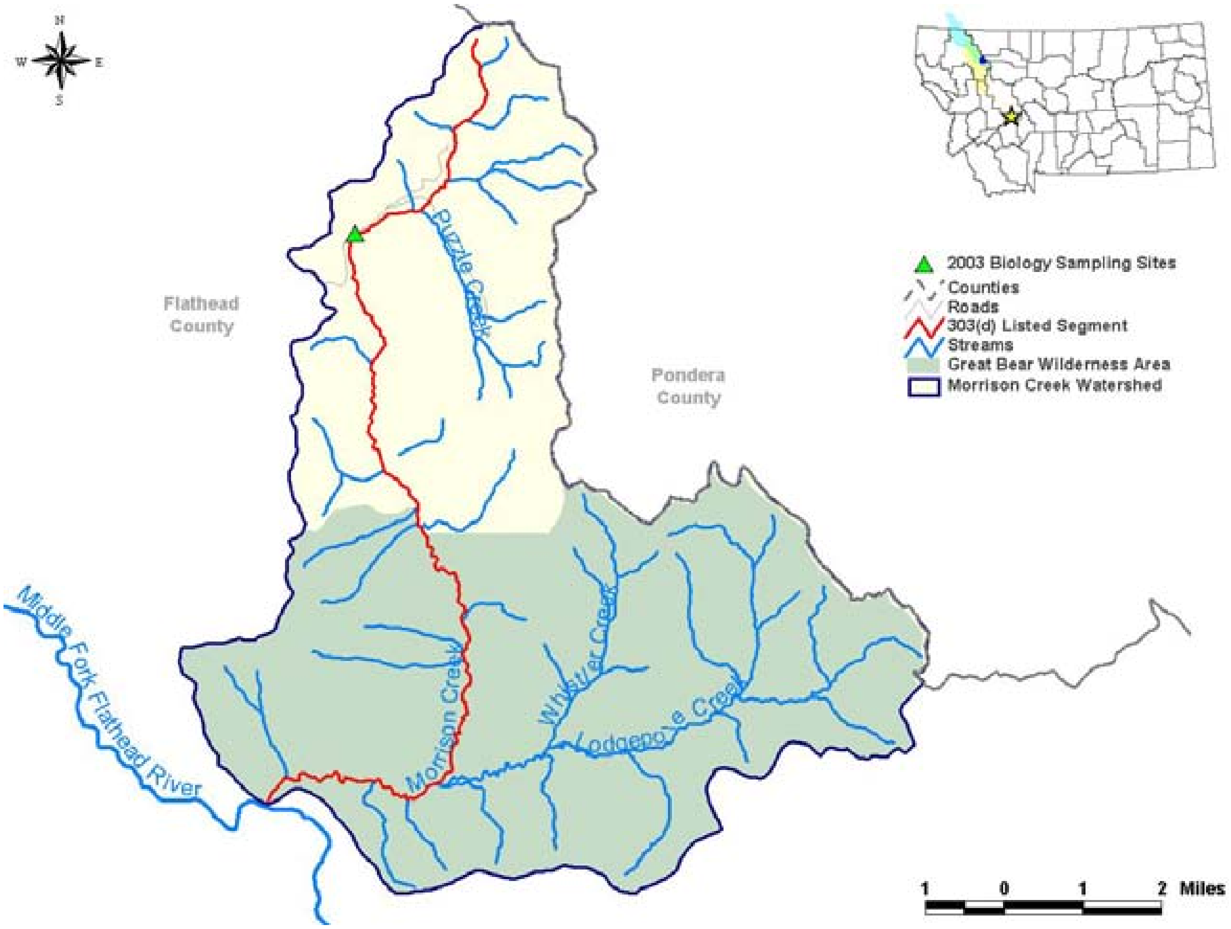


Figure 3-24. Morrison Creek watershed.

McNeil Core

MFWP collected McNeil core samples in 1990 and the mean value was 39.2 percent (Weaver et al., 2003). This individual value exceeds the proposed maximum target value of 35 percent. However, no recent data are available.

Substrate Scores

Substrate scores were calculated based on MFWP stream surveys conducted between 1986 and 2002 (Deleray et al., 1999). The mean substrate score for 1998 through 2002 was 13.4, indicating good juvenile bull trout rearing habitat quality. The mean score for the period of record was 12.7.

Pebble Counts

Pebble counts were collected at two reaches in Morrison Creek in 2003. At the upstream reach, percent surface fines smaller than 2 millimeters were 11.8 percent and 12.2 percent. Downstream, percent surface fines smaller than 2 millimeters were 14.7 percent and 9.8 percent. None of the samples exceed the supplemental indicator and there is no indication of a siltation impairment.

Macroinvertebrates

Macroinvertebrates were collected at one site on Morrison Creek in August 2003. Clinger data (15 taxa, 76 percent of the sample) indicate that sediment was not a cause of impairment at this site. The Mountain IBI was 86, which is above the 75 percent value necessary to be considered fully supporting aquatic life beneficial uses. There was a high number of EPT taxa (19).

Other supporting metrics also suggested that no water quality impairments were present. The HBI score was 2.40, which is lower than the recommended value of 3.5. One tolerant taxon found at this site comprised 0.3 percent of the sample. The dominant taxa (*Cricotopus Nostococladius, Rhithrogena, Baetis tricaudatus, Epeorus deceptivus,* and *Epeorus grandis*) are sensitive to pollution. Overall, the macroinvertebrate data suggest that the aquatic life beneficial use in Morrison Creek are not impaired because of siltation.

Fish Population

MFWP estimated juvenile bull trout populations from 1980 through 2002 (with the exception of 1981 and 1984) (Deleray et al., 1999). The population declined in the early 1990s from a maximum count of 17.54 bull trout 100 square meters in 1986 to a minimum count of 1.46 bull trout per 100 square meters in 1994 (Figure 3-25). Declines in the bull trout population were partially related to an upstream migration barrier that was removed by the Forest Service in 1992 (Deleray et al., 1999). Drought and impacts from trophic dynamic changes in Flathead Lake are other possible contributing factors to fluctuations in bull trout densities (Deleray et al., 1999). Bull trout densities have generally been increasing since 1997. MFWP conducted surveys of redd counts from 1980 through 2002 (Deleray et al., 1999) (Figure 3-26). There appears to be a slight decreasing trend over time. However, it is difficult to determine trends with any accuracy due to the large variation in the data (a minimum of 9 redds to a maximum of 99 redds). No data on westslope cutthroat populations have been collected on this stream.

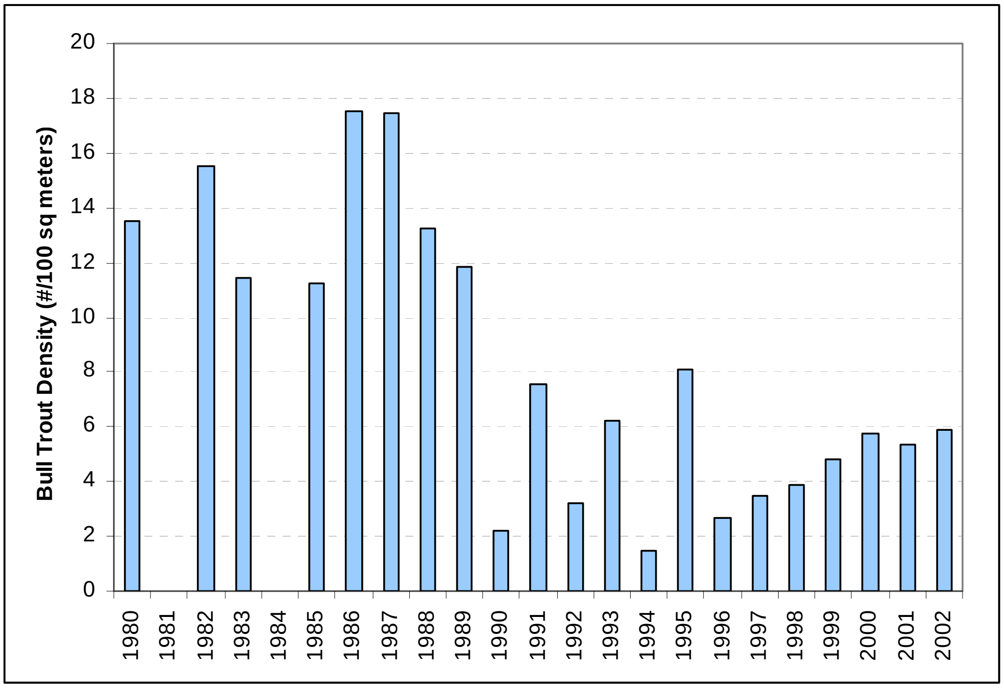


Figure 3-25. Bull trout densities in Morrison Creek.

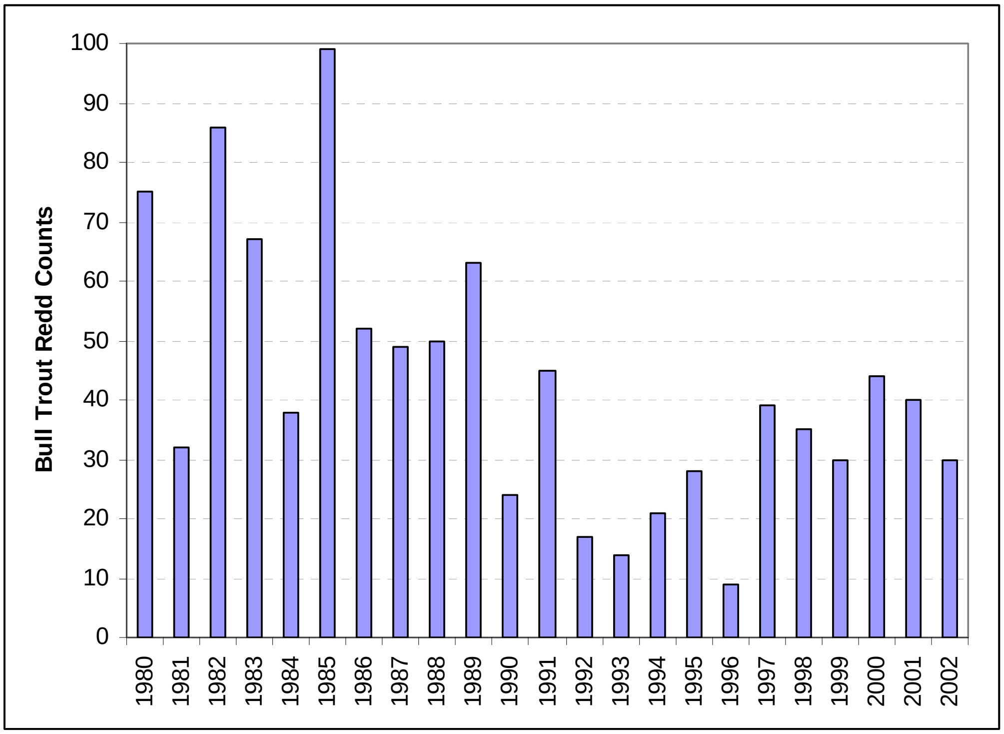


Figure 3-26. Bull trout redd counts in Morrison Creek.

Pfankuch Ratings

No recent Pfankuch surveys were performed in the Morrison Creek watershed. The most recent survey was completed in 1980, and is not considered useful in determining a current beneficial use.

Suspended Sediment Concentration

No SSC data have been collected.

Turbidity

No turbidity data have been collected.

Sources

No recent fires have occurred in the upper Morrison Creek watershed (upstream of the confluence with Lodgepole Creek). The last fire occurred in 1910, and impacts on the current stream condition are negligible. Two separate fires occurred in the Lodgepole Creek watershed in 1988, burning a total of 630 acres.

Since 1960, land was clear-cut during two years: 1972 and 1974. A total of 399 acres were cut during those years (1 percent of the total watershed). The ECA for 2004 is 0.49 percent, which is well below the supplemental indicator of 25 percent. Overall, a small percentage of the watershed was cut more than 30 years ago, and most likely has little effect on current conditions in Morrison Creek.

There are few roads in the Morrison Creek watershed (density = 0.12 miles per square mile), and most of those are permanently closed. A seasonally closed gate restricts road access within the Morrison Creek drainage (FNF, 2003). No high-risk culverts or road sediment sources were found, and all roads have appropriate BMPs. There is no indication that roads are contributing excessive sediment to Morrison Creek.

Morrison Creek Water Quality Impairment Summary

The cold-water fishery and aquatic life beneficial uses in Morrison Creek were listed on both the 1996 and 2002 303(d) lists as impaired because of habitat alteration and siltation. The basis for the 1996 listing is unknown. According to MDEQ's Assessment Record Sheet, the 2002 listing was based primarily on the results of a 1989 MDEQ stream assessment (MDEQ, 2002). A summary of the available data is presented below and in Table 3-36.

Overall, it appears that siltation is not currently impairing beneficial uses in Morrison Creek. Pebble count and substrate scores indicated good substrate conditions with no signs of siltation. There was a high number of clinger taxa in the macroinvertebrate sample, and sediment does not appear to be impairing that community. Only one McNeil core sample was collected in 1990, and it was not considered in this analysis given the fact that it is only a single reading and is 14 years old.

Other supplemental indicators generally support this conclusion. Macroinvertebrate data suggest that healthy, complex systems were present and there is no indication of impairment from any pollutants (high IBI score). There is no indication that anthropogenic sources are contributing sediment to Morrison Creek. There have been no recent fires, harvests, or major road activity. The ECA was only 0.49, roads have BMPs, and no failing road-stream crossings were found. More than half of the watershed is part of the Great Bear Wilderness Area (a roadless, non-harvested area). Although bull trout populations have declined from 1980s levels, this trend is similar to the trend in other streams in the North Fork and Middle Fork Flathead River watersheds, and is potentially due to changes in the Flathead Lake and Flathead

River ecosystem. Together, the collected data and lack of sources suggest that aquatic life and fishery beneficial uses are not impaired because of sediment in Morrison Creek.

Table 3-36. Comparison of Available Data with the Proposed Targets and Supplemental Indicators for Morrison Creek

Targets	Threshold	Available Data
5-year Mean McNeil Core Percent Subsurface Fines < 6.35 mm	35%	39.2 (One Sample Collected in 1990)
5-year Mean Substrate Scores	≥ 10	12.7
Percent Surface Fines < 2 mm	< 20%	12.0% / 12.3%
Clinger Richness	≥ 14	15
Supplemental Indicators	**Recommended Value**	**Available Data**
Juvenile Bull Trout and Westslope Cutthroat Trout Density	Documented increasing or stable trend	Bull: Increasing Since 1997 Cutthroat: NA
Bull Trout Redd Counts	Documented increasing or stable trend	Possible Decline
SSC Mean SSC Mean Annual Maximum SSC Maximum	3.2 ± 5.2 mg/L 14.6 mg/L 61.6 mg/L	NA
Turbidity	High flow – 50 NTU instantaneous maximum Summer base flow – 10 NTU	NA
Pfankuch Mass Wasting Score	“good”	NA
Pfankuch Bank Vegetation Score	“good”	NA
Pfankuch Cutting Score	“good”	NA
Pfankuch Deposition Score	“good”	NA
Montana Mountain Macroinvertebrate Index of Biological Integrity	> 75%	86%
Percentage of Clinger Taxa	“high”	76%
EPT Richness	≥ 22	19
Periphyton Siltation Index	< 20	NA
Fire	Evaluated on a case-by-case basis	No Recent Fires
Equivalent Clear-Cut Acres	< 25%	0.49%
Water Yield	< 10%	NA
Evaluated on a case-by-case basis	Evaluated on a case-by-case basis	No significant road sources

3.4.3 South Fork Flathead River Watershed

The South Fork Flathead River watershed encompasses 1,075,951 acres or 1,681 square miles of land (Figure 3-27). It flows 50 miles from the headwaters in the Bob Marshall Wilderness to the Hungry Horse Reservoir. From the reservoir, the river flows 5.1 miles to the confluence with the Flathead River. More than half the watershed (1,082 square miles) is designated as Wilderness Area (Bob Marshall Wilderness and Great Bear Wilderness Area), and the Forest Service manages 560 square miles outside the wilderness. The upper South Fork (upstream of Hungry Horse Dam) is not hydrologically connected to the Flathead River, Flathead Lake, Middle Fork Flathead River, or North Fork Flathead River because of the Hungry Horse Reservoir and Dam.

The water bodies listed as impaired on the Montana's 303(d) lists in the South Fork Flathead River watershed are Sullivan Creek, South Fork Flathead River, and the Hungry Horse Reservoir.

3.4.3.1 Hungry Horse Reservoir

The cold-water fishery and aquatic life beneficial uses in the Hungry Horse Reservoir were listed on the 1996 303(d) list as impaired because of flow alteration, siltation, and suspended solids. In 2000, MDEQ found the Hungry Horse Reservoir to be fully supporting its beneficial uses based primarily on the results of a 1999 MFWP study, indicating that

> *the reservoir appears to be supporting a healthy, viable native salmonid fishery. Bull trout may have even increased in recent years. There was no significant changes in the size distribution of bull trout and cutthroat trout. Populations appear to have stabilized. The reservoir has a low chlorophyll a concentration (oligotrophic) and high DO levels, high transparency and low conductivity, and alkaline pH. These are in part a result of basin geology. Drawdowns impact the fishery (cutthroat particularly) to some degree, although the overall fishery has been stable over time.*

Since it has been demonstrated that the Hungry Horse Reservoir is fully supporting its beneficial uses, no TMDL is necessary. As a result, Hungry Horse Reservoir is not discussed further herein.

3.4.3.2 South Fork Flathead River

The South Fork Flathead River was listed on the 1996 303(d) list for water quality impairments associated with habitat and flow alterations, and for flow alteration on the 2002 303(d) list. Since no "pollutants" are cited as probable causes of impairment on either the 1996 or 2002 303(d) list, no TMDLs are necessary. As a result, the South Fork Flathead River is not discussed further herein.

Figure 3-27. South Fork Flathead River watershed.

3.4.3.3 Sullivan Creek

Sullivan Creek is a third-order tributary flowing approximately 15.3 miles from its origin to its confluence with the Hungry Horse Reservoir (Figure 3-28). The watershed encompasses 73 square miles with tributaries including Quintonkon, Connor, Slide, Branch, and Ball creeks. The cold-water fishery and aquatic life beneficial uses in Sullivan Creek were listed on the 1996 303(d) list as impaired because of habitat alterations. MDEQ lacked sufficient credible data to include this water body on the 2002 303(d) list. The basis for the 1996 listing is unknown. As a result, reassessment sampling was completed for Sullivan Creek in August 2002.

A review of the available data is provided below. The available data include pebble counts, macroinvertebrates, periphyton, sources (harvest, fires, roads), an NRCS Visual Riparian Assessments, Pfankuch ratings, bull trout redd counts; and long-term, historical suspended sediment concentration and turbidity data.

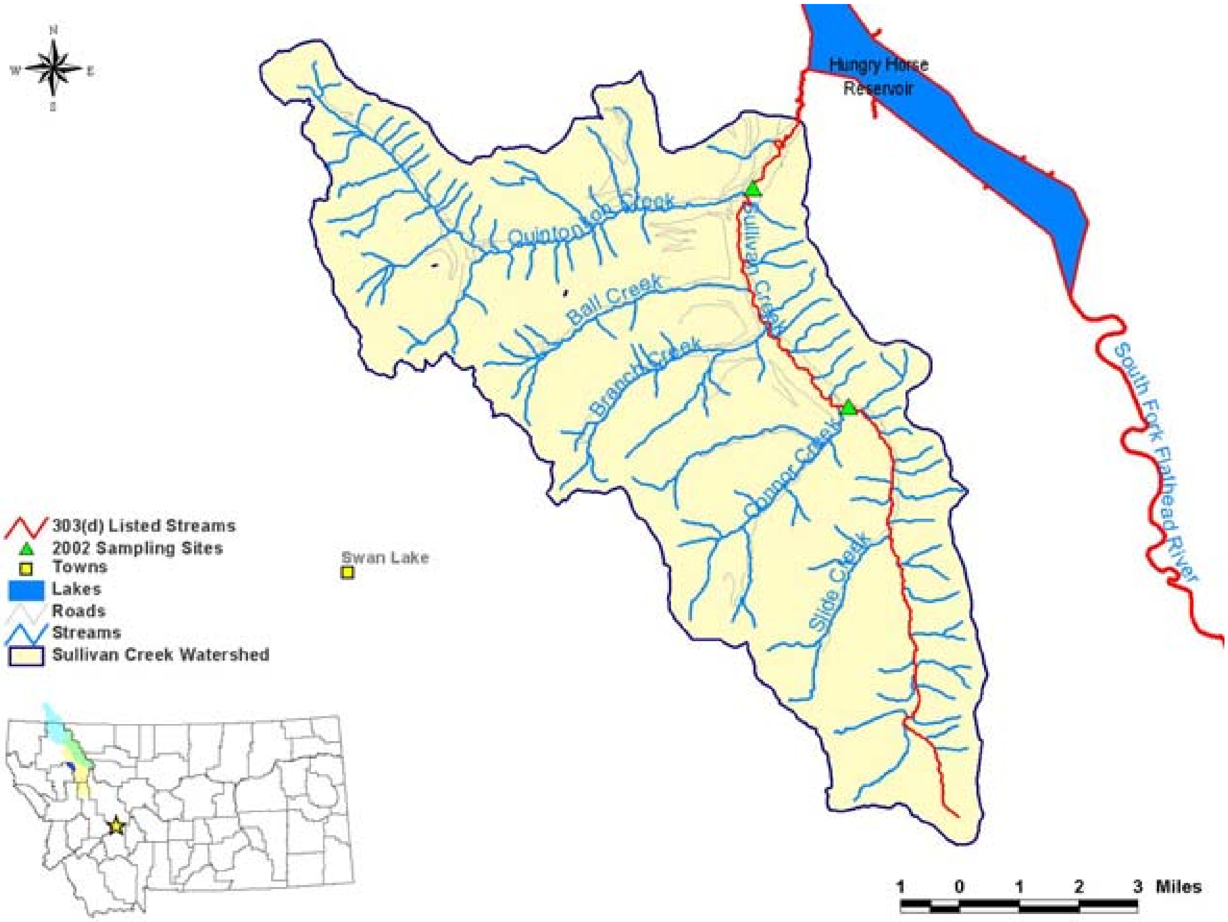


Figure 3-28. Sullivan Creek watershed.

McNeil Core

No samples have been collected.

Substrate Scores

No samples have been collected.

Pebble Counts

Wolman pebble counts were conducted at two sites on Sullivan Creek in 2002 (Figure 3-28). The percent fines smaller than 2 millimeters were 13.1 percent at the upper site and 5.0 percent at the lower site (average of 9.1 percent for the entire reach). The data do not suggest that sediment is impairing beneficial uses.

Macroinvertebrates

Macroinvertebrates were collected at two sites on Sullivan Creek in August 2002: just upstream of Connor Creek (upper) and downstream of Quintonkon Creek (lower).

Clinger data (14 taxa, 72 percent of the sample) indicate that sediment was not a cause of impairment at the upper site on Sullivan Creek. However, both the Mountain IBI score (71 percent) and the number of EPT taxa (17) were slightly lower than the proposed supplemental indicators values. Bollman (2003) noted that "clean, cold water" most likely existed at the time of sampling and "fine sediment deposition did not substantially limit hard substrate habitats." Overall, it does not appear that siltation is impairing the macroinvertebrate community at this site. Other metrics from the macroinvertebrate data show mixed results. The HBI score was 1.27, which is lower than the recommended supplemental indicator of 3.5 (i.e., no apparent nutrient or sediment influences). None of the five most dominant taxa (*Epeorus deceptivus, Cinygmula* sp.*, Baetis tricaudatus, Drunella coloradensis,*and *Apatania* sp.) are sensitive to pollution.

There was no evidence of sediment impairment at the lower site either. There was a high number of clinger taxa (16; 79 percent) and the Mountain IBI score was 76 (i.e., fully supporting beneficial uses). Bollman (2003) noted that "cold water and excellent water quality" existed with no evidence of sediment deposition. Only the number of EPT taxa (19) was slightly lower than the recommended value. The HBI score (1.32) suggests that no sediment or nutrient impairments exist. None of the five most dominant taxa (*Cinygmula* sp.*, Epeorus deceptivus, Baetis tricaudatus, Serratella tibialis,* and *Apatania* sp.) are sensitive to pollution. Overall, sediment does not appear to be impairing beneficial uses at the lower Sullivan Creek site.

Periphyton

Periphyton data were collected at two sites on Sullivan Creek in August 2002: just upstream of Connor Creek (upper site) and downstream of Quintonkon Creek (lower site). The siltation indices at both sites was low (0.0 – upper; 0.23 – lower) and do not suggest impairment from sediment. Furthermore, Bahls (2003) concluded that there were no overall impairments detected at the upper site and excellent water quality was present. Slight impairments due to organic loading, which may be natural, were noted at the lower site.

Fish Population

MFWP conducted redd counts from 1993 through 2002 in Sullivan Creek and Quintonkon Creek (a major tributary to Sullivan Creek). Counts for Sullivan Creek averaged 39.8 with a minimum number of 8 in 1994 and a maximum of 55 in 1999 (Figure 3-29) (Weaver et al., 2003). The data fluctuated over the 10-year period, and there was no apparent trend over the period of record.

Quintonkon Creek redd counts averaged 9.8, and showed an increasing trend over time. Bull trout populations were rated as "functioning acceptable" by the FNF (Van Eimeren, 2002).

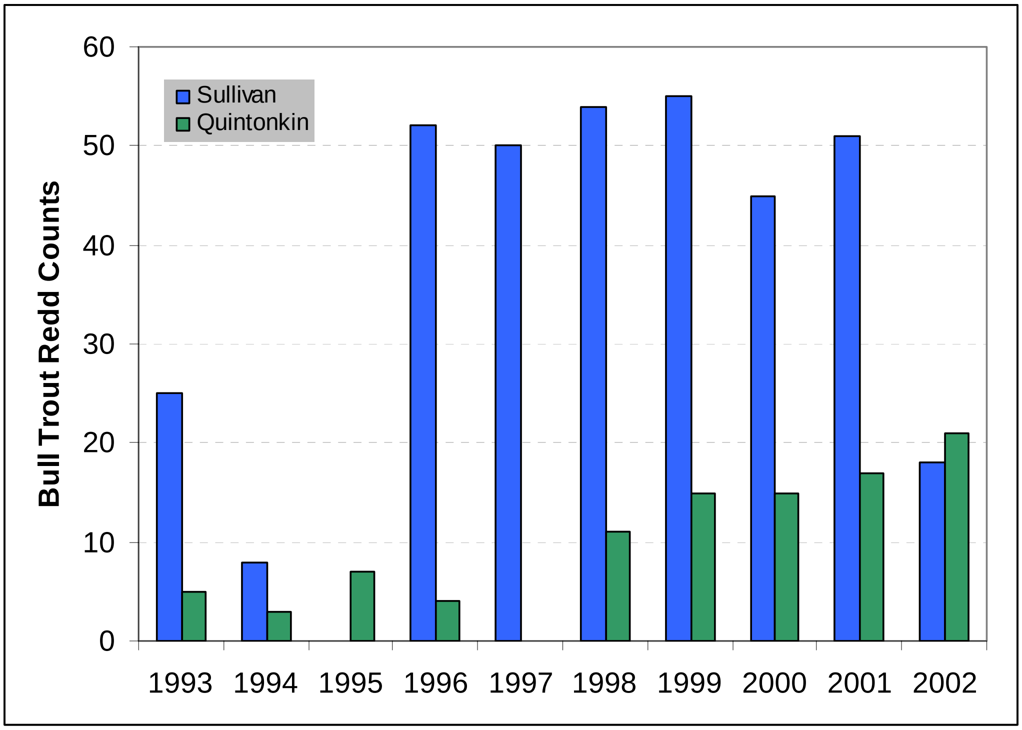


Figure 3-29. Bull trout redd counts in Sullivan Creek and Quintonkon Creek.

Pfankuch Ratings

Pfankuch ratings were completed in 1974, 1987, and 2002 at various locations in Sullivan Creek (Table 3-37). The age of most of this information makes it of limited utility in evaluating current conditions. Data collected in 2002 suggests that mass wasting, vegetative bank protection, and streambank cutting were good at the upstream site. Almost no sediment deposition was observed at this site (excellent deposition score). The Pfankuch ratings at the downstream site indicated worse conditions – large areas of mass wasting were observed. Few riparian plants were observed and streambank cuts were significant. There was also some sediment deposition (fair rating). However, the sampling site was located in an area of unconsolidated sediments and glacial till, and some sediment erosion and deposition is to be expected. This area has also historically been an area of high erosion and steep cutbanks, with the effects of the 1964 flood still evident (Stevens, personal communication, July 12, 2004).

Table 3-37. Pfankuch Ratings for Segments of Sullivan Creek

Stream Segment	Year	Mass Wasting	Vegetative Bank Protection	Cutting	Deposition
RM 1.96	1974	Excellent	Excellent	Fair	Fair
RM 3.85	1974	Excellent	Excellent	Fair	Fair
RM 4.69	1974	Good	Good	Excellent	Excellent
RM 6.87	1974	Good	Excellent	Good/Fair	Good
RM 9.85	1974	Poor	Fair	Poor	Fair
RM 3.65	1987	Poor	Fair	Fair/Poor	Fair/Poor
RM 3.96	1987	Poor	Fair	Fair/Poor	Fair/Poor
RM 6.90	1987	Fair	Good	Fair	Fair/Poor
RM 9.69	1987	Fair	Fair	Good/Fair	Fair
Upper Bridge	2002	Good	Good	Good/Fair	Excellent
Below Quintonkon	2002	Poor	Fair	Fair	Fair

RM = river mile.

Suspended Sediment Concentrations

Suspended sediment concentration (SSC) data were collected in Sullivan Creek from 1978 to 1983 and from 1985 to 1989 (n = 97). In general, samples were collected to capture spring runoff (in April, May, and June) as well as base flow conditions (in July, August, September, October, and November). However, the frequency of sampling varied from year to year. A lack of current data prohibits the use of the older data for making a current impairment determination, but the data are useful in evaluating long-term and historical trends. The mean for the period of record, mean annual maximum, and maximum reported values are presented in Table 3-38. The values slightly exceed the proposed targets; however, it should be noted that the targets are conservative since they were derived from a stream draining a 1,112 acre watershed compared with Sullivan Creek's 46,652 acres. For this reason, these data do not appear to suggest sediment impairment, prior to 1989, associated with excessive suspended sediment loads.

Table 3-38. Comparison of Available SSC Data for Sullivan Creek with the Supplemental Indicator Values

SSC Metric	Observed Value (mg/L)	Indicator Value for Comparison (mg/L)
Mean (mg/L)	4.54	3.15 ± 5.83
Mean Annual Maximum (mg/L)	20.59	14.56
Maximum (mg/L)	63.57	61.60

Turbidity

Turbidity data were collected in Sullivan Creek for approximately the same period of record as for the SSC data (1978–1989, n = 78). As with the SSC data, a lack of current data prohibits the use of the older data for making a current impairment determination, but the data useful in evaluating long-term and historical trends.

The mean turbidity for the period of record is 1.31 NTU and the median is 0.82 NTU. The maximum-recorded value was 12 NTU in May 1986. No impairments are evident from the turbidity data.

Riparian Assessment

An NRCS Visual Riparian Assessment was completed in 2002 (MDEQ, 2002). The overall stream reach score was 95.5 percent, indicative of excellent riparian condition

Sources

Between 1929 and 2002, only 38 acres burned in the Sullivan Creek watershed. The most recent fire occurred in 2003, burning 7,520 acres of land (16 percent). Effects of the fire are not evident in most of the Sullivan Creek data because the data were collected before 2003 (and during a long period of time with minimal fire). Natural sediment contributions will most likely increase in the future because of the severity of the 2003 fire.

Since 1960, approximately 6 percent of the watershed has been clear-cut (FNF, 2003). Since 1984, only 60 acres of land have been clear-cut. The ECA for 2004 is 15.7 percent, which is below the supplemental indicator of 25 percent and influenced by the 2003 fire. Because few acres have been recently clear-cut, and only a small portion of the total watershed has been historically cut, it appears that clear-cutting should have minimal impacts on stream water quality.

The FNF identified active upland erosion areas during the 2003 source assessment survey. Road density in the watershed is 0.96 miles per square mile, which is rated “properly functioning” by Forest Service criteria. A total of 103 road/stream crossings were identified, and 17 were at risk of failure. Only 7.5 of 69.8 road miles were located within 125 feet of a stream (25.7 miles within 300 feet). Portions of 33 miles of historical roads need to be evaluated for drainage problems that input sediment directly into stream networks.

In summary, it appears that forest fires and logging have had minimal impacts on water quality in Sullivan Creek (1984 through 2002). Several road issues were identified regarding poor road-stream crossings and historical roads that may need BMPs. However, the extent of water quality impacts from roads is unknown.

Sullivan Creek Water Quality Impairment Summary

The cold-water fishery and aquatic life beneficial uses in Sullivan Creek were listed on the 1996 303(d) list as impaired because of habitat alterations. MDEQ lacked sufficient credible data to include this water body on the 2002 303(d) list. The basis for the 1996 listing is unknown. As a result, reassessment sampling was completed for Sullivan Creek in August 2002. A summary of the available sediment data is presented below and in Table 3-39.

Overall, it appears that siltation is not currently impairing beneficial uses in Sullivan Creek. No siltation was evident in the pebble counts, and the number of clinger taxa were higher than the target at two sites. Information for the other targets (McNeil cores and substrate scores) was not available.

Supplemental indicators generally suggest good conditions in Sullivan Creek as well. Bull trout redd counts fluctuated over a 10-year period of sampling, but showed no apparent trends. The periphyton siltation index was very low (good) at two sites. SSC and turbidity values, although old, were low and similar to reference conditions. Clear-cut land is most likely not a major source of sediment because only a small percentage of the watershed has historically been clear-cut, and very little since 1984. At the upstream site, macroinvertebrate data indicate that aquatic life uses may be slightly impaired. However, Bollman (2003) noted that the data did not suggest that sediment was the cause of the impairment, and that “clean, cool water” was most likely present at the time of sampling. The Mountain IBI indicated full support at the downstream site. Good or excellent conditions were noted in the Pfankuch data at the upstream site, although not the downstream site. The fair ratings at the downstream site are thought to be due to natural conditions. A recent NRCS survey found excellent conditions in Sullivan Creek. Overall, the aquatic life and fishery beneficial uses do not appear to be impaired because of sediment in Sullivan Creek.

Table 3-39. Comparison of Available Data with the Proposed Targets and Supplemental Indicators for Sullivan Creek

Targets	Threshold	Upper	Lower
5-year Mean McNeil Core Percent Subsurface Fines < 6.35 mm	35%	NA	
5-year Mean Substrate Scores	≥ 10	NA	
Percent Surface Fines < 2 mm	< 20%	13.1%	5.0%
Clinger Richness	≥ 14	14	16
Supplemental Indicators	**Recommended Value**	**Upper**	**Lower**
Juvenile Bull Trout and Westslope Cutthroat Trout Density	Documented increasing or stable trend	Bull: NA Cutthroat: NA	
Bull Trout Redd Counts	Documented increasing or stable trend	Stable	
SSC Mean SSC Mean Annual Maximum SSC Maximum	± 5.2 mg/L 14.6 mg/L 61.6 mg/L	4.5 mg/L 20.6 mg/L 63.6 mg/L	
Turbidity	High flow – 50 NTU instantaneous max Summer base flow – 10 NTU	Mean: 1.31 NTU Median: 0.82 NTU Maximum: 12.0 NTU	
Pfankuch Mass Wasting Score	“good”	Good	Poor
Pfankuch Bank Vegetation Score	“good”	Good	Fair
Pfankuch Cutting Score	“good”	Good/Fair	Fair
Pfankuch Deposition Score	“good”	Excellent	Fair
Montana Mountain Macroinvertebrate Index of Biological Integrity	> 75%	71%	76%
Percentage of Clinger Taxa	“high”	72%	79%
EPT Richness	≥ 22	17	19
HBI Score	3.5	1.27	1.32
Periphyton Siltation Index	< 20	0.0	0.23
Fire	Evaluated on a case-by-case basis	Year: 2003 Acres: 7520 % Burned: 16	
Equivalent Clear-Cut Acres	< 25%	15.7%	
Water Yield	< 10%	NA	
Roads	Evaluated on a case-by-case basis	Some roads in need of BMPs	
NRCS Riparian Assessment	> 75%	95% (Excellent)	

3.5 Water Quality Impairment Status Summary

The previous sections presented summaries of all available water quality data for waters appearing on Montana's 1996 and 2002 303(d) lists. The weight-of-evidence approach described in Section 3.3 was applied to the listed water bodies to address beneficial use impairments. Using this approach, aquatic life and fishery beneficial use determinations were updated for each water body. A summary is presented in Table 3-40. The South Fork Flathead River, Hungry Horse Reservoir, Big Creek, and Challenge Creek have been addressed in other TMDLs or through MDEQ's 303(d) reassessment process and were therefore not considered in this analysis.

As shown in Table 3-40, none of the evaluated stream segments except Lower Coal Creek are impaired as a result of excessive levels of sediment. In Lower Coal Creek, the fishery beneficial use is impaired because of habitat alterations and an unknown cause, possibly sediment. Due to the uncertainty in this analysis, and to be proactive and protective of beneficial uses, a sediment TMDL will be developed for Lower Coal Creek. Although it does not appear that nutrients are impairing beneficial uses in North Fork Coal Creek, insufficient data are available at this time to make a final determination.

In summary, since no pollutants are currently causing impairments in Red Meadow Creek, Whale Creek, South Fork Coal Creek, Granite Creek, Skyland Creek, Morrison Creek, and Sullivan Creek, no TMDLs are necessary. However, implementation of a Voluntary Water Quality Improvement Strategy is proposed to address all identified anthropogenic sources of sediment in those watersheds where human-caused sources were identified (i.e., Red Meadow Creek, Granite Creek, Whale Creek, Sullivan Creek). Necessary follow-up monitoring and a conceptual strategy to improve overall watershed health for these water bodies is presented in Section 5.0. Because the fishery beneficial use in Lower Coal Creek is impaired as a result of habitat alterations and an unknown cause (possibly sediment), a sediment TMDL has been prepared and is presented in Section 4.0, along with load allocations, a restoration plan, and a sediment monitoring plan. A study is also proposed to address the uncertainties in the Lower Coal Creek beneficial use analysis, including a detailed habitat assessment in conjunction with a sediment source assessment, and temperature monitoring to evaluate possible temperature impairments. Section 4.0 also includes a monitoring plan to address the collection of supplemental nutrient data in North Fork Coal Creek.

Table 3-40. Current Water Quality Impairment Status for the Flathead River Headwaters TPA.

Water body Name and Number	Year Listed	Listed Probable Causes	Current Impairment Status	Proposed Action
Red Meadow Creek MT76Q002-020	1996	Habitat alterations/Siltation	Not impaired	▪ Implement Water Quality Improvement Strategy to address identified sources. ▪ Conduct follow-up McNeil core monitoring.
	2002	Habitat alterations/Siltation		
Whale Creek MT76Q002-030	1996	Habitat alterations/Siltation	Not impaired	▪ Implement Water Quality Improvement Strategy to address identified sources.
	2002	Habitat alterations/Siltation		
South Fork Coal Creek MT76Q002-040	1996	Habitat alterations/Siltation	Not impaired	▪ Implement TMDL to address identified sources and habitat alterations. ▪ Conduct habitat and source assessment to address uncertainties ▪ Conduct follow-up nutrient monitoring in North Fork Coal Creek.
	2002	Habitat alterations/Siltation		
Lower Coal Creek, SF to confluence with NF River MT76Q002-080	1996	Siltation	Impaired for Habitat Alterations and Sediment	
	2002	Siltation		
North Fork Coal Creek MT76Q002-070	1996	Nutrients/Siltation	Not impaired for siltation. Unknown for nutrients.	
	2002	Siltation		
Granite Creek MT76I002-010	1996	Habitat alterations/Siltation/Suspended Solids	Not impaired	▪ No action
	2002	Siltation/Bank Erosion		
Skyland Creek MT76I002-020	1996	Habitat alterations/ Siltation/Suspended Solids	Not impaired	▪ No action
	2002	Insufficient credible data		
Morrison Creek MT76I002-050	1996	Habitat alterations/Siltation	Not impaired	▪ No action
	2002	Habitat alterations/Siltation		
Challenge Creek MT76I002-040	1996	Habitat alter/Siltation	Not impaired	▪ No action
	2002	Not Listed		
South Fork Flathead River MT76J001-010	1996	Habitat alterations Flow alterations	Flow alteration	▪ No action
	2002	Flow alterations		
Sullivan Creek MT76J003-010	1996	Habitat alterations	Not impaired	▪ Implement Water Quality Improvement Strategy to address identified sources. ▪ Conduct follow-up McNeil core monitoring.
	2002	Insufficient credible data		
Hungry Horse Reservoir MT76J002-1	1996	Flow alteration Siltation Suspended Solids	Not Impaired	▪ No action

4.0 COAL CREEK SEDIMENT TMDL

As discussed in Section 3.4.1.7, the cold-water fishery in Lower Coal Creek is impaired. The bull trout population has failed to rebound in Lower Coal Creek unlike many of the other North Fork Flathead River tributaries. The cause of this impairment is unknown. The fact that the substrate conditions are slightly less than optimal when compared with the proposed threshold values may or may not explain this impairment. Other factors—such as physical habitat condition (e.g., large woody debris, number of pools, barriers, stream temperature), high loads of sediment delivered to the stream from natural sources, or historical anthropogenic sources—may be the cause. Or, perhaps, the impairment is caused by a combination of factors. Given the uncertainty and to be protective of beneficial uses, a TMDL focusing on addressing all known anthropogenic sediment sources and further study to identify the cause(s) of the bull trout population decline are proposed. The required TMDL elements (i.e., identification of all significant sources, water quality goals or targets, a TMDL, allocation, and margin of safety) are presented in this section.

Although it appears that only Lower Coal Creek is impaired, this section of the document and all the TMDL elements pertain to the entire Coal Creek watershed, from Coal Creek's confluence with the North Fork Flathead River upstream to the watershed divide.

4.1 Significant Sources of Sediment in the Coal Creek Watershed

Potentially significant natural and anthropogenic sources of sediment loading to streams in the Flathead River Headwaters TPA include fire, timber harvest activities, the forest road network including stream crossings, bank erosion, mass wasting from avalanche chutes, natural soil creep, and stream down-cutting. Each of these are discussed in the following subsections.

The FNF and MFWP conducted the most recent and comprehensive source assessments in the Coal Creek watershed, looking at in-stream sediment conditions and potential upland sources of sediment. This information, as well as information from additional analyses (GIS, and other reports), and personal communications is summarized in the following subsections. The full MFWP and FNF reports are given in Appendix B.

The conclusions presented herein have been developed from the best data available at the time this report was prepared. Measured sediment loads from all sediment sources are not available; therefore, estimates were made based on values in the scientific literature or were developed using various modeling techniques. Further, detailed, on-the-ground assessments have not been conducted in the entire watershed. As a result, interpolation was required and assumptions were made regarding conditions that were not directly observed. However, it is felt that the information contained in the following subsections allows reasonable comparisons to be made regarding the relative contributions of sediment from each of the various source categories. Uncertainties are discussed in greater detail in Section 4.1.8, and a strategy to address them is presented in Section 4.4.

4.1.1 Roads

Over the years, 125.3 miles of roads have been built in the Coal Creek watershed with a maximum road density of 1.52 miles per square mile. Since 1995, 29 miles have been fully decommissioned following FNF protocols, leaving a total of 96.3 road miles in 2004 (1.2 miles per square mile) (Figure 4-1). As shown in Table 4-1, the majority of these roads (38.7 miles) are closed yearlong (i.e., not open to motorized traffic that may cause increased erosion). Approximately 34 miles of roads are up to full Forest Service BMP standards (Figure 4-2).

Table 4-1. Road Characteristics in the Coal Creek Watershed

Watershed	Current Roads (mi)					Number of Road-Stream Crossings	Watershed Size (mi^2)	Road Density (mi/mi^2)	De-commissioned (Since 1995)
	Closed	Seasonal	Open Yearlong	Other	Total Road Miles				
Coal Creek	38.7	12.8	20.7	24.1	96.3	132	82.1	1.17	29.0

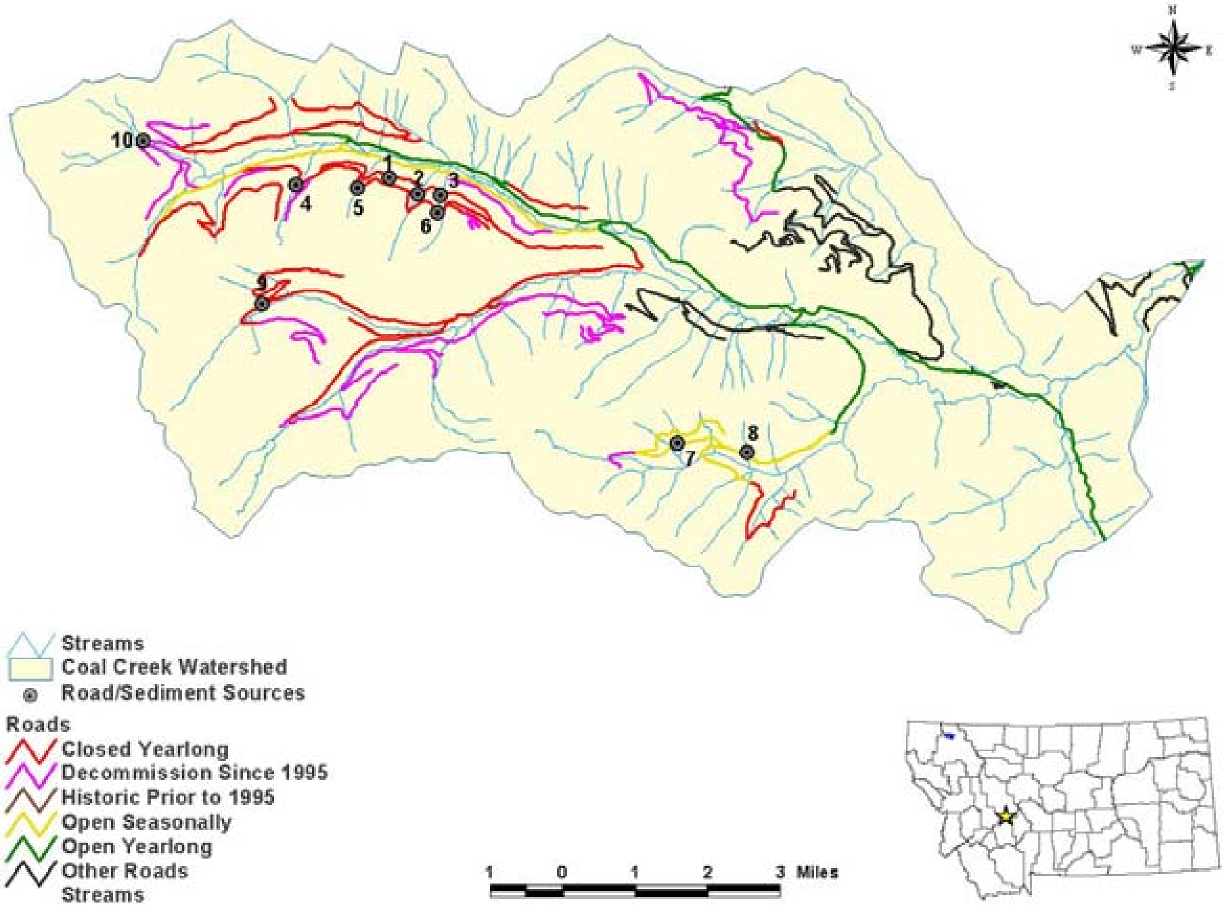


Figure 4-1. Location of roads in the Coal Creek watershed.

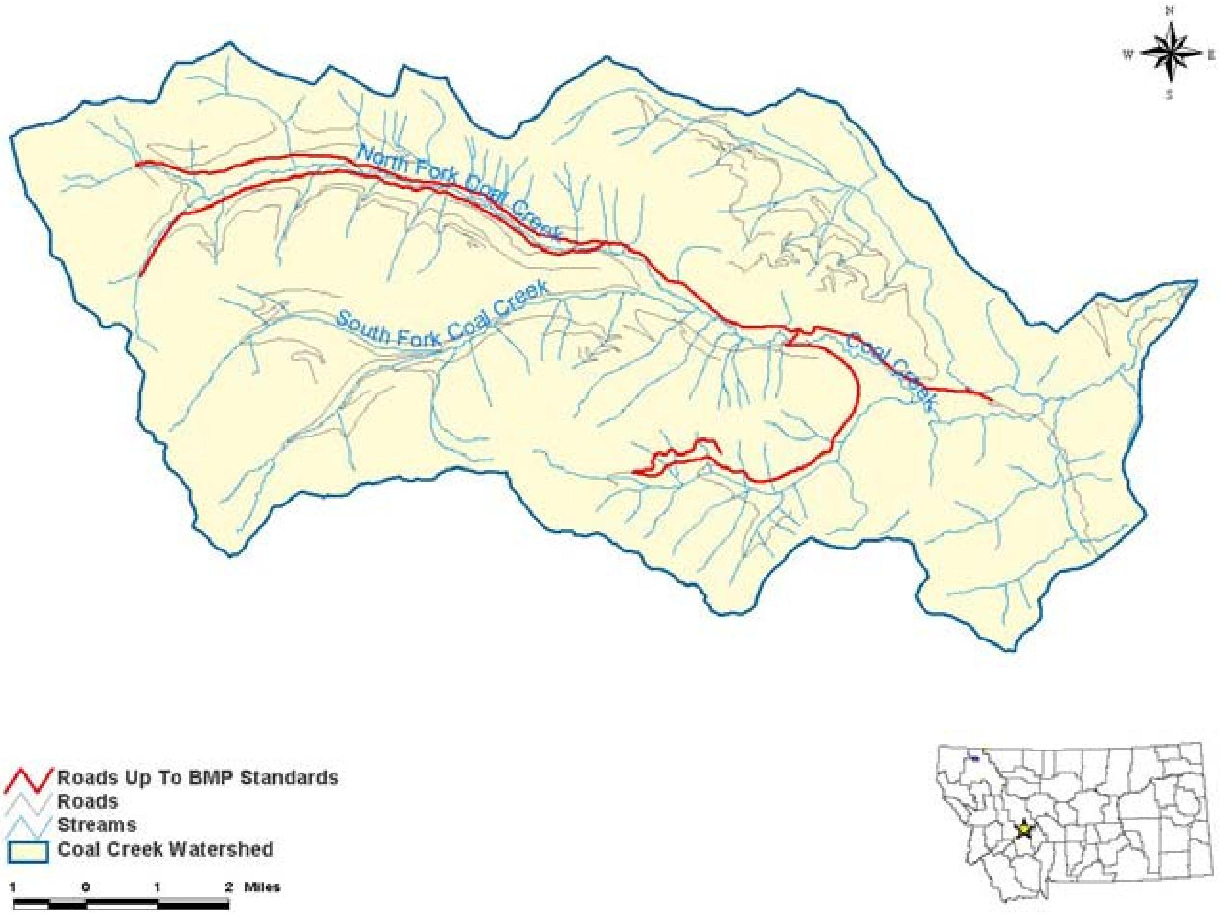


Figure 4-2. Roads up to full BMP standards in the Coal Creek watershed.

In 2002 and 2003 the FNF evaluated all roads and road/stream crossings in the Coal Creek watershed to determine whether they are currently contributing sediment to streams (see Appendix B for more detail). If it appeared that a road segment was delivering sediment to a stream, loads were quantified using the Forest Service's Water Erosion Prediction Model (WEPP-Roads). The WEPP-Roads model is described in more detail online at http://forest.moscowfsl.wsu.edu/fswepp/.

According to the FNF survey, a total of 10 road sites deliver sediment to the stream network (Figure 4-1). Average yearly loads are presented in Table 4-2. On average, approximately 1,000 pounds (0.5 ton) of sediment are directly delivered to the stream network per year. Examples of road sediment sources observed during the survey were plugged culverts at risk of failure, sediment slumps, and active streams eroding the road prism (Figures 4-3 through 4-5).

It should be noted that road conditions have greatly improved in the FNF over the past several years. Roads have been decommissioned or upgraded, and many road BMPs have been added (Figure 4-6). With funding made available after the Moose Fire in 2001, upgrading to BMP standards on approximately 26 miles of existing roadways was accomplished in 2002 and 2003. The reduction of sediment and road runoff delivery to the stream channel network will decrease water and sediment yield to streams by virtue of improved drainage from existing roads in the upper reaches of the watershed. The BMP standards include the following:

- The installation of drive-through dips (four to six per mile)
- The installation of ditch relief structures as needed to prevent scour and divert ditch flow away from stream channels and through adequate filtration zones
- The placement of slash filter windows below roads where needed
- The installation of sediment traps/basins above and below culverts as needed
- The addition of flared inlet sections to culverts where needed
- The replacement of 10 or more existing stream culverts with larger units designed to accommodate a 100-year flood event and promote fish passage where applicable. This also greatly reduces the risk of future culvert failure.

The FNF, in coordination with the Montana DNRC and MFWP, has overseen the road improvements to ensure proper design of fish passage structures. The road improvement work will result in decreased suspended sediment, decreased peak flow levels, and a decreased risk of sedimentation associated with culvert failure.

Although there are relatively few road sources of sediment today, it is acknowledged that sediment contributions from roads and road building activities were much higher in the past, and possibly have contributed to the elevated in-stream sediment noted in Coal Creek.

Table 4-2. Sediment Loads from Roads in the Coal Creek Watershed[a]

Affected Stream	Map ID	Road #	Avg Sediment Leaving Buffer (lbs/year)
North Fork Coal	1	5278	304.31
South Fork Coal	9	1604	267.28
Tributary of Deadhorse Creek	7	1691	22.7
Tributary of Deadhorse Creek	8	1693	176.9
Tributary to North Fork Coal	2	5278	42.68
Tributary to North Fork Coal	3	5278	69.75
Tributary to North Fork Coal	4	5270	47.3
Tributary to North Fork Coal	5	5270	24.32
Tributary to North Fork Coal	6	5270	43.16
Tributary to North Fork Coal	10	317	0.64
Total			999.04

Figure 4-3. Plugged culvert at Road 1693.

Figure 4-5. Plugged culvert on Road 1604.

Figure 4-4. Active stream eroding road prism on Road 5278.

Figure 4-6. Example of BMP to divert water from the road surface.

4.1.2 Bank Erosion

Bank erosion is a natural process in streams, and can contribute a significant natural load of sediment. However, anthropogenic sources—such as grazing, roads, riparian harvests, or flow modifications—can lead to increased bank erosion. MFWP identified areas with significant bank erosion during the 2002–2003 survey of the Coal Creek watershed, and the location of these sites is shown in Figure 4-7. Length and height of the bank erosion were recorded in North Fork Coal Creek, South Fork Coal Creek, Mathias Creek, and Lower Coal Creek upstream of the confluence with Deadhorse Creek. Examples of bank erosion sites are shown in Figures 4-8 through 4-10. Most of the bank erosion noted during the survey appears to be natural, although at one site (Site ID 1), bank erosion was due to an old road culvert that was improperly removed.

Rates of bank erosion were calculated using estimates of near bank stress and stream bank erodibility in conjunction with published literature values (Rosgen, 1996). Higher near bank stress or stream bank erodibility results in higher rates of erosion. Overall, estimated rates of erosion ranged from 0.18 feet to 0.5 foot per year. The rate of erosion was then multiplied by the area of eroding bank (in square feet) to obtain a volume of sediment per year, and then multiplied by the sediment density (i.e., average bulk density of 1.3 grams per cubic centimeter; USDA, 1998) to obtain a mass of sediment per year.

Table 4-3 shows the results of this analysis. It is estimated that approximately 700 tons of sediment are delivered to the stream network due to bank erosion per year. Approximately 0.1 ton per year appears to be attributable to human activity. The remainder is thought to be largely a natural phenomenon.

It should be noted that not all streams in the watershed were assessed for bank erosion, and the survey was conducted only on major streams upstream of the confluence with Deadhorse Creek. Therefore, there may be more bank erosion than reported by MFWP. Further study is recommended to better identify and quantify bank erosion in the Coal Creel watershed, and to address uncertainty in the current analysis and a margin of safety (MOS).

Table 4-3. Estimates of Bank Erosion and Sediment Loads

Map ID	Height (ft)	Length(ft)	Area (ft^2)	Near Bank Stress	Erodibility	Bank Erosion Rate (ft/year)	Sediment Volume (ft^3)	Sediment Load (tons/year)
1	1	20	20	moderate	moderate	0.18	4	0.1
2	16.4	33	541	moderate	high	0.3	162	6.6
3	6.6	65.5	432	moderate	high	0.3	130	5.3
4	3	30	90	moderate	high	0.3	27	1.1
5	32.8	50	1,640	moderate	high	0.3	492	20.0
6	197	98	19,306	moderate	high	0.3	5,792	235.0
7	66	66	4,356	moderate	high	0.3	1,307	53.0
8	7	10	70	moderate	high	0.3	21	0.9
9	10	50	500	moderate	high	0.3	150	6.1
10	20	66	1,320	moderate	high	0.3	396	16.1
11	33	82	2,706	moderate	high	0.3	812	32.9
12	33	50	1,650	moderate	high	0.3	495	20.1
13	8	33	264	moderate	high	0.3	79	3.2
14	60	164	9,840	high	high	0.5	4,920	199.7
15	33	115	3,795	high	high	0.5	1,898	77.0
16	20	82	1,640	moderate	high	0.3	492	20.0
Total								697.0

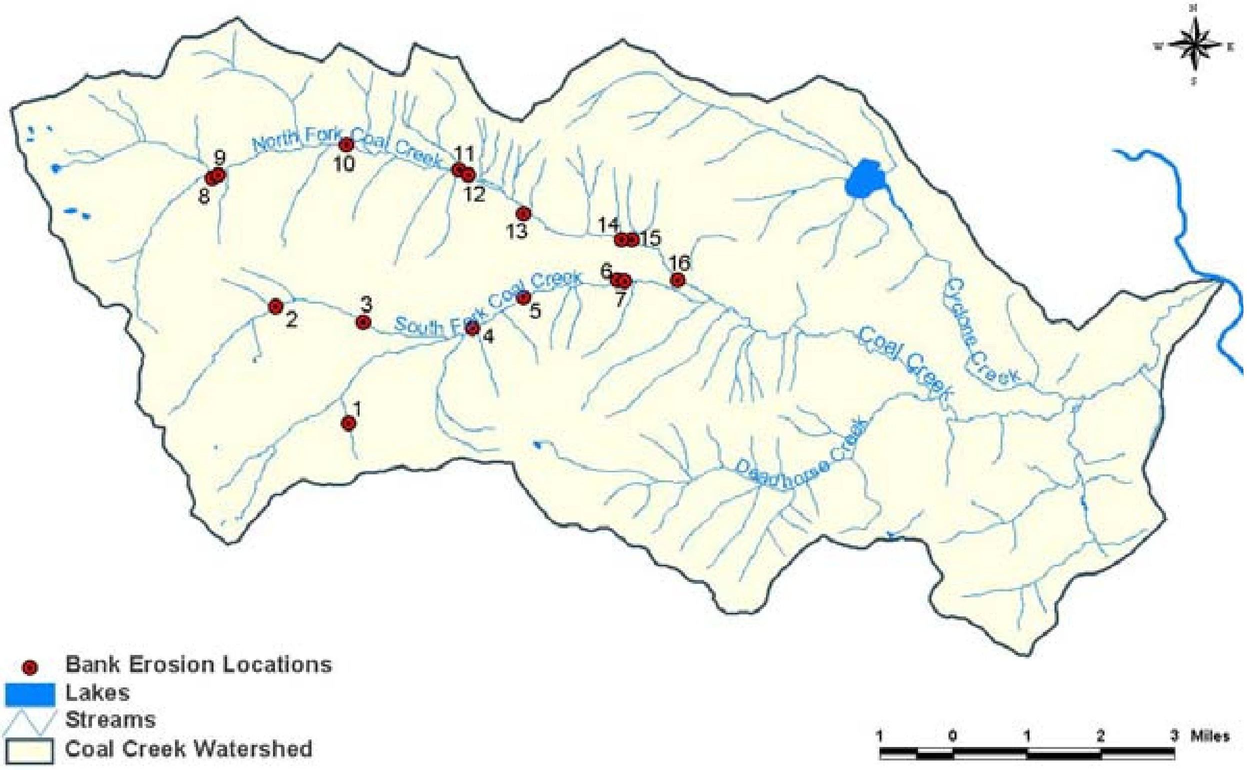


Figure 4-7. Location of bank erosion sites in Coal Creek as identified by MFWP.

Figure 4-8. Bank erosion at Old Road culvert (Map ID #1).

Figure 4-9. Bank erosion on North Fork Coal Creek (Map ID #13).

Figure 4-10. Bank erosion on North Fork Coal Creek (Map ID #15).

4.1.3 Fire

Fire can contribute to increased erosion because of increased surface water runoff and the removal of vegetation, forest litter, and root masses. In 2001, the Moose Fire burned 14,938 acres (30 percent) of the Lower Coal Creek watershed (See Figure 2-26). The FNF modeled the effects of the fire using the Water Erosion Prediction Model (WEPP-Disturbed) and soil map units (Sirucek, personal communication, August 3, 2004). A delivery ratio was then applied to the erosion value, because not all eroded soil makes it to the stream. The model estimated an annual sediment load of 53,000 tons for 2003, or an average of 3.55 tons of sediment per acre per year. However, the WEPP model assumed that average rainfall fell in the Coal Creek watershed in 2002 and 2003. This was not the case, as both 2002 and 2003 were extremely dry years. Because of the low rainfall and low intensity storms, sediment loads from the Moose Fire are most likely much less than predicted. Forest service personnel estimated that less than one ton of sediment per acre of land was actually delivered to streams in 2003, or approximately 10,000 total tons of sediment (Sirucek, personal communication, September 20, 2004). The amount of erosion due to the Moose Fire will continue to decrease in the future as the forest revegetates, and soils and water yield stabilize (Figure 4-11).

Figure 4-11. Effects of the Moose Fire and vegetative regrowth since 2001 (Note the shrub and herbaceous vegetation that has already resulted in excellent ground cover).

4.1.4 Harvest Activities

Harvest activities can also contribute to increased erosion because of increased water yields, ground disturbances, and removal of binding vegetation. Since 1960, 18 percent of the Coal Creek watershed has been harvested (9 percent intensive harvests), with 1 percent harvested since 1995 (See Figure 2-23). Examples of harvested sites are shown in Figures 4-12 and 4-13.

Land harvested between 1995 and 2003 was modeled using the WEPP-Disturbed model. This period was selected because land harvested 10 or more years ago most likely has little to no erosion today following revegetation and decreased water yields. Parameters required by the WEPP model, such as slope gradient and slope shape, were obtained from the FNF Soil Survey (USDA, 1998). Slope lengths were estimated using Digital Elevation Models (DEMs) in a GIS. Ground cover was assumed to be 50 to 75 percent, depending on the type of soil and slope. This range of values was chosen to represent the “worst case,” recognizing that percent ground cover may be much higher in many areas. This conservative approach was also chosen to represent a Margin of Safety (MOS), as required by the TMDL process. A delivery ratio was then applied to the WEPP results to take into account the fact that not all eroded soil makes it to a stream. Overall, the WEPP model estimated that 34 tons of sediment are contributed from harvest activities per year, as calculated in 2003. This load will continue to decrease in the future as the forest revegetates and water yields decrease.

It should be noted that past harvest activities may have contributed much more sediment than is being contributed today. This “historical” sediment input may have contributed to the elevated bedload sediment documented by the McNeil core and substrate scores.

Figure 4-12. Clear-cut land in the Coal Creek watershed (Year 2000).

Figure 4-13. Historical (1980s) clear-cut land in the Coal Creek watershed.

4.1.5 Other Potential Anthropogenic Sediment Sources

At the same time that roads were surveyed, FNF personnel verified previously mapped potential upland sediment sources. Two previously compiled sediment source maps were available. In July 2002, the FNF conducted a low-level helicopter reconnaissance flight over the Coal Creek watershed to transfer erosion sites spotted from the air to orthoquads. During the 2002 field season, the sites from the orthoquad were verified in the field to determine whether or not sediment was directly introduced into the stream network. Most of the previously identified sites were well vegetated and appeared to be stable. Overall, less than 2 acres of upland sediment sources were discovered that directly introduced sediment into stream networks. The results from this study suggest that there are very few upland sources of sediment in the Coal Creek watershed.

The MFWP survey found that an old skid trail resulted in the formation of a new stream channel in the Mathias Creek watershed (Figure 4-14; Appendix B). MFWP estimates that approximately 4,950 tons of sediment have been eroded over approximately a 45-year period. Equipment operation in this area also has resulted in erosion (Figure 4-15). The extent to which these sources are actively contributing sediment to the stream network is unknown at this time. Further study is recommended to determine the extent to which these sources are currently eroding and to develop a restoration strategy, if necessary.

Several other upland sources of sediment exist in the Coal Creek watershed. Avalanche chutes, stream down-cutting, and mass slumping are three natural sources of sediment. Sediment loads from these sources have not been quantified. Given the results of the FNF source assessment surveys, it is assumed that the loads from these sources are largely natural in origin.

Figure 4-14. Old skid trail with stream formation in the Mathias Creek watershed.

Figure 4-15. Eroding soils in the Mathias Creek watershed.

4.1.6 Large Woody Debris

It is important to understand the condition of large woody debris (LWD) because of its relationship to aquatic life, channel formation, and sediment transport. LWD helps to create pools and trap sediment, and provides essential fish and aquatic life habitat. LWD also has the potential to drastically alter flows and shift stream channels. Too much or not enough LWD can lead to altered sediment transport/deposition and poor aquatic life habitat.

MFWP evaluated the condition of LWD in several stream segments in Coal Creek. Three general classifications of LWD were derived from the MFWP study and are described below.

- **Normal** – normal or expected amounts of LWD in the stream, resulting from natural processes (wind blown trees, beaver activity, fire, normal forest processes). This classification represents reference conditions.
- **High** – excessive amounts of LWD in the stream due to human activities (e.g., harvest, roads), causing an excessive number of LWD dams and sediment traps. Large amounts of LWD due to fire are considered “normal.”
- **Low** – low or less than expected amounts of LWD in the stream. This recognizes that some streams may have a LWD deficit due to harvest or other activities that may remove LWD from the stream channel.

The results from the MFWP assessment are shown in Table 4-4. There were a variety of conditions noted in the Coal Creek watershed, some of which warrant further investigation and possible restoration. Segments with “high” or “low” amounts of LWD should be considered for future restoration. Detailed field notes from the MFWP survey, including source locations, are shown in Appendix B. Feature locations are plotted in Figure 4-16, and the corresponding numbers refer to the reference Map IDs in the MFWP report. Figures 4-17 through 4-19 provide examples.

In contrast to the MFWP study, Hauer et al. (1999) found that there was no relationship between the frequency of LWD in reference watersheds and managed watersheds in northwestern Montana, including Coal Creek. This points out that there is some uncertainty over the extent to which LWD is, or is not, influencing water quality and the cold-water fishery in Coal Creek. It should be noted that it is difficult to assess the condition of LWD in a stream and its implications for water quality, since the quantity and distribution of LWD is a function of both natural and human phenomena that often occur over very long periods of time. Nevertheless, the potential implications of LWD should be considered relative to the current bull trout situation in Coal Creek.

Table 4-4. Large Woody Debris Conditions in Selected Tributaries in the Coal Creek Watershed

Segment	LWD Condition
Unnamed Trib to Mathias Creek	Low, harvest-related (upper); High (lower)
Mathias Creek	Upper: Normal; Lower: High
South Fork Coal Creek to Confluence with Mathias Creek	Normal
South Fork Coal Creek, confluence w/ Mathias to Electrofishing section	Low, riparian harvest-related
South Fork Coal Creek, Electrofishing section to main Coal Creek	Low, riparian harvest-related and channel straightening
North Fork of North Fork Coal Creek	High
North Fork Coal Creek (to the confluence with North Fork of N. Fork Coal Creek	Normal
North Fork Coal Creek from confluence of N. Fork N. Fork to coring site	Normal
North Fork Coal Creek, coring site to 2 miles upstream of S. Fork Rd Bridge	Normal
North Fork Coal Creek, 2 miles upstream of S. Fork Rd Bridge to the Bridge	Low, riparian harvest-related, possible channel straightening
North Fork Coal Creek, S. Fork Rd Bridge to just past the confluence with the South Fork	Normal
Just below confluence with South Fork to Deadhorse Creek	High, partially due to fire

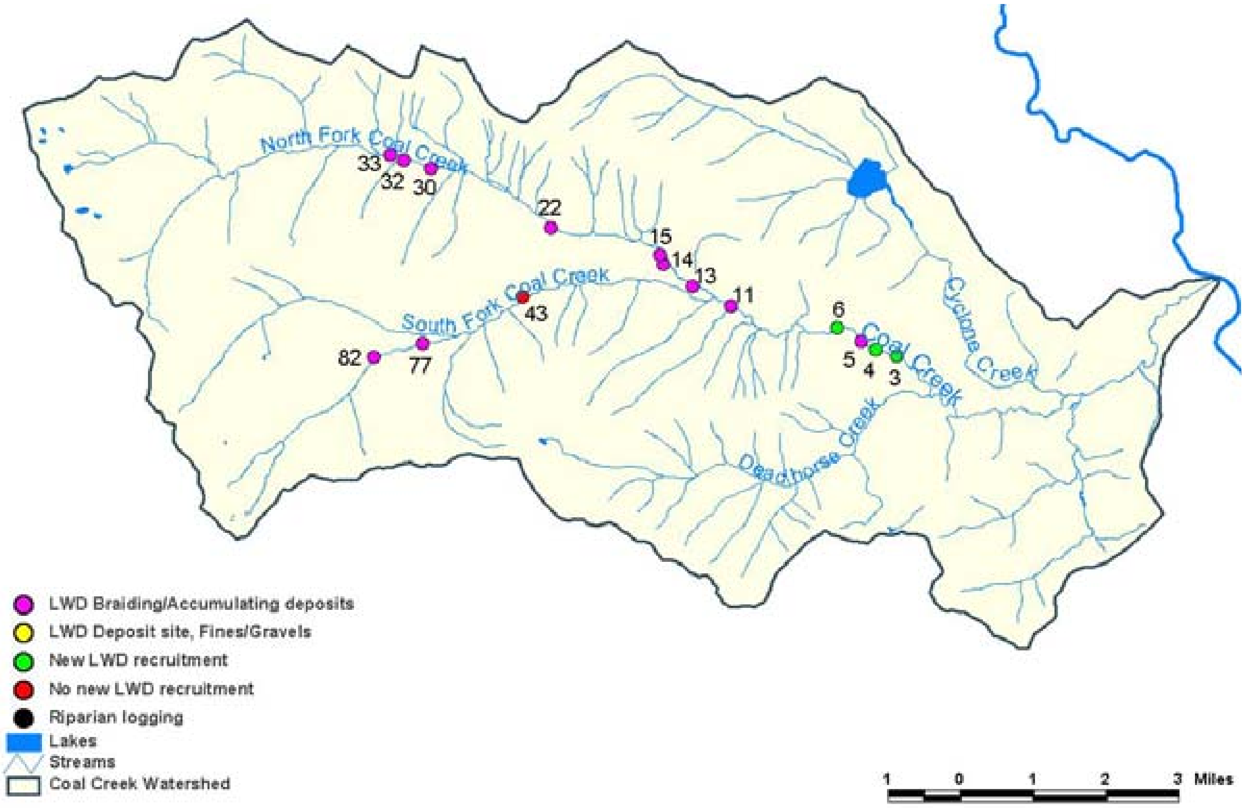


Figure 4-16. Location of LWD sites.

Figure 4-17. Portion of Coal Creek artificially straightened; lack of LWD.

Figure 4-19. Accumulation of LWD with accumulating deposits.

Figure 4-18. Accumulation of LWD with accumulating deposits.

4.1.7 Summary of Sources

Currently, the major sources of sediment in the Coal Creek watershed are bank erosion and overland erosion caused by the Moose Fire. Relative to these two sources, anthropogenic sediment loading (i.e., from timber harvests, roads, and the one site of bank erosion caused by human activity) is very small. Table 4-5 and Figure 4-20 summarize these sediment sources and present a relative comparison between the evaluated source categories. Fire-related sediment is currently 92 percent of the sediment load in Coal Creek, while harvests and roads are less than 0.1 percent of the total load. Bank erosion accounts for approximately 6 percent of the total load. However, it is recognized that not all sources have been documented, and future assessments are needed (See Section 4.5).

Sediment loading is a dynamic process that changes with harvest activities, fire, forest growth, and precipitation/stream discharge. For example, Figure 4-21 shows that anthropogenic sources of sediment would be a much larger percentage of the sediment load if there had been no fire in 2001. Also, current sources of sediment are not always correlated with current in-stream sediment. In the past, sediment loads may have been high because of harvests, roads, or floods. At that time, a high sediment load may have been delivered to the stream, and still remains in the stream today. In-stream sediment loads (or bedloads) take many years to flush out of the system. Therefore, a direct correlation does not always exist between the current sediment load or current sources of sediment and the measured substrate condition in a stream. The McNeil core and substrate fines data suggest that fine sediment in the bottom substrate may be higher in Coal Creek than in other North Fork watersheds. However, there does not appear to be a link between current anthropogenic sources of sediment and the in-stream sediment load, because current anthropogenic sources of sediment are very low relative to natural sources.

Table 4-5. Summary of Sediment Sources in the Coal Creek Watershed

Sediment Source	Sediment Load (tons/year)	Sediment Load (%)
Harvest	34	0%
Road	0.5	0%
Fire[1]	10,000	92%
Bank Erosion[2]	697	6%
Mathias Creek Skid Trail/Historical Equipment Operation	194	2%
Total	10,926	100%

[1] Based on Flathead National Forest estimates.

[2] Not all eroding banks have been documented. The actual contribution from bank erosion is most likely higher than reported.

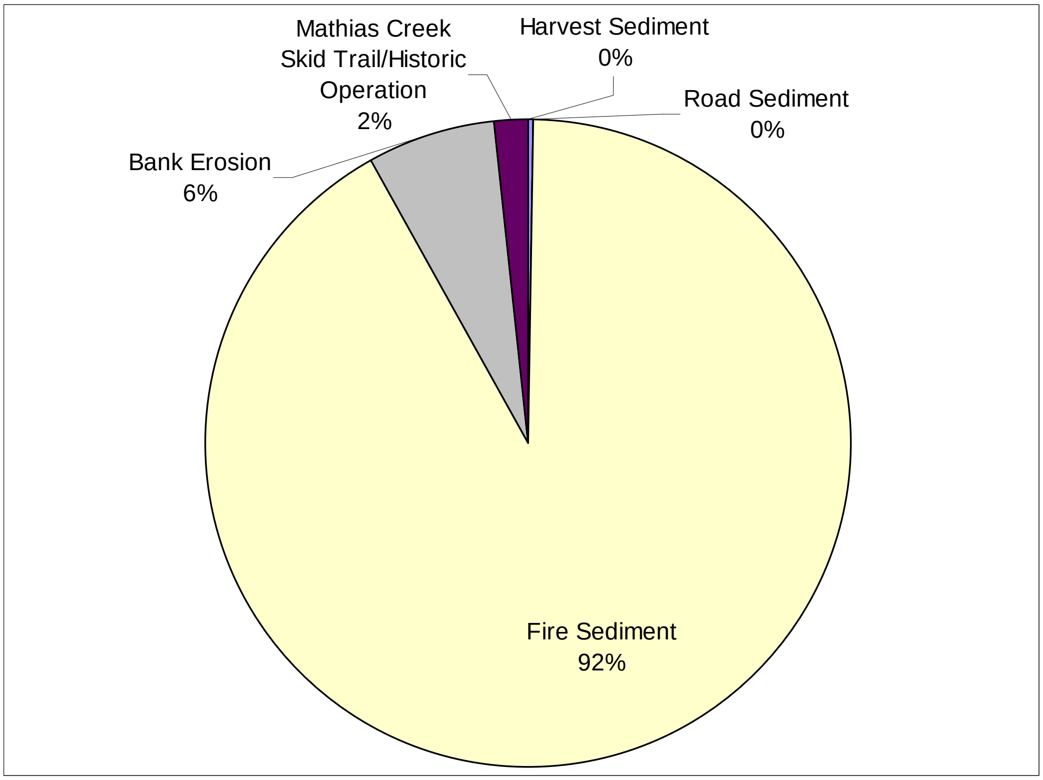


Figure 4-20. Distribution of sediment sources.

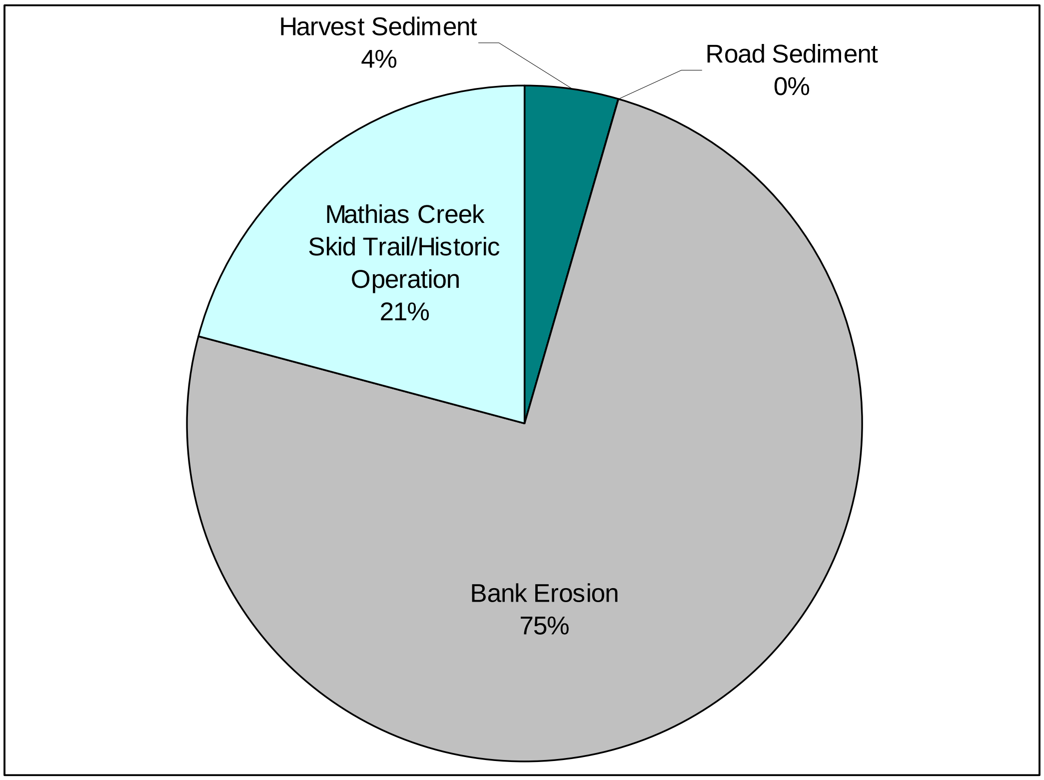


Figure 4-21. Distribution of sediment sources (Without Moose Fire).

4.1.8 Source Assessment Uncertainty

As described above and in Appendix B, a substantial effort was made to identify all significant anthropogenic sources of sediment loading in the Coal Creek watershed. Where possible, estimates of sediment loads from each of the sources were also made. 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 Coal Creek below Deadhorse Creek or in all major tributaries.
- The extent to which the old skid trail and eroded bank (shown in Figures 4-15 and 4-16) are actively contributing sediment to the stream network is unknown.
- The cause and effect relationship between large woody debris and bull trout in Coal Creek is unknown and the extent to which human actions have altered the quantity and distribution of large woody debris is unknown.
- The extent to which past activities such as harvest and road building have affected Lower Coal Creek is unknown.

These uncertainties will be addressed by the proposed activities described in Sections 4.3.6, 4.4, and 4.5.

4.2 Targets

As noted in Section 3.3, MDEQ is required to assess the waters for which TMDLs have been completed to determine whether compliance with water quality standards has been attained. The process by which this will be accomplished is discussed in Section 3.3 (Targets and Supplemental Indicators Applied as Water Quality Goals) and is shown in Figure 3-3. The sediment targets listed in Table 3-6, and restated below in Table 4-6, are proposed as the thresholds against which compliance with water quality standards will be measured in Lower Coal Creek. If all 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 this TMDL was unsuccessful just because one or more of the target threshold values have been exceeded. The circumstances around the exceedance will be investigated. For example, the exceedance might 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, or;
- changes in land management practices occur

Table 4-6. Coal Creek Water Quality Goals

Water Quality Goal	Threshold
5-year Mean McNeil Core Percent Subsurface Fines < 6.35 mm	35%
5-year Mean Substrate Score	≥ 10
Percent Surface Fines < 2 mm	< 20%
Clinger Richness	≥ 14

4.3 TMDL and Allocations

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 pollutant loads and the quality of the receiving water body. This definition is denoted by the following equation:

$$\text{TMDL} = \text{WLAs} + \text{LAs} + \text{MOS}$$

There are no point sources of sediment in the Coal Creek watershed; therefore, the waste load allocation for point sources can be removed from the equation. Furthermore, since people have no control over natural sediment loading (e.g., most of the eroding banks, fire-related loading, natural avalanche chutes), there is no practical purpose for considering natural loading in the TMDL equation. Therefore, the Coal Creek TMDL is expressed merely as the sum of the allocations to the known anthropogenic nonpoint sources. The hypothesis is that there is no more that can be accomplished to solve the problem if all the current anthropogenic sediment sources are addressed. However, given that the estimated loads from anthropogenic sources are very small in comparison with the estimated loads from natural sources, it is not known whether reducing anthropogenic sources will result in significant improvements to the bull trout fishery. Given the uncertainty of the link between current anthropogenic sediment loading and the current health of the bull trout population, an unconventional “Phase II” allocation is also proposed. The purpose of the Phase II allocation is to facilitate future study to (1) ensure that all of the anthropogenic sources are appropriately addressed, and (2) better understand the non-pollutant issues that may be having an impact on bull trout (e.g., large woody debris, physical habitat issues, channel morphology, barriers).

The TMDL and allocations are further summarized in Table 4-7 and are described in more detail in the following paragraphs. The proposed restoration and adaptive management strategy is presented in Section 4.5.

Table 4-7. Load Allocations for Sediment in Coal Creek

Sources	Current Load (tons/year)		Reduction	Allocation (tons/year) or Approach
Point Sources (WLA)	0		NA	0
Anthropogenic Nonpoint Sources (LA)	**Existing Roads**	0.5	75% 0.375 tons/year	0.125
	Historical/Current Harvest	34	100% (34 tons/year)	0
	Bank Erosion	0.1	90% 0.09 tons/year	0.01
	Other[a]	Unknown	To be determined	To be determined
	Future Roads and Harvest	Not specified	Not specified	No sediment loading increases other than potential minor predicted short-term increases associated with 100% compliance with applicable BMP standards.
Phase II – Uncertainty and Non-Pollutant Issues	To be determined		To be determined	To be determined

[a]See Sections 4.1.5 and 4.3.4 for a description of “other.”

4.3.1 Existing Road Allocation

As described in Section 4.1.1, 10 forest road-related sediment sources have been identified. This allocation assumes that each of these affected road segments will be brought up to the Forest Service's Road BMP Standards per Forest Service Handbook 2509.22, *Soil and Water Conservation Handbook*. Based on best professional judgment, it is estimated that this will result in approximately a 75 percent reduction in sediment loading from these sources.

4.3.2 Historical/Current Harvest Allocation

This source category is described in Section 4.1.4. The 100 percent load reduction assumes that the anthropogenic increases in sediment loading from these harvest activities will decline over time with forest regeneration and will eventually yield sediment at natural levels.

4.3.3 Bank Erosion Allocation

As described in Section 4.1.2, bank erosion appears to be one of the most significant sources of sediment loading to Coal Creek. With the exception of one eroding bank that was obviously caused by human activities (see Figure 4-8), the majority of the bank erosion is thought to be of natural origin. This allocation, therefore, focuses on elimination/reduction of the anthropogenic source. This eroding bank is a relatively small and localized phenomenon that appears to have resulted from the removal of an old culvert. It is felt that the sediment load from this source can be virtually eliminated using conventional engineering techniques; therefore, a 90 percent load reduction is proposed.

Although no other load reductions are currently sought from eroding banks, further study is proposed (see Section 4.3.6) to ensure that there are no other bank erosion sites caused by human actions that need to be addressed.

4.3.4 Other Allocation

As discussed in Section 4.1.5, MFWP identified two areas (shown in Figures 4-15 and 4-16) that appear to have contributed a significant load of sediment to Coal Creek in the past. At this time, it is not known whether sediment loading from these two areas is still significant. Further study is necessary to assess the current situation and determine whether or not sediment loading from these sites is significant. These sources will be addressed as part of the Phase II studies described in Section 4.3.6.

4.3.5 Future Roads and Harvest Allocation

It is not reasonable to assume that there will be no future silviculture activities in the Coal 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 100 percent compliance with the applicable best management practice (BMP) standards.

4.3.6 Phase II Allocation Strategy

The Phase II Allocation Strategy is primarily intended to address the uncertainty associated with the hypothesis that treating all known anthropogenic sediment sources will result in an improvement to the bull trout fishery. This will be accomplished by implementing the Monitoring and Restoration Strategies described in Sections 4.4 and 4.5, below.

4.4 Monitoring and Assessment Strategy

The purpose of the monitoring strategy is to provide answers to the following questions:

1. Has implementation of this plan resulted in attainment of water quality standards and full support of the cold-water fishery beneficial use? (i.e., trend and compliance monitoring)
2. Have all the significant anthropogenic sediment sources been identified? (supplemental monitoring)
3. Are other factors such as physical habitat limitations, stream channel morphology, and fish barriers having a significant negative impact on bull trout in Coal Creek? (supplemental monitoring)
4. Is North Fork Coal Creek impaired because of excessive anthropogenic nutrient loading? (North Fork Nutrient Assessment)

It is envisioned that the first step in the implementation of this monitoring and assessment strategy will be the development of a detailed work plan and sampling and analysis plan.

4.4.1 Trend Monitoring

MFWP has collected McNeil core, substrate score, bull trout population, and redd count data annually in North Fork Coal Creek, South Fork Coal Creek, and Lower Coal Creek since the early 1980s. Continued annual monitoring for these parameters within these water bodies is recommended. In addition, surface fines and macroinvertebrate data should be collected on roughly a 5-year basis to facilitate application of all the targets described in Section 4.2.

4.4.2 Supplemental Monitoring

Additional monitoring is also suggested to better assess channel, bank, and habitat conditions and to collect supplemental information regarding potential sources of sediment within the watershed. The following activities are recommended:

- Conduct a complete Rosgen Level II survey of the entire Lower, North Fork, and South Fork Coal Creek segments and suitable reference streams or segments.
- Conduct a quantitative large woody debris inventory of Lower, North Fork, and South Fork Coal Creek segments and suitable reference streams or segments.
- Conduct additional supplemental source assessment surveys to address the uncertainties identified in Section 4.1.8.
- Install temperature data loggers to assess the potential effect of temperature on bull trout populations.
- Evaluate the condition of permanent cross sections and longitudinal profiles established in 2003.

4.4.3 North Fork Nutrient Assessment

EPA conducted additional monitoring in August 2004 to provide supplemental data regarding the potential nutrient impairment in North Fork Coal Creek discussed in Section 3.4.1.6. Samples were collected following MDEQ field protocols (MDEQ, 2004) and analyzed for the following parameters:

- *Field Parameters* - Temperature, flow, dissolved oxygen, pH, turbidity, conductivity
- *Laboratory Parameters* - total phosphorus (TP), nitrate plus nitrite (NO_2 + NO_3), total Kjeldhal nitrogen (TKN), total nitrogen (calculated), ammonia, chlorophyll- *a* (benthic)
- *Biological Parameters* - Periphyton, macroinvertebrates

When the laboratory results become available in 2005, they will be evaluated to make a final determination regarding the water quality impairment status of North Fork Coal Creek relative to nutrients. If it is found that anthropogenic sources of nutrients are not causing an impairment, documentation will be provided to the MDEQ such that the 303(d) list status of this water body can be changed in 2006 (i.e., the next 303(d) list to be prepared by MDEQ). If, on the other hand, it is determined that anthropogenic sources of nutrients are causing impairment, a TMDL will be prepared.

4.5 Restoration Strategy

A phased restoration strategy is proposed. Phase I will involve implementation of the monitoring and assessment strategy described above in Section 4.4. A parallel Phase I effort should involve developing and implementing a detailed plan to obtain the sediment load reductions from the known anthropogenic sediment sources for which allocations have been assigned in Section 4.3 (i.e., the existing roads and the one anthropogenic bank erosion site).

Phase II will be defined through implementation of the Monitoring and Assessment Strategy. It may be determined that large woody debris and physical habitat issues are the primary problem and passive management (i.e., allowing the bed load and channel form to reach equilibrium naturally over time) is the best solution. On the other hand, it may be that a combination of active and passive management may be necessary to solve the problem.

It is envisioned that implementation of Phase I and II will be a joint effort among MFWP, the FNF, and Montana DNRC with some assistance from MDEQ and EPA. It is also likely that outside sources of funding (e.g., Clean Water Act Section 319 grants, EPA Consolidated Funding Grants) will be sought for implementation. Although the three primary agencies have agreed to apply for Phase I funding in 2004, the schedule for implementation will be dictated by the availability of funding and resources.

4.6 Dealing with Uncertainty and Margin of Safety

Based on the available data evaluated in Section 3.4.1.7 and consideration of the fact that the majority of the sediment load delivered to Coal Creek appears to be largely of natural origin, one could argue that no TMDL is necessary for Lower Coal Creek. However, interpretation of the state’s narrative water quality criteria is not a “black-and-white” exercise. The relevant narrative standards prohibit harmful or other undesirable conditions related to pollutant increases above “naturally” occurring levels. The beneficial uses listed as impaired in Lower Coal Creek (cold-water fishery and aquatic life) experience a high degree of “natural” variability as do many of the chemical and physical parameters used as targets or supplemental indicators. Are we certain that anthropogenic sediment loads are or are not significantly contributing to the bull trout declines? To be conservative and err on the side of water quality protection, a TMDL has been prepared. In the case of Lower Coal Creek, this fact alone provides a substantial margin of safety.

The phased allocation approach also provides a margin of safety by addressing the uncertainties regarding the identification/quantification of sediment sources outlined in Section 4.1 and by providing for additional study to better understand the potential causes of the bull trout decline.

5.0 VOLUNTARY WATER QUALITY IMPROVEMENT STRATEGY FOR RED MEADOW, WHALE, AND SULLIVAN CREEKS

As discussed in Section 3.0, the aquatic life and fisheries beneficial uses in Red Meadow, Whale, Granite, Skyland, Morrison, and Sullivan creeks are not impaired. As a result, no TMDLs are required. Nonetheless, minor sources of excess sediment from anthropogenic activities were identified in the watersheds of Red Meadow, Whale, and Sullivan creeks. No significant sources were found during the survey in the Granite Creek, Skyland Creek, and Morrison Creek watersheds (see Appendix B). Coal Creek was discussed in Section 4.0. The Voluntary Water Quality Improvement Strategy presented in this section is the first step in addressing these sources and improving overall watershed health in Red Meadow, Whale, and Sullivan creeks. This strategy is conceptual, focusing on accurate identification and prioritization of the sources, specifying any follow-up water quality monitoring that may have been identified as a need in Section 3.0, and providing a conceptual implementation strategy. Site-specific designs or plans are not presented herein. It should be noted that, relative to Section 303(d) of the Clean Water Act or the Montana Water Quality Act, implementation of this strategy is not required. Implementation is voluntary. It is envisioned that the Forest Service will address these sources when funding and resources are available following standard Forest Service protocols on a case-by-case basis for the purpose of improving watershed and aquatic health.

5.1 Identified Potential Sediment Sources

The FNF completed a comprehensive source assessment for Red Meadow Creek, Coal Creek, Whale Creek, Skyland Creek, Granite Creek, Morrison Creek, and Sullivan Creek in 2002 and 2003 (FNF, 2003). GIS, aerial photos, aerial verification, and field verification were used to locate and describe potential sources of sediment. The FNF fish passage team also completed field surveys at all road/stream crossings on perennial streams. Additional potential sources of sediment are addressed in Section 2.0 of this document (Section 2.1.9, Harvest History; Section 2.1.10, Fires; Section 2.1.11, Roads).

Table 5-1 summarizes sediment sources in the evaluated watersheds. Sources are summarized into five major categories: fire, clear-cuts/equivalent clear-cut acreage (ECA), roads, other natural sources of sediment (e.g., naturally eroding banks, avalanche chutes), and other anthropogenic sources of sediment. Overall, minor sources were found in almost all of the watersheds. Fire, timber harvest, and roads were the major sources of sediment, to varying degrees, in each watershed. Figures 5-1 through 5-3 show examples of the sediment sources and their locations as found in the FNF survey.

5.2 Monitoring Strategy

Continued annual McNeil core, substrate score, bull trout population, and redd count monitoring is proposed in the streams currently monitored by MFWP (Red Meadow Creek, Whale Creek, Granite Creek). The intent is to continue tracking trends in these important bull trout habitats. As noted in Section 3.0, no McNeil core data have been collected in Skyland or Sullivan creeks and no recent data is available for either Red Meadow or Morrison Creeks. Periodic (once every five-years) McNeil core monitoring is proposed for these three water bodies to complete the data set for the FTPA and provide additional data to further support the impairment decisions that were presented earlier in this document.

5.3 Conceptual Implementation Strategy

As shown in Table 5-1, roads are the primary anthropogenic sources of sediment in need of mitigation in the subject watersheds. Approximately 9, 21, and 33 miles of roads in the watersheds of Red Meadow Creek, Whale Creek, and Sullivan Creek, respectively, need further evaluation to identify specific source areas and restoration strategies. In addition, a number of issues regarding culverts and stream crossings need further evaluation to develop specific restoration strategies (Table 5-1 and Figures 5-1 through 5-3). Implementation will first involve additional investigation to compile sufficient information to prioritize restoration activities and to develop site-specific designs. Since all of the identified source areas are on lands managed by the FNF, FNF will be responsible for the actual implementation of restoration measures. The schedule for implementation will depend upon the availability of funding and resources.

Table 5-1. Potential Sources of Sediment in Selected Watersheds

Segment Name	Type	Description
Red Meadow Creek	Fire	• 1988 Red Bench Fire (24% burned in lower part of watershed)
	Harvests	• 13% clear-cut since 1960, last cut in 1990
	ECA	• 12%
	Roads	• Road 115 – 8 miles of road and crossings contributing sediment • Road 115A – 1 mile of road contributing sediment
	Other Natural	• Unknown
	Other Non-natural	• Unknown
Whale Creek	Fire	• 2003 Wedge Fire (12% burned in lower half of watershed)
	Harvests	• 16% Clear-cut since 1960, last major cuts 1999/2000 (72 acres) • "Active upland sediment sources induced by timber harvest activities is not a significant source of sediment in the Whale Creek drainage" (FNF, 2003).
	ECA	• 14%
	Roads	• Road 589 – five improperly removed culvert tank traps, sediment slumps, and active streams eroding the road prism • 11 (closed) road miles require work to reduce sediment (unspecified locations) • 10 (open) road miles contribute sediment at stream crossings or from relief culverts that handle too much surface drainage (unspecified) • 4 culverts need to be removed and channels restored (unspecified) • 8 perennial stream culverts contribute sediment directly into streams (unspecified)
	Other Natural	• Unknown
	Other Non Natural	• Unknown
Sullivan Creek	Fire	• 2003 Ball Fire (16% of watershed burned)
	Harvests	• 6% clear-cut since 1960, last major cuts 1997 (24 acres)
	ECA	• 15.7%
	Roads	• 17 road/perennial stream crossings at risk • 33 miles of old roads need to be evaluated for drainage problems
	Other Natural	• Unknown
	Other Non-natural	• Unknown

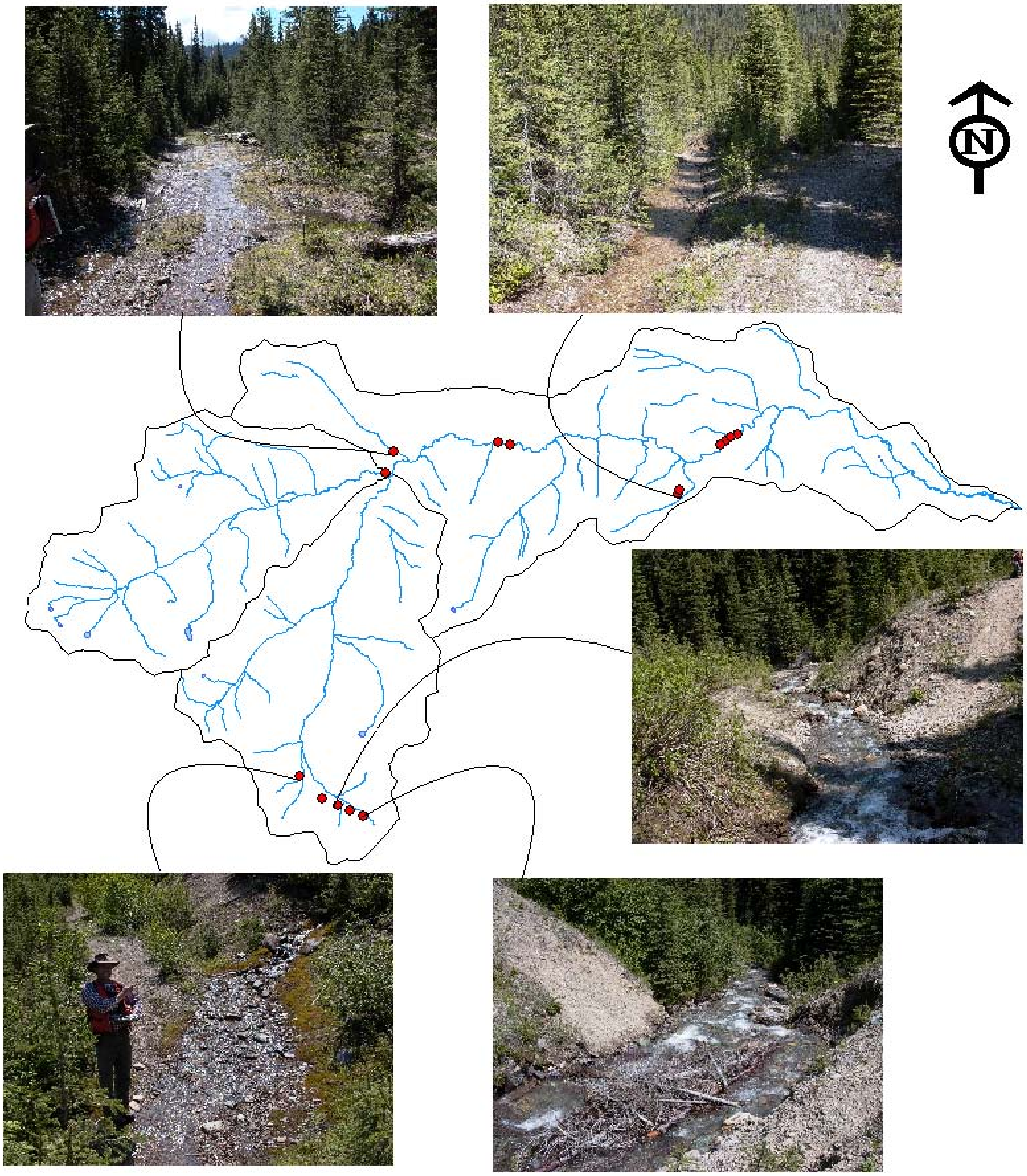


Figure 5-1. Examples of sources of sediment in the Whale Creek watershed.

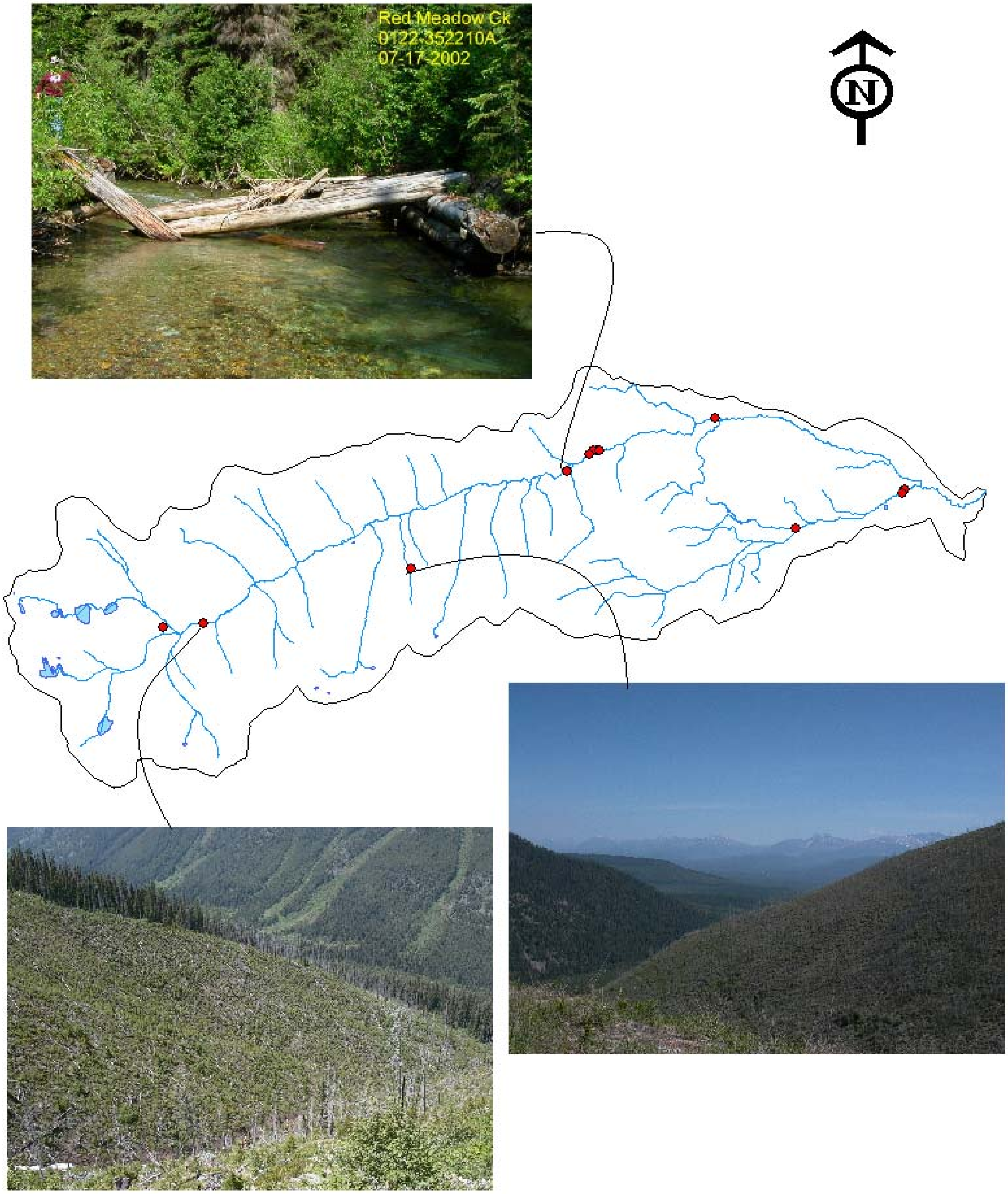


Figure 5-2. Examples of sources of sediment in the Red Meadow Creek watershed.

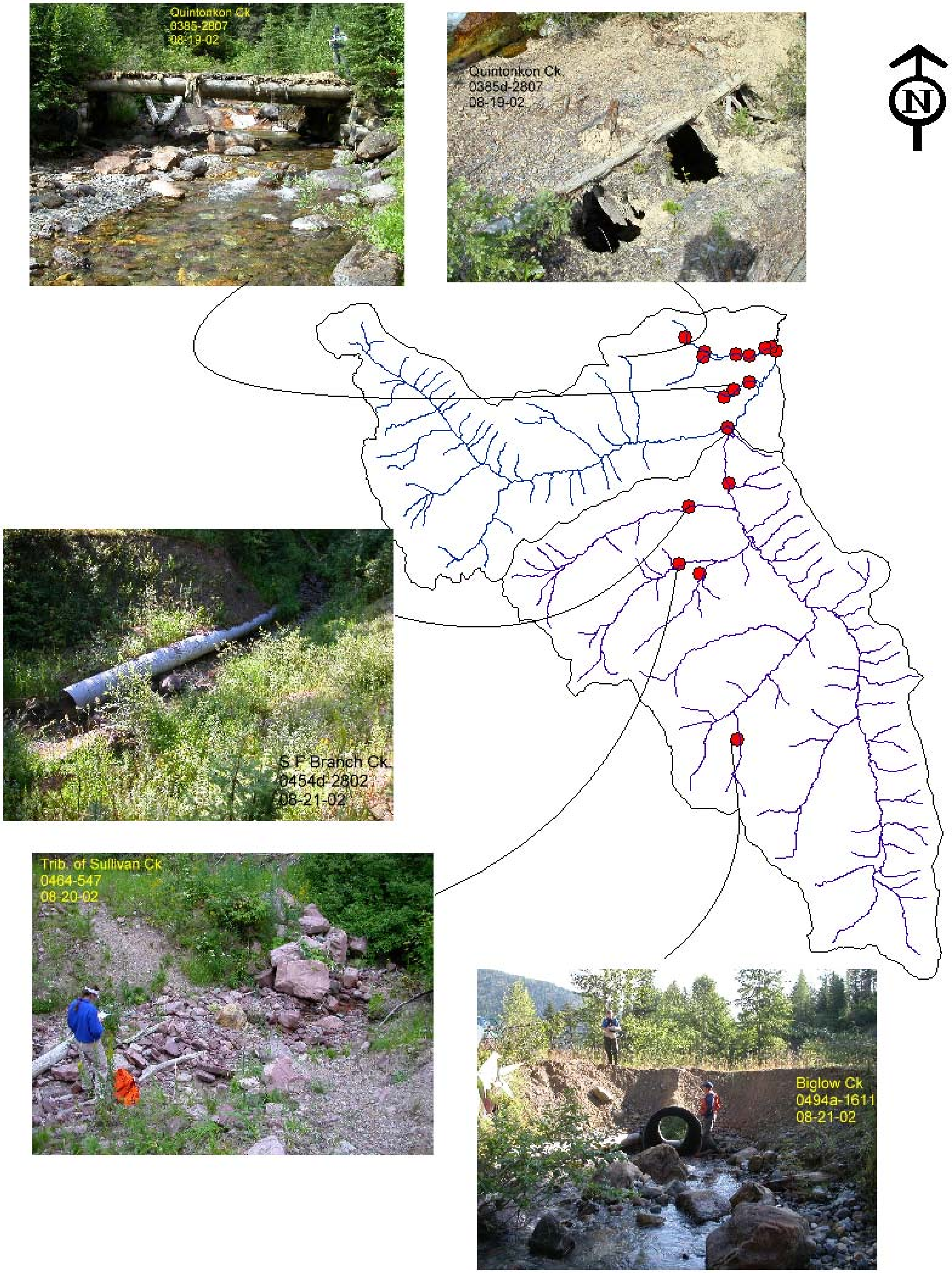


Figure 5-3. Examples of sources of sediment in the Sullivan Creek watershed.

6.0 PUBLIC INVOLVEMENT

As described in Section 2.3.3, the FTPA is largely under federal ownership with the U.S. Forest Service (Flathead National Forest) and National Park Service (Glacier National Park) as the primary land owners/managers. Although only a minor landowner within the entire FTPA, the Montana Department of Natural Resources and Conservation (DNRC) owns a significant portion of the land area within the Coal Creek Watershed. Private land ownership comprises only a small portion of the total area. As such, the primary land managers within the watershed include the Flathead National Forest, Glacier National Park, and DNRC. Other significant stakeholders within the watershed include the Flathead Basin Commission, due to their role in water quality throughout the entire Flathead Basin, and Montana Fish, Wildlife, and Parks (MFWP), due to their active role in bull trout protection in the basin. This document was prepared in close coordination with these primary stakeholders, with the exception of Glacier National Park. None of the subject water bodies were located with the boundaries of the park.

A series of project level meetings were held with the Flathead National Forest, DNRC, and MFWP including a meeting on July 14 and 15, 2004 at the Flathead National Forest office in Kalispell, Montana to present and discuss a pre-public release draft of the document. Additionally, at this meeting, conceptual plans were discussed regarding the development of a Section 319-grant application to implement this TMDL. The draft document was also on the agenda and discussed at the July Flathead Basin Commission meeting held in Lakeside, Montana. At that meeting, the FBC agreed to sponsor a 319-grant application for implementation of this TMDL. It was decided at that time that the "project partners" for the implementation project would include the Flathead Basin Commission, Flathead National Forest, DNRC, and MFWP.

The draft Water Quality Assessment and TMDLs for the Flathead River Headwaters Planning Area document was formally released for public review on October 20, 2004 (Appendix F). The notice of availability was made through a press release to the following media sources:

- Associated Press
- Bigfork Eagle
- Daily Interlake
- Hungry Horse News
- Independent Record
- KAJ TV-CBS
- KALS FM
- KCFW TV-NBC
- KGEZ – FM
- KOFI – AM/FM
- Whitefish Pilot
- Yellowstone Public Radio

Additionally, the notice was posted on the Montana Watershed Coordination Council's "list-serve" for watershed issues (WASHED@listserv.montana.edu). The document was made available for review on MDEQ's website (http://www.deq.state.mt.us/index.asp).

The formal public comment period extended from October 20, 2004 to November 20, 2004, and a public informational meeting was held on November 8, 2004. Formal written comments were submitted by five individuals. A summary of the public comments and the EPA/DEQ responses are presented in Appendix E.

7.0 REFERENCES

Alt, David. 2001. *Glacial Lake Missoula and Its Humongous Floods*. Mountain Press.

Bahls, L.L., B. Bukantis, and S. Tralles. 1992. *Benchmark Biology of Montana Reference Streams*. Montana Department of Health and Environmental Sciences, Helena, MT.

Bahls, L.L. 2003. *Biological Integrity of Sullivan Creek and Skyland Creek in the Upper Flathead River TMDL Planning Area Based on the Structure and Composition of the Benthic Algae Community*. Montana Department of Environmental Quality, Helena, MT.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fis.* Second edition. EPA 841-B-99-002. U.S. Environmental Protection Agency, Office of Water; Washington, DC.

Beschta, R.L., and W.S. Platts. 1986. *Morphological features of small streams: Significance and function*. American Water Resources Association, Water Resources Bulletin 22(3): 369-379.

Bollman. W. 1998. *Improving Stream Bioassessment Methods for the Montana Valley and Foothill Prairies Ecoregion*. Master's Thesis, University of Montana, Missoula, MT.

Bollman. W. 2003a. *A Biological Assessment of Sites on Sullivan and Skyland Creeks: Flathead County Montana*. Project #TMDL-C08. Montana Department of Environmental Quality, Helena, MT.

Bollman. W. 2003b. *A Biological Assessment of Sites on the North and Middle Forks of the Flathead River Drainage, Flathead County, Montana*. Montana Department of Environmental Quality, Helena, MT.

Bukantis, R. 1998. *Rapid Bioassessment Macroinvertebrate Protocols: Sampling and Sample Analysis SOP's*. Working draft, April 22, 1997. Montana Department of Environmental Quality, Planning Prevention and Assistance Division, Helena, MT.

Chesnut, J. 1999a. *Data Assessment Record for the 2002 303(d) List – Red Meadow Creek*. Montana Department of Environmental Quality, Planning, Prevention, and Assistance Division. Available at http://nris.state.mt.us/wis/environet/2002_303dhome.html. Accessed June 22, 2004.

Chesnut, J. 1999b. *Data Assessment Record for the 2002 303(d) List – Whale Creek*. Montana Department of Environmental Quality, Planning, Prevention, and Assistance Division. Available at http://nris.state.mt.us/wis/environet/2002_303dhome.html. Accessed June 22, 2004.

Chesnut, J. 1999c. *Data Assessment Record for the 2002 303(d) List – Morrison Creek*. Montana Department of Environmental Quality, Planning, Prevention, and Assistance Division. Available at http://nris.state.mt.us/wis/environet/2002_303dhome.html. Accessed June 22, 2004.

Chesnut, J. 2000. *Data Assessment Record for the 2002 303(d) List – Granite Creek*. Montana Department of Environmental Quality, Planning, Prevention, and Assistance Division. Available at http://nris.state.mt.us/wis/environet/2002_303dhome.html. Accessed June 22, 2004.

Cilimburg, A.C., and K.C. Short. 2003. *Forest Fire in the U.S. Northern Rockies: A Primer*. Available at http://www.northernrockiesfire.org/default.htm. Accessed June 29, 2004.

Constenius, Kurt N. 1996. *Late paleogene extensional collapse of the Cordilleran Foreland Fold and Thrust Belt*. GSA Bulletin 108 (1): 20-39.

Deleray, M., L. Knotek, S. Rumsey, and T. Weaver. 1999. *Flathead Lake and River System Fisheries Status Report*. Montana Fish, Wildlife, and Parks, Kalispell, MT.

Dodson, M. H., 2001. Letter dated July 23, 2001 from Max H. Dodson, U.S. Environmental Protection Agency, to Art Compton, Montana Department of Environmental Quality.

FBC (Flathead Basin Commission). 1991. *Flathead Basin Forest Practices Water Quality and Fisheries Cooperative Program: Final Report*. Flathead Basin Commission, Kalispell, MT.

FNF (Flathead National Forest). 2003. *Source Assessment Summary Conducted by the Flathead National Forest in 2002 and 2003*. Flathead National Forest, Kalispell, MT.

Ford, G.L., C.L. Maynard, J.A. Nesser, and D.S. Page-Dunroese. *Landtype Associations of the Northern Region: A First Approximation*. USDA Forest Service. Available at http://nris.state.mt.us/nrcs/soils/ltapage.html. Accessed June 16, 2004.

Galbraith, Alan F. 1973. *A Water Yield and Channel Stability Analysis Procedure, Kootenai National Forest, U.S. Forest Servic.* In Forest Hydrology, Hydrologic Effects of Vegetation Manipulation, Part II. December 1973.

Gray, J.R., G. Douglas Glysson, L.M. Turrios, and G.E. Schwartz. 2000. *Comparability of Suspended-Sediment Concentration and Total Suspended Solids Data*. Water Resources Investigations Report 00-4191. U.S. Geological Survey, Reston, VA.

Harrison, J.E., A.B. Griggs, and J.D. Wells. 2000. *Geologic and Structure Maps of the Wallace 1° x 2° Quadrangle, Montana and Idaho: A Digital Database*. USGS Miscellaneous Investigations Series Map I-1509-A. U.S. Geological Survey.

Harrison, J.E., J.W. Whipple, and D.J.Lidke. 2002. *Spatial Digital Database of Selected Data from the Geologic Map of the Western Part of the Cut Bank 1° x 2° Quadrangle, Northwestern Montana*. USGS Geologic Investigations Series Map I-2593. U.S. Geological Survey.

Hauer, F.R., and C.O. Blum. 1991. *The Effect of Timber Management on Stream Water Quality*. Flathead Basin Commission, Kalispell, MT.

Hauer, F.R., and E. Hill. 1997. *Analysis of 1994-1996 Headwaters Monitoring Data: A Contribution to the Master Plan for Monitoring Water Quality in the Flathead Basin*. Flathead Lake Biological Station Open File Report #140-97. Polson, MT.

Hauer, F.R., G.C. Poole, J.T. Gangemi, and C.V. Baxter. 1999. *Large Woody Debris in Bull Trout Spawning Streams of Logged and Wilderness Watersheds in Northwest Montana*. Canadian Journal of Fisheries and Aquatic Science 56: 915-924.

Hilsenhoff, W.L. 1987. *An Improved Biotic Index of Organic Stream Pollution*. Great Lakes Entomol. 20: 31-39.

Jones, J.A., and G.E. Grant. 1996. *Peak Flow Responses to Clear-Cutting and Roads in Small and Large Basins, Western Cascades, Oregon*. Water Resources Research 32(4): 959-974.

King, J., and L.C. Tennyson. 1984. *alteration of streamflow characteristics following road construction in North Central Idaho.* Water Resources Research 20(8): 1159-1163.

King, J. 1989. *Streamflow Response to Road Building and Harvesting: A Comparison with Equivelent Clearcut Area Procedure.* USDA Forest Service, Intermountain Research Station. INT-401.

Lundeen, L.J., and J.L. Hall. 1964. *Flood Damage Report*. Flathead National Forest, USDA Forest Service.

Martinson, A., W.J. Basko. 1998. *Soil Survey of Flathead National Forest Area, Montana.* USDA Forest Service in cooperation with Montana Agricultural Experiment Station.

MDEQ (Montana Department of Environmental Quality). 1996. *Montana List of Waterbodies in Need of Total Maximum Daily Load Development.* Montana Department of Environmental Quality, Helena, MT.

MDEQ (Montana Department of Environmental Quality). 2002. *2002 Montana 303(d) List – A Compilation of Impaired and Threatened Waterbodies in Need of Water Quality Restoration*. Montana Department of Environmental Quality, Planning, Prevention, and Assistance Division. Helena, MT.

MDEQ (Montana Department of Environmental Quality). 2004. Montana Numeric Water Quality Standards. Circular WQB-7 Montana Department of Environmental Quality, Planning, Prevention, and Assistance Division Water Quality Standards Section, Helena, MT. Available online at http://www.deq.state.mt.us/wqinfo/Standards/Index.asp.

MFWP (Montana Fish, Wildlife, and Parks). 2004. *Coal Creek Channel Survey – Preliminary Overview 2003*. Montana Fish, Wildlife, and Parks. Kalispell, MT.

Mudge, M.R., R.L. Earhart, J.W. Whipple, and J.E. Harrison. 2001. *Geologic and Structure Map of the Choteau 1° x 2° Quadrangle, Western Montana: A Digital Database*. USGS Miscellaneous Investigations Series Map I-1300. U.S. Geological Survey.

NMED (New Mexico Environmental Department). 2002. *Protocol for the Assessment of Stream Bottom Deposits on Wadable Streams*. New Mexico Environmental Department, Surface Water Quality Bureau. Santa Fe, New Mexico. Available at http://www.nmenv.state.nm.us/swqb/TMDL_Library.html. Accessed June 20, 2004.

Ott. 1993. An Introduction to Statistical Methods and Data Analysis – Fourth Edition. Duxbury Press. Belmont, California.

Pfankuch, D.J. 1975. *Stream Inventory and Channel Stability Evaluation: A Watershed Management Procedure*. USDA-FS. Northern Region. R1-75-002. Government Printing Office, Washington, DC.

Pfankuch, D.J. 1978. *Stream Reach Inventory and Channel Stability Evaluation*. U.S. Department of Agriculture, Forest Service, Northern Region.

Phillips. P. 2000. *Data Assessment Record for the 2002 303(d) List – Coal Creek* [Online]. Montana Department of Environmental Quality, Planning, Prevention, and Assistance Division. Available at http://nris.state.mt.us/wis/environet/2002_303dhome.html. Accessed June 22, 2004.

Rober, B.B., J.L. Kershner, E. Archer, R. Henderson, and N. Bouwes, 2002. *An evaluation of physical stream habitat attributes used to monitor streams*. Journal of the American Water Resources Association. December 2002.

Rosgen, D. 1996. *Applied River Morphology*. Wildland Hydrology. Pagosa Springs, CO.

Rothrock, J.A., P.K. Barten, and G.L. Ingman. 1998. *Land Use and Aquatic Biointegrity in the Blackfoot River Watershed, Montana*. Journal of the American Water Resources Association 34(3): 565-581.

Smith, Larry N. 2002. *Surficial Geologic Map of the Upper Flathead River Valley (Kalispell Valley) Area, Flathead County, Northwestern Montana*. Ground-Water Assessment Atlas No. 2, Part B, Map 6. Open-File Version January 2002. Montana Bureau of Mines and Geology.

Suplee. M. 1999a. *Data Assessment Record for the 2002 303(d) List – North Fork Coal Creek*. Montana Department of Environmental Quality, Planning, Prevention, and Assistance Division. Available at http://nris.state.mt.us/wis/environet/2002_303dhome.html. Accessed June 22, 2004.

Suplee. M. 1999b. *Data Assessment Record for the 2002 303(d) List – Coal Creek*. Montana Department of Environmental Quality, Planning, Prevention, and Assistance Division. Available at http://nris.state.mt.us/wis/environet/2002_303dhome.html. Accessed June 22, 2004.

USDA (U.S. Department of Agriculture). 1995. *State Soil Geographic (STATSGO) Data Base*. U.S. Department of Agriculture, Natural Resources Conservation Service. Available at http://www.ncgc.nrcs.usda.gov/branch/ssb/products/statsgo/index.html. Accessed May 11, 2004.

USDA (U.S. Department of Agriculture). 1998. *Soil Survey of Flathead National Forest Area, Montana,* Prepared in cooperation with Montana Agricultural Experiment Station, Natural Resources Conservation Service, and U.S. Forest Service.

USEPA (U.S. Environmental Protection Agency). 1997. *Revision to Rapid Bioassessment Protocols for Use in Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish*. U.S. Environmental Protection Agency, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2000. *Ambient Water Quality Criteria Recommendations – Information Supporting The Development Of State And Tribal Nutrient Criteria For Rivers And Streams In Nutrient Ecoregion II*. U.S. Environmental Protection Agency – Office of Water. EPA - 822-B-00-015.

Weaver, T., M. Deleray, S. Rumsey, G. Grisak, and C. Muhlfeld. 2003. *Flathead Lake and River System Fisheries Status Report*. DJ Report No. F-78-R-1 through 5, Element 1, Project 1 and 2, SBAS Project No. 3130. Montana Fish, Wildlife, and Parks, Kalispell, MT.

Weaver, T, and J. Fraley. 1991. *Fisheries Habitat and Fish Populations*. Flathead Basin Forest Practices Water Quality and Fisheries Cooperative Program. Flathead Basin Commission, Kalispell, MT.

Wolman, M.G. 1954. *A method of sampling coarse river-bed material*. Transactions of the American Geophysical Union (EOS) 35: 951-956.

Woods, Alan J., James Omernik, M. John, A. Nesser, J. Shelden, and Sandra H. Azevedo. 1999. *Ecoregions of Montana* (color poster with map, descriptive text, summary tables, and photographs); (map scale 1:1,500,000). U.S. Geological Survey, Reston, VA.

APPENDIX A: LANDFORM GROUPS IN THE FLATHEAD TMDL PLANNING AREA

Valley Bottoms (VA)

Valley bottoms are low in the landscape and are composed of stream terraces, floodplains, glacial outwash plains and outwash terraces. Parent materials are sands, silts, or gravels underlain by siltstones, or glacial deposits. The dominant slopes have gradients of 2% to 20%. Fossil terraces have very steep slopes on the front edge. The primary soils are deep with extremely gravelly sand and loam textures. The vegetation is a mosaic of deciduous forest, coniferous forest, and wet meadows or shrubland. The riparian vegetation is dominantly Abies lasiocarpa / Streptopus amplexifolius, Abies lasiocarpa / Calamagrostis canadensis and Picea / Cornus stolonifera habitat types. Sensitive soils occur on the wet, poorly drained flood plains and lacustrine deposits.

Breaklands (BK)

Breaklands occur in both upland and alpine landscape settings and are typically composed of structural breaklands and stream breaklands. The dominant slopes have gradients of 55% to 70%. Parent materials are volcanic ash overlying bedrock composed of argillites, siltstone, quartzite, dolomites, and limestone. Structural breaklands are formed in colluvial materials from weakly weathered meta-sedimentary Belt bedrock. Stream breaklands are formed in glaciofluvial material deposited during the last glacial epoch. The dominant soils are shallow to moderately deep with very gravelly loam textures. The vegetation is a mosaic of coniferous forest, and mountain shrub/grass lands.

The landform group is slight to moderately dissected by streams with sub-parallel and parallel stream patterns dominant. Streams are ephemeral at higher elevations and perennial at lower elevations and are typically classified as A or Aa+ types with gradients from 4% to greater than 10%. Straight (non sinuous) cascading reaches, with frequently spaced pools are characteristic. Streams are very stable when flowing through bedrock and boulders (A1 and A2) with low sensitivity to increases in water yields, peak flows or sediment. When flowing through finer materials – cobbles, gravels, or sands (A3 or A4), disturbed stream reaches can yield significant sediment.

The riparian vegetation is dominantly Abies lasiocarpa / Streptopus amplexifolius habitat type on poorly drained sites. Small pockets of Abies lasiocarpa / Oplopanax horridum habitat type is dominant on poorly drained soils. Sensitive soils occur on dissected breaklands that receive more than 50 inches of precipitation per year.

Steep Alpine Glaciated Lands (STGLMS)

Steep alpine glaciated lands occur in upland and alpine landscape settings and are primarily composed of glacial troughwall, cirque headwall, and cirque basin landforms. Parent materials are alpine glacial debris and colluviums derived from and underlain by argillite, siltstone, quartzite, limestone, and dolomite bedrocks. The landforms are typically high elevation and high precipitation areas. The vegetation is a mosaic of coniferous forest, alpine meadows, and shrubland associated with avalanche chutes.

Glacial troughwalls are formed in glacial tills on lower elevation slopes with volcanic ash influenced colluvium on the higher elevation slopes. Slope gradients range from 50% to 90%. Soils on the lower slopes are moderately shallow to deep, are moderate to highly developed, and have cobbly medium textures. The troughwall landforms are moderately to highly dissected by streams with parallel stream pattern dominant. Streams are either 1st or 2nd order, intermittent or ephemeral at the higher elevations and perennial at the lower elevations. Troughwall streams are characterized by moderate to high entrenchment, moderate to high confinement, and low sinuosity and are classified as Aa+ or A types with gradients from 4% to greater than 10%. Straight cascading reaches with frequent pools characterize streams within this landform. Streambeds of bedrock and boulders are typed as A1/Aa+1 or A2/Aa+2 and are normally very stable. Large flows produced from either rain on snow events, or large spring runoffs after wildfire events periodically erode the steep channels

Cirque headwalls and cirque basins are formed in glacial till on lower elevation slopes with volcanic ash influenced colluvium on the higher elevation slopes. Slope gradients range from 5% to 90%. Soils are shallow to moderately deep and weakly developed with very gravelly medium textures. The cirque basin landform generates flatter gradient streams through finer materials (small boulder to clay size deposits) than the troughwall landform. The streams are pre-dominantly B types with moderately steep gradients of 2% to 4% in narrow valleys with gently sloping sides. Riffles with frequently spaced pools are the dominant characteristic. Under normal flow conditions, streams are very stable. Increased peak flows through finer soil particles create streams moderately sensitive to channel erosion. Cirque lakes and associated wetlands are a minor component of the cirque basin map unit.

The riparian vegetation is dominantly Abies lasiocarpa / Streptopus amplexifolius habitat type on poorly drained sites. Small pockets of Abies lasiocarpa / Oplopanax horridum dominant habitat type occurs in poorly drained soils. All cirque basins have sensitive soils. Glacial troughwalls have sensitive soils where precipitation exceeds 50 inches per year.

Glaciated Mountainsides (GLMS)

Glaciated lands occur in both valley bottom and upland landscape settings and are primarily composed of glacial moraine landforms. Parent materials are continental or alpine glacial debris with or without volcanic ash surface layers. The soils are underlain by bedrock composed of argillites, siltstone, limestone, dolomites, and quartzite. The dominant slopes range from 5% to 50%. In the valley bottoms the glacial moraines create rolling hummocky topography with slopes ranging from 5% to 30%. On the uplands the glacial moraines create straight to slightly concave slopes that range from 20% to 55%. Glacial moraines typically occur at the base of glacial troughwalls. The primary soils are moderate to very deep with very gravelly, coarse and medium textures. The major vegetative cover is a dense coniferous forest with occasional meadow openings.

2nd to 4th order perennial streams have dissected the landform into a moderate to highly dendritic stream pattern. Streams occupy narrow valleys with gently sloping sides, are characterized by low to moderate entrenchment, low to moderate confinement, low to moderate sinuosity, and are typically classified either A or B stream types. The A types have gradients from 4% to 10% with straight (non sinuous) cascading reaches and frequently spaced pools. When flowing through boulders (A2) streams are very stable with low sensitivity to increases in water yields, peak flows or sediment. The lower elevation flatter streams are B types with gradients from 2% to 4%. Riffles are the dominant characteristic, with frequently spaced pools. The streambed materials typically range from fine sand to small boulder in size, with gravel to cobble size materials predominant. Large woody debris is the primary gradient control, unless stream flow is through finer soil particles, leading to greater sensitivity to channel erosion from increased peak flows.

The riparian vegetation is dominantly Abies lasiocarpa / Streptopus amplexifolius, Abies lasiocarpa / Oplopanax horridium, Abies lasiocarpa / Calamagrostis canadensis, and Picea/Cornus stolonifera riparian habitat types. Sensitive soils occur where this landform receives more than 50 inches of precipitation per year.

Mountain Slopes and Ridges (MSRI)

Mountain slopes and ridges occur in both the upland and alpine landscape settings and are typically composed of dissected mountain slopes, glaciated mountain slopes, and glacially scoured ridge tops. The geomorphic processes that occur on these areas include colluvial, fluvial and glacial, erosion or deposition. Parent materials are volcanic ash overlying bedrock composed of argillites, siltstone, quartzite, and limestone. The vegetation is a mosaic of coniferous forest, mountain shrub lands, and mountain grasslands.

The landform group is a combination of glacially scoured ridge tops and dissected mountain slopes (fluvial). Glacially scoured ridge tops have been strongly modified by continental ice. The prominent features are ridge tops and ridge noses with exposed bedrock. These areas have slopes that range from 10% to 45%. Soils are shallow to moderately deep, and are weak to moderately developed with medium textures. Slopes range from 30% to 60%.

The mountain slopes landform is moderately to strongly dissected by ephemeral and perennial streams that occupy narrow “v” shaped valleys, with the dominant stream pattern either dendritic or sub-parallel. Streams are typically classified as A or Aa+ types with gradients from 4% to 10% and are characterized by straight (non sinuous) cascading reaches and frequently spaced pools. When flowing on bedrock and boulders (A1 and A2) streams are very stable with low sensitivity to increases in water yields, peak flows or sediment. The streams in the ridge top landform position occur at the heads of drainages and are typically ephemeral or intermittent streams associated with seeps and springs.

The riparian vegetation is dominantly Abies lasiocarpa / Streptopus amplexifolius, Abies lasiocarpa / Oplopanax horridium and Picea / Cornus stolonifera riparian habitat types. There are no sensitive soils in this landform group.

Mass Wasted Slopes (MWSL)

This land type is a complex mixture of colluvial soils of various textures and residual soils on rolling to steep mass failure lands. Soil permeability is rapid due to rock fracturing. Drainages are usually short and dry with pattern defined by dominant rock fracturing or bedding. Seeps, springs and small ponds occur at slope breaks. Slopes are complex and result from debris slides and rotational slumps. Topography is subdued by secondary mass wasting on dipping bedrock associated with block gliding. Elevation ranges from 4,000 to 6,000 feet above mean sea level. The parent material is predominantly residuum derived from the underlying bedrock and colluvium deposited by mass failure. The parent material has a wide variety of physical and chemical properties depending on the degree of weathering and the bedrock source. The soils formed in colluvium occur on benches deposited by mass failure and are pale brown, silt loam volcanic ash influenced loess. Slopes on benches of colluvium are 30%. Soils formed in residuum occur on the steep scarps above the colluvial deposits and slopes are 50%. Residuum soils are brown, very gravelly loam glacial till that is neutral to medium acidic. The residuum soils have 45% to 80% angular coarse rock fragments.

The major habitat types on the benches with colluvium are Abies lasiocarpa / Clintonia uniflora, Abies grandis / Clintonia uniflora, and Thuja plicata / Clintonia uniflora. The major habitat types on the scarps that have residuum soils are Abies lasiocarpa / Xerophyllum tenax, and Abies lasiocarpa / Meniesia ferruginea.

Frost Shattered Mountain Ridges (FSMR)

Oversteepened cirque headwalls and narrow alpine ridges formed of dipping glacial scoured slab bedrock are the dominant characteristics of this landform group. The landform group usually surrounds amphitheater shaped basins at the head of glaciated valleys, some containing tarns, with elevations ranging between 4,000 to 8,000 feet above mean sea level. Slopes are convex and range from 40% to 60%.

The sub parallel, first-order drainages within the landform group are controlled by the jointing and fracture patterns of bedrock. Parent material consists of Precambrian quartzite, limestone, argillite and siltite. 50% to 70% of these land types are composed of rock land covered by lichen. Talus slopes are common. The remaining 30% to 50% of the ridges have thin, rocky soils that support trees, shrubs and grasses. Shallow soils are formed in pockets of volcanic ash influenced loess mixed by colluvial drift and frost churning.

The major habitat types found on soil pockets within the landform group are Abies lasiocarpa / Xerophyllum tenax, Abies lasiocarpa / Vaccinium scoparium, Pinus albicaulis / Abies lasiocarpa, and Larix lyalii / Abies lasiocarpa. The shallow pockets of soil that exist are sensitive.

APPENDIX B: FLATHEAD NATIONAL FOREST AND MONTANA FISH, WILDLIFE, AND PARKS SOURCE ASSESSMENTS

Flathead TMDL Planning Area

Source Assessment Summary Conducted by the Flathead National Forest in 2002 and 2003

1.0 Introduction

Under an interagency agreement with the U.S. Environmental Protection Agency (EPA), the Flathead National Forest (FNF) conducted a sediment source assessment survey in support of the development of all necessary total maximum daily loads (TMDL) for the Flathead River Headwaters TMDL Planning Area (FTPA). A summary of the methods and results of the survey are presented below.

2.0 Source Assessment

The 303(d) listed stream segments in the FTPA are listed as impaired for sediment. This document describes the source assessment work completed by the FNF in 2002-2003 to evaluate potential sediment sources in the TMDL watersheds. Three possible sediment sources were considered in the FTPA. Potential sources include possible contributions from:

- upland sources (e.g. soil loss resulting from forest harvest practices and timber management, mass wasting);
- localized influences and impacts to riparian areas (e.g. erosion from roads, road crossings, riparian harvests).
- instream sediment sources (a survey was conducted for Coal Creek from headwaters to confluence with Deadhorse by MFWP).

2.1 Upland Source Assessment

The FNF employed several techniques to determine possible sediment sources in the 303(d) listed watersheds. The process consisted of the following steps:

- To assess timber management impacts, GIS analysis of the harvest activity per watershed was completed and acreage with high erosion potential was summarized.
- Historical aerial photographs were reviewed to target both natural and timber-related sediment sources and to prioritize field verification efforts.
- A portion of the sediment sources identified in Steps 1 and 2 were field verified.

2.1.1 GIS Analysis

To determine the contribution of sediment attributed to harvest activity, areas with soil disturbance caused by past management activities and with low vegetation recovery were identified using GIS. Data sources used for analyzing the effects of timber management included the sediment hazard rating index (landtype information such as landslide prone areas, steep slopes, eroable soils and soil types, sensitivity to compaction, distance to stream network), and timber stand management history (extent of harvests, types of harvest, dates of harvest) from the Timber Stand Management Records System (TSMRS) database. The sediment hazard layer was overlain with the historic harvest layer and summarizations for each harvest type within high sediment hazard zones were identified. The GIS analysis identified historically managed areas with high potential to contribute sediment from previously harvested areas. The acreage considered as potential soil erosion areas due to soil disturbance are provided in Table 2-1.

Table 2-1. Summary of the Acreage Examined for Possible Sediment Contributions

Stream Segment	Historic TSMRS acres with soil disturbance identified with GIS	Final acreage amended to TSMRS acres after historic aerial photo review	Percent of Final Acreage Field Verified
Red Meadow	977	1028	72%
Whale Creek	1900	245	9%[1]
FNF Coal Creek	1270	1978	75%
Granite Creek	226	318	24%
Skyland Creek	136	73	17%
Morrison Creek	80	217	83%
Sullivan Creek	1524	NA[2]	NA

A higher percentage of final acreage was not assessed for Whale Creek because of the 2003 fires.
Sullivan Creek was considered fully supporting beneficial uses based on macroinvertebrate results from 2002 therefore; no sediment source analysis was completed.

2.1.2 Aerial Photographs

Historical aerial photographs were also evaluated for all 303(d) watersheds (with the exception of Sullivan Creek) to identify potential sediment source sites left after timber management activities. The photographs were at scale 1:16,000 and were taken in 1979, 1989, and 1999. The photos were examined for changes in texture, color and pattern to detect potential sediment sources within old harvest sites, especially skid trails and landings. Potential sediment sources from landslides, road cut banks and fill slopes, or avalanche fans were also targeted for field verification. The potential sediment sites were transcribed to orthoquads for the 303(d) drainages to facilitate finding them during field verification. The total acreage values for the potential sediment sources increased in some drainages due to non-timber management related sediment sources such as avalanche fans and road cut slopes. Other watersheds showed a decrease in potential erosion acres estimates based on vegetation recovery after historic harvest practices. Final numbers for potential erosion areas are provided in Table 2-1.

In July 2002, a low-level helicopter reconnaissance flight was conducted over 303(d) drainages within the North Fork watershed. The Three Forks Zone (TFZ) hydrologist (Dean Sirucek), TFZ fisheries biologist (Rick Stevens), and the FNF soil scientist (Bill Basko) identified potential sediment sources and transcribed them to orthoquads for Whale, Red Meadow, and Coal Creek watersheds. The orthoquads were used as guidance for field verification. The TMDL field crew visited each site to assess the potential for sediment to be input to the stream network.

All topographic maps, aerial photo stereographic pairs, highlighted orthoquads, and field notebooks are archived at the FNF Supervisors Office, Resources division.

2.1.3 Field Verification

The final step was to conduct a field visit to as many areas as possible to identify possible sediment sources. The FNF field crew conducted a visual survey of each site during 2002 and 2003, assessing soil and vegetation stability. Photographs were taken at sites with sparse vegetation recovery, particularly in riparian zones. Based on field observations, the crew determined whether or not the site remained an active sediment source.

2.1.4 Results

The majority of potential sediment sources on uplands were located on ephemeral and first-order streams that had been crossed with roads. The FNF looked at areas of potential erosion with one major filter:

- Is sediment introduced directly into the active stream network? Active streams were defined as channels with flowing water.

Based on the GIS analysis, estimation of current condition of historic timber management areas, aerial photograph review, and field verification, active upland sediment sources induced by timber harvest activities is not a significant source of sediment in the 303(d) listed watersheds.

2.2 Localized Sediment Contributions from Roads and Road/ Stream Crossings

Road surfaces and cut slopes are the primary sources of sediment in the FNF. Closing roads to vehicle use reduces erosion by eliminating the formation of ruts and by reestablishment of vegetation on the road surface. Road cuts on sensitive landtypes may continue to contribute sediment into ditches and first-order drainage systems.

Sensitive landtypes have the potential to be sources of sediment. The determinant characteristic of sensitive landtypes is an excess of water within the soil profile, usually on a seasonal basis, but in some landtypes, year around. Sensitive landtypes in a natural undisturbed condition act as a temporary storage site for water, allowing moisture to slowly move down slope until emerging as springs, wetlands, streams, or percolating into groundwater. Disruption of this hydrologic function by management activities such as road building or timber harvest can cause water held by sensitive landtypes to seep out and onto the road, skid trail or landing, moving quickly down slope into streams. Additional water yield increases the risk of sediment delivery to streams by the efficient routing of water over roads, skid trails and landings. Sensitive landtypes are priority places to search for sources of sediment to streams caused from plugged culverts, rutted roads, road ditches that concentrate large quantities of water, or old cutting units with water running down skid trails, known as “skid streams”. The big concern for sensitive land types is the increase in water yield associated with disturbance. The increased drainage efficiency is the lasting problem although increases in sediment are also a risk. Stream crossings per square mile indicate avenues for road sediment to enter the drainage network (Van Eimeren, 1998). Potential sediment contributions from roads were evaluated for all drainages. In 2002 and 2003, the FNF field crew completed driving and walking surveys on all open, closed, decommissioned, and maintained roads in the 303(d) listed watersheds (except Sullivan) to identify active sediment sources. Pictures and GPS locations were taken at each site for compilation in the restoration plan and to forward to road managers for inclusion in road maintenance plans. Table 2-2 provides summary information on stream crossings and roads located in each watershed.

In 2002, the FNF fish passage team completed field surveys at all road /stream crossings on perennial streams. Data compiled in 2002 by the fish passage field crews were reviewed to prioritize 2003 field efforts. Field surveys in 2003 were completed at all road/stream crossings for intermittent streams to determine culvert condition and sediment potential. The road/stream crossing survey evaluated the culvert’s risk of failure, erosion potential, and size. Culverts deemed to have a great risk of failing have been targeted for replacement by the FNF, based on availability of funding.

Table 2-2. Road / Stream Crossing Summary

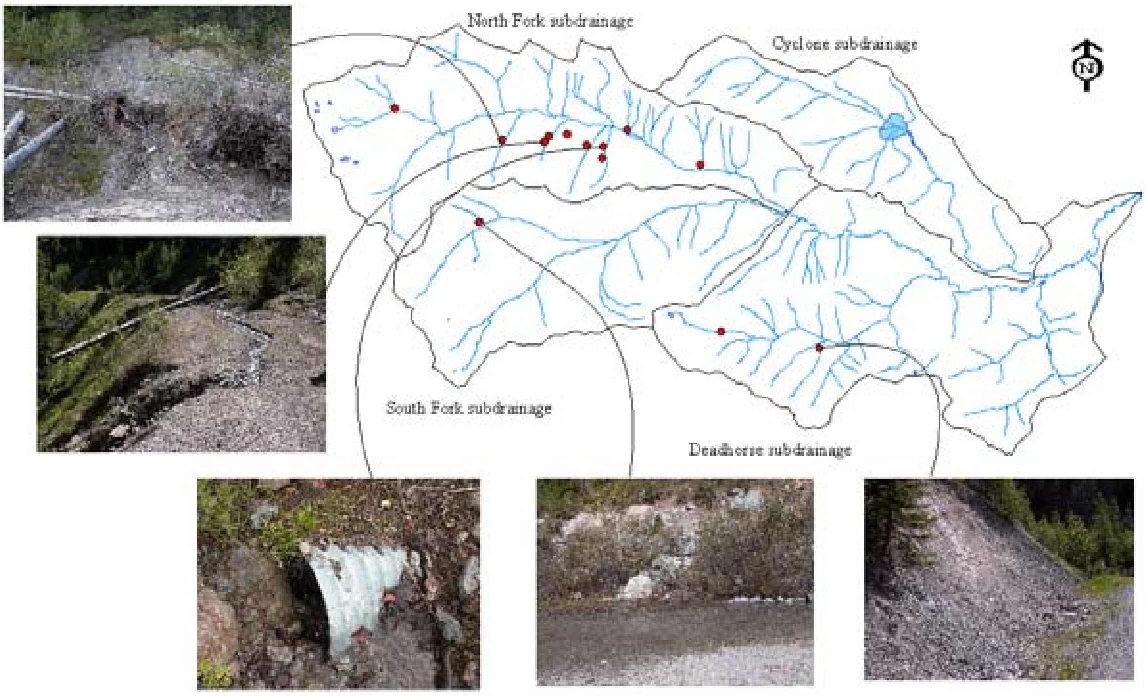
Stream Segment	Number of Road/Stream Crossings	Number of Road/Stream Crossings Evaluated	Number of Road/Stream Crossings at Failure Risk in the Watershed	Road miles in need of BMP's or upgrading	Road miles within 125' of stream	Road miles within 300' of stream
Red Meadow Creek	76	76	0	9	14.6	16.9
Whale Creek	84	84	8	21	26.8	30.2
FNF Coal Creek	142	135	16	40	13.8	34.9
Granite Creek	16	16	2	18	1.7	5.5
Skyland Creek	13	13	0	0	2.3	2.5
Morrison Creek	5	5	0	0	6.9	1.7
Sullivan Creek	103	55	Partially completed 2003 with BAER Fire funds	Partially completed 2003 with BAER Fire funds	7.1	25.7

3.0 Results

The results of the source assessment done for the 303(d) drainages are presented below in a series of maps with photos. The 303(d) drainages are presented in order of priority for restoration based on assumed impairment status, expectation of funding availability and projected improvement to conditions (reduction of fine sediment in active stream network) for enhanced support of aquatic life and cold-water fisheries.

3.1 Coal Creek

3.1.1 Road Survey results



Active upland sediment sources induced by timber harvest activities is not a significant source of sediment in the Coal Creek drainage. The five pictures above illustrate the typical sediment source problems found in the Coal Creek drainage. Eleven road / stream crossing sediment sources occur throughout the drainage. The major sediment sources occur on Roads 5270 and 5278 in the North Fork Coal, with three plugged culverts at risk of failure, sediment slumps, and active streams eroding the road prism. North Fork Coal Creek drainage contains 8 perennial stream culverts that input sediment directly into the stream network, 2 of which have partially failed and need to be removed and the stream channel restored. Portions of 17 miles of bermed, closed roads contribute sediment into the stream network and require work to reduce road sediment. There are 5 miles of heavily traveled road that require ditch drainage improvements, water bars, drain dip installation, culvert inlet armoring, and relief culvert installation to reduce sediment.

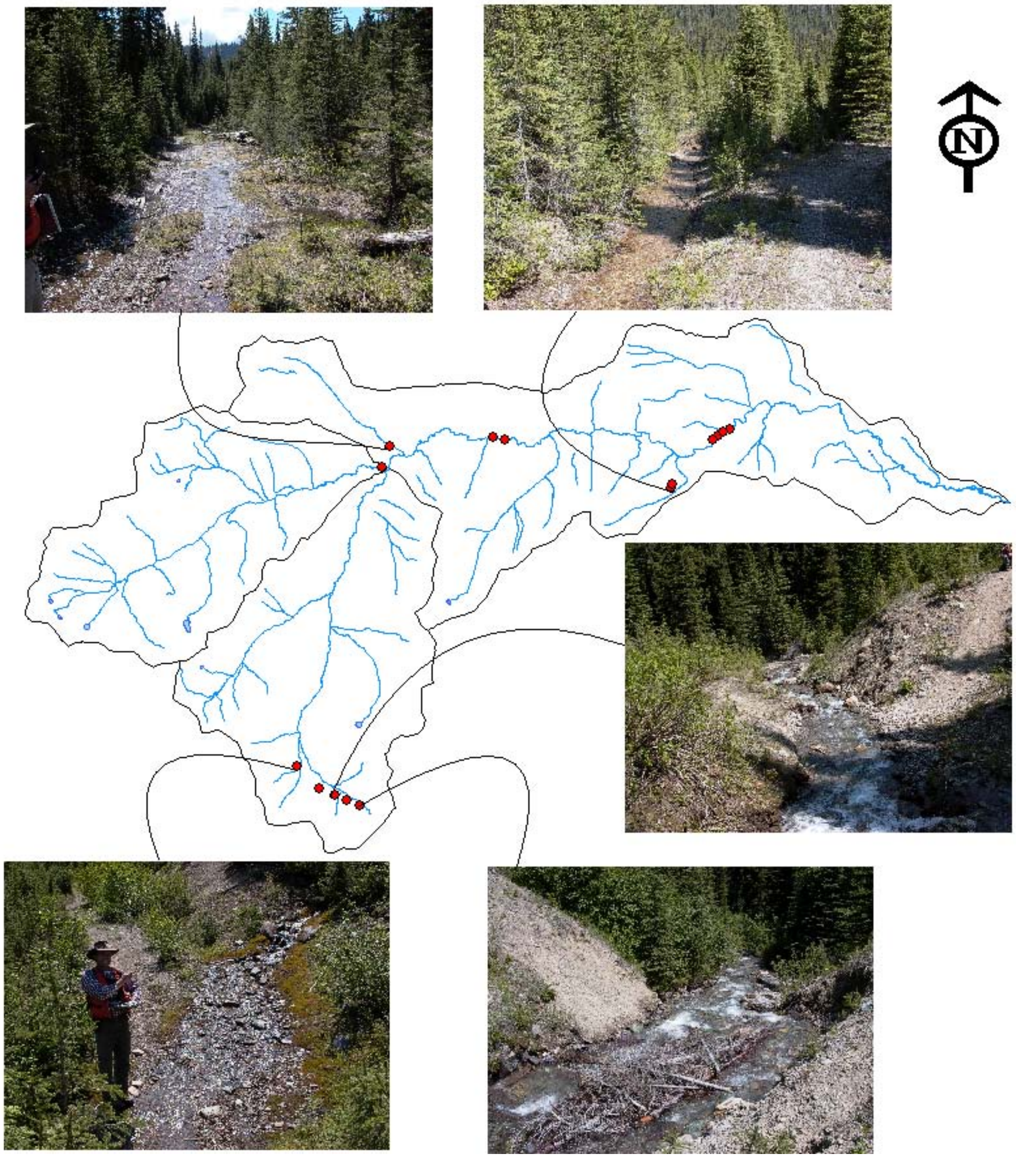
3.1.2 Stream Channel Survey Results

In the winter of 2002-2003 an interagency group convened to discuss stream habitat conditions in Coal Creek, a tributary to the North Fork of the Flathead River. The group consisted of representatives, mostly hydrologists or fisheries biologists, from the U.S. Forest Service, U.S. Fish and Wildlife Service, Montana Department of Natural Resources and Conservation, and Montana Fish Wildlife and Parks (MFWP). The group convened for several reasons, including declines in bull trout spawning, TMDL planning, and observed in-channel erosion and sedimentation. The group met a number of times including a fieldtrip to Coal Creek where we looked at active bank erosion. The outcome of these meetings was concurrence that the group needed to work towards improving habitat conditions in the stream. To do this, it was decided that we needed better information of existing channel conditions to take a holistic approach to restoration. Prior to working on isolated locations within the drainage, the group decided to do preliminary surveys of the forest road system, in-channel conditions, and water yields within the drainage. The Coal Creek Working Group felt this baseline information was important in order to proceed with a better likelihood of success. The report (Cavigili, 2004) completed by MFWP addresses the in-channel stream habitat conditions in Coal Creek and its tributaries upstream of the confluence with Dead Horse Creek.

From the information collected during that survey, MFWP were able to produce an overview of channel conditions in the drainage and provide information in a format that allows others to view channel conditions and assess the current status. This will allow members of the interagency working group and others to direct future restoration efforts. The MFWP report consists of six parts. These paragraphs are the introduction to that document summarizing the preliminary channel survey and containing methodology, and summaries of general channel conditions for four stream reaches.

Prior to this survey, a very similar survey was conducted in 1988 (Weaver, Tom. 1989. Coal Creek Fisheries Monitoring Study NO. VII and Forest-Wide Fisheries Monitoring-1988. Montana Fish, Wildlife and Parks, Kalispell, MT). The FNF and Montana Fish Wildlife and Parks conducted this earlier study through a cooperative effort. This report provided a narrative description of stream features beginning in the headwaters and working downstream identifying sediment sources, bank instability concerns, and restoration measures. This report stated that there were highly unstable channel areas in each of the three major forks in the Coal Creek drainage. The vast majority of the problems were related to land-management, logging and road building activities of the 1950’s and 1960’s. It noted that sediment generated decades ago continued to cause channel instability and erosion in the late 1980’s. Since the 1980’s, there had been a number of road improvement projects on federal and state lands to improve stream crossings and road drainage. However, a number of the problems observed in the 1988 report had not been addressed. The 2003 survey aimed to repeat the 1988 survey and determine current status of and if there were major changes in channel condition. MFWP personnel (Jon Cavigli, Tom Weaver, and Mark Deleray) split the roughly 28 miles of stream between the three recorders, which took 15 person-days. For reporting purposes, MFWP broke the river miles into four reaches. One reach was Mathias Creek and its tributaries down to its confluence with the South Fork of Coal Creek. The second was the South Fork of Coal Creek from the headwaters down to the confluence with main Coal Creek. The third was the upper two forks of main Coal Creek. And the forth reach was main Coal Creek from the confluence of the upper two forks down to the confluence with Dead Horse Creek. Starting at the headwaters or upstream end of a reach, observers walked downstream noting in-channel sediment deposits, eroding banks or other sediment sources. Major features were noted in narrative field notes, digital photographs, and GPS coordinates. Digital photos and GPS coordinates may not be available for some reaches due to availability of equipment. This survey provides a qualitative overview of channel conditions that can be compared to similar information from the 1988 report and provide a holistic view of the drainage to direct future surveys and restoration needs (Cavigili, 2004).

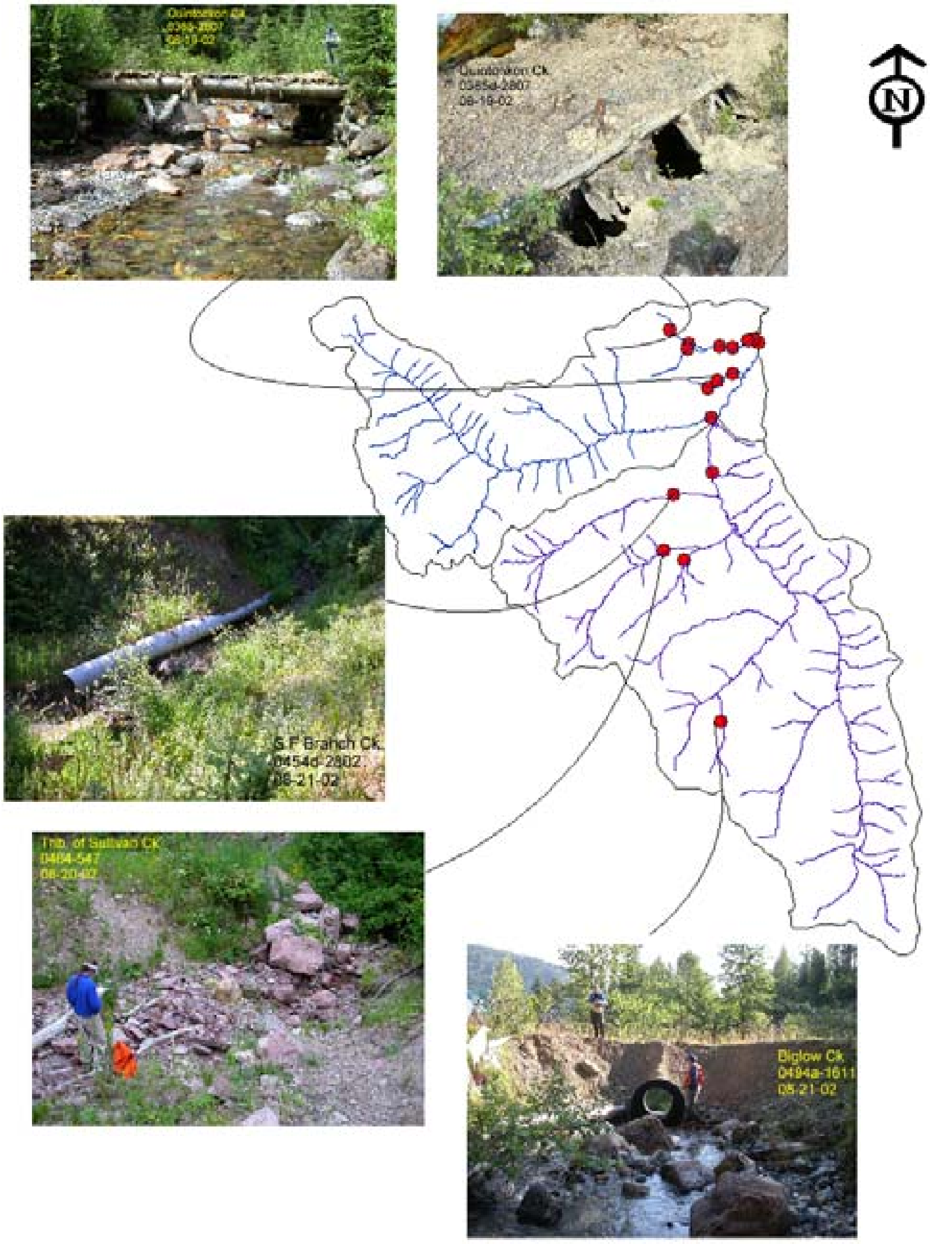
3.2 Whale Creek



3.2.2 Road Survey results

Active upland sediment sources induced by timber harvest activities is not a significant source of sediment in the Whale Creek drainage. The five pictures above illustrate the typical sediment source problems found in the Whale Creek drainage. Eight road / stream crossing sediment sources occur throughout the drainage. The major sediment sources occur on historic road 589 in the Shorty Creek tributary, with five improperly removed culvert tank traps, sediment slumps, and active streams eroding the road prism. Whale drainage contains 8 perennial stream culverts that were installed in a manner that contributes sediment directly into the stream network. The road system within the drainage contains approximately 11 road miles that are closed to traffic and require work to reduce sediment. There are 10 road miles that are open to traffic that contribute sediment at stream crossings or from relief culverts that handle too much surface drainage. Four culverts need to be removed and channels restored.

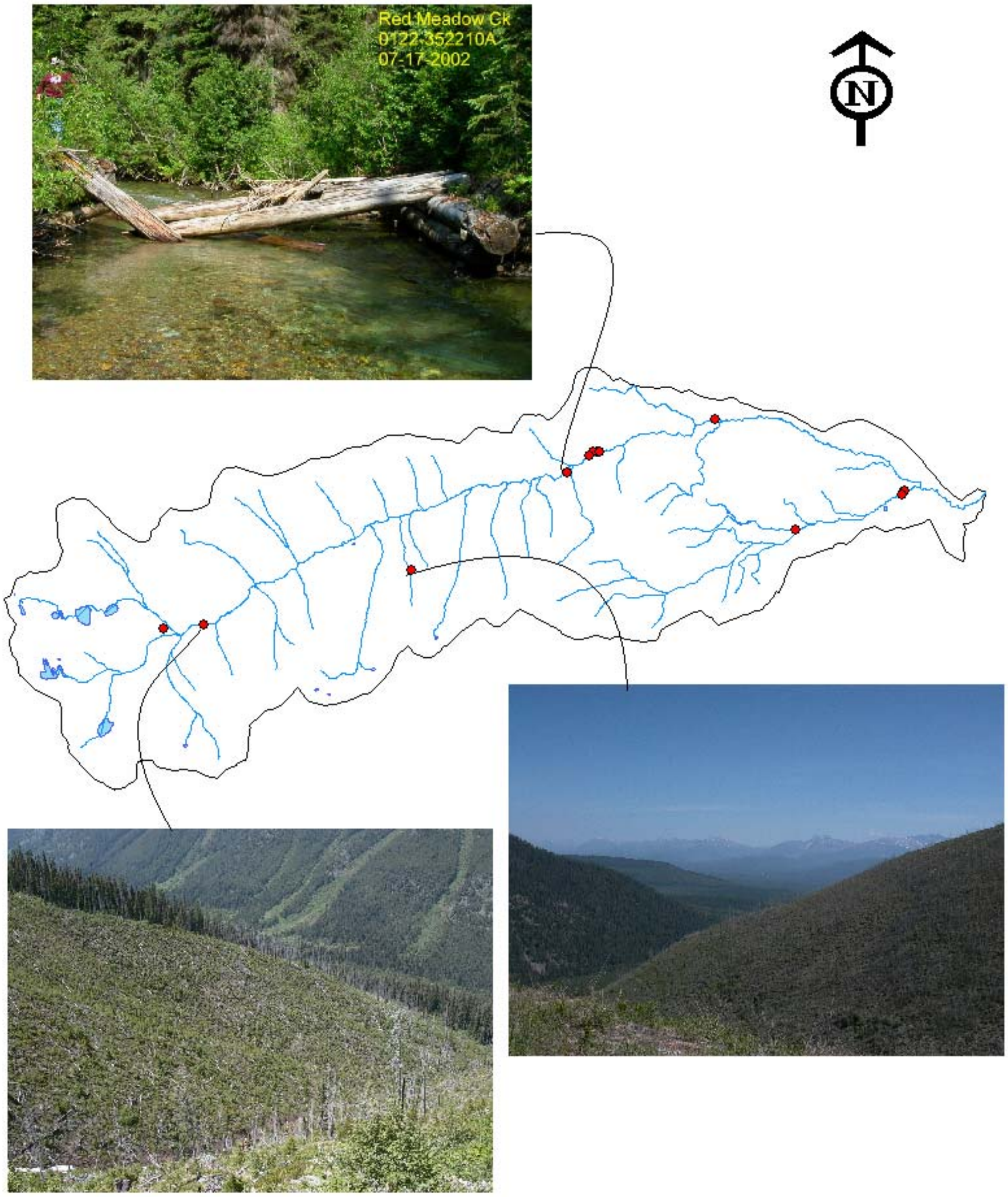
3.3 Sullivan Creek



3.3.3 Road Survey results

Active upland sediment sources induced by timber harvest activities are unknown in the Sullivan/Quintonkin drainage. The five pictures above illustrate the typical sediment sources found by the fish passage crew in the Sullivan/Quintonkin drainage in 2002. There are 17 road/perennial stream crossings at risk in the Sullivan/Quintonkin drainage. Portions of 33 miles of historic roads need to be evaluated for drainage problems that input sediment directly into stream networks. In 2003, the Ball Fire burned approximately 7520 acres in the Sullivan/Quintonkin drainage. Burn Area Emergency Restoration (BAER) addressed immediate sediment sources within the burn area and independent fire suppression rehabilitation was conducted on reopened roads and fire lines to address risks to watershed health directly because of fire suppression efforts.

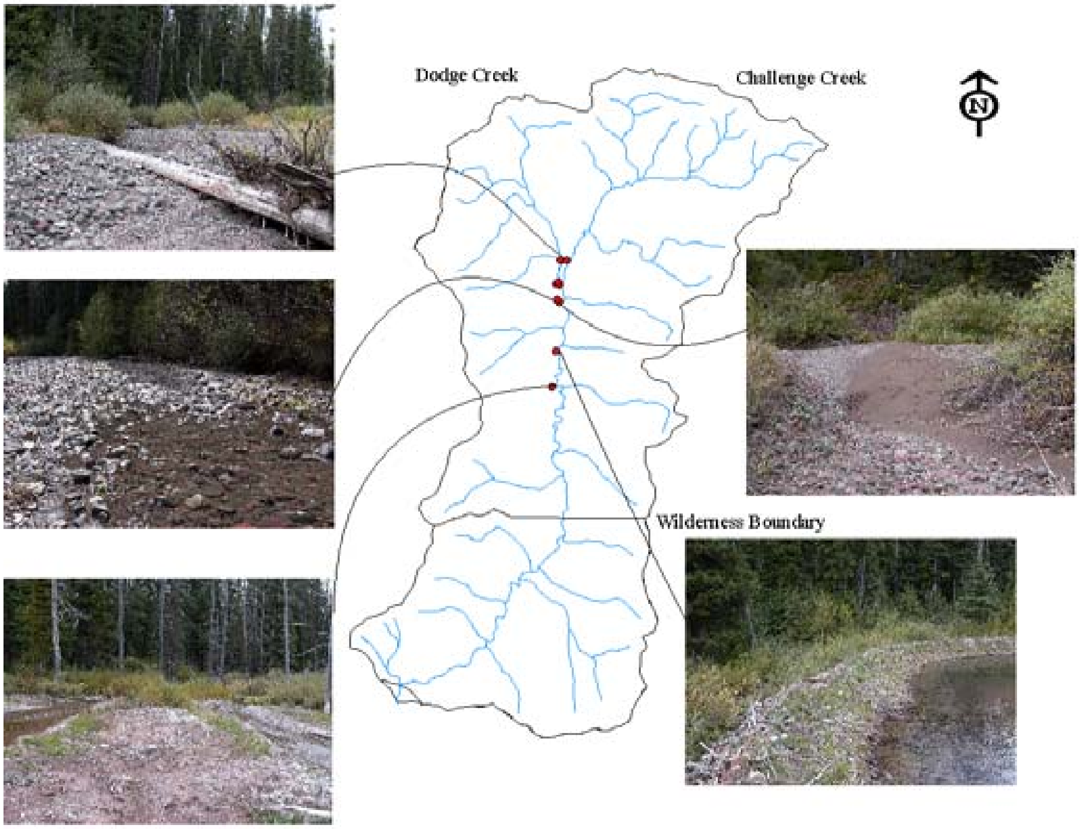
3.4 Red Meadow Creek



3.4.1 Road Survey results

Red Meadow drainage contains approximately 15 acres of historic harvest within high altitude, NE aspect, steeply sloping riparian zones that have not yet attained full vegetative recovery. Planting native trees, shrubs, and grasses would restore riparian zone health and reduce potential for mass failures and sediment input into first order tributaries. The main access road (Road 115) has 8 miles of road currently contributing sediment into Red Meadow Creek. This road needs improved drainage at first-order stream crossings and more ditch relief culverts to reduce sediment. Approximately 1 mile on Road 115A needs grading, ditch relief, water bars, and culverts unplugged to reduce sediment and provide access across the Whitefish divide for a popular driving loop and access for hikers and horses to trailheads into upper lakes.

3.5 Granite Creek



3.5.1 Road Survey Results

Active upland sediment sources induced by timber harvest activities are not significant sources of sediment in the Granite drainage. Roads to Granite are accessed through the Skyland drainage. The TMDL road survey did not find any sediment source problems at road/ stream crossings outside normal road maintenance parameters. Granite Creek is formed by the confluence of Challenge and Dodge Creeks. The main problem for aquatic life support and cold-water fisheries in the Granite Creek drainage is channel dewatering. The stream channel occupies a wide alluvial valley that has experienced historic riparian harvests. The historic timber management units are well vegetated and the historic haul roads are bermed or gated to prevent traffic.

3.5.2 Stream Channel Survey Results

A walk-down stream survey was conducted from the confluence of Dodge and Challenge to the wilderness trailhead in an attempt to obtain a macroinvertebrate sample for Granite Creek. The discharge from Dodge Creek was dry and the discharge from Challenge Creek continued downstream from the confluence approximately 50 meters before plunging below the surface. The channel intercepted groundwater again at the confluence with Sign Creek, but inchannel flow plunged below surface again at Tumbler Creek. The channel was filled with large, woody debris (LWD) and pocket pools harboring stranded Westslope Cutthroat trout. Historic beaver activity was pervasive with recent evidence of new colonization in the lower portion of the survey. Old mid-channel bars, point bars and slumping banks indicated past flooding caused by peak flows in 1997 and 1964.

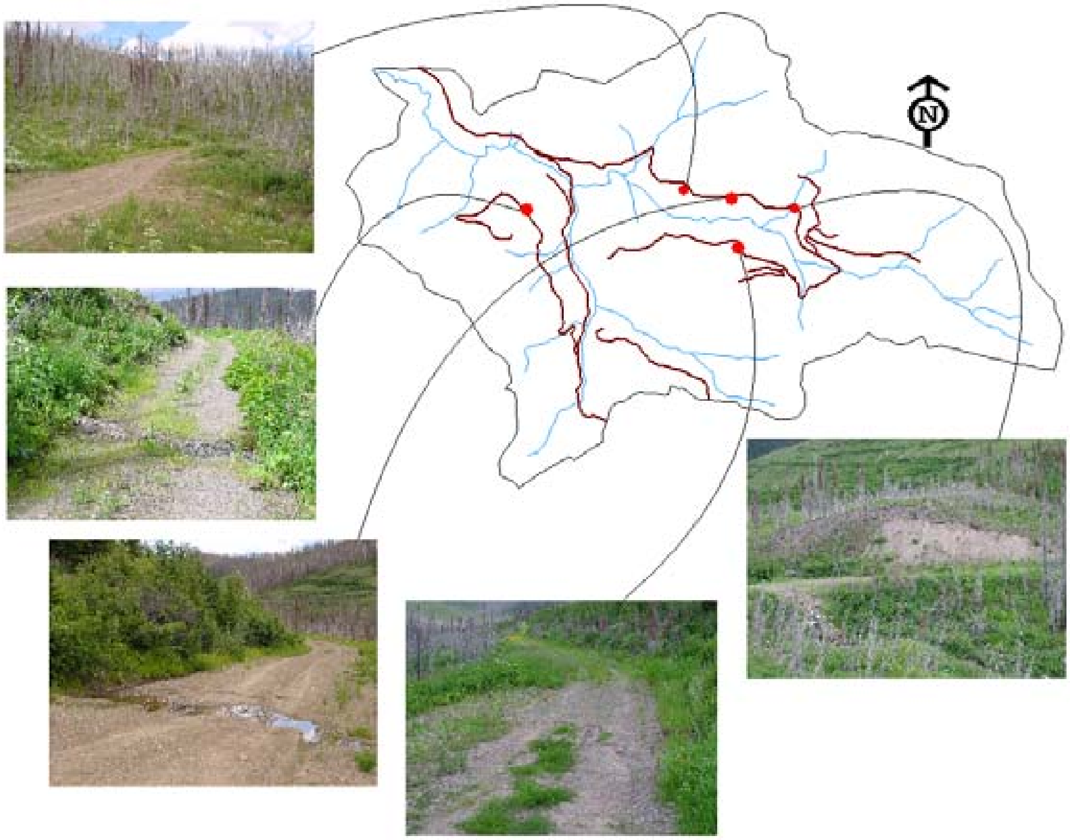
3.6 Morrison Creek

3.6.1 Road Survey results

Active upland sediment sources induced by timber harvest activities are not significant sources of sediment in the Morrison drainage. A gate closed seasonally restricts road access within the Morrison Creek drainage. The major use comes from horse packers during hunting season and from snowmobiles during winter months. No high-risk culverts or road sediment sources were found. The initial construction of roads during timber harvest in the late 1970's created springs that now have established wetlands on the old, unused roadbeds. As long as traffic does not impact wetlands with rut formation and vegetation disturbance, the wet areas act as a reservoir for runoff and as habitat for terrestrial aquatic and amphibian species. The historic roadbeds are well vegetated past the bridge at the confluence of Morrison with Puzzle Creek and are well traveled by deer, elk, moose and bear.

The pictures above illustrate the bedrock dominated channel type in the upper reaches of Morrison Creek. Morrison Creek flows south by southeast into the Bob Marshall Wilderness Area and on to confluence with the Middle Fork of the Flathead River system. No reference site was installed due to the assumption of non-impairment status.

3.7 Skyland Creek



3.7.1 Road Survey results

Active upland sediment sources induced by timber harvest activities are not significant sources of sediment in the Skyland drainage. All 14 miles of roads within the Skyland drainage have been brought up to current Best Management Standards. The pictures above illustrate proper function of drain dips, water bars, and ditch relief culverts. Routine maintenance is conducted on the roads that are open seasonally for recreational use.

REFERENCES

Cavigili, Jon, Tom Weaver, Mark Deleray, Coal Creek Channel Survey Preliminary Overview 2003, Montana Fish Wildlife and Parks, February 2004.

Harrelson, C.C., C.L. Rawlings, J.P. Potyondy, Stream Channel Reference Sites: An Illustrated Guide to Field Technique, USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-245, 1994.

Montana Department of Environmental Quality (MDEQ), Protocols and Stream Reach Assessments, 2003.

Pfankuch, Dale, J., Stream Reach Inventory and Channel Stability Evaluation, A Watershed Management Procedure, USDA Forest Service, Northern Region, 1978.

Rosgen, Dave, River Morphology , December 1996.

Van Eimeren, Pat, Biological Assessment for Forest Service Activities within the North, Middle, and South Forks of the Flathead River Drainage on Bull Trout (Salvelinus confluentus), 1998.

Wolman, M.G. 1954, A method of sampling coarse riverbed material. Transactions of American Geophysical Union 35: 951-956.

Coal Creek Channel Survey
Preliminary Overview 2003

Conducted and Prepared By:
Jon Cavigli
Tom Weaver
And
Mark Deleray

Montana Fish Wildlife and Parks
490 N. Meridian Rd.
Kalispell, MT
59901

February 2004

Introduction and Methods

In the winter of 2002-2003 an interagency group convened to discuss stream habitat conditions in Coal Creek, a tributary to the North Fork of the Flathead River. The group consisted of representatives, mostly hydrologists or fisheries biologists, from the U.S. Forest Service, U.S. Fish and Wildlife Service, Montana Department of Natural Resources and Conservation, and Montana Fish Wildlife and Parks (MFWP). The group convened for a number of reasons, including declines in bull trout spawning, TMDL planning, and observed in-channel erosion and sedimentation. The group met a number of times including a fieldtrip to Coal Creek where we looked at active bank erosion. The outcome of these meetings was concurrence that the group needed to work towards improving habitat conditions in the stream. To do this, it was decided that we needed better information of existing channel conditions to take a holistic approach to restoration. Prior to working on isolated locations within the drainage, the group decided to do preliminary surveys of the forest road system, in-channel conditions, and water yields within the drainage. We felt this baseline information was important in order to proceed with a better likelihood of success. This report addresses the in-channel stream habitat conditions in Coal Creek and its tributaries upstream of the confluence with Dead Horse Creek.

From the information collected during this survey, we were able to produce an overview of channel conditions in the drainage and provide information in a format that allows others to view channel conditions and assess the current status. This will allow members of the interagency working group and others to direct future restoration efforts. This report consists of six parts. The first is this document summarizing the preliminary channel survey and containing a brief introduction, methodology, and summaries of general channel conditions for four stream reaches. Also included are four GIS maps (one for each reach) with GPS locations and photographs of channel features. Some digital photographs are embedded in the maps. The maps were built by MFWP (Jeff Hutten) in the Information Services Unit located in the MFWP Region 1 headquarters. The third part of this report is a copy of our field notes with an appendix that contains a table relating numbered locations on the maps to field observations and photographs. The fourth portion is an Access database, which provides this information in a format that may be useful in future assessments. The fifth part is a file containing all photographs taken during the survey. The last part of this report is a copy of the narrative summary from the 1988 survey (see below). By referring to the maps, field notes, appendix table, or the Access database a reader can electronically view the information collected in this survey.

Prior to this survey, a very similar survey was conducted in 1988 (Weaver, Tom. 1989. Coal Creek Fisheries Monitoring Study NO. VII and Forest-Wide Fisheries Monitoring-1988. Montana Fish, Wildlife and Parks, Kalispell, MT). The FNF and Montana Fish Wildlife and Parks conducted this earlier study through a cooperative effort. This report provided a narrative description of stream features beginning in the headwaters and working downstream identifying sediment sources, bank instability concerns, and restoration measures. This report stated that there were highly unstable channel areas in each of the three major forks in the Coal Creek drainage. The vast majority of the problems were related to land-management, logging and road building activities of the 1950’s and 1960’s. It noted that sediment generated decades ago continued to cause channel instability and erosion in the late 1980’s. Since the 1980’s, there had been a number of road improvement projects on federal and state lands to improve stream crossings and road drainage. However, a number of the problems observed in the 1988 report had not been addressed. The 2003 survey aimed to repeat the 1988 survey and determine current status of and if there were major changes in channel condition.

MFWP personnel (Jon Cavigli, Tom Weaver, and Mark Deleray) split the roughly 28 miles of stream between the three recorders, which took 15 person-days. For reporting purposes, we broke the river miles into four reaches. One reach was Mathias Creek and its tributaries down to its confluence with the South Fork of Coal Creek. The second was the South Fork of Coal Creek from the headwaters down to the confluence with main Coal Creek. The third was the upper two forks of main Coal Creek. And the forth reach was main Coal Creek from the confluence of the upper two forks down to the confluence with Dead Horse Creek. Starting at the headwaters or upstream end of a reach, observers walked downstream noting in-channel sediment deposits, eroding banks or other sediment sources. Major features were noted in narrative field notes, digital photographs, and GPS coordinates. Digital photos and GPS coordinates may not be available for some reaches due to availability of equipment. This survey provides a qualitative overview of channel conditions that can be compared to similar information from the 1988 report and provide a holistic view of the drainage to direct future surveys and restoration needs.

Summaries of Stream Habitat Conditions in Four Reaches

Mathias Creek – Map 1

The headwaters reach of Mathias Creek is steep with step pools formed by bedrock slabs and large woody debris. Upstream from the Road 317 crossing the channel appears relatively stable with the exception of a reach through the old cutting unit near the upper fork. No Streamside Management Zone (SMZ) was provided here and the channel has migrated through areas of deposition on large woody debris. Several low cut banks are present. Frequent avalanches from the steep slopes north of the channel compound the erosion problem. Surveyors noted 20 sites where large woody debris held gravels and fine sediments, two depositional plugs where the channel braided (This feature is a plug of sediment often associated with large woody debris that will be referred to as Plug Deposition Braiding (PDB)) and eleven wind-thrown trees in the channel area between the old cutting unit and the 317 crossing.

Most of the fill has been removed from the upper crossing of Road 317; the pipe is still in place. Downstream from this crossing extensive deposition is evident on old logging debris. Several old machine crossings are present and wind-thrown trees are common along the channel throughout an old logging unit. Bull trout spawning occurred throughout this general area during past years.

Approximately 1.3 km below the crossing of Road 317 a small tributary flows into Mathias Creek from the South. This drainage has been highly impacted by past land management activities. The survey team accessed this area by continuing past the upper Mathias Creek crossing on Road 317 approximately 1.2 km to where this drainage is crossed by Road 317 in Section 4. This drainage has been a major sediment contributing area. Portions of Sections 4 and 5 above Road 317 north of the Mathias-Hallowatt saddle were logged approximately 45 years ago. Poor skid trail location and equipment operation in the channel area resulted in an estimated 6100 m^3 of material delivered and transported downstream. Water yield and transport has been enhanced by a "new" channel system and channel stability problems are evident throughout the drainage downstream. The culverts where these channels cross Road 317 were removed in 1999, but banks were left too steep and erosion of road fill is ongoing. Downstream from these crossings, channels are very steep and sediment traps are full of stored fine material. This small tributary to Mathias should be evaluated for future restoration potential.

Lower Mathias Creek remains relatively steep downstream from the confluence with this small tributary. The large woody debris storing major deposits of fine sediment is old and some of it is failing, allowing sediment movement that created new channels. As the gradient decreases, this situation becomes more common. Lower Mathias Creek passes through logging units and potential for new recruitment of large woody debris is generally limited or nonexistent. In some areas, lateral deposition is being colonized by vegetation and appears to be stabilizing. Surveyors noted approximately six major plugs of deposition causing braiding (PDB) through this reach.

Main Coal Creek Headwaters – Map 2

The fork of main Coal Creek flowing out of Haines Pass covers a distance of 4.8 km from the headwaters (Section 36) to the junction with the north fork of Coal Creek in Section 19. The upper 1.0 km drains an undeveloped area; however, slopes north of the pass appear highly erosive and natural slumping has occurred in several areas. The channel here is steep but stable. Deposited materials are generally larger than 2.0 mm. The area in the vicinity of the trailhead (#26) has contributed a substantial amount of fine sediment, largely from management-related activities. Deposition on stable channel debris is evident and streambed substrate in low gradient areas is highly embedded. Large woody debris is generally lacking throughout this reach but where jams occur a large amount of sediment is stored. Surveyors noted four PDBs in the reach. Bull trout spawning has been documented just upstream from the junction with the north fork of Coal during past surveys.

The fork flowing out of the unnamed lake in Section 23 is characterized as steep and stable. We call this headwater reach the north fork of Coal Creek. Bedrock step pools with large amounts of large woody debris are common. As the gradient decreases debris jams cause deposition and gradient checks. Cut stumps and logging debris are present in the channel through old cutting units and a short reach (300 m) appears to have been straightened and channelized by machinery. A gradient break is present as the channel flows out into the Haines Fork valley. Active cutting and depositional areas occur approaching the junction with Haines Fork. The survey team identified four large depositional areas, six PDBs and 22 lateral deposits all associated with large woody debris in the north fork of Coal Creek. This reach should be evaluated for future restoration potential.

South Fork Coal Creek – Map 3

The headwaters of South Coal Creek are undeveloped from the Whitefish Divide down to just above the 1686 crossing in Section 31. Sediment sources are natural and materials deposited are generally >2.0 mm. The fill has been removed from the tops of each end of the 72” open arch culvert where 1686 crosses; the pipe is still in place. Below this crossing the channel is steep with bedrock and boulders forming cascades and falls. Large old debris, both natural and logging related is storing sediment. Old cutting units occur on both sides. A 2.5 m falls is formed by large woody debris on bedrock 1.4 km downstream from the 1686 crossing. This barrier is located at the upstream end of the bull trout redd count section. Stream gradient lessens from here down. Many depositional areas due to old debris accumulations create braiding (PDBs). Cutting units exist on both banks with inadequate SMZs. Cut stumps occur in the channel and there is evidence of logging debris being cut out of the channel during past years (≈15 years ago). Proceeding downstream, these debris accumulations causing deposition and braiding become more common as gradient decreases. Wind-thrown trees are common along old cutting units with inadequate SMZs on South Coal Creek and adjacent wetlands. Intercepted groundwater forms small channels, which are full of fine sediments. South Coal joins with Mathias Creek approximately 3.8 km downstream from the 1686 crossing.

The lower portion of South Coal Creek runs through old cutting units with no SMZs. Cut stumps are visible in the channel area, which has been artificially straightened. Large woody debris is lacking through these old units and the potential for recruitment is limited or non-existent. This reach should be evaluated for future restoration potential. Several slumping banks occur on the north side of the channel through these old units. Once the stream leaves the logged area, gradient increases and it becomes more confined. Five large logjams have caused major deposition and braiding (PDBs). Two large slumps are present just upstream from the junction with main Coal Creek.

Main Coal Creek – Map 4

Downstream from the confluence of the upper two forks of main Coal Creek, the channel ran through old cutting units where inadequate SMZs and machine operation in the channel area and adjacent wetlands caused instability. Logging debris and cut stumps in the channel were common. Seven PDBs were noted along with several slumping banks upstream from the campsite crossing at the edge of Section 17. Bull trout spawning has been documented throughout this reach. Below the crossing in Section 17 the channel is similar. We noted several additional PDBs in the mile below this crossing. The bull trout redd count section ends approximately 1.4 km below the Section 17 crossing. From here downstream to the junction of South Coal Creek, main Coal Creek passes through a canyon-like area with large substrate, bedrock, and higher gradient. Surveyors noted 15 PDBs and a lack of debris in the upstream section of this reach. Several large slumping banks are present downstream from the 317 Bridge.

Downstream from the Coal-South Coal confluence deposition is extensive and generally finer material; PDBs are practically continuous. Sand deposits occur in channel and on gravel bars. Substrate is highly embedded with sand “wind rows” obvious behind mid-channel obstructions. Downstream from Dead Horse Bridge large woody debris because of the Moose Fire became more evident. Many logs across the channel and in jams have burned. Beaver activity became more common and is causing braiding in several areas. All large debris jams have extensive deposits of sand and gravel and low velocity areas have a thin layer of organic sediment. We ended this survey in the willow meadow area at the mouth of Dead Horse Creek.

MFWP Coal Creek Channel Survey – 2003

Field Comments

Note: Underlined photo numbers are the photos included on printed maps.
ID#'s are labeled on map.

Map One

Tributary to Mathias Creek approximately 1.4 km below upper crossing of Rd. 317
7/08/03 Weaver

- Begin narrative 2100 paces downstream from the crossing of Forest Road #317 on Mathias Creek (T33N R22W Sec5). Approximately 1.4 km (2100 paces) below the upper crossing of road 317 a small tributary flows into Mathias Creek from the South. This drainage has been a major sediment contributing area in Coal Creek. Increased water yields resulting from formation of new channels in Sections 4 and 5 continue to exacerbate channel stability problems in downstream areas of Mathias, South Coal and main Coal Creeks.
- Portions of Sections 4 & 5 above road 317 North of the Mathias-Hallowat saddle were logged (likely clearcut) approximately 40 years ago. It appears that a small draw draining the Southeast corner of Section 5 was used as a skid trail ***(Photo P7080023)***.
- Runoff concentrated in this draw, eroding the shallow soils down to bedrock in many places ***(Photos P7080024, P7080027)***. This "new" channel is approximately 1450m in length and an estimated 3450 cubic-meters of material has been delivered and transported downstream.
- The culvert where this channel crosses road 317 was removed in 1999. This channel joins the first order stream draining the western half of Section 4 approximately 250 m below road 317.
- Equipment operation in the channel area of the first order stream has resulted in similar erosion and water yield problems ***(Photos P7080016, P7080022)***. An estimated 1200 m of stream has been impacted resulting in approximately 2650 cubic-meters of material delivered and transported downstream.
- The culvert at the crossing of road 317 was also removed in 1999 ***(Photos P7080013, P7080015)***.
- In all, over 6100 cubic-meters of material resulted from this unit. Deposition is still evident within these channels but most of this material has been transported downstream. Water yield has been enhanced by the "new" channel system and channel stability problems are evident throughout the entire Coal Creek drainage downstream.

Map One
Mathias Creek from barrier falls down to forest Rd. 317 uppermost crossing
7/09/03 ***Cavigli***

- Walked upstream from highest road crossing to barrier falls. ***(Photo P7090011)***.
- Gradient steep from falls to highest old cutting unit. Step pools formed by bedrock slabs. Moss covered banks with old, mature LWD holding back gravels here and there.
- Top of highest cutting unit. Lots of LWD in stream through this unit, holding gravels and fine sediments. Cut stumps prevalent in riparian area. Stream looks unraveled compared with reach above ***(Three Photos P7090005, P7090006, P7090007)***.
- ***(Two Photos P7090009, P7090008)*** One picture of avalanche chute coming down to stream, the other picture is view looking in the opposite direction. Just downstream of ID97.
- Approximately 200-300 meters below above photos high water channel with cobble substrate ***(Photo P7090013)***.
- ***(Photo P7090014)*** Gravels deposited on stream margin.
- ***(Two Photos P7090015, P7090016)*** Two different **PDB's -- Plug, Deposition, Braiding.** (Woody debris plug, deposition of sediment, resulting braided channel). One has island of grasses, non-woody plants, and Spruce growing on it.

- Lower reach all the way down to road crossing contains a good amount of old LWD ***(Photo P7090017)***. Last photo is good example of LWD with some gravel storage.
- Ending point. Culvert @ road crossing.
- Summary: Upper reach is very steep with step pools formed by bedrock slabs. Some old LWD holding back gravels. Stable looking channel. Through cutting unit there is lots of LWD holding material and stream looks unraveled with braids and low cut banks. Rest of stream down to road crossing has lots of LWD. Counted 20 sites associated with LWD holding gravel and sediment deposits. Counted two PDB's and eleven tree wind-throws below the highest cutting unit. Overall the stream looked pretty good.

Map One
Tributary south of Mathias Cr. to Mathias and down to confluence with South Coal
7/09/03 ***Deleray***

- This is the pulled culvert site on Rd. 317 that received water from manmade channel described by Weaver on 7/08/03. There is up to six feet of eroding road fill on one side, up to three feet on the other. The six-foot side is very steep, 1:1 and vertical in the six foot eroded area. Possible project: Re-slope fill, and stabilize.
- Upstream: 1) No recruitment of LWD in years and for years to come. 2) Fill and bed-load stored behind deteriorating logs, some have already failed. Possible project: Add LWD
- Downstream: Within the first 50 yards there are five logs with sediment trapped behind, forming stair steps, plug, after plug, after plug. This steep area has numerous "step pools" but all the "pools" are filled in with sediments, stored behind the LWD.
- Halfway down, a new channel forms off side of sediment plug formed by LWD (just above confluence with other channel to the northeast).
- Below this confluence there's a lot of sediment stored in side-bars and behind LWD.
- ***(Photo P7090031)*** Sediment plug is above a six-foot drop.
- Steep reach: Less stored sediments, some stored on stream margin, some in LWD and large rocks. It is too steep to store much.
- Lower half of this steeper reach is less steep and once again has old LWD storing sediments. There also appears to be fines stored on banks and are now being covered by moss and small vegetation. Channel appears to be narrowing and healing ***(Photo P7090032)***.
- Confluence with Mathias Cr.
- Mathias Cr.: Boulder section, sediments on margins appear trapped behind LWD with some vegetated, stable channel and bank. {***(Photo P7090033)*** LWD plug stabilized}
- Periodically, large deposits of sediment, gravel, etc. are behind LWD dams. There is still some moderate gradient. ***(Photo P7090034)***
- As gradient drops, there are large deposits of sediment and increased occurrence of braiding, leaving mid-stream gravel bars at times, and forming "new" side-channel through the woods with dirt and gravel beds. **These are very similar to the one that we looked at last winter with the interagency group. **(*Photo P7090035*, of "new" side-channel)**
- Wide channel with high embeddedness
- With exception noted above, most of this reach looks good, pools have returned and runs also. There are still sediments behind LWD and on margins. ***(Photo P7090036)*** Still, there are some mid-channel bars, but banks are stable.
- ***(Photos P7090037, P7090038)*** Sediments on margin bars are being colonized by vegetation (i.e. Recovery).
- There is still a lot of small material being stored in mobile bars, mid-channel. Also, still periodic large sediment plugs behind LWD in mid-channel with new small channel on edges going around. Numerous lateral bars (small, some vegetated, some not and appear active) since the confluence with Mathias. I have been in a large, harvested unit with low recruitment of LWD, no new stuff with branches in channel ***(Photo P7090039)***. Where there is old LWD there is a

sediment plug behind it.

- ***(Photo P7090040)*** Note tree above channel. It's top is flat and notched for walking.
- Lower in reach: Numerous lateral bars and mid-channel bars with increased incidence of braiding around deposits. New channels appear fairly well established. Low incidence of raw, actively eroding banks. Stream is in process of healing, but not yet healed. {***(Photos P7090041, P7090042)*** Braid and vegetated plug}
- Extensive in-stream deposits are behind LWD. ***(Photo P7090043)*** Photo is of LWD plug with water flowing under it and around it.
- ***(Photos P7090044, P7090045)*** Same photo twice; this large plug is active and underwater in high flows. Juvenile DV approximately 100 mm observed.
- ***(Photo P7090046)*** In-stream sediment deposits are present mid-channel and numerous. Braiding is occurring with gravel and sand deposits common, some active eroding topsoil.
- Lower, there is more LWD with stored sediment. Channel is wide and relatively shallow with lots of sediment in channel. Banks appear stable except in recently braided sections.
- ***(Photo P7090047)*** Margin deposits, channel moved to right creating newer channel. High water uses old channel.
- This is a large depositional area with three braids. ***(Photo P7090048)***
- End at confluence with South Coal creek.
- Map **ID76** is where we parked our truck near Kelly hump on road 317 for this days survey.
- *** Probably six or so deposits and associated braids through this section like the one the winter interagency group looked at.

Map Two
North Coal Cr. (Upper reach) down to confluence with Coal Creek (Haines)
7/11/03 ***Cavigli***

- ***(Photo P7110001)*** Beginning point above last cutting unit on North Coal. Took photo of starting point, LWD with associated gravel plug and gradient drop.
- This reach characterized by steep gradient, falling through bedrock steps.
- Lots of LWD, big stuff, gravels are piled up on stream margin and behind LWD plugs.
- ***(Photo P7110002)*** Barrier? Approximately a 4-meter drop.
- ***(Photo P7110003)*** Gravels deposited below LWD jam, boulders, and on stream margin.
- ***(Photo P7110004)*** Cut tree in riparian of stream channel.
- ***(Photo P7110005)*** Large deposit of gravels, 30'x 15', with Willows established on stream margin. Does not look real stable.
- PDB, first one, log jam has forced out of channel movement, no fines left.
- ***(Photo P7110006)*** More gravel deposits on stream margin.
- ***(Photo P7110007)*** Another barrier looking bedrock formation.
- ***(Photo P7110008)*** Smaller gravel and fines accumulation on stream margin below LWD.
- ***(Photo P7110009)*** PDB #2, a result of LWD jam (logging debris). Out of channel stream movement. Below this point are small cut banks with fines removed. What's left is moss covered large cobble.
- ***(Photo P7110010)*** Cut stump in riparian, downed log parallel to stream has gravels deposited behind it.
- ***(Photos P7110011, P7110012)*** Large PDB #3 has extended gravel bar associated with it and has deposition into island of trees between migrated braid and low water channel. Second photo shows LWD jam plugging this deposit. This is largest plug with fines that I've seen today.
- ***(Photo P7110013)*** Immediately below PDB #3 are gradient checks made of LWD holding more gravels and cobble. Stream turns at this point and begins dropping into Haines Fork valley, straight section of about 300 meters.
- PDB #4 caused by major LWD pile-up. Gravel deposited on stream margin.

- ***(Photo P7110014)*** Eroded bank sprigged and toe anchored, fix by Hank Dawson some years ago. Looks like it is healing well.
- ***(Photo P7110015)*** PDB #4. Gradient change occurs here, slope lessens. Channel braids here at LWD jam. Can easily see clearcut on other side of Haines Fork.
- After a 300-400 paces the braided channels come back together.
- ***(Photo P7110016)*** Two cut stumps on stream margin with gravel deposits behind them.
- ***(Photo P710017)*** Ending point at confluence with Coal Creek (Haines). North Coal at this time was 56°F while Coal was 49°F.
- Summary: Upper reach characterized by steep gradient with bedrock step pools. Lots of LWD with, in my opinion, a fair amount of gravel deposits. Middle reach has a little less gradient with lots of LWD causing jams and gradient checks, backing up a lot of deposited gravels and fine sediments. Lower reach I'd say begins at ID62 where there is an obvious gradient reduction with braiding beginning at initial depositional area. There is some active cutting into banks in this braided section with associated gravel bars and gravel deposits on stream margin. Did observe WCT today, whole length of stream. They were all juvenile sized fish. According to my notes I identified 4 large plugs of sediment, 6 PDB's, and 22 stream margin depositional areas all associated with LWD.

Map Two
Coal Creek (Haines) down to confluence with North Coal
7/11/03 ***Deleray***

- Start @ upper road crossing ***(Photo P7110061 Walking bridge)***
- Stream appears stable @ crossing. Moss on rocks, mid channel has old LWD storing bed load.
- About 100 yards downstream in an old unit the bed load is stored behind old LWD. Counted twenty through here, all approximately ten yards long ***(Photos P7110062, P7110063)***. Excessive bed load stored in stream and on margins.
- ***(Photos P7110064, P7110065)*** Old LWD retaining bed load and upstream bar becoming vegetated.
- Bridge and deck storing bed load, channel moved to right side of bridge. This was a low bridge with approximately one foot of clearance. Gap was plugged and bed load filled in behind it ***(Photo P7110066)***.
- ***(Photo P7110067)*** Old LWD plug of sediment. LWD failed and now channel cut out and by passes half of plug.
- ***(Photo P7110068)*** Between LWD plugs, there are sections of stream without LWD.
- Mini **PDB – Plug, Deposition, Braiding.** (Woody debris plug, deposition of sediment, resulting braided channel) has island with established Alders on it. Channel is stable.
- Adult WCT, 8-10 inches long. No other fish seen to this point.
- ***(Photo P7110069)*** Failed LWD dam.
- Tally for failed LWD dams to this point, four. These are the obvious ones, recent failures with many others already likely failed.
- Large deposit, 5'x 30'x 60', new channel has formed and is still forming around plug. PDB situation (#1). This is 50' above ID52.
- There must be some type of gradient change. This reach is wide, 30' or so and shallow, averages 6" deep ***(Photo P7110070)***. There are large bed load deposits, new channels going into the trees. Another PDB (#2). Observed two WCT, 5-6" and 6-7".
- Gradient increases, series of cascades present. Between ID52 and ID51 the channel looks really good, narrower and deeper than above. It has nice pools, stable banks with no excessive bed load deposits.
- Just below ID51, large deposits present behind old LWD jam. Stopped adding to tally of plugs.
- Where there are old LWD jams (2) there are sediment plugs stored behind. There is an obvious

lack of newer LWD. All LWD is old and rotten. Sections without LWD have large substrate with relatively straight channels.

- These old log jams form mini PDB's with new channels on both edges of stream.
- Cascade with 1-2 meter drops, a potential barrier to fish passage. *
- ***(Photo P7110071)*** Approximately 3-meter drops, fish barrier made of bedrock.
- Culvert (4' diameter) is not a barrier at this flow with an approximate one-foot jump into nice drop pool. *
- Following 100 meters below pipe is high gradient cascade with a 1-2 meter jump. No sediment stored between ID50 to just below ID48. After 100 m gradient drops, LWD jams (2) store sediments. Saw fish again here.
- Ending place @ confluence with N. Coal Creek. ID48 to ID47, gradient is low to moderate. Where LWD exists it holds bed load and forms pools. This reach looks pretty good. Sediments stored on margins and behind LWD, but low frequency of pools that are present look good.*** *Summary for today's reach: Looks relatively good. There are few actively eroding banks. LWD lacking. There is no newer LWD. All LWD without branches, bark, and is deteriorating. Only thing that could be done is to add LWD to reach. This reach is currently producing relatively low amounts of sediment to the lower reaches.*

Map Three
Upper reach South Coal Creek to confluence with Mathias Creek (No GPS unit)
7/09/03 ***Weaver***

- Begin survey 1000 paces upstream from crossing of Forest Road 1686 in Section 31. This is the headwaters of South Coal Creek.
- Upstream from starting point South Coal Drainage is undeveloped. Sediment sources are natural; mostly from wind-thrown trees in the channel area; materials deposited in overflow channels and on logs across stream are generally > 2.0 mm; mostly large gravel; lots of large, older naturally recruited woody debris present. The main channel subs and resurfaces several times in the headwaters reach.
- A depositional area and related overflow channel is located 445 paces below he starting point.
- Small stream joins the main channel 514 paces below the starting point. This small inflow drains from an old cutting unit on the North side of the drainage; this is the uppermost development in South Coal Creek.
- A raw bank 10 m long by 1.0 m high contributes sediment 785 paces downstream from the starting point.
- At pace 900 an uprooted tree resulted in sediment input 6.0 m long by 2.0 m high.
- Forest Road 1686 crosses at pace 1000. The pipe is still in place with fill on it, but most of the fill material has been removed at each end of the 72-inch open bottom arch ***(Photos Q7090001, Q7090002)***. If this pipe plugged, the stream would pass through where fill has been removed. Although sediment input resulting from a failure has been reduced, a substantial amount would still occur.
- Downstream from this crossing, bedrock, boulders and large debris form many cascades/falls. Many are natural, but old logging debris is storing fine sediment in many locations. This situation exists for approximately one-mile below the 1686 crossing. Old units occur on both sides with adequate SMZ present.
- An old bridge crossing is present 2200 paces below the 1686 crossing.
- Just upstream a 5.0 m long by 3.0 m high cut bank on the North side contributes fine sediment.
- At pace 2240 a bedrock falls with old debris creates a 2.5 m falls. This is the upstream end of the bull trout spawning area in South Coal Creek. Basin-wide redd counts begin here.
- Stream gradient lessens from here down and many depositional areas occur due to old debris accumulations; channel has migrated in many areas forming sediment sources during active period.

- At pace 3300 a 10.0 m long by 5.0 m high cut bank with downed trees forms a sediment source; lots of deposition at the foot of this bank. Bull trout spawning has been documented from here down.
- Cutting units exist on both banks; stumps in channel area; NO SMZ; logging debris in channel some of which has been cut out 15 or so years ago.
- At pace 4000, debris accumulations causing braiding and deposition become more common; lots of wind-throw in old cutting units; NO or inadequate SMZ on South Coal channel and adjacent wetlands. Intercepted groundwater forms stream channels that are full of fine material and contribute to main channel.
- The Mathias Creek Road 317 crosses at pace 5615.
- The junction with Mathias Creek is at pace 5650, today's ending point. Deposition and braiding occur down to this point.

Map Three
South Fork Coal, confluence with Mathias down to electrofishing section
7/10/03 *Deleray*

- First quarter mile or so, moderate gradient few deposits of sediment. Ones that were there were small, six foot long associated with LWD on margins (looks good).
- Large deposits of sediment, gradient break (lower) with stream braiding into three or so small channels, some of deposition is vegetated with Willow, Alder, grasses, etc. ***(Photo P71000<u>49</u>)***. This could be an Interagency type project.
- LWD is relatively abundant at plug and below, storing sediment. Newer channels, one pretty established channel with some actively eroding banks, but not much. Fines are moving annually and show new deposits on margins.
- LWD storing large deposits
- Avalanche chute, small deposits, it is relatively stable. LWD holding sediments.
- Channel to here is stable with exception of ID45 plug. Looks good.
- Stream has healed in sections. Alder and Willow on large deposits, looks stable.
- Bridge crossing, few LWD in last 300 yards, otherwise channel looks good and stable.
- Braid (two channels). Large, mid-channel deposits of mostly cobble, five feet high, vegetated with Cottonwood, Alder, Willow, and Spruce. It is teardrop shaped, approximately thirty feet long with eroding bank (raw) at downstream end of teardrop island ***(Photos P7100050, P7100051)***.
- Just downstream, outside bank of meander is eroding. Large gravel bar deposited on inside of meander with few LWD across channel. It is up on banks and sides.
- I've been in an old unit. No LWD, somewhat incised channel.
- Haven't climbed over LWD since bridge ***(Photo P71000<u>52</u>)***. Stream has long reaches of boulder/cobble runs with no sediment storage. There is one meander present between bridge and photo site. No LWD recruitment for years to come. This reach does not appear to be contributing much sediment at this time, but it isn't storing any either.
- Gravel bars and meander at end of long straight reach ***(Photos P7100053, P71000<u>54</u>)*** just below ID43.
- Channel began meandering after ID43. Short sections of banks are eroding on outside bends in same areas.
- Extensive riparian logging occurred in this unit, through reach, numerous stumps in channel ***(Photo P7100055)***.
- Cabled trees. ***(Photos P7100056, P7100057)*** Erosion at upper end, trees lay parallel to bank. They are not storing sediment.
- Braiding, large sediment deposits in riparian of harvested unit ***(Photos P71000<u>58</u>,***

P7100059). I counted DV redds in this braided section last year. Some bank erosion active at this time, reach is somewhat unstable with numerous banks eroding for short reach (each has small contribution)

- End @ electrofishing section on South Coal. ***(Photo P7100060)***
- *** Stream reach through unit was straightened by dozer therefore no LWD and channel has incised nature. This would be potential project to re-establish natural stream configuration and LWD.

Map Three
South Coal Creek, electrofishing section to confluence with Main Coal Creek

7/10/03 *Weaver*

- Begin survey at the lower block net line in the South Coal electrofishing section. Mark did the reach upstream.
- Braiding occurred 340 paces below the starting point where an old jam caused deposition of fine material.
- A 20 m long by 2.0 m high cut bank was present on the North side at pace 400.
- At pace 550 deposition in the channel resulted in braiding and a vegetative plug; cut stumps are in the channel area; old unit with No SMZ.
- Another plug occurred at pace 1400 with lots of deposition, braiding and wind-thrown trees.
- An actively slumping bank on the North side contributed sediment (15 m long by 10 m high) at pace 2060.
- Channel artificially straightened ***(Photo P81300003)***
- An old debris jam at pace 2350 caused major deposition and channel braiding; jam span entire channel and contains logging debris; this area extends several hundred paces downstream ***(Photo P81300004, P81300005)***.
- Another similar but more extensive plug is present at pace 2650. This one extends 300 paces downstream; fish passage during low flow is questionable (No WP).
- Another plug is located at pace 3975 extending downstream 200 paces (No WP).
- A 60 m high by 30 m long cut bank is actively contributing fine sediment at pace 4300 (No WP).
- Another plug with large wood, deposition and active braiding occurred at pace 4400. This jam is 3.0 m to 4.0 m high.
- At pace 4500 lots of debris and a 20 m by 20 m slumping bank were present. A major depositional area was located just downstream in mid-channel.
- The South Fork of Coal joined main Coal Creek at pace 4850**.**

APPENDIX C: 2002 AND 2003 FIELD SAMPLING DATA (AVAILABLE UPON REQUEST FROM MONTANA DEQ)

APPENDIX D: MCNEIL CORE, SUBSTRATE SCORE, AND FISHERIES DATA

Table D-1. McNeil Core data for streams in the Flathead River Headwaters Planning Area.

Year	Lower Coal	NF-Coal	SF-Coal	Whale	Granite	Big Creek	Challenge	Trail	Red Meadow	Morrison Creek
1981	34.1			25.1		23.8		25.7		
1982	40.2			31.8	44.6	32.6		36.1		
1983	39.3			32.6		28.2		27.2		
1984	32.8			29.5		27.8		28.1		
1985	36.4	34.9	36	22.5		28.7		26.2		
1986	34.8	29.4	31.8	26	49	21.6		25		
1987	40.8	30.2	31.4	28.9	41.3	29.1	32.5	27.4		
1988	39.2	39.8	32.1	37.2	45.5	40.4	40.9	30		
1989	37.8	37.8	36.9	35.3	45.2	48.4	43.5		40.1	
1990	42.1	32.8	33.6		33	53.4	33	34.6		39.2
1991	36.1	32.6	32.7	34.2	37.2	32.9	38.2	33.7		
1992	35.8	33.5	34	32.2	41.4	37.4	41.9	29.5		
1993	35.5	30	28.4	33.4	36	37.2	36.8	33.6		
1994	32.6	25.5	26.2	29.5	33.5	34.5	34.6	24.8		
1995	37.5	30.8	28.8	32.6	34.8	32.2	37.9	29.5		
1996	38.2	29.6	30.1	31.4	33.6	30	38.1	34.5		
1997	36.4	30.1	29.2	30.9	32.5	31.1	36.4	29.8		
1998	37.4	30.9	30.2	31.3	32	32.2	35.9	30.2		
1999	37.6	31.4	30.8	31.9	35.1	33.1	33.1	30		
2000	36.5	31	30	30.8	34.7	31.4	35.1	29.7		
2001	37.6	31.8	30.9	31.6	33.7	32.1	36	30.4		
N	21	17	17	20	17	21	15	20	1	1
Average	37.1	31.9	31.4	30.9	37.8	33.2	36.9	29.8	40.1	39.2
Std Dev	2.4	3.3	2.7	3.4	5.5	7.3	3.3	3.3	NA	NA
Coefficient of Variation	6.6%	10.4%	8.7%	11.1%	14.5%	21.9%	8.8%	11.1%	NA	NA
CI	1.0	1.6	1.3	1.5	2.6	3.1	1.6	1.5	NA	NA
Range	9.5	14.3	10.7	14.7	17	31.8	11	11.3	NA	NA
Median	37.4	31	30.9	31.5	35.1	32.2	36.4	29.75	40.1	39.2
Min	32.6	25.5	26.2	22.5	32	21.6	32.5	24.8	40.1	39.2
Max	42.1	39.8	36.9	37.2	49	53.4	43.5	36.1	40.1	39.2
5-yr Ave	37.1	31.04	30.22	31.3	33.6	31.98	35.3	30.02	NA	NA
5-yr Median	37.4	31	30.2	31.3	33.7	32.1	35.9	30	NA	NA

Source: Weaver et al., 2003

Table D-2. Substrate score data for streams in the Flathead River Headwaters Planning Area.

Year	Big Creek	Cyclone	Coal Creek	Granite	Morrison	North Fork Coal	Ole	Quintonkin	Red Meadow	South Fork Coal	Whale
1984			10.2			12.2					
1985			11.6			13.5				12.8	
1986	12.2		12.3		12.3	14.2	12.5			12.0	
1987	11.5		10.0		12.8	13.7	12.3	13.0		12.2	
1988	11.2		9.8		12.8	13.0		12.5	12.7	12.0	11.7
1989	11.8	11.3	9.6		13.0	12.3	11.8		11.8	11.8	11.5
1990	11.3	11.6	10.4		11.1	13.2			10.9	11.5	11.3
1991	11.8		9.8		11.9	12.7			11.3	11.4	11.8
1992	11.1		11.2		12.1	12.5			11.5	11.9	11.2
1993	10.8		10.7		11.5	12.1			11.8	11.4	11.3
1994	10.6		10.5		13.1	13.1			12.0	12.4	12.1
1995	10.9	11.1	10.8		12.7	13.6			12.3	12.5	11.8
1996	11.1	11.3	10.7		12.5	13.7		13.2	12.1	12.3	12.0
1997	11.0	11.6	10.5		12.8	13.7		13.1	12.3	12.7	11.6
1998	11.3	11.4	10.4		13.1	13.9	12.9	12.8	12.2	12.6	11.9
1999	11.8	11.9	10.1		13.3	13.6	12.8	13.0	12.3	12.8	12.1
2000	11.7	11.4	9.8		13.6	13.8	12.9	12.8	11.9	12.8	12.5
2001	11.6	11.6	9.7	11.6	13.7	13.6	12.4	12.5	11.7	12.9	12.4
2002	12.0	11.1	9.4	11.4	13.2	13.4	12.1	12.3	11.4	12.6	12.2
Average	11.4	11.4	10.4	11.5	12.7	13.3	12.5	12.8	11.9	12.3	11.8
5-yr Ave	11.7	11.5	9.9	11.5	13.4	13.7	12.6	12.7	11.9	12.7	12.2
Std Dev	0.5	0.2	0.7	0.1	0.7	0.6	0.4	0.3	0.5	0.5	0.4
Coefficient of Variation	4.0%	2.2%	7.0%	1.2%	5.6%	4.7%	3.2%	2.4%	4.0%	4.1%	3.4%
Median	11.3	11.4	10.4	11.5	12.8	13.5	12.5	12.8	11.9	12.4	11.8
5-yr Median	11.7	11.4	9.8	11.5	13.3	13.6	12.8	12.8	11.9	12.8	12.2
Min	10.6	11.1	9.4	11.4	11.1	12.1	11.8	12.3	10.9	11.4	11.2
Max	12.2	11.9	12.3	11.6	13.7	14.2	12.9	13.2	12.7	12.9	12.5
Range	1.6	0.8	2.9	0.2	2.6	2.1	1.1	0.9	1.8	1.5	1.3

Source: Weaver et al., 2003

Table D-3. Redd data for streams in the Flathead River Headwaters Planning Area.

Year	Big	Coal	Granite	Morrison	Quintonkin	Sullivan	Trail	Whale
1980	20	34	34	75				45
1981	18	23	14	32			78	98
1982	41	60	34	86			94	211
1983	22	61	31	67			56	141
1984	9	53	47	38			32	133
1985	9	40	24	99			25	94
1986	12	13	37	52			69	90
1987	22	48	34	49			64	143
1988	19	52	32	50			62	136
1989	24	50	31	63			51	119
1990	25	29	21	24			65	109
1991	24	34	20	45			27	61
1992	16	7	16	17			26	12
1993	2	10	9	14	5	25	13	46
1994	11	6	18	21	3	8	15	32
1995	14	13	25	28	7		28	28
1996	6	3	4	9	4	52	8	35
1997	13	5	12	39	0	50	9	17
1998	30	14	22	35	11	54	17	40
1999	34	7	37	30	15	55	21	49
2000	32	3	26	44	15	45	42	68
2001	22	0	18	40	17	51	27	77
2002	12	0	18	30	21	18	26	71
Average	19	25	25	43	10	40	39	81
5-yr Ave	26	5	24	36	16	45	27	61
Std Dev	10	21	10	23	7	18	25	50
Coefficient of Variation	50.2%	86.1%	42.6%	53.2%	71.3%	44.8%	63.1%	62.0%
Median	19	14	24	39	9	50	28	71
5-yr Median	30	3	22	35	15	51	26	68
Min	2	0	4	9	0	8	8	12
Max	41	61	47	99	21	55	94	211
Range	39	61	43	90	21	47	86	199

Source: Weaver et al., 2003

Table D-4. Westslope cutthroat trout densities for streams in the Flathead River Headwaters Planning Area.

Year	Challenge	Cyclone	North Coal	South Coal	Red Meadow
1981	13.26				
1982	10.72		3.15		
1983	9.57	18.33	2.36		9.22
1984			4.18		
1985			4.66	6.01	
1986	20.51		3.98		3.56
1987	31.19		5.43	3.77	3.62
1988	22.69	37.82	5.33	4.45	11.17
1989	21.41	18.41	5.67	6.56	5.82
1990	12.8		3.36	4.29	7.02
1991	11.71		2.76	1.28	
1992	20.29		6.27	2.55	
1993	10.42		6.53	2.73	
1994	4.74		4.22	2.67	5.2
1995	3.68		3.29	1.59	8.72
1996	14.07		3.44	0.25	4.17
1997	16.14	6.32	5.53	1.64	
1998		13.25	8.67	0.86	5.82
1999	18.62	2.53	8.71	1.4	6.53
2000	8.15		7.65	2.01	8.58
2001	8.34	11.11	9.94	3.87	12.34
2002	9.7	9.99	8.39	3.05	6.77
N	19	8	21	17	14
Average	14.1	14.7	5.4	2.9	7.0
Std Dev	6.9	10.8	2.2	1.8	2.7
Coefficient of Variation	49.0%	73.4%	40.9%	61.0%	38.2%
CI	3.1	7.5	0.9	0.8	1.4
Range	27.5	35.3	7.6	6.3	8.8
Median	12.8	12.2	5.3	2.7	6.7
Min	3.7	2.5	2.4	0.3	3.6
Max	31.2	37.8	9.9	6.6	12.3
5-yr Ave	11.2	9.2	8.7	2.2	8.0
5-yr Median	9.0	10.6	8.7	2.0	6.8

Source: Weaver et al., 2003

Table D-5. Bull trout densities for streams in the Flathead River Headwaters Planning Area.

Year	Coal	Granite Creek	Morrison Creek	North Fork Coal	Ole Creek	Red Meadow	South Fork Coal	Whale Creek
1980			13.52					
1981								4.69
1982	4.87		15.50	1.34	2.10			
1983	3.17		11.44	1.57		5.87		2.44
1984	4.28			4.18				
1985	4.38		11.27	3.67			5.91	
1986	6.57		17.54	2.96	2.91	5.72		2.15
1987	8.33		17.47	4.05	3.10	3.00	1.16	3.82
1988	4.92		13.23	4.08		1.93	2.48	
1989	4.07		11.87	4.89	3.59	1.91	1.73	2.14
1990	2.99		2.22	2.84		4.05	4.38	2.30
1991	4.80		7.57	0.69			4.38	
1992	3.26		3.21	1.50			5.38	6.19
1993	2.14		6.25	0.63			1.45	3.42
1994	2.27		1.46	0.22		0.40	0.75	5.10
1995	2.00		8.07	0.24		0.16	3.77	4.39
1996	0.26		2.66	0.10		0.34	0.41	2.13
1997	0.07		3.46	0.08			1.96	0.57
1998	0.36		3.89	0.10	3.85	1.04	0.16	8.52
1999	0.62		4.84	0.16	0.78	0.93	1.17	3.18
2000	0.32		5.74	0.43	2.88	0.44	1.04	3.03
2001	1.31	5.99	5.37	0.75	3.25	0.58	1.54	4.30
2002	0.58	4.13	5.90	0.53	2.51	0.63	2.60	6.32
N	21	2	21	21	9	14	17	17
Average	2.9	5.1	8.2	1.7	2.8	1.9	2.4	3.8
Std Dev	2.3	1.3	5.1	1.7	0.9	2.0	1.8	2.0
Coefficient of Variation	77.5%	26.0%	62.4%	99.4%	33.0%	102.8%	74.5%	51.5%
CI	1.0	1.8	2.2	0.7	0.6	1.0	0.8	0.9
Range	8.3	1.9	16.1	4.8	3.1	5.7	5.8	8.0
Median	3.0	5.1	6.3	0.8	2.9	1.0	1.7	3.4
Min	0.1	4.1	1.5	0.1	0.8	0.2	0.2	0.6
Max	8.3	6.0	17.5	4.9	3.9	5.9	5.9	8.5
5-yr Ave	0.6	5.1	5.1	0.4	2.7	0.7	1.3	5.1
5-yr Median	0.6	5.1	5.4	0.4	2.9	0.6	1.2	4.3

Source: Weaver et al., 2003

APPENDIX E: RESPONSE TO PUBLIC COMMENTS

Response to Comments

As described in Section 6.0, the formal public comment period extended from October 20, 2004 to November 20, 2004. Five individuals submitted formal written comments. Their comments have been summarized/paraphrased below. Responses prepared by EPA and DEQ follow each of the individual comments. The original comment letters are located in the project files at DEQ and may be reviewed upon request.

1. **Comment:** The document is very difficult to read, due to a lack of organization, unity, and coherence. One should not have to be an aquatic expert to understand the data presented and with some reorganization, the EPA could make this document much easier for the public to understand.

Response: By necessity, TMDL documents are generally very technical in nature with much of the subject matter required by regulation or otherwise recommended by EPA and/or State guidance. The TMDL documents, therefore, will generally be relatively lengthy and contain considerable technical information that may or may not be commonly understood by the layperson. The State of Montana has chosen to organize the documents such that the required elements are apparent to the reader/reviewer of these documents and also include much of the technical analysis within the body of the document. As we produce our TMDL documents, we are walking a fine line between production of a document that the average layperson can understand versus production of a document that can withstand the pressures of technical, peer review and possibly litigation. It is difficult to meet the demands of both in a single document. Therefore, we generally include a brief executive summary that presents the important points of the document in an easily readable format.

Although we included an executive summary with the draft document, we have prepared a brief “summary report” in response to this comment. The summary report is a stand-alone document that will be made available with the Final TMDL document. On a case-by-case basis where future TMDL documents become excessively lengthy and/or technical, DEQ will provide similar “Summary Reports” to give the layperson an alternative to reading the entire TMDL document.

2. **Comment:** It seems the EPA jumped ahead into Phase III of the planning stage, making conclusions without first collecting and analyzing data thoroughly.

Response: We disagree. This report was prepared following the same approach utilized for all of the TMDLs prepared in Montana in 2004. The first step involved characterizing the watershed in which the subject water bodies exist (Section 2.0). This was followed by the compilation and review of all available water quality data, and identification of data gaps for all of the streams in the TPA appearing on the 1996 or 2002 303(d) list. A sampling and analysis plan was then developed and implemented to address data gaps associated with in-stream water quality as well as watershed scale source assessment information (see Appendix C and our response to Comment 9). An understanding of the current water quality condition of each of the subject streams was then developed and has been articulated in Section 3.0. Lower Coal Creek was determined to be the only water body in need of a TMDL. Targets, a total maximum daily load, allocations, a monitoring strategy, and restoration strategy were then developed for the entire Coal Creek Watershed (Section 4.0).

3. **Comment:** It appears that grant money will be used to fund implementation of the Coal Creek TMDL and the Voluntary Water Quality Improvement Strategy for Red Meadow, Whale, and Sullivan Creeks and the remaining money would be obtained from local sources. What are these local sources?

Response: The Flathead Basin Commission submitted a 319 Grant Application to the Montana Department of Environmental Quality in December 2004 to implement the Coal Creek TMDL and Voluntary Water Quality Improvement Strategy for Red Meadow, Whale, and Sullivan Creeks. Since final funding decisions have not yet been made, it is not possible to provide an answer to this question at this time.

4. **Comment:** We must question if the Coal Creek TMDL and Voluntary Water Quality Improvement strategy will improve future water quality to the same degree that increased forest restoration and stewardship efforts would do.

Response: Comment noted.

5. **Comment:** We urge DEQ to recognize and include substantial road reclamation in its Flathead Headwaters TMDL restoration plan as a primary means to reduce the degree to which road density and road location are impairing stream reaches in their ability to support bull trout and other aquatic life.

Response: Road reclamation is included as part of the Coal Creek TMDL (Section 4.0) and the Voluntary Water Quality Improvement Strategy for Red Meadow, Whale, and Sullivan Creeks (Section 5.0). In 2003, the Flathead National Forest identified all road segments contributing sediment to 303(d) listed streams (See Section 3.3.2.7, pg. 73). Ten road segments in Coal Creek were identified for restoration activities (Section 4.1.1, page 146), and DEQ proposed road restoration activities for these 10 segments in Section 4.5. Potential road sources of sediment are discussed for Whale Creek, Red Meadow Creek, and Sullivan Creek in Section 5.0. Section 5.3 then discusses the implementation strategy for road restoration activities in these watersheds. Furthermore, various road reclamation activities have been and continue to occur throughout the Flathead National Forest and Coal Creek State Forest (See Section 4.1.1).

6. **Comment:** We have reviewed substantial data indicating many of these streams need on-the-ground restoration work, especially in terms of reclaiming roads in order to reduce road densities that have caused may of these streams to receive "functioning at risk" or "functioning at unacceptable risk" ratings in Forest Service biological assessments for bull trout.

Response: As described in Sections 4.1 and 5.1, source assessment surveys were conducted within the watersheds of all of the subject streams. As described in Sections 4.0 and 5.0, on-the-ground restoration work is proposed for all identified sources of sediment (including, but not limited to, roads). Further, in December 2004 the Flathead Basin Commission submitted a 319 Grant Application to implement many of these activities.

7. **Comment:** There is no mention of public involvement anywhere in this document. All stakeholders should be provided a voice in this important clean up process.

Response: A public involvement summary is presented in Section 6.0 of the final document.

8. **Comment:** The fires have done far more to degrade the water quality and fisheries habitat in Coal Creek than any established road or forestry activities ever have.

Response: The relative contribution of sediment from fire in Coal Creek is presented in Section 4.1.3 of the document.

9. **Comment**: The TMDL includes very little recent data for any of the streams.

Response: Recent data were evaluated for all of the subject streams considered in this document (see individual stream discussions in Section 3.4, Appendix B, Appendix C, and Appendix D). The Sampling and Analysis Plan in Appendix C highlights an EPA/USFS sampling effort conducted in 2002 and 2003 that included physical surveys (i.e., cross-sectional measurements, longitudinal profiles, Pfankuchs, and Wolman pebble counts) and macroinvertebrates. These data were all considered in this document. Additionally, McNeil Core data, Substrate Score results, and bull trout redd count and/or population density information from as recently as 2001, 2002, or 2003 was reviewed for most of the streams (i.e., the most recent data from Montana Fish, Wildlife and Parks available at the time this report was prepared). Recent McNeil Core data was not available for Red Meadow, Skyland, Sullivan, and Morrison Creeks. Additional McNeil Core data collection efforts are proposed for these streams in Section 5.2. Finally, the Flathead National Forest conducted a sediment source assessment survey in 2002 and 2003 of the entire TMDL Planning Area (see Appendix B) and Montana Fish, Wildlife, and Parks conducted a source assessment survey in the Coal Creek Watershed in 2002 and 2003 (see Appendix B).

Although older data was evaluated and considered in this document, it was generally only considered as supplemental information to assist us in the development of an overall understanding of the current water quality condition of the subject streams (see Section 3.3.2).

10. **Comment**: The TMDL should have evaluated temperature as a pollutant

Response: None of the subject water bodies ever appeared on any of Montana’s 303(d) lists for impairment associated with temperature. As a result, there was no requirement to address temperature as part of this process at this time. Nonetheless, it was recognized that temperature could be one of the causal factors in the bull trout declines in the Coal Creek Watershed. That is why the installation of temperature data loggers was included in the proposed supplemental monitoring program presented in Section 4.4.2.

11. **Comment**: The road density threshold value of 1.5 miles/mile^2 is too high. For example, a road density less than 1.5 miles (Table 2-10) per square mile can be an acceptable risk. However, its value as an indicator is significantly less valuable unless the number of road crossings, cut and fill slope failures, and distances from stream channels are also evaluated.

Response: We agree and offer the following two-part response to this comment. First, road density (or roads in general) was considered one of the supplemental indicators. As described in Section 3.3, the supplemental indicators were not considered sufficiently reliable to be used alone as a measure of impairment. Road density, and all of the supplemental indicators were only used when one or more of the target threshold values were exceeded to provide supporting and/or collaborative information when used in context with all of the other available data.

Secondly, the potential implication of roads within the watersheds of the subject streams was evaluated on a cases-by-case basis, based on a GIS analysis and field survey conducted by the USFS (see Appendix B). Factors such as road density, number of stream crossing, distance from road surface to stream, culvert condition, etc. were all considered in the road analysis. Of all of the road/stream crossings, 87 percent were evaluated in the field. The supplemental indicator “road density” (1.5 miles/mile2) that appeared in the draft document has been changed to “roads” in the final document (see Section 3.3) and the numeric threshold value was changed to a narrative threshold (i.e., no significant road sources).

12. **Comments pertaining to percent subsurface fines < 6.35 mm threshold value** (the following 3 related comments have been addressed together)

- Comment 12a. The 35% subsurface fines ≤ 6.35 mm target threshold value assumes too much risk.
- Comment 12b. We recommend no individual year should exceed an upper range, which to be conservative should not exceed 30 percent. The average should not exceed 20 or 25 percent.
- Comment 12c. We are very concerned that the EPA presents averages for highly variable parameters, without reporting any measures of variability. It is not clear from the available information that sufficient data were collected to apply a statistical approach. Specific examples of this failure include analyses associated with McNeil cores, suspended solids, and fisheries data. With regard to McNeil core data, the EPA designates an average as the target with no acknowledgment of the great variability associated with measures of substrate composition.

Response: As articulated in Appendix A of Montana's 303(d) lists, DEQ uses the following methods to determine reference condition:

Primary Approach
- Comparing conditions in the subject water body with baseline data from similar, but minimally impacted ("reference") water bodies in a nearby watershed.
- Evaluating historical data from the subject stream.
- Comparing conditions in the subject water body to conditions in other portions of the same water body.

Secondary Approach
- Use literature values
- Seek expert opinion
- Apply modeling techniques

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

A combination of the above primary and secondary approaches were used to derive the proposed 35% threshold "target" value for subsurface fines <6.35 mm. We began with the "Primary Approach" by comparing McNeil Core data collected in the subject streams with the available reference data. Using the McNeil Core data available to them at that time, Weaver and Fraley (1991) calculated an average value of 31.7% to represent natural or "reference" conditions in streams with minimal human-disturbance in the Flathead Basin. Values in the "reference" streams ranged from 24.8% to 39% and the highest reference values came from streams reported to have significant natural sediment sources. The calculated 95 percent confidence interval for the reference McNeil core mean (i.e., 31.7%) is plus or minus 2.9. (Ott, 1993) Unfortunately, the "reference" streams considered by Weaver and Fraley differed from the subject streams in terms of watershed size, geological characteristics, and history of natural occurrences that effect stream sediment (i.e., fire, floods).

For those streams where historical McNeil Core data were available (i.e., Coal Creek, North Fork Coal Creek, South Fork Coal Creek, Whale Creek, and Granite Creek), we then attempted to define a reference value based on historical conditions. However, the earliest McNeil Core data dates back only to 1981. There is no easily definable time period between 1981 and the present that necessarily represents a reference condition. The effects of forest management had begun much earlier and continued sporadically throughout the period of record. For this reason, it was determined it would not be appropriate to use historical data from the subject water bodies to define a reference condition and/or derive a target value for subsurface fines.

We then evaluated literature values and expert opinion following the "secondary approach". According to the Flathead Basin Cooperative Program Summary Report published by the Flathead Basin Commission in 1991, westslope cutthroat habitat is considered threatened when the percentage of fine materials in spawning gravels in any given year is greater than 35% and impaired when it exceeds 40 percent.

When considering all of this evidence together, the range of potentially suitable threshold target values for McNeil Core subsurface fines ranges from a low of 31.7 (the average for "reference" streams) percent up to 40 percent.

It was not felt that managing to a threshold of "impaired" (40%) was appropriate. At the same time it was not felt that it was appropriate to select the lowest value from the reference streams given the wide range in reported values (24.8 to 39) from minimally disturbed streams. The proposed target value of 35% was selected based on the literature/expert opinion and also because it is virtually the same as the average value from the reference streams in the Flathead Basin (i.e., 31.7 plus or minus 2.9).

13. **Comment**: The use of a running five-year average for the subsurface fines < 6.35 mm target is inappropriate. The relationship between percent less than 6.35mm and embryo survival to emergence is an annual occurrence. I don't understand the point of assessing this as a running 5-year average. The best assessment is a comparison of annual coring results for a site with the estimate of age 1 fish two years later.

Response: The subsurface fines < 6.35 mm target was selected because it provides a literature-based link between excessive sediment in the stream and cold-water fish habitat. As with the other targets and supplemental indicators used in this document, this target is not used alone to make judgments about the current water quality impairment status of the stream. Rather it is used in combination with all of the targets and supplemental indicators. A running five-year average was selected to account for the year-to-year variability in this target value. Year to year variability appears to be a function of a number of both natural and potentially human-caused factors and ranges up to 20 percentage points based on the data that has been evaluated (see Table D-1 in Appendix D). It is thought that natural events such as flushing flows or low-flow periods may account for much of this variability. The running 5-year average was proposed to account for this variability. The use of the running 5-year average was also selected based upon the assumption that Montana Fish, Wildlife, and Parks (FWP) will continue to collect data on an annual basis. With the annual data, it will be relatively easy to calculate the running 5-year average on an annual basis and to observe trends over time. If FWP cannot continue to collect McNeil Core data on an annual basis, we will modify the target to an annual not to exceed 35% threshold at that time.

14. **Comment:** DEQ should also understand that the thresholds it is using for subsurface fines mainly concern spawning success. They have no relation at all with surface fines and loss of pool habitat because of accelerated sedimentation.

Response: We agree and our use of the weight of evidence approach as described in Section 3.3 of the document is predicated upon the fact that there is no single parameter that can be applied alone to provide a direct measure of beneficial use impairments associated with sediment. The subsurface fines target was selected specifically to provide one measure of potential sediment impairment associated with the cold-water fisheries beneficial use. The information provided by this parameter was then used in combination with the information provided by all of the other targets and supplemental indicators to reach conclusions about water quality impairment. Surface fines were specifically addressed by the "surface fines" target and indirectly addressed by the "percent clingers" target, periphyton siltation index supplemental indicator, etc.

15. **Comment:** We note when presented with data that exceed 35 percent for subsurface fines, such as the sample for Red Meadow Creek of 41 percent, DEQ dismisses it as invalid because it is only one sample.

Response: One sample was collected in 1988 and one in 1989 in Red Meadow Creek, both shortly after the Red Bench fire. This data was not considered because: 1) it is 15 years old and does not reflect the current condition in Red Meadow Creek, and 2) because it is possible that it may be high due to the natural fire event that occurred in that approximate time period. As stated in Section 5.2, supplemental McNeil Core data collection is proposed in Red Meadow Creek.

Further, although no recent McNeil Core data was available for Red Meadow Creek, none of the other target or supplemental indicator values suggested that this stream is currently impaired. For example, the substrate score, percent surface fines, and percent clinger target values were all met indicating good water quality conditions. The only supplemental indicator value that suggested impairment was the bull trout data. Although bull trout population densities and redd counts have declined, there is no indication that conditions in Red Meadow Creek are currently causing the declines. Cutthroat populations over the same period of record in Red Meadow Creek have shown no overall trend. Given the complexities associated with the interpretation of fish data in streams connected with Flathead Lake, it is not appropriate to assume that the problem is in Red Meadow Creek, when none of the other target or supplemental indicator values suggest that the a water quality problem exists.

16. **Comment:**. DEQ says the five-year average of McNeil core data for the North Fork of Coal Creek (p. 97) indicates "good substrate conditions." However, this conclusion is based, mysteriously, on a mean value only from the past five years and not the full period of record, which is 16 years.

Response: DEQ acknowledges that there are extensive data for some streams (20+ years). The full period of record for all data was used to identify trends, variability, and long-term averages (See Appendix D). Trends, where identified, were discussed in the waterbody-by-waterbody discussions in Section 3.4. However, DEQ feels that a McNeil Core value from the early 1980s does not necessarily represent current conditions in any stream. The purpose of this analysis was to determine if beneficial uses are currently impaired. Because of the dynamic nature of activities in the watershed, historic data, while useful, should not be used when making a current impairment determination. DEQ feels that data from the past five-years is most representative of current conditions, and a five-year average also accounts for natural variation in the data.

17. **Comment:** We are concerned about DEQ's inconsistent and inappropriate use of "means" or "averages" when using quantitative data to determine impairment.

Response: DEQ has provided additional information in Section 3.3.1 and 3.3.2 to better explain the use of averages.

18. **Comment**: The draft is rife with conclusions that aren't supported with data. For example, in numerous places the draft concludes that food web changes in Flathead Lake are the causal agents for bull trout decline in streams in this evaluation. The draft provides no supporting data.

Response: First, the fact that the introduction of non-native fish and the non-native opossum shrimp in Flathead Lake in 1981 have caused widespread changes the Flathead Lake ecosystem resulting in bull trout declines is well documented (Spencer et al., 1991). Deleray et.a.l. (1999) further emphasized how important the inter-connected lake, river, and tributary system is to fisheries of the entire Flathead drainage, especially to native fish species. It is indisputable that the food web changes have had an affect on migratory bull trout populations in those streams within the Flathead Basin that are connected to Flathead Lake.

Given that we know that the migratory bull trout population has declined due to the food web changes in Flathead Lake, it would not be appropriate to ascribe a bull trout decline in one of the interconnected tributaries solely to causal agents that only affect the tributary. Clearly, the migratory population that enters that tributary has also been affected by changes in Flathead Lake. The fish population dynamics in the tributaries within the Flathead Basin that are connected to Flathead Lake are very complex and are likely a function of a variety of both human-caused and natural factors. For this reason, it is not possible to rely on bull trout alone as an indicator of water quality in the tributaries.

As stated in Section 3.3.2.4 of the draft report, since it was understood that fish populations may change due to a variety of both human-caused and natural phenomena, fish data was used only as supplemental information in combination with the full suite of targets and supplemental indicators (see Section 3.3 for a complete description of the weight-of-evidence approach used with targets and supplemental indicators). In no case did the draft document “conclude” that the food web changes in Flathead Lake were the sole causal agent for bull trout declines in any of the subject streams. Rather, the available fisheries data provided a “piece of the puzzle” in the context of the weight-of-evidence approach described in Section 3.3.

Finally, in no case were any of the targets or supplemental indicators used alone to reach a final conclusion regarding water quality impairment. In all cases, the final conclusion was reached based on consideration of all of the evidence provided by the full suite of targets and supplemental indicators used in context with one another.

19. **Comment:** Discussion of statistical validity of conclusions regarding fish populations is not present.

Response: As stated in Section 3.3.2.4 of the draft report, since it was understood that fish populations may change due to a variety of both human-caused and natural phenomena, fish data was used only as supplemental information in combination with the full suite of targets and supplemental indicators. As described in Section 3.3, the supplemental indicators were not considered sufficiently reliable to be used alone as a measure of impairment. Fish data, and all of the supplemental indicators were only used when one or more of the target threshold values were exceeded to provide supporting and/or collaborative information when used in context with all of the other available data. The available fisheries data provided a “piece of the puzzle” in the context of the weight-of-evidence approach described in Section 3.3. Therefore, since we are only using the fish data qualitatively and only as supplemental information, we do not believe that it is necessary to provide a discussion of statistical validity.

20. **Comment:** The “stable or increasing trend” supplemental indicator for bull trout redd counts and population densities should be changed to “increasing to a level approaching carrying capacity”.

Response: As indicted in our response to Comments 18 and 19, bull trout redd count and population density data is used in the context of the supplemental indicators. These supplemental indicators were used only to assist in making current water quality impairment determinations. In the context of supplemental indicators, we feel that a qualitative measure of a “stable or increasing trend” is appropriate.

If we chose to use bull trout redd counts and/or population densities as targets (i.e., water quality goals for the future as opposed to supplemental indicators for making water quality impairment determinations), such as those shown in Section 4.2, we would agree that the above-suggested change would be appropriate. However, given the reasons presented in our response to comment 18, we do not believe that bull trout redd counts or population densities are appropriate targets for assessing compliance with water quality standards, in this case.

21. **Comment**: Too much reliance has been placed on Pfankuch channel stability ratings. This method is mainly a qualitative, rapid assessment technique.

Response: As described in Section 3.3.2.3, Pfankuch channel stability ratings were considered supplemental indicators. As described in Section 3.3, the supplemental indicators were not considered sufficiently reliable to be used alone as a measure of impairment. Pfankuch ratings, and all of the supplemental indicators were only used when one or more of the target threshold values were exceeded to provide supporting and/or collaborative information when used in context with all of the other available data. The available Pfankuch data provided a “piece of the puzzle” in the context of the weight-of-evidence approach described in Section 3.3.

22. **Comment:** Use of visual observations of substrate composition is another low quality parameter. Visual estimations of substrate are fraught with interobserver bias. Use of this indicator as a target without a discussion of associated data quality measures is not acceptable.

Response: DEQ recognizes the bias that can be introduced by pebble counts. That understanding underscored the need to select a suite of targets to evaluate possible sediment impacts. Pebble counts were used as "one piece of the puzzle" to evaluate sediment impacts on streams in the Flathead River Headwaters Planning Area. Channel morphology measurements served as a complement to the pebble count data to evaluate possible changes in channel dimension. Furthermore, the personnel who conducted the pebble count/substrate analyses were trained professionals with extensive field experience. These personnel also were contributing authors to the TMDL report and therefore realized how the data were to be used and the importance of data bias.

23. **Comment:** The Flathead assessed 79 sub-watersheds (6th-Code Hydrologic Units, or HUCs) and found 38% to be "functioning at unacceptable risk" due to road density and locations, 32% to be "functioning at risk" due to road density and locations, and only 30% to be "functioning appropriately" in this regard. We ask that you review the Flathead's bull trout biological assessments and reconsider the TMDL restoration plan in light of them.

Response: The Flathead National Forest was part of the team that prepared this document. As such, all useable data within the Flathead National Forest’s files were used, including the biological assessments. The conclusions (e.g., functioning appropriately, functioning at risk, functioning at unacceptable risk) reached in the biological assessment did not necessarily have a direct relationship to whether or not a water body meets water quality standards. The focus of this document was on whether or not Montana’s narrative standards for sediment were met. Therefore, the biological assessments were used to provide background information. Also, an attempt was made to directly obtain and use some of the supporting data that was collected/compiled when the biological assessment reports were prepared. However, many of the data contained within the above mentioned biological assessment reports were old and more recent data was available from other sources. In other cases it was not possible to determine how, where (specifically), or by what method they were collected. In these cases the data were not used.

24. **Comment:** Concerning total suspended solids, this factor represents a significant stressor on fish and other aquatic life. Thus, it is especially important to account for the severity of this stressor on aquatic systems. Yet this document does not display any degree of variance.

Response: No recent suspended solids concentration or total suspended solids data were available for any of the subject streams. The available data, therefore, were used only for comparison purposes and as collaborating evidence when combined with the other supplemental indicators and targets. As described in Section 3.3.2.5, suspended sediment concentration data was considered one of the supplemental indicators and the available data provided a "piece of the puzzle" in the context of the weight-of-evidence approach described in Section 3.3.

25. **Comment**: In several places the draft concludes that if cutthroat populations are stable but bull trout numbers down, then the cause of impairment to the native char cannot be sediment. This assumes that both species have identical life history strategies and identical sensitivities to increased sediment in stream systems. That's not necessarily the case.

Response: We agree and considered that in our use of the fisheries data. That is also why fish data were used only in the context of supplemental indicators.

26. **Comment**: The determination that Sullivan Creek is not impaired is not supported by data. Table 3-39 says bull trout spawning redd counts are "stable." Yet spawning data in the document indicates that current redd counts are about 40 percent less than the five-year mean between 1996-2001 (Figure 3-29). How can this condition be considered "stable," and thus fully supporting aquatic life?

Response: We agree that the use of the word "stable" to describe the bull trout redd count data presented in Table 3-29 is not appropriate. The language in Table 3-29 and the narrative in the final document have been changed to "no apparent trend over the period of record".

Nonetheless, the bull trout data evaluated for Sullivan Creek is not conclusive relative to the water quality impairment status of the stream. As described in Section 3.3.2.4, fish populations might change from year-to-year due to effects outside of management control such as temperature, peak runoff, primary productivity, and competition from other fish species, illegal harvest, invertebrate populations and others. For this reason, fish data were placed in the supplemental indicator category. As described in Section 3.3, the supplemental indicators were not considered sufficiently reliable to be used alone as a measure of impairment. Fish data, and all of the supplemental indicators were only used when one or more of the target threshold values were exceeded to provide supporting and/or collaborative information when used in context with all of the other available data.

Using the weight-of-evidence approach described in Section 3.3 it was concluded that Sullivan Creek was not impaired. Although no data were available regarding McNeil Core subsurface fines and substrate scores, the other two targets (surface fines and clinger taxa richness) indicated good water quality conditions in Sullivan Creek. The available macroinvertebrate data suggested clean, cold water and excellent water quality. The periphyton data suggested no water quality problems associated with man's actions. A riparian assessment conducted in 2002 indicated excellent conditions. The Pfankuch results for the downstream sampling site provide the only indication of a potential source of impairment. However, the low Pfankuck rating at this site are thought to be largely a result of natural causes.

27. **Comment**: All conclusions about rebounding redd counts – even though they still remain below historical averages -- do not consider additional causal elements. For example, the small rebounds that have occurred in some tributaries in the last five or six years cannot necessarily be attributed to improved habitat conditions. During this period, the fish were listed as threatened and, importantly, all legal harvest was curtailed.

    Response: We agree and that is why fish data were only used in the context of supplemental indicators. See responses to Comments 18, 19, and 20.

28. **Comment**: DEQ needs to re-evaluate this draft TMDL before it delists any stream. DEQ needs additional data.

    Response: Considerable additional data were collected and evaluated relative to all of the subject streams and a rigorous weight-of-evidence approach was used to verify water quality impairments as described in Section 3.3. The additional data that has been collected and evaluated has been described previously in our response to Comment 9.

29. **Comment**: A huge amount of sediment was contributed to Mathias and South Coal. However, this material has been transported downstream over the years, and its now deposited in Lower Coal Creek and is causing the chronic high sediment levels.

    Response: Although we have been unable to quantify the amount of sediment that has been historically delivered to Lower Coal Creek, we agree that the current degraded condition of Lower Coal Creek is likely at least partially a result of past actions.

30. **Comment:** I totally disagree with the lower Coal Creek impairment summary.

Response: Comment noted. Based on discussions with numerous water quality specialists, hydrologists, and fisheries biologists employed by the U.S. Forest Service, U.S. Fish and Wildlife Service, Montana Fish, Wildlife and Parks, Montana Department of Environmental Quality, and U.S. EPA, there is much disagreement over the cause of water quality impairment in Coal Creek. That is why the next step in the process for Coal Creek involves further study as described in Sections 4.4 through 4.6. As mentioned in earlier comments, the Flathead Basin Commission is applying for grant funds to implement this study.

APPENDIX F: PUBLIC NOTICE OF AVAILABILITY

FOR IMMEDIATE RELEASE
October 20, 2004

FOR MORE INFORMATION

Ron Steg
(406) 457-5024
steg.ron@epa.gov

SEEKING COMMENTS ON THE WATER QUALITY ASSESSMENT AND TMDLS FOR THE FLATHEAD HEADWATERS PLANNING AREA

HELENA – The Montana Department of Environmental Quality and United States Environmental Protection Agency has released a draft water quality protection plan for the Flathead River Headwaters TMDL Planning Area. The document addresses twelve water bodies and includes a Total Maximum Daily Load (TMDL) for sediment in the Coal Creek Watershed where the Bull Trout population has declined. A TMDL is the total amount of a pollutant that a water body may receive from all sources without exceeding water quality standards. The Flathead River Headwaters is found in Flathead County near Kalispell, Montana.

The DEQ invites members of the public to attend an open house on Monday November 8, 2004 in the "Large Conference Room" at the Montana Department of Fish, Wildlife and Parks offices at 490 North Meridian, Kalispell Montana. Open house hours are from 3:00 to 8:00 pm. A short presentation will start at 6:00 pm. Members of the public may stop by at a time convenient to speak with a water quality specialist about their questions and comments.

The Department will make reasonable accommodations for persons with disabilities who wish to participate in this open house or who need an alternative accessible format of this notice. If you require an accommodation, please contact Carole Mackin, no later than 5:00 p.m., November 3, 2004 at (406) 444-7425; fax (406) 444-6836, or by email at cmackin@state.mt.us.

The draft document is available for review on the DEQ web site: http://www.deq.state.mt.us/index.asp. Public comments will be accepted until 5 p.m., November 20, 2004. The comments may be mailed to Montana Department of Environmental Quality, PO Box 200901, Helena, Montana 59620-0901 or emailed to TMDLComments@state.mt.us. For more information please contact Ron Steg, EPA, (406) 457-5024, steg.ron@epa.gov or Robert Ray, DEQ Watershed Program Manager, 406-444-5319, rray@state.mt.us .

END