Yaak River Watershed Sediment Total Maximum Daily Loads

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SECTION 1.0 INTRODUCTION & EXECUTIVE SUMMARY

1.1 Background and Purpose

Section 303(d) of the federal Clean Water Act (CWA) and Section 75-5 of the Montana Water Quality Act (WQA) provide authority and procedures for monitoring and assessing water quality in Montana's streams and lakes. These also provide authority and procedures for developing Total Maximum Daily Loads (TMDLs) for those waters not meeting state water quality standards. This plan presents all necessary TMDLs for sediment in the Yaak TPA as specified in Montana's 2006 Integrated 305(b)/303(d) Water Quality Report to the United States Environmental Protection Agency (EPA).

A TMDL is a pollutant budget that identifies the maximum amount of a particular pollutant that a water body can assimilate without causing applicable water quality standards to be exceeded. For streams exceeding water quality standards, a TMDL may be expressed as a reduction in pollutant loading that will result in the attainment of water quality standards. A TMDL plan establishes quantitative water quality goals (targets) and necessary sediment reductions for each impaired stream segment. The plan also provides recommendations for reducing pollutant loads and establishes a framework for the implementation of monitoring and adaptive management strategies.

Primary contributors to data collection, analysis, and technical considerations presented herein include the Kootenai National Forest (KNF), the EPA, and the Montana Department of Environmental Quality (DEQ¹).

1.2 The TMDL Planning Process

Development of TMDL Plans follows a series of successive steps required by EPA. The first step in developing TMDLs is to thoroughly evaluate and describe the water quality problems of concern. This includes understanding the physical characteristics of the watershed, documenting the location and extent of the water quality impairments, and identifying contributing causes and sources of impairment.

The next step in the process is to develop water quality targets for each impaired stream segment and for each pollutant of concern. Targets are numerical translations of the applicable water quality standards and are used as benchmarks to evaluate attainment of standards. Pollutant reductions necessary to meet water quality targets are then allocated to various identified pollutant sources throughout the TMDL planning area (TPA), and restorative or mitigative measures may be suggested as means to meet allocations. Allocations may be applied on the basis of source category (e.g. forestry, urban, agriculture, mining, transportation, etc.), land ownership (federal, state, private), sub-watersheds or tributaries, or any combination of these. Specific allocations may also be established for future growth and development in the watershed and for any natural sources that may be present.

¹ The acronym "DEQ" refers to The Montana Department of Environmental Quality unless otherwise indicated.

The pollutant allocations and mitigative measures become the basis for a water quality restoration strategy, which may include a combination of non-point and point source pollution control measures. Montana has adopted a policy of voluntary compliance for addressing non-point sources of pollution from private lands. As a result, non-point source control measures rely heavily on public education and other programs that encourage the application of appropriate land, soil, and water conservation practices. Point source pollution is regulated through the state-administered Montana Pollution Discharge Elimination System (MPDES) discharge permit program, and any point source allocations included in a TMDL shall be incorporated into the appropriate MPDES discharge permits (MCA 75-7-703(6)).

Lastly, the TMDL must include a monitoring component designed to evaluate progress in meeting the water quality targets established by the plan and to ensure that restorative measures are implemented and monitored for their effectiveness in reducing pollutant loads. The monitoring strategy also provides useful information to help fine-tune the restoration and reduction plans over the long-term. This process is called adaptive management. It is a component of watershed-scale restoration plans because of the complexity of the water quality problems and the inherent uncertainties involved with establishing cause-and-effect relationships between pollution sources and their effects over such large geographic areas. Taken together, the steps in the process described above constitute a water quality-based approach to water pollution control.

1.3 Yaak Watershed TMDLs: Executive Summary

The majority of the Yaak River Watershed is located in Lincoln County in the northwest corner of Montana. The Yaak Watershed encompasses a geographic area of approximately 507,660 acres, 393,822 of which lie in the United States, with the remaining portion in Canada (113,838 acres). The Yaak Watershed in the U.S. is located within the KNF.

Impaired waterbodies requiring TMDLs within the Yaak Watershed include Seventeenmile Creek, Lap Creek, and the South Fork Yaak River. This document focuses on sediment impairments in three water bodies. Sediment TMDLs are provided for Seventeenmile Creek, Lap Creek, and the South Fork Yaak River. Source assessments identify the unpaved forest road network as the predominant source of human-caused sediment in these three watersheds. Consequently, reductions in sediment from this source are called for through the implementation of best management practices (BMPs) and the application of all reasonable land, soil, and water conservation strategies.

Implementation of restorative and mitigative measures identified in this document is voluntary, cannot divest water rights or private property rights, and does not financially obligate identified stakeholders unless such measures are already a requirement under existing federal, state, or local regulations. The pollution control measures and strategies identified in this document are intended to balance the varying uses of water while adhering to Montana's water quality and water use laws. This document should be considered dynamic by providing an 'adaptive management strategy' approach to restore water quality in the Yaak River Watershed. This water quality plan is intended to identify the knowledge we have at present and to identify a future path

for water quality restoration. As more knowledge is gained through the restoration process and future monitoring, this plan may change to accommodate new science and information. Montana's water quality law provides an avenue for using the adaptive management process by providing for future TMDL reviews.

The document structure provides specific sections that address TMDL components and watershed restoration. Sections 1.0 through 3.0 provide background information about the Yaak River watershed, Montana's water quality standards, and Montana's 303(d) Listings. Section 4.0 presents TMDL targets and impairment status reviews by water body. Sections 5.0 & 6.0 present specific sediment source assessments and sediment loading estimates, TMDLs, and allocations. Section 7.0 presents a framework strategy for implantation and water quality monitoring, and Section 8.0 provides a brief summary of the public involvement process. Table 1-1 provides a very general summary of the water quality restoration plan and TMDL components discussed in this document.

Table 1-1. Water Quality Plan and TMDL Summary Information

Impaired Water Body Summary	Seventeenmile Creek, Lap Creek, and South Fork Yaak River are listed as impaired for sediment on the State's most recent (2006) impaired waters list.						
Impacted Uses	Coldwater fishery and aquatic life beneficial uses are negatively impacted from sediment-related causes.						
Pollutant Source Descriptions	The predominant anthropogenic source of sediment is the unpaved forest road network from historic timber harvest activity. Sediment delivered to streams is primarily from erosion of forest roads, and sediment delivered to streams at stream crossings.						
Sediment Targets Indicators	 % fine particles in stream substrates Macroinvertebrate bioassessment scores Stream width-to-depth ratios Variety of supplemental indicators where appropriate 						
Other Use Support Objectives (non- pollutant & non-TMDL)	Provide passage of juvenile fish through culverts at stream crossings.						
Sediment TMDL and Allocation Summary	 Load allocations are provided for forest roads, natural background, bank erosion sources (lumped category) and mass wasting events. Estimated annual sediment load allocations to all significant source categories are provided and are based on estimates of BMP performance. 						
Restoration & Mitigation Strategy	The restoration strategy identifies general restoration approaches for assessed sources. Addressing the sources in the restoration strategy will likely achieve TMDLs. An adaptive management component is also provided for determining if future restoration will meet targets provided in the document.						

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SECTION 2.0 WATERSHED CHARACTERIZATION

This watershed characterization provides an overview of watershed characteristics in the Yaak River TPA. This section also provides some detail regarding characteristics of the watershed that may play a significant role in pollutant loading (e.g., geographical distribution of soil types, vegetative cover, or land use). The information provided herein is intended to serve as a general description of physical, climatic, hydrologic, and other ecological features within the planning area.

The majority of the data available is from the portion of the watershed located in the United States. Unless otherwise noted, information on the Canadian portion of the Yaak Watershed is not included in this watershed characterization. Maps illustrating information in this watershed characterization are included in Appendix D.

2.1 Physical Characteristics

2.1.1 Location and Ecoregion

The majority of the Yaak River Watershed is located in Lincoln County in the remote northwest corner of Montana (Map 1, Appendix D). The Yaak Watershed encompasses a geographic area of approximately 507,660 acres, 393,822 of which lie in the US, with the remaining portion in Canada (113,838 acres). The Yaak Watershed in the U.S. is located within the KNF. The North Fork Yaak originates in British Columbia and flows for 25 miles before entering Montana. Three miles within the U.S. border, the East Fork Yaak joins the North Fork, giving rise to the Yaak River. The West Fork Yaak flows from Montana into British Columbia for approximately four miles and then back into Montana where it joins the Yaak River downstream of the confluence of the East and North Forks. The Yaak River flows through the heavily wooded, mountainous terrain of the Purcell Mountains to its confluence with the Kootenai River six miles downstream of the town of Troy.

The entire Yaak Watershed lies within the Northern Rockies Level III Ecoregion (Omernik, 1987). The Yaak Watershed includes the following Level IV Ecoregions: Purcell-Cabinet-North Bitterroot Mountains, Salish Mountains, and patches of High Northern Rockies (Woods et al., 2002).

2.1.2 Topography

The Yaak landscape is dominated by two north-south trending mountain ranges, specifically, the McGillivray range to the east and the Purcell range to the west (Kasworm et. al., 2004). The Yaak River runs through valley bottom land of the Purcell Mountain range. Topography in the watershed is varied, with glaciated rugged peaks in the Northwest Peaks Scenic Area and rounded peaks and ridges in much of the remainder of the watershed where continental glaciation shaped the landscape (Kasworm et. al., 2004). The highest point in the Yaak Watershed is Northwest Peak at 7,705 feet (2,349 meters). Other points over 7,000 feet within the watershed

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include Robinson Mountain (7,539 feet), Mount Henry (7,248 feet), and Rock Candy Mountain (7,204 feet). The lowest point in the watershed is at the mouth at approximately 1,791 feet (546 meters). The average elevation in the Yaak Watershed is 4,574 feet (1,394 meters) (United States Geological Survey [USGS], 2002).

2.1.3 Climate

The climate in the Yaak Watershed can be described as "modified pacific maritime" in character, meaning that compared to the remainder of Montana, this area's climate resembles that found along the Pacific Coast. The character becomes "modified" by occasional intrusions of arctic air masses more commonly found in the remainder of the state (KNF Environmental Impact Statement [EIS], 1987).

The only long-term climate station within the watershed is Troy 18 N (248395). This station is located in the lower Yaak Watershed just north of the town of Sylvanite. According to SNOTEL weather station data from 1961-1994, average yearly precipitation outside of Troy, MT, was 36.41 inches. Figure 2-1 illustrates average temperature and precipitation patterns for the Troy weather station. The average annual total snowfall for the period of record is 87.06 inches (Western Regional Climate Center, 2001). Map 2 (Appendix D) shows average annual precipitation for the Montana section of the Yaak Watershed. This map illustrates that there are areas in the Yaak Watershed that receive much greater precipitation than the SNOTEL site. Some of the mountainous areas of the Yaak receive 60-70 inches of precipitation annually (Natural Resources and Conservation Service [NRCS] Water and Climate Center, 1998).

Maximum monthly average temperature from the 1971-2000 dataset was 55.1° F, and minimum monthly average temperature was 31.4° F. July is the hottest month of the year in the Yaak Watershed with an average maximum temperature of 82.4° F. The coldest month of the year is January with an average minimum temperature of 16.1° F.

2.1.4 Hydrology

The Yaak River drains an area encompassing approximately 793 square miles (mi²) (507,660 acres). Of this drainage area, approximately 617 mi² (394,850 acres) are located within the United States. From the confluence of the East and West Forks the Yaak meanders through valley bottom land and wetlands for approximately 17 miles. The stream gradually increases gradient for the next 21 miles through a heavily forested setting that is primarily National Forest land. At river mile 38, the Yaak cascades over Yaak Falls. The river then rushes through eight miles of deep canyon then slows down parallel U.S. Highway 2 to the confluence with the Kootenai River (KNF EIS, 1987).

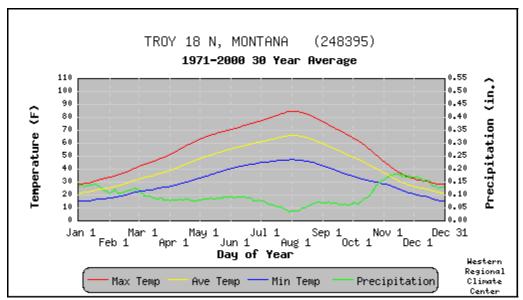


Figure 2-1. Patterns in Average Precipitation and Temperature for Northwest of Troy, MT (Western Regional Climate Center, 2001)

2.1.4.1 Drainage Basin General Characteristics

Subwatersheds within the Yaak Watershed generally are characterized by dendritic drainage patterns. The most common valley types in the Yaak Watershed, following the terminology in Rosgen (1996), include types 1, 2, and 5. Type 1, valleys with notched canyons and rejuvenated sideslopes, are present in the headwaters and are generally associated with stream types A and G. Type 2, valleys with moderately steep, gentle sloping side slopes, are in foothills areas and often associated with 'B' stream types. Type 5, valleys with moderately steep slopes characteristic of U-shaped glacial trough valleys, describes the large valleys of the Yaak River and lower, larger tributary valleys. The Yaak River is low-gradient in many areas and meanders in the floodplain, creating moist meadows and riparian areas (Kasworm et. al., 2004).

2.1.4.3 Streamflow Data

Historical stream gage data are available for two sites on the Yaak River. USGS gage 12304200 Yaak River near the town of Yaak; Montana, has data from only April 1957 – September 1962. The majority of the discharge information is from USGS gage station 12304500. This station has data from 1956 to present and is located at the mouth near Troy, Montana. Figure 2-2 is a hydrograph constructed from historical gauge station data.

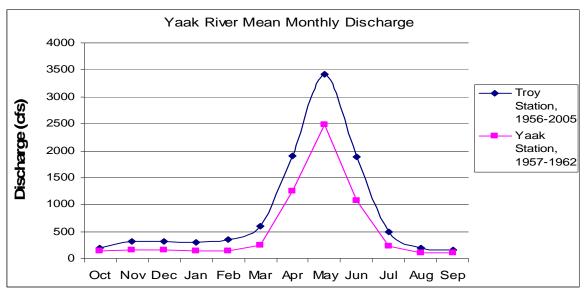


Figure 2-2. Historical Flow Data from Yaak River near Troy and Yaak, MT (USGS, 2006)

On average, in the last 50 years, mean monthly discharge was below 500 cubic feet per second (cfs) for August through February. Historical data indicate an average peak flow at approximately 3,500 cfs in May (Figure 2-2). The mean historical flow does not reveal the magnitude of, or variation in, peak flows. As an example of the variability in flow, Figure 2-3 illustrates daily mean discharge for 2006, which reached a peak of nearly 6,000 cfs in June.

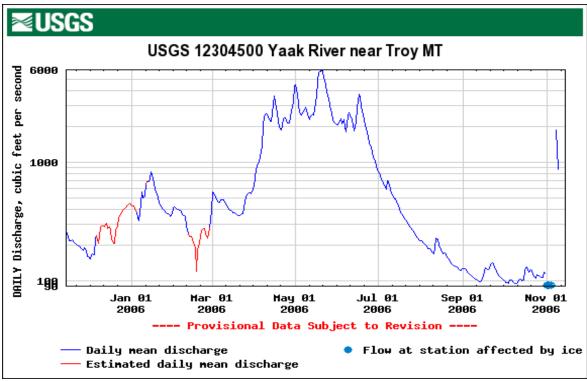


Figure 2-3. Recent Streamflow data for Yaak River (USGS, 2006)

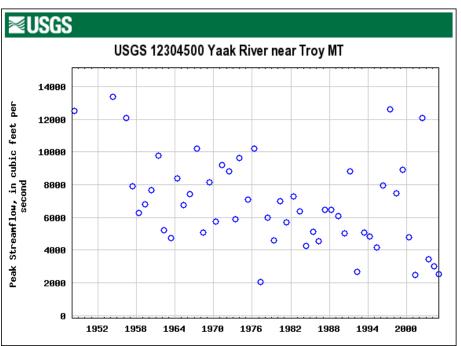


Figure 2-4 illustrates the range in historical peak flows on the Yaak River at USGS gage station 12304500.

Figure 2-4. Historical Peak Flow Yaak River (USGS, 2006).

These data demonstrate that the peak flow was over 10,000 cfs seven times in the period of record. The highest flow on record for the Yaak River was 13,400 cfs on May 20, 1954.

2.1.5 Geology and Soils

Glaciation was a forming factor in the landscape of the Yaak River Watershed. The Purcell Mountains were overridden by the continental ice mass, which covered much of the watershed. The ice scoured and rounded the mountains and filled many of the valleys with glacial till. Most of the bedrock exposed in the area belongs to the Belt Supergroup of Precambrian age, which exceeds 40,000 feet in thickness. The dominance of Belt Series geology can be seen in Map 3 (Appendix D). A small percentage of the rock is igneous, diorite sills of the Prichard Formation. The Purcell anticlinorium dominates the structural pattern of the watershed. This is a large north or northwest trending fold that exposes the deepest parts of the Belt Supergroup in the western part of the watershed (Johns, 1970; KNF EIS, 1987). The dominant rock type is Precambrian Belt Supergroup metasedimentary rocks, over lain in places by later glacial deposits. Major soil types in the Yaak Watershed are shown in Map 4 of Appendix D.

2.1.6 Land Use and Land Cover

Land cover types in the Yaak River Watershed are listed in order of dominance in Table 2-1 below. Table 2-1 shows the dominant vegetation in the majority of the watershed is evergreen forest (96.3%). Mixed rangeland is the second most abundant vegetation type (1.3%).

Table 2-1. Land use/cover in Yaak River Watershed

Land Use/Cover Type	Area (Acres)	Percentage
Evergreen Forest	379,390	96.3%
Mixed Rangeland	4,983	1.3%
Brush Rangeland	2,692	0.68%
Mixed Forest	2,514	0.64%
Exposed Rock	1,941	0.49%
Crop/Pasture	1,263	0.32%
Grass Rangeland	293	0.074%
Reservoir	185	0.047%
Lake	175	0.044%
Deciduous Forest	172	0.044%
Residential	94	0.024%
Wetland	94	0.024%
Mine/Quarry	41	0.010%

Data Source: NRIS, from USGS GIRAS files.

This table also shows that very little of the land area in the Yaak Watershed is residential; the watershed is largely undeveloped. Land cover types are also illustrated in Map 5 (Appendix D). A more detailed description of the vegetation follows.

According to the KNF Plan (1987), trees native to the area include western red cedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), western white pine (*Pinus monticola*), lodgepole pine (*Pinus contorta*), ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga menziesii*), subalpine fir (*Abies lasiocarpa*), grand fir (Abies grandis), whitebark pine (*Pinus albicaulis*), alpine larch (*Larix lyallii*), western larch (*Larix occidentalis*), mountain hemlock (*Tsuga mertensiana*), Englemann spruce (*Picea engelmannii*), and Rocky Mountain juniper (*Juniperus scopulorum*). The Yaak Watershed commonly supports cedar/clintonia and hemlock/clintonia habitat types. Hemlock/devil's club (*Oplopanax horridus*) and cedar/lady fern (*Athyrium filix-femina*) are found in moist high water table bottoms in the watershed (KNF EIS, 1987)

2.2 Biological Characteristics

2.2.1 Fisheries and Associated Aquatic

As a tributary to the Kootenai River, the un-dammed Yaak River and its tributaries provide spawning and rearing habitat for fish populations which produce some of western Montana's popular sport fish, such as brook trout (*Salvelinus fontinalis*) and rainbow trout (*Oncorhynchus mykiss*). Streams in this watershed also support species of special concern including westslope cutthroat trout (*Oncorhynchus clarkii lewisi*) and Columbia Basin redband trout (*Oncorhynchus mykiss gairdneri*).

Westslope cutthroat trout (*Oncorhynchus clarki lewisi*) is a subspecies of cutthroat trout native to Montana and is found in the Kootenai Watershed, the Clark Fork Watershed, and the headwaters of the Missouri River. Westslope cutthroat trout were first described by Lewis and Clark and were once extremely abundant. Cutthroat trout have declined due to habitat loss caused by poor grazing practices, historic logging practices, mining, agriculture, residential development, the lingering impact of forest roads, dewatering, and dams. Hybridization with rainbow trout, and even other non-native cutthroat trout subspecies, is another reason for the decline in population. Genetically pure westslope cutthroat trout exist in an estimated 8-20% of their historic habitats (Shepard et al, 2003). Many remnant genetically pure cutthroat trout populations are located above barriers that have protected them from non-native species, such as the barriers found in the Yaak Watershed. The most significant isolated populations of westslope cutthroat trout presently occur in the West Fork Yaak River Watershed. Westslope cutthroat trout occurrence in the Yaak Watershed is summarized in Table 2-3.

The Columbia River redband trout is a subspecies of rainbow trout (Oncorhynchus mykiss). It is threatened by logging, mining, agriculture, grazing, dams, over-harvest, and hybridization and competition with other trout species (Muhlfeld N.d). These factors have contributed to the decline of redband trout abundance, distribution, and genetic diversity in the Columbia River Basin (Williams et al., 1989; Behnke, 1992). The Kootenai River redband population in Montana supports subpopulations of the resident form which inhabit smaller tributaries and headwater areas for their entire lives, although a migratory fluvial and/or adfluvial component may be undetectable due to hybridized populations inhabiting the lower portions of the drainage (Muhlfeld, 1999). Results of genetic surveys indicate that redband trout were native to lowgradient valley-bottom streams throughout the Kootenai River drainage but are presently restricted to headwater areas. The Yaak River is not dammed but has a natural fish barrier at Yaak River Falls nine miles from its confluence with the Kootenai River. There is a barrier falls in the lower East Fork of the Yaak River. These falls have isolated Columbia River redband rainbow trout populations. Populations also exist in North Fork Yaak River and Seventeenmile Creek. (Kris Newgard, pers comm.) Table 2-2 summarizes Montana Fisheries Information System (MFISH) data for species and their relative distribution found in the Yaak River.

Table 2-2. Species and relative abundance for the Yaak River

Species	River Mile (RM)								
	0-3.2	3.2-7.9	7.9-8.9	8.9-10.0	10.0-12.1	12.1-17.9	17.9-49.2	49.2-53.4	
Brook trout	R	С	С	С	С	С	С	С	
	es	es	es	es	es	es	es	es	
Bull trout	I	I	I						
	es	es	es						
Columbia Basin	С	C	С	С	С	С	С	С	
Redband Trout	ess	es	es	es	es	es	es	es	
Kokanee	I	R	R						
	es	es	es						
Largescale Sucker	Α	A	A	A	A	A	A		
	es	es	es	es	es	es	es		
Longnose Dace				A	A	A	A		
				es	es	es	es		
Longnose Sucker	A	A	A	A	A	A	A		
	es	es	es	es	es	es	es		
Mottled Sculpin			R						
			es						
Mountain Whitefish	A	A	A	A	A	A	A		
	es	es	es	es	es	es	es		
Northern Pike Minnow	C	C	C						
	es	es	es						
Rainbow Trout	С	C	C	C	C	C	C		
	es	es	es	es	es	es	es		
Redside Shiner	С	C	C	C	С	С	С	С	
	es	es	es	es	es	es	es	es	
Slimy Sculpin			R		R			R	
	<u> </u>		es		es			es	

C = Common, A = Abundant, R = Rare, I = Incidental

ess=extrapolated from extensive samples

RM = River Mile

Data Source: Montana Fish, Wildlife and Parks (MFWP), MFISH

This data is from the MFISH website and includes only those species with known information. Table 2-3 displays the fish abundance for selected tributaries to the Yaak River.

pj= professional judgment.

es= extrapolation from surveys.

Table 2-3. Species and relative abundance for 303(d) Listed streams in the Yaak River Watershed

	Westslope Cutthroat Trout	Rainbow Trout	Brook Trout	Mountain Whitefish	Columbia Basin Redband Trout	Sculpin	Slimy Sculpin	Longnose Dace
East Fork Yaak (rm 0.0-13.9)			R es	R es	C es	A es		
East Fork Yaak (rm 6.5-7.2)								
Seventeen Mile Creek (rm 0.0-4.6)			С				R es	
Seventeen Mile Creek (rm 0.0-8.8)			С		C es			
Seventeen Mile Creek (rm 4.6-15.1)	A ess		С					
Seventeen Mile Creek (rm 8.8-15.1)			Срј					
Lap Creek (rm 0.0-0.6)	Срј							
Lap Creek (rm 0.6-4.8)	C es							
Spread Creek (rm 0.0-12.2)			C es	C es				
Pete Creek (rm 0.0-10.1)	C es		C es			A ess		A es
South Fork Yaak (rm 0.9-11.0)		C pj						
South Fork Yaak (rm 3.4-11.0)			Срј					
South Fork Yaak (rm 0.0-11.0)	Срј							
West Fork Yaak (rm 0.0-9.5)	С	R es	R es	R es				
West Fork Yaak (rm 0.0-3.9)	С						R es	
West Fork Yaak (rm 3.9-9.5)	С					C es		
West Fork Yaak (rm 0.0-0.6)	A ess.							
West Fork Yaak (rm 0.6-1.6)	C es		•					
West Fork Yaak (rm 1.6-4.2)	Срј		•					
West Fork Yaak (rm 4.2-9.5)	A ess.							

C = Common, A = Abundant, R = Rare, I = Incidental

pj= professional judgment, no survey.

es= extrapolation from surveys.

ess= extrapolated from extensive samples Data Source: MFWP, MFISH, USFS

2.2.2 Threatened and Endangered Species (and Species of Special Concern)

The Yaak Watershed is home to 17 animal and 19 plant species of concern in the State of Montana's Natural Heritage Program (Table 2-4).

Table 2-4. Yaak Watershed Species of Concern

Scientific Name	Common Name	Species	US Fish and	State	US Forest
Acipenser transmontanus	White Sturgeon	Type Animal	Wildlife Status ENDANGERED	Rank S1	Service Status ENDANGERED
Canis lupus	Gray Wolf	Animal	ENDANGERED,	S3	ENDANGERED
			Experimental Population		
Contopus cooperi	Olive-sided Flycatcher	Animal	•	S3B	
Corynorhinus townsendii	Townsend's Big- eared Bat	Animal		S2	SENSITIVE
Cottus rhotheus	Torrent Sculpin	Animal		S3	
Falco peregrinus	Peregrine Falcon	Animal		S2B	SENSITIVE
Gavia immer	Common Loon	Animal		S2B	SENSITIVE
Histrionicus histrionicus	Harlequin Duck	Animal		S2B	SENSITIVE
Lynx canadensis	Canada Lynx	Animal	THREATENED	S3	THREATENED
Oncorhynchus clarkii lewisi	Westslope Cutthroat Trout	Animal		S2	SENSITIVE
Oncorhynchus mykiss gairdneri	Columbia River Redband Trout	Animal		S1	SENSITIVE
Picoides arcticus	Black-backed Woodpecker	Animal		S2	SENSITIVE
Plethodon idahoensis	Coeur d'Alene Salamander	Animal		S2	SENSITIVE
Poecile hudsonica	Boreal Chickadee	Animal		S1S2	
Salvelinus confluentus	Bull Trout	Animal	THREATENED	S2	THREATENED
Synaptomys borealis	Northern Bog Lemming	Animal		S2	SENSITIVE
U. arctos horribilis	Brown Bear	Animal	THREATENED	S2S3	THREATENED
Bidens beckii	Beck Water-marigold	Plant		S2	SENSITIVE
Botrychium ascendens	Upward-lobed Moonwort	Plant		S1S2	SENSITIVE
Botrychium crenulatum	Wavy Moonwort	Plant		S2S3	SENSITIVE
Botrychium montanum	Mountain Moonwort	Plant		S3	
Brasenia schreberi	Watershield	Plant		S1S2	SENSITIVE
Bryoria subdivergens		Plant		S1	SENSITIVE
Carex rostrata	Beaked Sedge	Plant		S1	SENSITIVE
Corydalis sempervirens	Pale Corydalis	Plant		S2	SENSITIVE
Drosera anglica	English Sundew	Plant		S2S3	SENSITIVE
Lomatium geyeri	Geyer's Biscuitroot	Plant		S2	SENSITIVE
Lycopodium dendroideum	Treelike Clubmoss	Plant		S1	SENSITIVE
Lycopodium lagopus	Running Pine	Plant		S1	SENSITIVE
Peatland	Peatland	Plant		SNR	
Platyhypnidium riparioides		Plant		S1	

Table 2-4. Yaak Watershed Species of Concern

Scientific Name	Common Name	Species	US Fish and	State	US Forest
		Type	Wildlife Status	Rank	Service Status
Racomitrium pygmaeum		Plant		S1	
Scheuchzeria palustris	Pod Grass	Plant		S2	SENSITIVE
Scirpus subterminalis	Water Bulrush	Plant		S2	SENSITIVE
Thelypteris phegopteris	Northern Beechfern	Plant		S2	SENSITIVE

State Rank Scale: 1=High Risk to 5=Common Source: Montana Natural Heritage Program (MNHP)

The majority of these species are considered sensitive according United States Fish and Wildlife Service (USFWS). The gray wolf and white sturgeon are the two federally listed endangered species in the watershed. The gray wolf's status in the area is modified by the fact that the majority of the wolves found in the area are likely reintroduced, (i.e. experimental populations). The brown (grizzly) bear and Canada lynx are threatened species found within the Yaak Watershed. Additionally, bull trout have incidental occurrence downstream of Yaak Falls.

2.3 Cultural Characteristics

2.3.1 Population and Land Use History

The Yaak Watershed is predominately National Forest land. The U.S. portion of the watershed has an estimated population of 316 people, according to the 2000 population census. The two towns in the watershed are Yaak and Sylvanite, with population estimated at 19 and 16, respectively (Montana State Library, 2003).

Humans have probably inhabited the Yaak Watershed for at least 7,000 years (KNF, 1987). These early people were wandering hunters and gatherers, who took advantage of the wide range of mineral resources in the watershed, as well as the varied plant, animal, and aquatic life. The last prehistoric group to inhabit the area was the Kootenai Indians. The exact time of their arrival as well as their exact origin is not known. The Kootenai language is unique and remains distinctive from those of neighboring tribes. Recent ethnographic research of the Kootenai Tribe suggests they were highly influenced by elements of the European culture, including horses, fur trapping and trade, missionaries, mining, and homesteading, which were present in the Yaak by the 19th century (KNF EIS, 1987).

Logging and mining are the primary occupations in the area (KNF EIS, 1987). Mining has a long history in the Yaak Watershed. The first placer gold reportedly was discovered in 1864 (Calvi, 1993). The Sylvanite mining district was the heart of the most important placer and lode mining activity in the watershed. Proterozoic rocks of the Belt series underlie the Sylvanite district (Map 3). Ore deposits are associated with the geological structure created by faulting and folding. Specifically, gold-quartz veins, such as those located in the Sylvanite district, are found in the Prichard Formation (Johns, 1970). Gold was found along the lower reaches of the Yaak River in the late 1880s. In this area a temporary camp known as Snipetown was established around 1890. The number of miners grew with the discovery, three years later, of placer gold just over the border on the Moyie River in Idaho (Renk, 1994).

The Keystone and Goldflint mines were both established in the Sylvanite district in the late 1800s. The town of Sylvanite grew with the mines, and at its peak, Sylvanite was home to 500 people. However the town of Sylvanite was short-lived and by August, 1898 the town was nearly deserted, and both the Goldflint and Keystone mills were silent (Hauge, 1994; Renk, 1994).

After more than a decade of inactivity, Canadian investors formed the Lincoln Gold Mining Company in 1910 to operate the Keystone and Goldflint. They reopened the mines, constructed a 20-stamp mill and tramway, and attempted to revitalize the district. Before the mill ever operated, however, a forest fire swept through the valley in August and burned the mill and mine structures along with all but one building in town. Although the company planned to rebuild, it never did. The mines revived in the 1930s under different ownership, operating from 1931-1937 (Timmons, 1986; Renk, 1994).

In the early 1900s, settlers of Troy and Libby migrated to the area. Some intended to homestead, and others worked for the Forest Service fighting fires and packing supplies and materials for the lookout cabins and towers that were being built as a result of the aftermath of the 1910 fire year. The original Yaak Store was built in the early 1930s. It served to supply goods to the local community as well as provide a meeting place for locals to gather and play cards while waiting for the mail to come through. The first school was also built in the early 1930s (Eureka Chamber of Commerce).

The Yaak Valley has been extensively logged. Prior to formation of the KNF, logging in the area was only conducted to meet the needs of the settlers and to support the mining industry. Timber production increased through the 1900s, most notably in the 1950s/1960s and in the early 1980s to address spruce bark beetle outbreak and to meet the demands of the rapidly expanding economy (USFS, 2003). In 1987, forest plans for the KNF established allowable sale quantities (ASQs) for the maximum amount of timber that could be harvested from the forest. Timber production on the Kootenai National Forest since 1987 has been well below the ASQs, due to a number of factors, including a shift in management focus increasingly from timber production to wildlife habitat, watershed concerns, litigation, appeals, deferrals, and changes in management area designation (KNF, 1997). Timber volume sold from the entire Kootenai National Forest in northwest Montana declined from 200 million board feet (mmbf) per year to about 50 mmbf per year from 1998 to 2001 (USFS, 2003). Timber harvest continues in the Yaak at a slower production volume than past levels.

2.3.2 Land Use and Ownership

The vast majority (96.5%) of the land in the Yaak Watershed is public land managed by United States Forest Service (USFS) (Table 2-5)

Table 2-5. Land Ownership in the Yaak Watershed

Owner	Acres	Sq. Miles	% of Total
U.S. Forest Service	381,093	595.5	96.5%
Private	12,814	20.0	3.2%
Stimson Timber lands	692	1.1	0.2%
Water	159	0.2	0.0%
TOTAL	394,758	616.8	

Source: NRIS, MTNHP

Private land holdings account for 3.2% of the land. In addition, Stimson Timber Company owns another 0.2% of the total area of the watershed (Map 6). Land use in the watershed is primarily logging. In the past, portions of the Yaak Watershed have been heavily logged (Map 7). Past logging operations and their associated roads may contribute to the listed causes of impairment of siltation, habitat alteration, and suspended solids. Current logging operations are significantly reduced on Forest Service land compared to historic levels. Only 0.32% of the total area of the watershed is cultivated (Table 2-1). Grazing, while minimal on the US side, is significant within Canada, specifically along the West Fork Yaak River.

2.3.3 Recreation

Outdoor recreation is considered an important aspect of living in the Yaak Watershed with hunting, fishing, hiking, and camping being popular activities. The Kootenai Forest supports populations of elk, moose, bighorn sheep, mountain goats, whitetail and mule deer, black bear, and mountain lion. Many of these animals are hunted and the rivers and lakes of the watershed provide ample fishing opportunities (KNF EIS, 1987). In addition to local use there is some commercial growth in guiding of outdoor recreation in the area (Eureka, Montana Chamber of Commerce).

2.3.4 Resource Management

There are no major dams located within the Yaak Watershed. As mentioned above, extraction of wood products historically has been important economically to the area. According to the Kootenai Forest Management Plan, the Yaak Watershed contains some of the most suitable timberlands and contributes substantially to the Kootenai annual timber production (KNF EIS, 1987). Map 7 shows the Percent Equivalent Clear Cut Area (%ECA) for the Yaak Watershed. This map illustrates that a considerable portion of the watershed has been impacted by logging. Road density is shown by subbasin in Map 8. Most of these roads were constructed for timber harvest activities on the KNF.

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SECTION 3.0 TMDL REGULATORY FRAMEWORK AND WATER QUALITY STANDARDS

Section 3 provides the existing status of all 303(d) Listed waterbodies in the Yaak Watershed TMDL Planning Area (i.e., which waterbodies are listed as impaired or threatened and for which pollutants). This is followed by a summary of the applicable water quality standards.

3.1 TMDL Regulatory Requirements

Section 303(d) of the Federal CWA requires states to identify water bodies within its boundaries that do not meet state water quality standards. States track these impaired or threatened water bodies through the 303(d) List, a component of Montana's Water Quality Integrated Report (IR). State law identifies that a methodology for determining the impairment status of each water body is used for consistency, and the actual methodology is identified in DEQ's *Quality Assurance Project Plan for Sampling and Water Quality Assessment of Streams & Rivers in Montana*, 2005.

Under Montana State Law, an "impaired water body" is defined as a water body or stream segment for which sufficient credible data show that the water body or stream segment is failing to achieve compliance with applicable water quality standards (MCA 75-5-103(11)). A "threatened water body" is defined as a water body or stream segment for which sufficient credible data and calculated increases in loads show that the water body or stream segment is fully supporting its designated uses but threatened for a particular designated use because of a) proposed sources that are not subject to pollution prevention or control actions required by a discharge permit, the nondegradation provisions, or reasonable land, soil, and water conservation practices or b) documented adverse pollution trends (MCA 75-5-103(31)). State law (MCA 75-5-703) requires that DEQ to develop all necessary TMDLs for impaired or threatened water bodies.

TMDLs are developed for pollutants. These are water quality impairments that can be quantified and a load can be calculated. Riparian degradation and habitat alteration are not pollutants but are considered pollution-related impairments and thereby do not require TMDLs. Additionally, flow alteration and dewatering are impairment issues related to water quantity and when viewed alone are not subject to a TMDL. However, sediment-related impairments may be related to stream energy and flow conditions. Likewise, riparian degradation and habitat alteration, when considered alone, do not require a TMDL. Yet both are often linked to pollutant loading and may exacerbate and contribute to the loading and influence of a pollutant in a stream. As such, flow and habitat conditions are often considered when conducting TMDL analysis.

A TMDL is a pollutant budget for a water body identifying the maximum amount of the pollutant that a water body can assimilate without causing applicable water quality standards to be exceeded. TMDLs are often expressed in terms of an amount, or load, of a particular pollutant (expressed in units of mass per time such as pounds per day). TMDLs must account for loads/impacts from point and nonpoint sources, in addition to natural background sources, and must incorporate a margin of safety and consider influences of seasonality on analysis and compliance with water quality standards.

To satisfy the Federal Clean Water Act and Montana State Law, TMDLs are developed for each water body-pollutant combination identified on the state's list of impaired or threatened waters. State Law (Administrative Rules of Montana 75-5-703(8)) also directs DEQ to "support a voluntary program of reasonable land, soil, and water conservation practices to achieve compliance with water quality standards for nonpoint source activities for water bodies that are subject to a TMDL..." This is an important directive that is reflected in the overall TMDL development and implementation strategy within this plan. It is important to note that water quality protection measures are not considered voluntary where such measures are already a requirement under existing federal, state, or local regulations.

3.2 Water Bodies and Pollutants of Concern

The assessment of streams, lakes, and wetlands to identify impaired waters for inclusion on the state's Water Quality Integrated Report is an important step a process intended to ensure that all waterbodies in the state will have water quality adequate to support all of their classified beneficial uses. The process has been developed and shaped by legal mandates, water quality standards, the tools and techniques of water quality monitoring, the availability of information, and the funds and administrative resources that can be devoted to assessment efforts.

The impairment causes and sources determination included on the 1996 303(d) List was based on data that showed impairments, however many determinations were based on professional judgment and involved limited data. Since the development of the 1996 303(d) List, DEQ has instituted procedures that more fully assess and identify impaired waters. This procedure, the Sufficient Credible Data Assessment & Beneficial Use-Support Determinations (SCD/BUD) Process, conducted by the DEQ in response to legal requirements stipulated in 75-5-702 MCA, resulted in updates to the 1996 303(d) Listing. Consequently, impaired uses, causes, and sources on the 2006 303(d) List may differ from the original 1996 listings as a result of the data review and associated list revisions.

While the 2006 303(d) List is now Montana's most current list, and is based on more thorough data review and analysis than the 1996 list, a ruling by the U.S. District Court (CV97-35-M-DWM) on September 21, 2000 required that the State of Montana must complete all necessary TMDLs for waters listed as impaired or threatened on the 1996 303(d) List. Where new data has resulted in changes to the 303(d) Listing status for 1996-listed waters through the state's SCD/BUD process, DEQ will complete TMDLs based on updated impairments status resulting from this new information.

Waterbodies reviewed by the state's SCD/BUD process fall into five categories. The level of beneficial use support for the listed waters can be as fully supporting all designated beneficial uses (F), threatened (T), partially support (P), not supporting (N) and lacking sufficient credible data (X). The beneficial use-support determination for the 303(d) Listed streams in the Yaak River TPA is provided in Table 3-1. The causes and sources of impairment for the 1996 303(d) List are shown in Table 3-2. The 2006 303(d) List is summarized in Table 3-3. A map of segment locations is given in Figure 3-1.

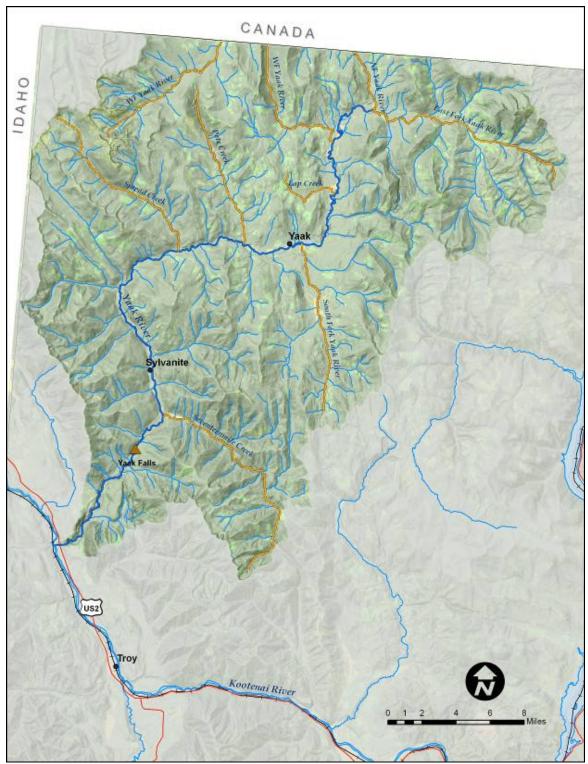


Figure 3-1. Water Body Segments in the Yaak TMDL Planning Area

Table 3-1. Impaired Uses from both 1996 and 2006 303(d) Lists*

Table 3-1. Impaneu (JSCS II OIII DOUI 1770 AIIU 2000 SUS(U) Lists
	1996 Use-Support	2006 Use Support

Stream Reach (MT Waterbody ID)	Use Classification	Life	Cold-water Fishery	Water	ıre		Contact Recreation	Use Classification	Life	Cold-water Fishery	Water	ıre		Contact Recreation
	Use Class	Aquatic Life	Cold-wat	Drinking Water	Agriculture	Industry	Contact]	Use Class	Aquatic Life	Cold-wat	Drinking Water	Agriculture	Industry	Contact]
SEVENTEENMILE CREEK MT76B002_010	B-1	·	T		·			B-1	P	P	F	F	F	F
EAST FORK YAAK RIVER MT76B002_100	B-1		T					B-1	P	P	F	F	F	F
NORTH FORK YAAK RIVER MT76B001_020	B-1		Т					B-1	F	F	F	F	F	F
LAP CREEK MT76B002_020	B-1	P	P					B-1	N	N	F	F	F	F
SPREAD CREEK MT76B002_060	B-1		Т					B-1	F	F	F	F	F	F
PETE CREEK MT76B002_070	B-1		T					B-1	P	P	F	F	F	F
SOUTH FORK YAAK RIVER MT76B002_080	B-1		Т					B-1	N	N	F	F	F	F
WEST FORK YAAK RIVER MT76B002_090 *DEO_1996_2006	B-1		T					B-1	P	P	F	F	F	F

^{*}DEQ, 1996, 2006

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Table 3-2. 1996 303(d) List Information for the Yaak River TMDL Planning Area*

Segment Name (MT Waterbody ID)	Length (miles)	Probable Cause	Probable Source
SEVENTEENMILE CREEK MT76B002_010	15.1	Flow alteration Other habitat alterations Siltation Suspended solids	Silviculture
EAST FORK YAAK RIVER MT76B002_100	13.9	Flow alteration Other habitat alterations Siltation Suspended solids	Silviculture
NORTH FORK YAAK RIVER MT76B001_020	4.2	Flow alteration Other habitat alterations Siltation Suspended solids	Silviculture
LAP CREEK MT76B002_020	4.8	Flow alteration Other habitat alterations	Harvesting, Restoration, Residue Management Logging Road Construction/Maintenance Silviculture
SPREAD CREEK MT76B002_060	12.2	Flow alteration Other habitat alterations Siltation Suspended solids	Silviculture
PETE CREEK MT76B002_070	10.1	Flow alteration Other habitat alterations Siltation Suspended solids	Silviculture
SOUTH FORK YAAK RIVER MT76B002_080	11	Flow alteration Other habitat alterations Siltation Suspended solids	Silviculture
WEST FORK YAAK RIVER MT76B002_090	19.8	Flow alteration Other habitat alterations Siltation Suspended solids	Silviculture

^{*}DEQ, 1996

Table 3-3. 2006 303(d) List Information for the Yaak River TMDL Planning Area*

Segment Name (MT	Length	Probable Cause	Probable Source
Waterbody ID)	(miles)		
SEVENTEENMILE	15.1	Sedimentation/Siltation	Forest Roads (Road Construction and Use)
CREEK		Nitrate/Nitrite	Silviculture Harvesting
MT76B002_010			Source Unknown
EAST FORK YAAK	13.9	Nitrate/Nitrite	Silviculture Harvesting
RIVER			Source Unknown
MT76B002_100			
NORTH FORK YAAK	4.2	Fully supporting all beneficial i	uses
RIVER			
MT76B001_020			
LAP CREEK	4.8	Sedimentation/Siltation	Forest Roads (Road Construction and Use)
MT76B002_020		Nitrate/Nitrite	Silviculture Harvesting
			Source Unknown

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Table 3-3. 2006 303(d) List Information	for the Yaak River	TMDL Planning Area*

Segment Name (MT	Length	Probable Cause	Probable Source
Waterbody ID)	(miles)		
SPREAD CREEK	12.2	Fully supporting all beneficial u	uses
MT76B002_060			
PETE CREEK	10.1	Nitrate/Nitrite	Silviculture Harvesting
MT76B002_070			Source Unknown
SOUTH FORK YAAK	11	Sedimentation/Siltation	Forest Roads (Road Construction and Use)
RIVER			Silviculture Harvesting
MT76B002_080			_
WEST FORK YAAK	19.8	Nitrate/Nitrite	Silviculture Harvesting
RIVER			Source Unknown
MT76B002_090			

^{*}DEQ 2006

Stream reassessment information collected since the 1996 303(d) List provided substantial new sufficient and credible data, resulting in changes to the 303(d) Listing status for several water bodies in the Yaak TPA. DEQ will complete TMDLs based on updated impairments status resulting from the updated 2006 listing information.

Pollutants of concern on the 2006 303(d) List (in bold, Table 3-3) include:

 Nitrate/Nitrite (Seventeenmile Creek, East Fork Yaak River, Lap Creek, Pete Creek, West Fork Yaak River)

Nitrate/nitrite are soluble forms of nitrogen that are bioavailable to aquatic plants and may contribute to nuisance algal growth if present in excessive amounts.

Because nitrate/nitrite was first identified as a probable source of impairment in 2006, comprehensive nutrient assessments have not yet been completed. Nitrate/nitrite assessments and TMDLs are beyond the scope of this document and will be addressed by DEQ at a future time.

• Sediment (Seventeenmile Creek, Lap Creek, South Fork Yaak River)
Sediment-related impairments relate to excessive sediment deposited on stream bottoms and in the water column. Presently listed sediment impairment causes in the Yaak TPA include sedimentation and siltation.

Sediment TMDLs are prepared for sediment-impaired streams, Seventeenmile Creek, Lap Creek, and the South Fork Yaak River. Section 4.0 provides an evaluation of sedimentation/siltation conditions for these streams. Section 5.0 presents Sediment TMDLs for these streams.

3.3 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 non-degradation policy that protects the high quality of a water body. The ultimate goal of this TMDL plan, once implemented, is to ensure that water quality standards are met for all pollutants of concern identified on the state's list of impaired waters, the 303(d) List. Water quality standards form the basis for the primary

and supplemental impairment indicators described in Section 4. Section 3.3.2 provides a summary of the applicable water quality standards for each of these pollutants.

3.3.1 Classification and Beneficial Uses

Classification is the assignment (designation) of a single 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, recreation, and wildlife. The Montana WQA directs the Board of Environmental Review (BER, i.e., the state) to establish a classification system for all waters of the state that includes their present (when the Act was originally written) and future most beneficial uses (Administrative Rules of Montana [ARM] 17.30.607-616) and to adopt standards to protect those uses (ARM 17.30.620-670).

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

Descriptions of Montana's surface water classifications and designated beneficial uses are presented in Table 3-4. All water bodies within the Yaak River TPA are classified as B-1.

Table 3-4. Montana Surface Water Classifications and Designated Beneficial Uses

Classification	Designated Uses
B-1 CLASSIFICATION:	Waters classified B-1 are to be maintained suitable for drinking, culinary and food
	processing purposes after conventional treatment; bathing, swimming and recreation;
	growth and propagation of salmonid fishes and associated aquatic life, waterfowl and
	furbearers; and agricultural and industrial water supply. (ARM 17.30.623(1))

3.3.2 Standards

In addition to the use classifications described above, Montana's water quality standards include numeric and narrative criteria as well as a nondegradation policy. The applicable water quality standards for sediment (i.e., the only pollutant currently being addressed in the Yaak TPA) are narrative.

<u>Narrative</u> standards have been developed for substances or conditions for which sufficient information does not exist to develop specific numeric standards. The term "Narrative Standards" commonly refers to the General Prohibitions in ARM 17.30.637 and other descriptive portions of the surface water quality standards. The General Prohibitions are also called the "free from" standards; that is, the surface waters of the state must be free from substances attributable to discharges, including thermal pollution, that impair the beneficial uses of a water body. Uses

may be impaired by toxic or harmful conditions (from one or a combination of parameters) or conditions that produce undesirable aquatic life.

Sediment (i.e., coarse and fine bed sediment) and suspended sediment are addressed via the narrative standard identified in Table 3-5. The standard does 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 condition in which any increases in sediment above naturally occurring levels are not harmful, detrimental, or injurious to beneficial uses (Table 3-5).

Table 3-5. Applicable Rules for Sediment Related Pollutants

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

SECTION 4.0 WATER QUALITY ASSESSMENT

Section 4.0 provides a review of data and information used to make impairment determinations for streams listed for sedimentation/siltation impairment on Montana's 2006 Integrated 305(b)/303(d) Water Quality Report: Seventeenmile Creek, Lap Creek, and South Fork Yaak River. Because nitrate/nitrite was first identified as a probable source of impairment in 2006, comprehensive nutrient assessments have not yet been completed. Nitrate/nitrite assessments and TMDLs are beyond the scope of this document and will be addressed by DEQ at a future time.

4.1 Water Quality Assessment Framework

As described in Section 3.0, Montana's water quality standards for sediment are narrative. To determine if the applicable water quality standards are met for pollutants with narrative criteria, it is necessary to develop measurable, numeric interpretations of the narrative criteria.

There are many natural factors that influence the volume and location of sediment in a stream, especially the substrate (channel bottom). Geophysical attributes such as stream depth, stream gradient, flow, precipitation, geology, soils, and channel roughness have a great influence on the size and distribution of sediment deposits found within a stream. Type, size, and distribution of vegetation both along and within the stream corridor also have an impact. Human management, however, such as grazing, timber harvest, road building, and flow alterations can alter these attributes leading to a significant change in the channel substrate and in water quality.

While it is widely acknowledged that changes in sediment can greatly affect the biota within the system, measuring the direct impact of sediment on a system is difficult because 1) it is not always possible to discriminate between an aquatic species response to sediment versus a response from some other stressor, 2) the sediment regime in most streams is both spatially and temporally variable, and 3) inherent variability of biotic systems makes it difficult to evaluate whether a water body is at its full potential, or whether anthropogenic stressors (sediment) limit biological integrity. Because of these concerns, there is not one single indicator or standard to be used to determine if an anthropogenic sediment increase or decrease is impairing fish and aquatic life beneficial uses in Montana streams.

Because no single indicator has been shown to be reliable, a suite of indicators is proposed to assess whether sediment is impairing beneficial uses in the streams within the Yaak TPA. These indicators are listed in Table 4-1 and discussed individually in Sections 4.2.1 - 4.2.7.

Table 4-1. Sediment Impairment Indicators for the Yaak TPA

Table 1 17 Seatment Impairment Indicators for the Table 1111						
Sediment Impairment Indicator	Recommended Threshold Value	Indicator Type				
In-Stream Sediment Indicators						
Bankfull Width to Depth Ratio	Within Expected Range	Primary				
Percentage of Channel Surface Fines <6mm	<20%	Primary				
Percentage of Channel Surface Fines <2mm	<20%	Primary				
Percentage of Subsurface Fines <6mm	<28%	Primary				
Entrenchment Ratio	Within Expected Range	Supplemental				
Pfankuch Stream Channel Stability	> "fair" SCS Rating	Supplemental				

Table 4-1. Sediment Impairment Indicators for the Yaak TPA

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Sediment Impairment Indicator	Recommended Threshold Value	Indicator Type
Stream Channel Stability:	> "fair"	Supplemental
Scouring and/or Deposition		
Stream Channel Stability: Distribution and Stability of	> "fair"	Supplemental
Channel Bottom Materials		
Biological Indicators		
Montana Multimetric Index SCORE (MMI)	>63	Primary
River Invertebrate Prediction and Classification System	>.80	Primary
SCORE (RIVPACS)		
Fine Sediment Index -EPT (FSI-EPT)	≥ 17	Supplemental
Percentage of FSI - Sensitive taxa	>40%	Supplemental
Macroinvertebrate FSI	≥ 205	Supplemental
Landscape-Scale Sediment Indicators		
Current %ECA of Watershed	<25%	Supplemental
Watershed Stream Crossing Density (#/mi ²)	<3	Supplemental
Watershed Total Road Density (miles/ mi ²)	<3	Supplemental
Sediment Source Survey Data	Qualitative Assessment	Supplemental
Historic Information - Channel Morphology,	Qualitative Assessment	Supplemental
Macroinvertebrates and Stream Channel Stability		

The indicators listed in Table 4-1 are classified into Primary and Supplemental indicators. Primary indicators are those that represent a measure of aquatic life beneficial use support, either as a surrogate parameter (% fines) or as a direct measure of aquatic assemblages (bioassessments). Supplemental indicators are those parameters that do not provide a direct or verified link to beneficial use support but may provide additional information that allows more thorough interpretation of primary indicator values. When combined, this suite of indicators is intended to answer the following four questions relating to a sediment-impairment determination.

1. Are the fish/aquatic life beneficial uses impaired?

If fish and/or aquatic life are not adversely affected, the water quality standards for support of fish and associated aquatic life are not violated. Therefore, direct and indirect measures of these assemblages have been included in the suite of indicators. Aquatic life applies to a variety of fauna. Typically, support of aquatic macroinvertebrates and fish assemblages is evaluated to assess whether aquatic life uses are being supported.

Aquatic macroinvertebrate health and support is assessed quantitatively and qualitatively through a variety of metrics. Primary metrics include the Montana Multi-Metric Index SCORE (MMI) and River Invertebrate Prediction and Classification System SCORE (RIVPACS). Supplemental metrics include Fine Sediment Index (FSI) values developed by Relyea (2005).

Fish health and support is assessed through indirect measures of the health of the fisheries community. Substrate sediment information is predominantly used to assess impacts of sediment on stream habitats and growth and propagation of fish. Typically, percentage of channel surface fines <6mm, percentage of channel surface fines <2 mm, and percentage of subsurface fines <6mm are included as predominant indicators of sediment impacts to fish.

2. Have anthropogenic sources increased sediment erosion and/or delivery, contributing to or causing impairment?

Impairment is defined as a negative-impact on beneficial uses caused by human sources. Therefore, the chosen suite of indicators provides a means to differentiate between "naturally occurring" conditions and conditions adversely influenced by humans and/or detect the presence or absence of anthropogenic sediment sources/causes.

%ECA of the watershed, stream crossing density (#/mi²), total road density (miles/mi²), and Sediment Source Survey field data have been included in the suite of indicators to provide direct and indirect measures of the extent of human influence within the watersheds of the subject streams in the Yaak TPA.

3. Is there a sediment supply problem contributing to impairment (i.e., is there too much or too little sediment in the stream)?

Indicators have been selected to demonstrate or indicate whether or not there is, or has been, an excessive discharge of sediment to the stream. The focus here is on the quantity of sediment (coarse, fine, or suspended) in the stream (i.e., too much or too little sediment).

Percentage of channel surface fines <6 mm and <2 mm, and percentage of subsurface fines <6mm are included in the suite of indicators as a direct measure of a potential sediment supply problem. The bankfull width-to-depth and entrenchment ratios provide information to evaluate this question as well.

4. Is there an indication of an in-channel sediment transport problem contributing to or causing impairment?

Factors such as natural or human-caused flow alterations (e.g., irrigation, dams, drought, water yield increases) and/or channel modifications can result in symptoms similar to those that may be observed as a result of an excessive sediment supply.

Stream morphology values such as width-to-depth and entrenchment ratios provide indirect indicators of possible sediment transport problems that may occur, or have occurred in the Yaak TPA. The Pfankuch Stream Channel Stability (Sum), Stream Channel Stability-Scouring and/or Deposition Item, and the Stream Channel Stability-Distribution and Stability of Channel Bottom Materials Items all can be used to answer this question as well.

4.2 Sediment Impairment Indicators

Table 4-1 lists the indicators used to assess sediment impairment in the Yaak TPA. The individual indicators listed are explained below. Due to its relevance to sediment assessments, the concept of "reference condition" precedes a discussion of indicators. The suite of indicators selected for the Yaak TPA were chosen based on:

- the region, ecoregion, and general watershed setting
- the availability of existing data
- the availability of suitable reference data

- EPA and DEQ experiences with sediment indicators
- information being collected by other monitoring programs

4.2.1 Reference Condition

DEQ uses a "reference condition approach" to evaluate *naturally occurring conditions* (those conditions where "all reasonable land, soil and water conservation practices have been applied") for assistance in determination of sediment impairment. Several approaches are used to assist in developing reference criteria. Primary approaches include utilizing data from known equivalent reference sites and historical condition. Secondary approaches include literature-supported criteria, water quality modeling, and judgment of qualified professionals. Typically, a combination of primary and secondary approaches is used to develop appropriate reference condition criteria.

For this study, a total of 83 reference sites that met reference criteria were used to evaluate impairment conditions at Yaak TPA study sites. Reference sites selected were considered to be indicative of "un-impacted conditions" that could be expected at the evaluated reaches if no management impacts had occurred. Nine of these sites were from the nearby Cabinet Mountains. Four reference sites were within the Yaak TPA: Grizzly Creek, North Fork Seventeenmile Creek, Flattail Creek, and Independence Creek. Candidate reference sites were ground-verified before measurement to ensure that channel and stream bottom conditions had not been modified by any human activity.

Since data from reference sites were primarily being used to interpret possible sediment impacts, sample collection focused on physical habitat measurements that are related to or dependent on sediment. Channel morphology and pebble count data were collected at the reference sites following the sampling protocols employed throughout the rest of the study, providing comparable results. Threshold values for entrenchment ratio, width/depth ratio (w/d ratio), and percent surface fines <6mm and <2mm were established by stratifying reference sites by Rosgen stream type and then averaging the values for a given parameter within the stratification. Generally, one standard deviation (SD) was used to define the acceptable range for a given parameter. Some substrate measurement results, however, were evaluated based on a quartile approach in order to minimize the effects of outliers in smaller nonparametric data sets. Further discussion of the application of reference values for each parameter can be found below.

4.2.2 In-Stream Sediment Indicators

4.2.2.1 Primary Indicator: Bankfull Width to Depth Ratio

The bankfull w/d ratio is defined as the bankfull width divided by the mean bankfull depth of a stream channel cross-section. It is a prime descriptor of channel shape; narrow, deep streams will have small w/d ratios; wide, shallow streams will have large w/d ratios (Rosgen, 1994).

Of all the channel morphology parameters, stream width is the most responsive to stress within the channel or watershed (Leopold, 1994). Stream width, and hence, w/d ratio can change due to shifts in boundary stress (energy or stream power available along the channel margin) as a result of changes in riparian vegetation, changes in streamflow, and/or changes in sediment load. These changes can occur as a result of water diversions, channelization, timber harvest, excessive grazing, road encroachment, or other land-uses within the watershed (Rosgen, 1996). In the Yaak TPA, changes in w/d ratio might indicate peak flow increases resulting from excessive harvest within a watershed, riparian clearing, sediment increases from both natural and man-caused actions, or a combination of these.

To effectively utilize the w/d ratio, it must be defined for individual stream types. This can be done through a numerical classification system, such as Rosgen (1994), or by sampling "reference" streams within the region of concern. The use of reference reaches is a recommended approach for comparing managed and un-managed streams (Dissmeyer,1993). As stated above, this is the method used in the Yaak TPA.

Collection of data from reference stream reaches on the Kootenai National Forest has yielded the following w/d ratios for stream types commonly found in the area (Table 4-2).

Table 4-2. Bankfull Width / Depth Ratios for Kootenai National Forest Reference Streams

Rosgen Stream Type	Number of Reference Sites	Mean width/ depth ratio	Indicator Acceptable Range
A	4	15.6	7.3 - 23.8
В	58	19.5	11.9 – 27.2
С	10	18.6	13.3 – 23.8
Е	3	9.1	8.3 – 9.8
F	8	26.4	14.8 – 37.9

The indicator values for w/d ratios for streams within the Yaak TPA are shown in the right-hand column. These indicator values represent +/- one SD from the mean, and are partitioned into Rosgen classes to more accurately assess the potential at each site. For example, for Rosgen B stream types, the standard display of +/- 1 SD from the mean would produce a range of 11.9 – 27.2. A stream classified as a Rosgen "B" with a w/d ratio outside of this range, especially one greater than the value of 27.2, would imply impairment. Note: Where a small number of sites were involved on creating the mean and SD statistics (A's and E's in Table 4-2 above), care must be taken in the use of the threshold value ranges.

4.2.2.2 Supplemental Indicator: Entrenchment

Entrenchment is the ratio between the width of the flood-prone area (horizontal distance across a channel, measured at twice the maximum bankfull depth) and the bankfull width of the channel. It is a prime descriptor of the relationship of the stream channel and its valley/landform features (Rosgen, 1994). Streams that are highly entrenched have little opportunity to dissipate flood flows outside the channel, while floods in slightly or non-entrenched streams spread out across the valley bottom. Consequently, entrenchment ratios will vary with stream type. Changes in entrenchment often occur simultaneously with changes in w/d ratio, and can result from changes in sediment supply or competency of the system.

A significant shift in entrenchment results in severe ramifications for sediment supply, as the ability to dissipate flood flow energy is a large factor in the amount of channel erosion that occurs. Changes in sinuosity, gradient, and w/d ratio can affect the entrenchment ratio. Entrenchment is not as responsive to land-use changes within the watershed as the w/d ratio, but a negative shift in entrenchment (toward a more entrenched state) is an indicator of instability.

Table 4-3 displays average entrenchment ratios of KNF reference streams, and the accompanying acceptable reference range adopted from Rosgen (1994) for streams of different channel types. The threshold values for entrenchment ratio for streams within the Yaak TPA are shown in the right-hand column. As larger entrenchment values are more desirable, an upper threshold value is not given. Rather, reference values from Rosgen (1994) are used as threshold indicators for possible impairment.

Table 4-3. Entrenchment for Kootenai National Forest Reference Streams

Rosgen Stream Type	Number of Reference	Mean Entrenchment Ratio	Indicator Threshold*
	Streams		
A	4	1.4	<1.4
В	54	1.7	>1.4
С	10	3.5	>2.2
Е	3	2.6	>2.2
F	8	1.2	<1.4

^{*}from Rosgen (1996)

4.2.2.3 Primary Indicator: Percent Surface Fines Less than 2mm and 6mm, Percent Subsurface Fines <6mm

Streams naturally have a wide variety of bed material sizes. Streams with too much fine material, however, can have inhibited biological communities due to the effects of fine sediment on the habitat requirements of aquatic organisms. Excessive fine sediment deposited on stream substrates can degrade the habitat of aquatic invertebrates and cause shifts in the invertebrate assemblage (Platts et al., 1989; Hawkins et al., 1983; Rinne, 1988; Mebane, 2001). For streams where excess fine sediment is a cause of concern, surface sediment size fractions of <2mm and <6mm in diameter are typically evaluated because aquatic life is most sensitive to increases in these size fractions. Evaluation of these sediment criteria provides evidence for support of aquatic life uses (fish and macroinvertebrates).

Several studies have linked increases in **surface fines <2mm** and **6mm** to detrimental effects on aquatic life:

- In a study of 562 streams in four northwestern states, Relyea et al. (2000) found that changes in invertebrate communities occur as fine sediments <2mm increase above 20% coverage by area.
- Hill et al. (2000) found that percent fines <2mm negatively correlated with periphyton biomass in mid-Atlantic streams.
- Zweig et al. (2001) in their work on four Missouri streams determined that taxa richness significantly linearly decreased with increasing deposited sediment in 3 of 4 streams.
- Suttle et al. (2004) showed that increasing concentrations of fines deceased growth and survival of salmonids. Linear relationship between increasing fine sediment and salmonid growth suggested that there is no threshold below which increased fine sediment delivery would not be detrimental to the growth of salmonids.
- Mebane (2001) found that higher levels of surface sediment <6mm negatively affected ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa and salmonid and sculpin fish species.

Stream channel substrate sampling (pebble counts) provides an indication of the type and distribution of bed material (surface fines <2mm and 6mm) in a stream. Wolman pebble counts (Wolman, 1954) were collected at numerous sites in the Yaak TPA prior to this study and at all 83 sites in 2003/2004 as part of the Yaak TPA Process. Interpretation of pebble count data allows data comparisons to reference conditions, literature values, or other criteria.

In addition to surface fines, increases in <u>subsurface</u> fines (those within the several upper inches of channel substrate) have shown to be detrimental to the propagation of salmonids. Weaver and Fraley (1991) showed a direct correlation between successful fry emergence and fine sediment in spawning gravels: increases in the percentage of fine sediment <6mm resulted in a decrease in fry emergence. Sampling and evaluation of subsurface fines (McNeil et al, 1964) through McNeil core sampling provides an indicator of impacts to embryo survival and emergence and are therefore good indicators to use for evaluation of aquatic life support uses – specifically fishery support.

Surface Fines Criteria (<2mm and <6mm)

Threshold surface fine sediment values have not been fully developed by DEQ or EPA. Local criteria development must consider both 'threshold effects' to aquatic life and reference conditions to determine whether beneficial uses are being impacted.

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 <2mm in diameter. The most sensitive taxa were affected at 20 percent surface fines, and a definite threshold was observed at 30 percent surface fines (Relyea, personal communication, April 28, 2004).

Reference reach data from streams in the KNF classified by Rosgen stream type for surface fines less than 2mm and 6mm is given in Table 4-4. Of all streams measured, most were B stream types, the predominant stream type on the KNF. These data demonstrate that natural (reference)

levels of fine sediment for a variety of stream types on the KNF are predominantly under 10%, with the exception of C3 stream types (n=4). Notwithstanding C3 streams, there is also little difference between the percent surface fines less than 6 mm and the percent surface fines less than 2 mm for the 79 reference streams measured. The lower end of particle size distribution curves for reference streams on the KNF is reasonably flat, showing approximately a 2-3% difference between 2mm and 6mm. (Figure 4-1).

Table 4-4.	Maan	Parcent	Straamh	and Finas	from	KNFI	Rafaranca	Straams
I ADIC 4-4.	viean	rerceni	Sireann	ea rines	irom		Keierence	Sireams

Rosgen	Number of	% <2mm	% <6mm
Rosgen Stream Type	Reference Streams		
В3	41	6	8
B4	28	4	5
C3	4	15	24
C4	11	2	4
E4	4	6	9
F3	4	10	11
F4	3	9	10

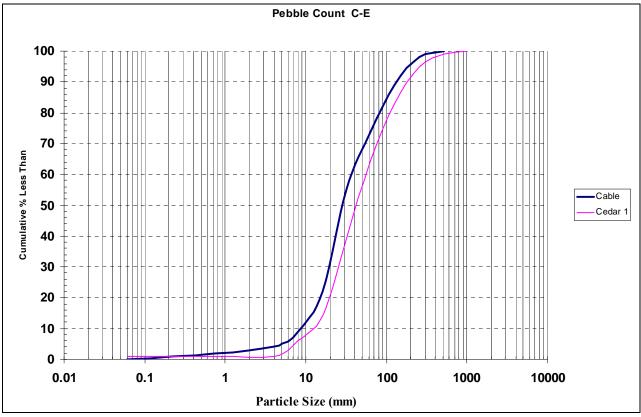


Figure 4-1. Wolman Pebble Count Curves for Two Reference Reaches

Subsurface Fines Criteria (<6mm)

As with percent surface fines, threshold subsurface fine sediment (<6mm) values have not been developed by DEQ or EPA. Criteria development must consider both 'threshold effects' to aquatic life and reference conditions.

Weaver and Fraley (1993) found a significant inverse relationship ($r^2 = 0.72$, P < 0.005, N = 17) between fry emergence success and the percentage of substrate fines <6.35 mm in diameter in streams in the Flathead National Forest. Mean fry emergence success was 76, 55, 39, 34, 26, and 4%, respectively, in cells containing 0, 10, 20, 30, 40, and 50% substrate materials < 6.35 mm (Figure 4-2).

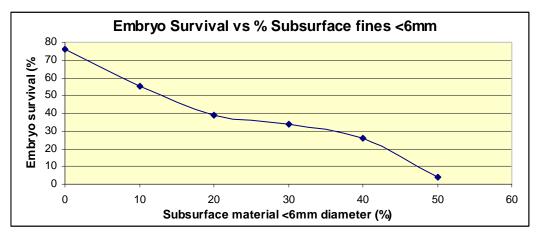


Figure 4-2. Embryo Survival vs. % Subsurface Fines <6mm (Weaver & Fraley, 1991)

Percentile statistics from reference data from streams in the KNF are given in Table 4-5. Percentile values rather than standard deviations are used to summarize the data. For nonparametric data sets, quartiles are often used to describe the data. Quartiles (25th and 75th percentiles) maintain the benefit of minimizing the effects of skewness and outliers. 75th percentiles of reference data are typically used by DEQ as water quality criteria for non-normal data sets. Kootenai reference site results show average percent substrate fines at reference sites monitored from 1997 –2003 ranged from 17 to 29 percent. Flattail Creek lies within the Yaak TPA and represents the most likely reference conditions suitable for impaired streams in the Yaak TPA. The 75th percentile values in Table 4-5 fall at or below 28% subsurface fines <6mm. Using the relationship in Figure 4-2, a value of 28% subsurface fines <6mm correlates roughly to a embryo survival rate of 34% to 39%, and serves as water quality indicator criteria for evaluation of aquatic life support uses – specifically fishery support for streams in the Yaak TPA.

Table 4-5. Kootenai National Forest Reference Data: Subsurface Fines <6mm

Tuble 1 5. Robbenul 1 autonul 1 of est Reference Duta. Subsultuce 1 mes - omm							
Kootenai Reference Sites	Percent subsurface fines <6mm						
(1997 - 2003)	Mean SD 25th Percentile 75th Percentile						
Bear Creek	19.0	6.0	16.7	22.5			
Flattail Creek	26.7	7.2	23.2	28.3			
Himes Creek	29.1	4.4	26.4	28.2			
Libby Creek	25.4	4.5	24.4	27.9			
West Fork Quartz Creek	17.1	3.6	15.2	18.0			
Upper Silver Butte Creek	21.0	4.3	19.2	23.0			

Summary of Surface and Subsurface Fine Sediment Indicator Values

Based on reference subsurface fines data, and threshold effects studies, percent surface fines (the fraction <2 mm and the fraction <6 mm) less than 20% are used as indicators of impairment in the Yaak TPA. Because reference values for surface fines <2mm and <6mm are generally lower than 20% (Table 4-4), and threshold effects on macroinvertebrate communities from fine sediment inputs are unclear, further examination of fine sediment thresholds for evaluation of macroinvertebrate aquatic life support determinations is warranted. Increases in surface fine sediment levels above reference conditions (and below the 20% threshold), while not directly attributable to threshold impacts to aquatic organisms, may impede growth and survival and should be cause for concern. Further monitoring to assess the impacts of increasing fine sediment levels on aquatic organism may help to refine threshold effects levels for aquatic organisms. The indicator value for subsurface fines <6mm is 28% based on reference conditions found in the KNF.

4.2.2.4 Supplemental Indicator: Pfankuch Stream Channel Stability

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, 1975). This procedure uses a qualitative measurement with associated mathematical values to reflect stream conditions. The rating is based on 15 scoring items in 3 categories: 6 items related to the bottom of the stream channel (the part of the channel covered by water yearlong), 5 items related to the lower banks (covered by water only during spring runoff), and 4 items related to the upper banks (covered by water only during flood stages). The sum of the 15 scoring items is then used to place the reach into one of three Rosgen Stream Type categories: good (or excellent), fair, or poor. Because of the value of this information, and the potential for similar historical information in many Yaak stream segments, the total (sum of the 15 scoring-items) Pfankuch Stream Channel Stability is used in this impairment assessment.

Because of natural differences among variables determining stream types, stream channel stability scores vary by Rosgen stream type. A rating of "fair" was chosen as the threshold for impairment because anything lower (poor) strongly suggests problems with the stream channel. Table 4-6 displays the threshold value score for each Rosgen Stream Type.

Table 4-6. Pfankuch Stream Channel Stability Scores for "Fair" Ratings, based on Rosgen Stream Types

Rosgen Stream Type	Threshold value SCORE for at least "Fair" rating
A2	<u>≤</u> 47
A3	<u>≤</u> 129
A4	<u>≤</u> 132
B2	<u>≤</u> 58
В3	≤78
B4	<u>≤</u> 84
C2	<u>≤</u> 61
C3	<u><</u> 105
C4	<u><</u> 110
E3	<u><</u> 86
E4- E5	<u>≤</u> 96

E6	<u>≤</u> 86
F2	<u>≤</u> 105
F3	≤125
F4	<125

In addition, two of the individual Pfankuch Stream Channel Stability evaluation items/factors were used to provide additional interpretative information for defining impairment. These are the portion of the channel bottom categorized as stable (called Channel Bottom Size Distribution Description) and the amount of scouring/deposition (Channel Bottom Scour/Deposition Description). These categories can provide information useful for interpretation of potential sediment impairments at selected sites within the Yaak TPA. 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 either of the items). Channel stability ratings are based on visual interpretation, and are therefore subject to observer bias, so use of this data is primarily used as supporting evidence of potential sediment impairments. In lieu of information that indicates the potential of a stream, a rating of "fair" or better is used as an impairment-indicator value for the Channel Stability ratings.

Channel Bottom Scouring and Deposition refers to the amount of movement or rearrangement of stream bottom particles into lateral and mid-channel bars in response to flow events. Scores are assigned from 6 to 24 as defined in Table 4-7.

Table 4-7. Stream Channel Stability, Channel Bottom Scour/Deposition Description

Condition Description	SCORE	Rating
<5% bottom affected by scour or deposition	6	Excellent
6-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	12	Good
31-50% affected. Deposits and scour at obstructions, constrictions, and bends. Some filling	18	Fair
of pools.		
More than 50% of bottom in flux nearly yearlong.	24	Poor

Channel Bottom Size Distribution and Percent Stable Materials refers to the fraction of the stream bottom that is considered stable during flow events, i.e., remains in place. This factor is evaluated as a deviation from what is expected for this stream segment, based on the surrounding streams, channels, and recent flood history. Scores are assigned from 4 to 16, as defined in Table 4-8.

Table 4-8. Stream Channel Stability, Channel Bottom Size Distribution Description

$\mathcal{L}_{\mathcal{L}}}}}}}}}}$	3)				
Condition Description	SCORE	Rating			
Expected distribution of channel bottom materials, stable material 80-100%	4	Excellent			
Slight shift from expected distribution of channel bottom materials, stable material 51-	8	Good			
80%					
Moderate shift from expected distribution of channel bottom materials, stable material 21-	12	Fair			
50%					
Pronounced shift from expected distribution of channel bottom materials, stable material	16	Poor			
0-20%					

Scores of at least "fair" for each of these items was established as the threshold value for these Supplementary Indicators (Table 4-7). Thus if more than 50% of the channel bottom was

affected by scouring and/or deposition, or if less than 21% of the channel bottom was identified as being "stable", impairment was implied.

4.2.3 Biological Indicators

Macroinvertebrate data help to provide a better understanding of the cumulative and intermittent impacts that occur over time in a stream and are a direct measure of the aquatic life beneficial use. Macroinvertebrate assemblages respond to siltation with a shift in natural or expected taxa to a prevalence of sediment tolerant taxa over those that require clean gravel substrates. Macroinvertebrate bioassessments scores are an assessment of the macroinvertebrate assemblage at a site and are used by DEQ to evaluate impairment condition and beneficial use support. A variety of macroinvertebrate metrics and indices have been developed to help assess aquatic life support conditions. Some are useful for assessing the overall health of the aquatic life community, while others assess the effects of a specific stressor on macroinvertebrate assemblages. The advantage of these bioassessment tools is that they provide a measure of support of associated aquatic life, an established beneficial use of Montana's waters.

Two bioassessment methods, RIVPACS and MMI (Section 4.2.3.1) have been adopted by DEQ and provide the primary indicator of whether macroinvertebrate aquatic life uses are being supported. Where appropriate, supplemental bioassessment metrics that distinguish cumulative or stressor-specific impacts are qualitatively evaluated. Supplemental biological indicators are not considered to be as reliable in distinguishing between specific stressors or degrees of impact, and so are weighted accordingly in impairment determinations.

4.2.3.1 Primary Indicators: RIVPACS and MMI SCORE

In 2006, DEQ adopted impairment thresholds for bioassessment scores based on two separate methodologies. The Multi-Metric Index method assesses biological integrity of a sample based on a battery of individual biometrics. The River Invertebrate Prediction and Classification System (RIVPACS) method utilizes a probabilistic model based on the taxa assemblage that would be expected at a similar reference site. Based on these tools, DEQ adopted bioassessment thresholds that were reflective of conditions that supported a diverse and biologically unimpaired macroinvertebrate assemblage, therefore a direct indication of beneficial use support for aquatic life.

The MMI is organized based on the different ecoregions within Montana. Three MMIs are used to represent the various Montana ecoregions: Mountain, Low Valley, and Plains. Each region has specific bioassessment threshold criteria that represent full support of macroinvertebrate aquatic life uses. The Yaak Watershed falls within the Mountain MMI region. The MMI score is based upon the average of a variety of individual metric scores. The metric scores measure predictable attributes of benthic macroinvertebrate communities to make inferences regarding aquatic life condition when pollution or pollutants affect stream systems and instream biota.

The RIVPACS model compares the taxa that are expected at a site under a variety of environmental conditions with the actual taxa that were found when the site was sampled. The RIVPACS model provides a single dimensionless ratio to infer the health of the

macroinvertebrate community. This ratio is referred to as the Observed/Expected (O/E) value. Used in combination, the results suggest strong evidence that a water body is either supporting or non-supporting its aquatic life uses for aquatic invertebrates.

For the MMI, individual metric scores are averaged to obtain the final MMI score. The score will range between 0 and 100. The impairment threshold for the mountain MMI is 63. This impairment threshold (10th percentile of the reference dataset) represents the point where DEQ technical staff believed macroinvertebrates are affected by some kind of impairment (e.g. loss of sensitive taxa).

The RIVPACS impairment threshold for all Montana streams is any O/E value <0.8. However, the RIVPACS model has a bidirectional response to nutrient impairment. Some stressors cause macroinvertebrate populations to decrease right away (e.g. metals contamination) which causes the score to decrease below the impairment threshold of 0.8. Nutrient enrichment may actually increase the macroinvertebrate population diversity before eventually decreasing below 0.8. High RIVPACS scores (>1.2) may indicate impairment from nutrient enrichment.

Most scores significantly below the RIVPACS and MMI impairment thresholds indicate impairment. Some model scores may be close to the threshold. These sites may be considered unimpaired in some situations. For example, a site classified in the Mountain ecoregion may have a Mountain MMI score of 83, well above the Mountain MMI threshold (63), and a RIVPACS score of 0.76, close to the RIVPACS impairment threshold (0.8). The assessor may determine that the macroinvertebrate community at the site is unimpaired. Ultimately, the assessor will determine the degree of impairment (i.e. moderate or severe) using best professional judgment and guidance found in the state's bioassessment process (DEQ, 2006).

4.2.3.2 Supplemental Indicator: Fine Sediment Index-EPT (FSI-EPT)

A large-scale study of western streams found that not all Ephemeroptera, Plecoptera, and Trichoptera taxa respond to increases in fine sediment in the same way (Relyea 2005). The EPT are generally considered sensitive to pollution and EPT metrics are commonly used in bioassessment protocols. However, when only fine sediment is considered as the pollutant, these groups have taxa that range from very sensitive, Rhithrogena, to very insensitive, Paraleptophlebia, even though both are Ephemeropterans. In a study of 428 streams in the Northern Rockies ecoregion, the average Fine Sediment Index -EPT taxa had 13 sensitive taxa per stream (Relyea, 2005). This value was combined with the maximum FSI-EPT score to select an indicator value of 17 FSI-EPT taxa, a surrogate indicator for streams in the Northern Rockies ecoregion least impacted by fine sediment.

4.2.3.3 Supplemental Indicator: Percentage of FSI-Sensitive Taxa

This metric describes the percentage of the community that is sensitive to increases in fine sediment (Relyea, 2005). In western montane streams, the number of macroinvertebrate taxa that are sensitive to fine sediment is typically 50% of the total or higher. In the Yaak TPA, a value of 40% sensitive taxa was chosen as a surrogate indicator for streams least impacted by fine sediment.

4.2.3.4 Supplemental Indicator: Fine Sediment Index

The FSI is a regional, stressor-specific biomonitoring index for use in assessing fine sediment (<2mm) impacts on macroinvertebrate communities. The FSI can be useful because of the documented relationship between the macroinvertebrate metric, aquatic life health, and sediment stressors. It is, however, best used to indicate stress to the aquatic system as it is not able to identify a threshold where sediment impacts begin.

Benthic macroinvertebrate and substrate particles sizes for 1,134 streams spanning 16 western Level III ecoregions (Omernik, 1987) were examined to determine species sensitivity to fine sediment (Relyea, 2005). For every species found, relative abundances and range of occurrence over fine sediment categories from 0% through 100% fines were used to determine species sensitivity to fine sediment. All taxa examined could be found in streams with up to 20% fine sediment (<2mm), however, above this level, taxa started disappearing. In the western U.S., 116 taxa exhibit some degree of sensitivity to fine sediment. Macroinvertebrate taxa are assigned values corresponding to their sensitivity. The values from all sensitive taxa in a sample are then tallied to provide a score for that stream. Using only streams from the Northern Rockies Ecoregion (n=428), a threshold value of 205 was developed at the 75th percentile. Northern Rockies streams scoring 205 or higher are considered not to be stressed by sediment (or other stressors). For streams scoring below 105 (25th percentile), stress by sediment and/or other causes is suggested. Scores between the 75th and 25th percentile suggest moderate stress to the aquatic system, possibly due to fine sediment.

4.2.4 Landscape-Scale Sediment Indicators

Several other landscape-scale information sources were included to help define impairment and to describe the impact and magnitude of potential sources of sediment in the Yaak TPA. Factors used are listed below.

- Percent Equivalent Clear-Cut Acres
- Road/Stream Crossing Density
- Watershed Road Density

These factors were chosen because of the availability of data, the linkage to potential sediment inputs, and because they are congruent with USDA/KNF Watershed Condition Evaluation criteria in the Draft Comprehensive Evaluation Report (CER) for the Kootenai and Idaho Panhandle Proposed Land Management Plans (USDA, 2006).

"The CER evaluates the relevant conditions and trends under the 1987 Forest Plans and the Proposed Land Management Plan (the Plan). The CER identifies factors that affect conditions and trends, includes information on what is causing conditions to change, and describes the influence the Plan has on moving toward desired conditions. In addition, the CER evaluates the likelihood of meeting the desired conditions and objectives pertinent to the social, economic, and ecological sustainability elements through Plan implementation. Results derived from forest plan monitoring and evaluation reports are included in assessing the performance of Land Management Plan direction and implementation." (USDA, 2006)

Appendix H – Watershed, Soils, and Aquatic Species and Habitat (USDA, 2006), of the CER establishes a methodology for evaluating watershed condition, and utilizes the Watershed Condition Disturbance Evaluation Factors in Table 4-9. Two of the most heavily weighted variables (% ECA and Stream Crossing Density) were used as supplemental indicators of impairment in the Yaak TPA. Screening criteria was set in the 'moderate' range for these indicators. In addition, watershed road density (rather than riparian area road density) was used as a supplemental indicator. These indicators are useful screening tools to evaluate possible impacts to the stream and to aid in interpreting primary indicators. However, they are not direct measurements of water quality condition and may not be a reflection of current channel or ground conditions.

Table 4-9. Watershed Disturbance Calculation

Watershed Condition Disturbance Evaluation	Factor	High	Moderate	Low
Factors	Weight	(3x)	(2x)	(1x)
1) %ECA for the Watershed	3	>30%	15-30%	<15%
2) % Intact Riparian	2	< 70%	70-80%	>80%
3) Stream Crossing Density (#/mi2 of Watershed)	3	$>3/\text{mi}^2$	1.5/mi2-3/mi2	$<1.5/mi^{2}$
4) % Detrimental Compaction	1	>10%	4-9.9%	<4%
5) Riparian Area Road Density (Factor based on Mean A	Annual Prec	ipitation (MAP)	for the 6th HUC V	Vatershed)
MAP >45"	2	>2.0 mi/mi ²	$0.5-2.0 \text{ mi/mi}^2$	<0.5 mi/mi ²
MAP 20-45"	2	>3.0 mi/mi ²	$1.0-3.0 \text{ mi/mi}^2$	<1.0 mi/mi ²
MAP <20"	2	>3.0 mi mi ²	1.5-3.0 mi/mi ²	<1.5 mi/mi ²

USDA, 2006

4.2.4.1 Supplemental Indicator: Percent Equivalent Clear-Cut Acreage

The potential peak flow impact of forest harvest was evaluated by calculating the equivalent clear-cut acreage (ECA) for each watershed, looking at the last 40 years of information. ECA is an estimate of the cumulative effect of multiple years of forest crown removal (from harvest, fire and roads) and is calculated by considering the timing and/or amount of activities in the watershed. ECA includes a vegetative recovery component for harvested acreages, reflecting current conditions.

Regarding appropriate ECA thresholds that may indicate impacts to surface waters:

- Jones and Grant (1996) stated that a basin harvest of greater than 25% suggests a potential for channel alteration as a result of altered flow regimes within the watershed.
- The Draft Comprehensive Evaluation Report for the Kootenai and Idaho Panhandle Proposed Land Management Plans considers ECAs of <15% low, 15-30% as moderate, and >30% as high in its 'watershed condition disturbance evaluation'.

For this reason a threshold value of 25% ECA was used as supplemental screening threshold in the Yaak TPA analysis.

4.2.4.2 Supplemental Indicator: Stream Crossings Density

Roads have long been known to be the source of the majority of sediment delivered to stream channels from logging operations (Swanston et al, 1976; Rice and Lewis, 1991). Stream crossings are generally the most sensitive part of the road system from a sediment production standpoint and are often the source of introduced fine sediment. The number of stream crossings is an indicator of the opportunity for sediment introduction and also may also represent sites where streamflow is augmented by road-intercepted runoff. For these reasons, this factor was included as one of the Supplemental Indicators for defining and evaluating impairment.

The *Draft Comprehensive Evaluation Report for the Kootenai and Idaho Panhandle Proposed Land Management Plans* considers steam crossing densities of <1.5/mi² low, 1.5/mi² -3.0/ mi² as moderate, and >3.0/ mi² as high in its 'watershed condition disturbance evaluation' (Appendix H). A value of 3.0 crossings/ mi² was chosen as a screening-level criteria for potential sediment impacts to streams in the Yaak TPA.

4.2.4.3 Supplemental Indicator: Watershed Road Density

As described above under Stream Crossings Density, roads can have a dramatic impact on watershed conditions in a basin. Thus a variable called Road Density was derived that relates the miles of road to the size of the basin, as an indicator of the amount of activity and disturbance within a given watershed.

A road network density of <3.0 miles per square mile of watershed area was used as a screening level criteria for potential sediment impacts to streams in the Yaak TPA. This value does not imply direct sediment impacts to streams but indicates that potential problems may exist where road densities are high. This value was generated in 2002 by the Hydrologists in the KNF as part of a forest wide project to create consistent indicators of watershed health and condition and to assist in impairment status evaluations.

4.2.5 Additional/Supplemental Information

4.2.5.1 Sediment Source Surveys

Sediment source surveys have been conducted in the Yaak TPA by the Yaak Headwaters Partnership Group since 2001. Surveys have been completed in several watersheds within the Yaak TPA including the South Fork Yaak River, Seventeenmile Creek, and Lap Creek. All major stream channels and most tributaries were walked by survey crews. Information was collected at every road crossing and other sites that deliver sediment to streams such as mass wasting sites, road fill failures, bank erosion. Sediment delivery from road crossings and non-crossing sites are classified as "none", "minor", "moderate", or "substantial" based on comparison to other sites reviewed. Both natural and anthropogenic sediment sources were inventoried and quantified where possible.

4.2.5.2 Additional Site- and Basin-Specific Information

At several sites within the Yaak TPA, similar data has been collected in the past at the same locations as were sampled in 2003/2004, and at numerous other locations. Over the last 10-15

years, stream channel stability, channel morphology and aquatic macroinvertebrate-information was also collected within the Yaak TPA. Some of this information is every bit as valuable as that collected during the field-sampling phase of this impairment determination (the aquatic macroinvertebrate information), but some of it is not as precise, or was done differently than is currently done (channel stability and the channel morphology variables).

In addition, some other data-types (i.e. McNeil core data, Riffle Stability Index [RSI]) had been collected as part of these previous surveys. Where available, these data were used to further describe conditions that existed in a given reach.

4.3 Water Quality Impairment Summary

Section 4.3 presents evaluations and summaries of all available water quality data for sediment impaired streams in the Yaak TPA: Seventeenmile Creek, South Fork Yaak River, and Lap Creek. The weight-of-evidence approach described above in Section 4.1, using a suite of delineative criteria, supplemental indicators and supplemental information has been utilized to evaluate sediment impairment conditions.

4.3.1 Seventeenmile Creek

Seventeenmile Creek is a relatively large (39,900 acre watershed) tributary to the mainstem Yaak River, entering the Yaak River Valley from the east about three miles above Yaak Falls (Figure 4-4) Major named tributaries include North Fork Seventeenmile Creek (7,000 acre watershed) and Flattail Creek (6,500 acres).

The Seventeenmile Creek Watershed includes several non-forested areas, with some private cleared fields, particularly in the lower part of the watershed. Two Inventoried Roadless Areas (Roderick and Saddle Mountain) make up over 60% of the watershed. The Forest Service manages the entire watershed with the exception of 330 acres of private land along the lower section of Seventeenmile Creek. Historic fire has played a significant role in the watershed, particularly at the upper elevations, in the early 1900s and in 1994. The Gunsight and Seventeenmile Fires of 1994 (lightning-caused) burned over 2,400 acres (6%) in this watershed.

Forest management (timber harvest) was significant in the upper watershed between the 1950s and early 1980s. Since harvest, Grizzly Bear Core Management Area (GCMA) designation has resulted in the closure of forest roads within GCMA in the Seventeenmile Creek watershed. Many roads within GCMA have been closed for at least ten years (more in some areas).

The cold-water fishery beneficial use was listed as impaired on the 1996 303(d) List for flow alteration, other habitat alteration, siltation, and suspended solids. The basis for the 1996 listing was unknown. DEQ lacked sufficient credible data to include this waterbody on the 2000 303(d) List. As a result, reassessment sampling for Seventeenmile Creek began in August of 2003 and was completed in October of 2004, and updated impairment determinations were included on the 2006 303(d) List.

Several survey sites were established and measured on Seventeenmile Creek in 2003 and 2004 as part of the Yaak TPA (Figure 4-4). Three sites were established on the mainstem and one each on the North Fork Seventeenmile, Flattail Creek, and Lost Fork Creek. In addition, information from several other sites on the mainstem and on tributaries was evaluated in the basin review, including some with data back to the 1990s.

The main channel of Seventeenmile Creek flows through a Type II valley bottom. Typical of most Type II valleys, the Seventeenmile Creek channel is predominately a Rosgen "B" stream type with many Rosgen "C" reaches. There is little evidence of channel instability caused by natural processes, and the streambanks are stable and well-vegetated. Figures 4-5 through 4-8 display some of the stream and channel characteristics common to sites on Seventeenmile Creek.

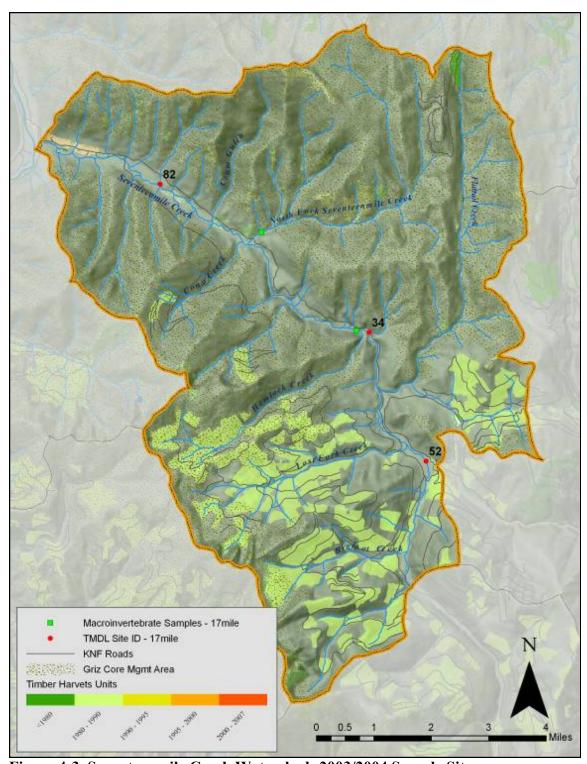


Figure 4-3. Seventeenmile Creek Watershed: 2003/2004 Sample Sites

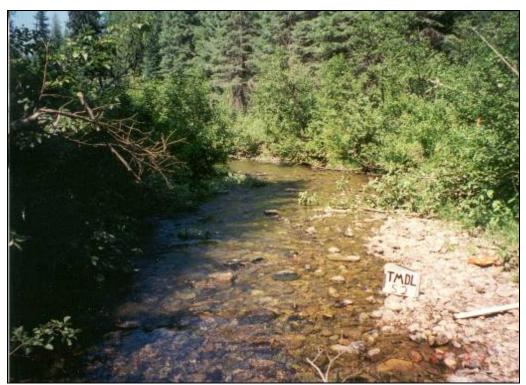


Figure 4-4. Upper Seventeenmile Creek (site 52 above Bridle Creek)



Figure 4-5. Middle Seventeenmile Creek at Site 34, looking downstream (site is above Hemlock Creek confluence)



Figure 4-6. Middle Seventeenmile Creek above Hemlock Creek (site 34, upper reach looking upstream)



Figure 4-7. Lower Seventeenmile Creek at Site 82 looking downstream (site is above Bridle Creek)

4.3.1.1 Seventeenmile Creek In-Stream Sediment Indicators

A review of the available data is presented here including channel morphology information, channel substrate (Wolman pebble counts), Pfankuch Channel Stability Items, RSI, McNeil core samples, and potential sediment sources.

Cross-section channel morphology data was collected at three sites on Seventeenmile Creek in 2003 and 2004. Site 82, lowest Seventeenmile Creek, was added in 2004 to provide information for the lower part of the channel. These data were analyzed to determine width-to-depth ratios and entrenchment (i.e. channel morphology) for each sampling location and the results were compared to data from local reference sites. The results for each site are presented in Table 4-10. Bolded-values indicate delineative criteria exceedences.

Table 4-10. Mainstem Seventeenmile Creek Channel Morphology Values, 2003/2004

Site ID	Site Name	Stream Type	Entrenchment	Width/Depth Ratio
52	Upper Seventeenmile (above Lost Fork)	ВЗс	1.5	21.2
34	Seventeenmile(above Hemlock)	C4	3.5	19.9
82	Lower Seventeenmile (above Bridle)	C4c	2.5	14

Review of this table reveals that all sites on the mainstem of Seventeenmile Creek met the channel morphology criterion. At the site (reach) above Hemlock Creek (34), there are numerous unvegetated gravel bars, signs of localized instability. RSI information collected at this site in both 1995 and 2003 indicated a high percentage of the channel was instable. This is an area that has historically had beaver dams and it could have been affected by a beaver-dam breach during one of the recent high water events (spring runoff). Given the natural beaver and recent runoff history here, it does not appear that the channel morphology parameters imply sediment impairment.

Table 4-11 displays historic channel morphology and channel stability information collected on Mainstem Seventeenmile Creek, collected in 1993 and 1995, from sites located between just above Bridle Creek to above Big Foot Creek (criterion exceedences are noted in bold).

Table 4-11. Mainstem Seventeenmile Creek Channel Morphology Values, 1993 and 1995

Site ID	Site Location	Date sampled	Stream Type	Width/depth	Entrench- ment	SCS SCORE
CE-13	Seventeenmile above North Fork	1993	ВЗс	21.5	1.4	
CE-14	Seventeenmile above Bigfoot	1993	B4c	30	1.8	
17MI3560	Seventeenmile above Lost Fork (near 52)	7/6/1995	C4	23.4		
17MI3600	Seventeenmile between Lost Fork and Big Foot	7/22/1993	C4	15.2		120
17MI3760	Seventeenmile above Big Foot	7/20/1993	C4	15.0	4.0	108

Width-depth exceedences (bold): CE-14 value is above/outside of the reference range and suggest concern. All other exceedences are below the bottom value in the threshold value range.

Stream Channel Stability exceedences (bold): 17MI3600 is the only site in this historic data set that exceeded the threshold value.

Channel Surface Fine Sediment Less than 2 mm and 6 mm: Channel substrate information has been collected at five sampling sites on Seventeenmile Creek. Two sites have data from the early 1990s, and the remaining three sites were sampled in 2003 (Table 4-12).

Table 4-12. Seventeenmile Creek Channel Surface Fine Sediment (% <2mm and <6mm)

Site ID	Site Name	199	91	19	92	19	93	19	95	2003	/2004
		<2	<6	<2	<6	<2	<6	<2	<6	<2	<6
52	Upper Seventeenmile									21	21
	(above Lost Fork)										
34	Seventeenmile									20	20
	(above Hemlock)										
CE 13	Seventeenmile	16	16	5	10	14	20	5	9		
	(above North Fork)										
CE 14	Seventeenmile					12	25				
	(above Bigfoot)										
82	Lower Seventeenmile									5	10
	(above Bridle)										

Bolded-text indicates exceedence of threshold values (less than 20%, for both size classes). Analysis of the 2003 and 2004 data indicates that two of the three sites have percent surface fines values that are just at or slightly above the threshold value of 20%. Surface fines at the lower mainstem sampling location (82) had surface fine values below threshold values. Both of the long-term cumulative effects stations (CE-13 and CE-14) slightly exceeded the threshold value in 1993 but were within thresholds in all other years sampled. No observable trend in surface sediment is observed in the data.

High surface fines levels at the upper two sites (52 and 34) suggests that there may be an impairment to fish and aquatic life (indirect evidence given the relationship between % fines and these beneficial uses). Also, the data at the upper two sites suggests that there may be a sediment supply problem that has resulted in deposition of fines <2mm and <6mm above reference levels (Table 4-4).

Other available data included McNeil core samples that were collected in the early to mid-1990s at site CE-13. The McNeil core data from this site ranged from 16.6% to 22.3% for subsurface fines between 1991 and 1995, below the 28% criteria for McNeil core data.

Channel Stability evaluations were conducted at three sampling locations in 2003 and 2004 (Table 3-18). All three sites met both the total and the specific-item thresholds. Field notes indicate the middle and lower sampling locations (sites 34 and 82) reflected some past accelerated bedload sediment movement in the form of depositional bars, reflected in the scores for these two items. These findings were corroborated by data from the 1990s.

Table 4-13. Seventeenmile Creek Channel Stability Ratings, 2003/2004

Site ID	Stream Name	Channel Stability		Scouring and	Stable Channel
		Threshold value	SCORE	Deposition	Bottom Materials
52	Upper Seventeenmile (above Lost Fork)	≤78	60 / Good	Good	Good
34	Seventeenmile (above Hemlock)	<u>≤</u> 110	93 / Fair	Fair	Fair
82	Lower Seventeenmile (above Bridle)	≤110	63 / Good	Good	Fair

In addition, Stream Channel Stability evaluations were conducted on Seventeenmile Creek between 1993 and 1995 at seventeen different reaches, from the headwaters upstream of Big Foot Creek to the confluence with the Kootenai River. Examination of these Channel Stability Ratings indicated that almost all sites met the core values for their specific stream type. Only Seventeenmile Creek at elevation 3,600 feet (17MI3600), a Rosgen C4 channel reviewed in 1993, had a channel stability outside of the acceptable range.

4.3.1.2 Seventeenmile Creek Biological Indicators

During the primary data gathering period for the Yaak TPA Impairment Determination, macroinvertebrate samples were collected at two stations. One sampling location on the mainstem of Seventeenmile Creek (K03SVNTC02) and one site on lower end of the North Fork of Seventeenmile Creek (K03SVNTC01) (Figure 4-4) were sampled. Tables 4-13A and 4-13B display and summarize the available macroinvertebrate information for both sites. Bolded values indicate exceedences of threshold values (threshold values indicated in parentheses).

Table 4-14a, Seventeenmile Creek RIVPACS and MMI Results

Site Name	RIVPACS (>0.80)	MMI (>63)
Seventeenmile Creek (K03SVNTC02)	0.93	76.9
North Fork of Seventeenmile Creek (K03SVNTC01)	1.00	85.4

Table 4-14b. Seventeenmile Creek FSI Summary

Site Name	FSI- EPT	% FSI Sensitive	FSI
	(<u>≥</u> 17)	(>40)	(<u>≥</u> 205)
Seventeenmile Creek (K03SVNTC02)	17	60	225
North Fork of Seventeenmile Creek (K03SVNTC01)	23	56	265

Seventeenmile Creek scored within the threshold values for all macroinvertebrate metrics. Macroinvertebrate assessments in Seventeenmile Creek do not imply impairments to the macroinvertebrate community: 60% of the community is sediment sensitive and seven taxa are semivoltine, meaning that more than one year is required for the aquatic portion of the life cycle. Semivoltine organisms usually require stable stream conditions and their presence indicates minimal stream disturbances and adequate flows.

4.3.1.3 Seventeenmile Creek Landscape-Scale Sediment Indicators

Table 4-15 displays the landscape-scale sediment indicators analyzed for Seventeenmile Creek watershed, including information for tributary watersheds with confluences above the identified sites.

Table 4-15. Seventeenmile Creek Basin-Level Forest Management Indicators

Site ID	Site Name	%ECA Stream Crossing		Road Density
		Value	Density	$(<3.0 \text{ mi/mi}^2)$
		(<25%)	(<3.0 crossings/mi ²)	
52	Upper Seventeenmile (above Lost Fork)	20	2.9	4.1
34	Seventeenmile (above Hemlock)	14 (19*)	2.3 (2.9*)	2.7 (3.5*)
82	Lower Seventeenmile(above Bridle	12	1.7	1.8
	Creek confluence)			

^{*}values with reference watershed, Flattail Creek, removed from analysis

Percent Equivalent Clearcut Acres: ECA values for all sites met the threshold value of 25%. With the exception of Flattail Creek drainage which has a low %ECA, ECAs in the upper watershed are moderate (20%). In the 1970s, the calculated ECA for the watershed was 30% so the current ECA reflects the vegetative recovery that has occurred since that timeframe.

Stream Crossing Density: Stream crossing densities for each site were at or below the indicator value of 3.0 crossings per square mile at all sampling sites located along the mainstem of Seventeenmile Creek.

Road Density: The road density threshold was exceeded at the upper mainstem site (52), but was well under at the other sites and for the portion of the basin above that site.

ECA, stream crossing density, and road density in the upper watershed are the highest in the entire watershed. Upper Seventeenmile Creek was heavily managed for timber harvest in the early 1980s (Figure 4-4). This activity may have contributed to the higher surface fine values at sites 52 and 34 (Table 4-12) and may be contributing to legacy fine sediment effects in Seventeenmile Creek.

4.3.1.4 Seventeenmile Creek Sediment Source Surveys

Sediment Source Surveys were conducted in Seventeenmile Creek by the Yaak Headwaters Restoration Partnership² (YHRP) in the summer of 2005 and 2006. Survey crews identified and assessed nearly all (over 130) road/stream crossings in the watershed: over 75% of crossings were in the Upper Seventeenmile watershed (above site 34). Many road/stream crossing sites were within GCMA, a special designation by the USFWS. All roads within GCMA are closed to motorized use, and a majority of the forest roads have been closed for more than ten years. Since closure, vegetative growth on many GCMA roads has drastically reduced sediment contributed to streams at these crossings. Approximately 30% of the road/stream crossings in Seventeenmile Creek are within GCMA.

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² YHRP is a collective consisting of representation from the USFS, USFWS, FWP, Yaak Valley Forest Council, Trout Unlimited, and the Cutthroat Trout Foundation.

In addition to roads within GCMA, the USFS has closed other roads for administrative use only. Sediment contributions from these roads is likely considerably less than from seasonally-open forest roads.

Survey crews also identified twelve (12) non-road-related sediment sources in the Seventeenmile Creek Watershed. Non road related sources consisted of areas of identified bank & hillslope erosion and upslope mass failure. Non-road – related sources were predominantly natural occurrences: anthropogenic non-road-related source occurrences were not significant sources of sediment to Seventeenmile Creek.

4.3.1.5 Seventeenmile Creek Water Quality Impairment Summary

Table 4-16 provides a summary of Primary and Supplemental Indicators used for determining impairment condition for Seventeenmile Creek.

Table 4-16. Sediment Impairment Data Evaluation - Seventeenmile Creek

Sediment Impairment Indicator	Threshold Value	Available Data or Information
In-Stream Sediment Indicators	,	
Width to Depth Ratio	Variable	23 sites evaluated- All sites except 1 site in 1993 and 1 in
	(Table 4-2)	1995 met threshold
Entrenchment	Variable	20 sites evaluated: seven sites exceeded threshold.
	(Table 4-3)	
Percentage of Surface Fines <6 mm	<20%	8 site/date combinations evaluated- 1 of 3 2003/2004
		sites met threshold, 2 slightly exceeded; 2 sites in 1993 exceeded
Percentage of Surface Fines <2 mm	<20%	8 site/date combinations evaluated- 1 of three 2003/2004
-		sites met threshold, 2 slightly exceeded
Percentage of Subsurface Fines <6mm	<28%	One site evaluated: met threshold.
Pfankuch Stream Channel Stability	<u>></u> "fair"	20 sites evaluated- All 2003 sites met threshold, 1 site in
		1993 exceeded
Stream Channel Stability-	<u>></u> "fair"	3 sites evaluated in 2003- All sites met threshold
Scouring/Deposition		
Stream Channel Stability- Distribution	≥ "fair"	3 sites evaluated in 2003- All sites met threshold
and Stability of Channel Bottom		
Materials		
Biological Indicators		
Montana Multimetric Index SCORE	>63	Both mainstem and North Fork tributary met threshold
(MMI)		
River Invertebrate Prediction and	>0.80	Both mainstem and North Fork tributary met threshold
Classification System SCORE		
(RIVPACS) Fine Sediment Index-EPT	>17	Doth mainstant and North Early tribute ment through ald
		Both mainstem and North Fork tributary met threshold
Percentage of FSI-Sensitive Taxa Macro-Invertebrate FSI	<u>>40%</u>	Both mainstem and North Fork tributary met threshold Both mainstem and North Fork tributary met threshold
	≥ 205	Both manistem and North Fork tributary met threshold
Landscape-Scale Sediment Indicators	250/	2 2 4 1 11
% Equivalent Clear-Cut Area	<25%	3 sites met threshold
Stream Crossing Density (#/mi2)	<3.0	3 sites met threshold
Total Road Density (miles/mi2)	<3.0	2 of 3 sites met threshold
Sediment Source Survey	Qualitative	125 road/stream crossings

Information contained in Table 4-16 was used to answer the four key questions relating to a sediment-impairment determination.

- 1. Are the fish and aquatic life beneficial uses impaired?

 Primary biological indicators (MMI and RIVPACS) do not suggest impairment to macroinvertebrate communities. Primary sediment indicators (surface fines <6mm and <2mm) suggest possible aquatic life impairment (fish) as there were exceedences among the data, particularly for the upper reaches. Elevation of surface fines above reference and/or threshold conditions is an indicator of potential impacts to aquatic life and is cause for an impairment determination when supported by supplemental indicators of impairment.
- 2. Have anthropogenic sources increased sediment erosion and/or delivery, contributing to or causing impairment?
 Historic timber harvest in upper Seventeenmile Creek Watershed has resulted in high % ECA, stream crossing density, and total road density (table 4-15). This activity has increased sediment loading (predominantly from road/stream crossings) to streams and may be responsible for high channel surface fine values in Seventeenmile Creek.
- 3. Is there a sediment supply problem contributing to impairment (i.e., is there too much or too little sediment in the stream)?

Sediment Source Surveys verify fine sediment contribution at road/stream crossings and channel surface fines are elevated above reference conditions. In some instances, surface fines are elevated above aquatic impairment thresholds, indicating potential impairment to aquatic life.

4. Is there an indication of an in-channel sediment transport problem contributing to or causing impairment?

Current bankfull width-to-depth and the entrenchment ratios also do not suggest sediment transport problem contributing to or causing impairment. Pfankuch Stream Channel Stability Information collected at 20 sites over a 10 year period, Stream Channel Stability- Scouring and/or Deposition Item, and the Stream Channel Stability- Distribution and Stability of Channel Bottom Materials Items also do not indicate sediment transport problem contributing to or causing impairment.

Due to elevated surface fine values and legacy effects of historic timber harvest activities (high ECA, road crossing densities, and total road densities) in the Upper Seventeenmile watershed, Seventeenmile Creek was listed as impaired from sediment on the 2006 303(d) List. A sediment TMDL for Seventeenmile Creek is presented in Section 6.

4.3.2 Lap Creek

Lap Creek is a relatively small (3,500 acre watershed), generally east-flowing 3rd order tributary to the Yaak River (Figure 4-9). Lap Creek Watershed is almost entirely managed by the Forest Service. Forest harvest was significant in the upper watershed between the 1950s and early

1980s. Since harvest, GCMA designation has resulted in the closure of nearly all forest roads within Lap Creek Watershed in the early 1990s.

The cold-water fishery beneficial use was listed as impaired on the 1996 303(d) List for flow alteration and other habitat alteration. The basis for the 1996 listing was unknown. DEQ lacked sufficient credible data to include this water body on the 2002 303(d) List. As a result, reassessment sampling was completed for the Lap Creek in August 2003 and updated impairment determinations were included on the 2006 303(d) List.

Three monitoring sites were located on Lap Creek in 2003 for the Yaak TPA Process (Figure 4-9). The sampling locations included one site (28) very near a Forest Service Cumulative Effects (CE) site that had been established in 1991 (CE-21) in the middle portion of the watershed; and two additional sites above and below the CE site, sites 53 and 27, respectively.

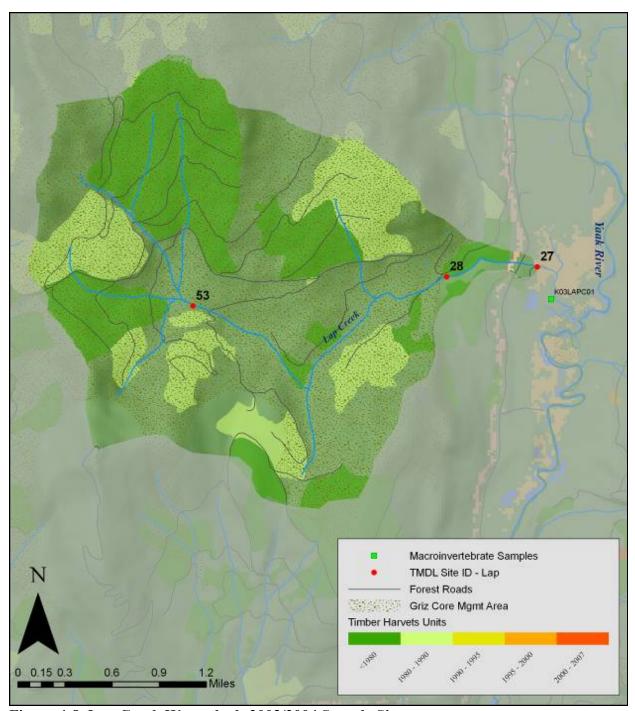


Figure 4-8. Lap Creek Watershed: 2003/2004 Sample Sites

The main channel of Lap Creek flows through a Type II valley bottom. Typical of Type II Valleys, Lap Creek is predominately a Rosgen "B" stream type. There is little evidence of channel instability caused by natural processes. Stream banks are stable and well-vegetated. Figures 4-10 through 4-12 display some of the stream and channel characteristics common to sites on Lap Creek.



Figure 4-9. Lap Creek, Lower Reach (Site 27) Looking upstream



Figure 4-10. Lap Creek, Lower Reach (Site 28) Looking downstream

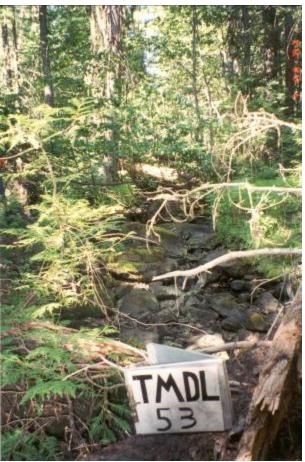


Figure 4-11. Lap Creek, Upper Reach (Site 53) Looking upstream

4.3.2.1 Lap Creek In-Stream Sediment Indicators

A review of the available data is presented here, including channel morphology information, channel substrate (Wolman pebble counts), Pfankuch Channel Stability Items, RSI, Mc Neil core samples, and potential sediment sources.

Cross-section channel morphology data was collected at three locations on the mainstem of Lap Creek in 2003 (Table 4-17). These data were analyzed to determine width-to-depth ratios and entrenchment for each sampling location and the results were compared to data from reference sites. The results for each site sampled in 2003 are presented in Table 4-17. Table 4-18 displays historical channel morphology data from the CE-site sampled in 1993 and from 3 other sites sampled in 1995. In both tables, **bolded-values** indicate delineative criteria exceedences.

Table 4-17. Lap Creek Channel Morphology Values, 2003/2004

Site ID	Site Name	Stream Type	Entrenchment	Width/Depth Ratio
53	Upper Lap Creek	B3a	1.8	10.5
28	Middle Lap Creek	B3a	1.6	45.6
27	Lower Lap Creek	В3	1.6	18.5

Table 4-18. Lap Creek Channel Morphology Values, 1993 and 1995							
Site ID	Site Location	Date	Stream	Width	Entrench-		
		sampled	Type	/ depth	ment		
LAP4040	Lap Creek headwaters, at elevation 4040'	6/29/1995	A3+	13.9			
LAP3640	Lap Creek middle, below site 53, at elevation 3640'	6/29/1995	B3a	17.3			
CE-21	Lap Creek, above site 28	8/31/1993	C4	14.1	2.3		
LAP3160	Lap Creek lower-middle, below site 28, at elevation	6/28/1995	B2a	16.9			
	3160'						

W/d ratio at the upper 2003 site (53) was less than the threshold range, meaning it was "deeper" than the reference values, which is not necessarily a sign of impairment. The high value at site 28, however, reveals that this parameter was well outside of the KNF reference range that was based on 54 sampled segments. Entrenchments at all three 2003-sites were all within the threshold ranges. Historic w/d ratios were all within the threshold ranges.

Channel Surface Fine Sediment Less than 2 mm and 6 mm: Channel substrate information was available for four sites on Lap Creek (Table 4-19). One site (CE-21) had data from 1993, and the remaining three sites were only sampled in 2003.

Table 4-19. Lap Creek Channel Surface Fine Sediment (% <2mm and <6mm)

Site ID	Site Name	1993		2003	
		<2 <6		<2	<6
53	Upper Lap Creek			22	22
28	Middle Lap Creek			7	7
27	Lower Lap Creek			6	8
CE-21	Lap Creek, above site 28	11	14		

In 2003, the percent surface fines exceeded the threshold value at the upper site on Lap Creek but the other two sites were well within the threshold value range. The overall steep gradient of Lap Creek (average 6.2%) moves fine sediment through the system, so deposition of fine sediment within the channel would be unexpected. The gradient at site 53, a Rosgen B3a was 5.6%, so this level of fine sediment is unusual.

Channel stability measurements were taken at three sites on Lap Creek in 2003 (Table 4-20).

Table 4-20. Lap Creek Channel Stability Ratings

Site ID	Stream Name	Channel Sta	bility	Scouring	Stable Channel
		Threshold value	Overall SCORE	and Deposition	Bottom Materials
53	Upper Lap Creek	<u><</u> 78	99 / Poor	Good/Fair	Good/Fair
28	Middle Lap Creek (CE)	<u>≤</u> 78	59 / Good	Good	Good
27	Lower Lap Creek	<u>≤</u> 78	72 / Fair	Good	Good

Only at site 53 did the overall Channel Stability ratings fall outside the threshold value range for this parameter. Scoring of Upper and Lower-Channel bank items produced the "Poor" overall score, even though scouring and deposition, and the stable channel bottom item scores (listed),

were in the good/fair category. Neither Scouring and Deposition nor Percent Stable Bottom Materials rated Poor at any of the sites.

4.3.2.2 Lap Creek Biological Indicators

During the primary data gathering period for the Yaak TPA Impairment Determination, a macroinvertebrate sample was collected at a single site on Lap Creek (K03LAPC01, just below site 27) (Figure 4-9). Tables 4-21a and 4-21b display and summarize the available macroinvertebrate information at site K03LAPC01. Bolded values indicate exceedences of threshold values (threshold values indicated in parentheses).

Table 4-21a. Lap Creek RIVPACS and MMI Results

Site Name	RIVPACS (>0.80)	MMI (≥63)
Lap Creek (K03LAPC01)	0.786	72.4

Table 4-21b. Lap Creek FSI Summary

Site Name	FSI- EPT	% FSI Sensitive	FSI	
	<u>(≥</u> 17)	(>40)	(<u>≥</u> 205)	
Lap Creek (K03LAPC01)	10	19	120	

Lap Creek was outside the threshold values for all but one of the many macroinvertebrate metrics. This stream had the lowest FSI score, 120, of all streams in the Yaak TPA study. Fortynine percent of the aquatic community was dominated by three sediment tolerant taxa which could help explain the low FSI score. Only 18% of the entire macroinvertebrate community was sediment sensitive; typically western streams have 50% or higher sediment sensitive taxa. The two most sediment sensitive groups only comprised 6.6% of the total population.

A relatively low number of macroinvertebrates were captured (227 organisms) in comparison to the average number captured (1,728 organisms) in the study area. Lap Creek is the smallest stream in the study but another small stream, Grizzly Creek, had twice the number of organisms per sample and much higher diversity than Lap Creek. While the poor metric scores and lack of sediment sensitive taxa does indicate sediment impairment in Lap Creek, the low numbers of organisms collected in this stream also may indicate other sources of disturbance and also may confound interpretation of metric results.

4.3.2.3 Lap Creek Landscape-Scale Sediment Indicators

Supplemental indicators (%ECA, road and stream crossings – variables) were calculated at each sampling location using Geographic Information System (GIS) derived data from the forest record. Table 4-22 displays the Landscape-Scale Sediment Indicators analyzed for Lap Creek, including a summation-value for the watershed basin above site 27.

T	ah	le.	4_	22.	I	Landscape	-Sca	le	Se	diment	In	dicators	for	Lan	Creel	Z
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Site ID	Site Name	% ECA	Stream Crossing	Road Density
		Value (<25%)	Density (<3 crossings/mi2)	(<3 mi/ mi2)
53	Upper Lap Creek	25	8.0	5.4
28	Middle Lap Creek	22	4.1	4.3
27	Lower Lap Creek (3,483 acres)	22	4.0	4.2

Percent Equivalent Clearcut Acres: ECA values for the two lower sites met the indicator level of 25%, while the upper site slightly exceeded it. Sixty four percent of the harvest in Lap Creek took place in the 1970s and early 1980s, and the current ECA figures reflect the vegetative recovery that has taken place since that period.

Stream Crossing Density: The Upper Lap Creek stream crossing density was more than double the threshold value, and the lower two sites exceeded the threshold.

Road Density: The number of roads per square mile exceeded the indicator value of 3.0 miles/mile² at all of the sites within Lap Creek.

Road density and stream crossings values are a result of the roads built as part of an aggressive lodge pole pine salvage program of the 1970s and 1980s. Lap Creek has among the highest road crossing densities and total road densities observed in all study streams in the Yaak TPA. Examination of the watershed scale indicators, particularly road density and stream crossings, indicate a strong potential for impaired conditions in this watershed, as no BMP or decommissioning or road decommissioning activity has yet taken place in the Lap Creek watershed.

4.3.2.4 Lap Creek Sediment Source Surveys

Sediment Source Surveys were conducted in Lap Creek by the Yaak Headwaters Partnership Group in the summer of 2006. Survey crews identified and assessed nearly all (22) road/stream crossings in the watershed. 14 of 22 of crossings were in the Upper Lap watershed (above site 53). With the exception of where Lap Creek crosses the main Yaak River road, all road/stream crossing sites were within Grizzly Bear Core Management Area and have been closed to motorized use for more than ten years. Since closure, vegetative growth on many Lap Creek roads has drastically reduced sediment contributed to streams. Survey crews identified a single non-road-related sediment source in the Lap Creek watershed, a hillslope failure that was attributed to natural conditions. Non-road – related sources are not significant sources of sediment to Lap Creek.

4.3.2.5 Lap Creek Water Quality Impairment Summary

Table 4-23 provides a summary of Primary and Supplemental Indicators used for determining impairment condition for Lap Creek.

Table 4-23. Sediment Impairment Data Evaluation - Lap Creek

Sediment Impairment Indicator	Threshold Value	Available Data or Information					
In-Stream Sediment Indicators							
Width to Depth Ratio	Variable (Table 4-2)	5 of 7 sites evaluated met threshold values					
Entrenchment	Variable (Table 4-3)	3 of 4 sites evaluated met threshold values					
% of Surface Fines <6 mm	<20%	4 site/date combinations evaluated- 3 of 4 met threshold values; 2003 sample exceeded threshold values					
% of Surface Fines <2 mm	<20%	4 site/date combinations evaluated- 3 of 4 met threshold values; 2003 sample exceeded threshold values					
% of Subsurface Fines <6mm	<28%	No data					
Pfankuch Stream Channel Stability	≥ "fair"	3 sites evaluated in 2003 2 of 3 sites evaluated met threshold					
Stream Channel Stability-	≥ "fair"	3 sites evaluated in 2003					
Scouring/Deposition	_	All sites met thresholds					
Stream Channel Stability- Distribution and	<u>></u> "fair"	3 sites evaluated in 2003					
Stability of Channel Bottom Materials		All sites met thresholds					
Biological Indicators							
MMI	<u>≥</u> 63	Only site sampled met threshold.					
RIVPACS	<u>≥</u> 0.80	Only site sampled exceeded threshold.					
Fine Sediment Index-EPT	<u>≥</u> 17	Only site sampled exceeded threshold.					
Percentage of FSI-Sensitive Taxa	<u>≥</u> 40%	Only site sampled exceeded threshold.					
FSI	≥ 205	Only site sampled exceeded threshold.					
Landscape-Scale Sediment Indicators							
% Equivalent Clear-Cut Area	<25%	2 of 3 sites met thresholds					
Stream Crossing Density (#/mi2)	<3.0	All three sites exceeded thresholds					
Total Road Density (miles/mi2)	<3.0	All three sites exceeded thresholds					
Sediment Source Survey	Qualitative	22 road/stream crossing sites					

Information contained in Table 4-23 was used to answer the four key questions relating to a sediment-impairment determination.

1. Are the fish/aquatic life beneficial uses impaired?

Lap Creek was outside the threshold values for multiple macroinvertebrate metrics and had the lowest FSI score, 120, of all streams in the Yaak TPA study. However, low taxa counts and /or multiple stressors may limit interpretation of biometrics. Exceedences of surface fine thresholds at upper Lap Creek site 53 also indicate possible impacts to fish and associated aquatic life.

2. Have anthropogenic sources increased sediment erosion and/or delivery, contributing to or causing impairment?

Percent equivalent clear-cut area of the watershed, stream crossing density (#/mi2), and the total road density (miles/mi²) information evaluated in the Lap Creek watershed suggests a strong potential for impaired conditions in this watershed. Road and stream crossing densities are high at all sites, in all cases well above the threshold values. It

appears that historic forest management has caused conditions that have led to impacts within the watershed, possibly contributing to impairment (see item 1).

3. Is there a sediment supply problem contributing to impairment (i.e., is there too much or too little sediment in the stream)?

Surface fines <6 mm and <2 mm and the bankfull width-to-depth ratio information are not definitive in supporting an impairment call. However, there were some exceedences among the data, particularly the high sediment values (22%) at the upper site. Field notes indicate that the channel goes dry at the middle site (28) as a result of bedload sediment filling the channel, forcing the water to go sub-surface. At the lower site (27), dense riparian vegetation keeps the stream width from increasing, but bedload deposition is evident throughout the reach. Channel-gradient begins to drop here (3.2% vs. 5.4% and 9.3% upstream) and the channel has filled with bedload. The small number of pools compared to reference B stream types (4.2 vs. 21.8) indicates that the deposition is filling pools and altering habitat conditions. It appears there is a sediment supply problem contributing to impairment.

4. Is there an indication of an in-channel sediment transport problem contributing to or causing impairment?

The data and the field-information strongly suggest that channel incision has occurred at the upper site, and extreme channel widening has occurred at the middle site. It appears that little recovery has taken place, as gravel bars throughout the channel are both abundant and un-vegetated with few pools. It appears that pools have been filled in by the migration of the bedload sediment. Levels of fine sediment do not necessarily reflect impairment, but the steep gradient of the stream throughout the watershed generally precludes deposition of fines in these channels. Information relating to bedload sediment quantities and locations within the basin suggest a sediment transport concern: it appears that Lap Creek has a sediment transport problem that is contributing to an impaired condition.

In summary, it appears that the historical activities within the basin have left a legacy of sediment that is still affecting beneficial uses. Channel morphology and condition has been altered throughout the length of the channel. Although the B stream type is present at all 2003-sites, channel erosion has led to incision at the upper site, widening at the middle site, and pool filling at the lower site. Macro invertebrate information strongly suggests impairment of aquatic uses, and bedload sediment information identifies sediment transport concerns. Sediment Source Surveys identified very few non-natural instream sediment sources, but identified over 22 crossings that were contributing sediment to some degree. Based on this information, Lap Creek was listed as impaired from sediment on the 2006 303(d) List. A sediment TMDL for Lap Creek is presented in Section 6.

4.3.3 South Fork Yaak River

The South Fork Yaak River (40,130 acre watershed) is a fourth order stream that originates in the eastern portion of the Yaak watershed, flowing north until it joins the mainstem Yaak River near the town of Yaak (Figure 4-13). Major tributaries to the South Fork Yaak include Beaver

Creek (6,751 acre watershed), Fowler Creek (6,330 acre watershed), Dutch Creek (7,400 acres), and Zulu Creek (3,400 acres).

Land ownership in the watershed consists of private (1%) and Forest Service (99%) ownership. The upper basin is an old glacial lakebed, and bank materials are silt and sand. Channel types in the upper most watershed alternate between Rosgen B, E and F. Most of the basin is forested, although there are non-forested riparian sections of shrub-meadow. Eight percent of the watershed was burned by wildfire in 1994, primarily in the Zulu and Fowler tributaries. Sixteen percent was burned by wildfire in 2000 primarily in Kelsey, Can, Fowler and Beaver Creek tributaries.

Forest harvest has been conducted periodically in the South Fork Yaak River Watershed (Figure 4-13), with the most recent salvage and harvest activity occurring in the Kelsey and Fowler Creek drainages. GCMA designation has resulted in the closure of forest roads within GCMA in the South Fork Yaak River watershed. Roads within GCMA have been closed for at least ten years (more in some areas). Considerable BMP activity and road decommissioning work has recently been accomplished in the South Fork Yaak River watershed.

The cold-water fishery beneficial use was listed as impaired on the 1996 303(d) List for flow alteration, other habitat alteration, siltation, and suspended solids. The basis for the 1996 listing was unknown. DEQ lacked sufficient credible data to include this water body on the 2000 303(d) List. As a result, reassessment sampling was completed for the South Fork Yaak River in August 2003 and updated impairment determinations were included on the 2006 303(d) List.

Data was collected at four sampling locations on the South Fork Yaak in 2003 (Figure 4-13): South Fork River below Smoot Creek, site 50; South Fork River below Zulu Creek, site 68; South Fork River below Fowler Creek, site 18; and the South Fork River below Beaver Creek, site 16. Sites were also established on Smoot, Zulu, Clay, Fowler and Beaver Creeks. One of the sites, #16, South Fork below Beaver, had been sampled from 1991-1995 by the Forest Service as a Cumulative Effects Analysis Station (CE-11). Data from another FS site sampled in 1992 was also used in the analysis.

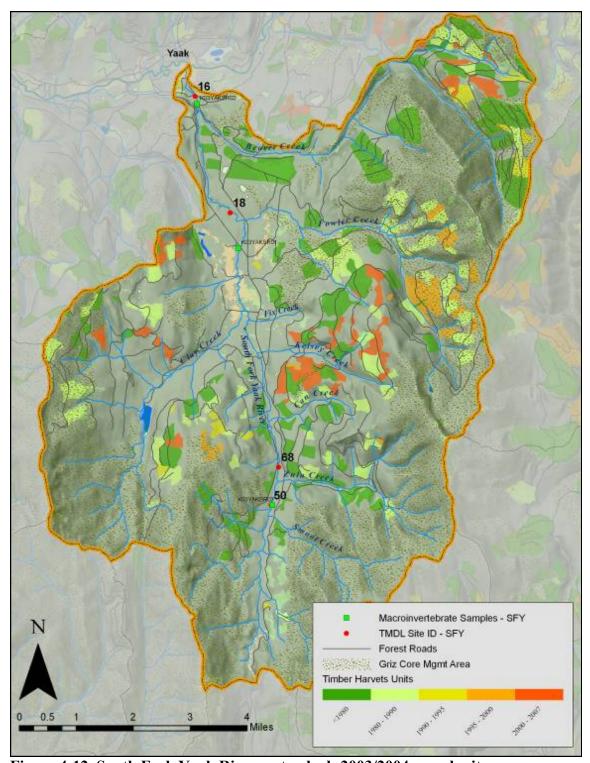


Figure 4-12. South Fork Yaak River watershed: 2003/2004 sample sites

The main channel of the South Fork Yaak flows through a Type II valley bottom. Typical of Type II valleys, the South Fork Yaak channel is predominately a Rosgen "B" stream type with C inclusions. Figures 4-14 through 4-17 display channel conditions at the four sites established and evaluated on the South Fork Yaak River in 2003.



Figure 4-13. South Fork Yaak River below Smoot Creek, site 50



Figure 4-14. South Fork Yaak River below Zulu Creek, site 68



Figure 4-15. South Fork Yaak River below Fowler Creek, site 18



Figure 4-16. South Fork Yaak River below Beaver Creek, site 16

4.3.3.1 South Fork Yaak River In-Stream Sediment Indicators

A review of the available data is presented here, including channel morphology information, channel substrate (Wolman pebble counts), Pfankuch Channel Stability Items, RSI, Mc Neil core samples, and potential sediment sources.

Cross-section channel morphology data was collected at four sites on the South Fork Yaak River in 2003. The same information was also available for the two historic sites. These data were analyzed to determine width-to-depth ratios and entrenchment for each sampling location and the results were compared to reference data. The results for each site are presented in Table 4-24. Bolded values indicate exceedences of threshold values.

Table 4-24. South Fork Yaak River Channel Morphology Values, 2003

Site ID	Site Name	Stream Type	Entrenchment	Width/Depth Ratio
50	South Fork Yaak below Smoot	F4	1.2	21.9
68	South Fork Yaak below Zulu	F4b	1.2	14.8
18	South Fork Yaak below Fowler	B4c	1.7	14.7
16	South Fork Yaak below Beaver	ВЗс	1.7	19.2
Yaak SF-CE11	South Fork Yaak below Beaver (near site 16)	В3	1.6	24.1

Width-to-depth ratios for all five sites meet the threshold range; five meet the entrenchment thresholds. Channel morphology for all sites on the mainstem South Fork Yaak River seem to be stable and reflect the continuing maintenance of the stream type, given the geology, slope, etc., which should exist at the given sites.

Channel Surface Fine Sediment Less than 2 mm and 6 mm: Channel substrate information was collected using Wolman pebble count data at four sampling sites on the South Fork Yaak River in 2003 (Table 4-25). Pebble count information from the other two Forest Service sites, one of which had data for five years, is also displayed and analyzed.

Table 4-25. South Fork Yaak Channel Surface Fine Sediment (% <2mm and % <6mm)

Site ID	Site Name	19	91	19	92	19	93	19	94	19	95	20	00	20	03
		<2	<6	<2	<6	<2	<6	<2	<6	<2	<6	<2	<6	<2	<6
50	SF Yaak													42	42
68	SF Yaak													16	17
SF-01	SF Yaak			11	13										
18	SF Yaak													31	32
16	SF Yaak													6	7
SF- CE11	SF Yaak	9	15	4	6	6	10			14	20				
	(~site 16)														

In 2003, two of the four sampling sites (site 50, South Fork Yaak below Smoot Creek and South Fork Yaak below Fowler (18)) were well above the 20% threshold, indicating a fine sediment problem.

Site 50 below Smoot Creek is located immediately adjacent to a harvest unit that had riparian harvest, and this is likely the source of the fine sediment. Field notes also describe mid-channel bars and many root wads and downed trees along the stream banks. The gradient of this reach is fairly flat (1.1% gradient), so much of the material remains in this portion of the channel. Field surveys to identify sediment sources in 2004 identified a road crossing above site 50 that was producing substantial sediment.

Site 68 below Zulu has a gradient of over 5%, so it is unlikely that fine sediment would be deposited there. Given the gradient, the amount of surface fines <2% at that location (16%) is a fairly high percentage. Although not over the threshold level of 20%, it is significantly elevated above reference conditions.

Site 18 is immediately below Fowler Creek, which had a recorded value of 48% <2mm in 2003. Natural glacial deposits in this area contribute fine material to the substrate in some areas and may be responsible for higher fines throughout this reach.

McNeil core data were collected in the early to mid-1990s at the CE-site near site 16 (below Beaver Creek). While not the same as surface fines, these do represent the amount of subsurface fines, another measure of instream sediment concentrations. Between 1991 and 1995, subsurface fines fluctuated between 35% and 15% with an average of 25%, slightly below the reference criteria of 28%.

The very high levels of fines at two of the four sites, plus the Fowler Creek fine-sediment value suggests possible sediment impacts to the South Fork Yaak.

Stream Channel Stability measurements were collected at four sampling locations in 2003, and data was available from one of the older sites for 1992 (Table 4-26).

Table 4-26. South Fork Yaak Stream Channel Stability Ratings

Site ID	Stream Name	Channel S	Channel Stability		Stable
		Threshold value	Overall SCORE	And	Channel
				Deposition	Bottom
					Materials
50	SF Yaak	<125	94 / Good	Fair	Fair
68	SF Yaak	<125	59 / Good	Good	Good
SF-01	SF Yaak	<78	65/Fair		
18	SF Yaak	<84	56 / Good	Good	Good
16	SF Yaak	< 78	52 / Good	Good	Good

The channel stability data document that overall channel stability, scouring and deposition, and percent stable bottom materials were within thresholds at all sites for all sampling times.

4.3.3.2 South Fork Yaak River Biological Indicators

Macroinvertebrate samples were collected at three sites on the South Fork Yaak in 2003: South Fork Yaak River below Smoot (K03YAKSR03, near site 50), South Fork Yaak mid-section near site 18, between Fix and Fowler Creeks (K03YAKSR01), and the South Fork Yaak below Beaver Creek near site 16 (K03YAKSR02) (Figure 4-13). The data is display and summarized in Tables 4-27a and 4-27b. A major tributary to the South Fork Yaak, Beaver Creek was also sampled, but is not displayed in this table. Bolded values indicate exceedences of threshold values (threshold values indicated in parentheses).

Table 4-27a, South Fork Yaak River RIVPACS and MMI Results

Site Name	RIVPACS (>0.80)	MMI (≥63)
Upper South Fork Yaak River (K03YAKSR03) 50	0.92	76.2
Middle South Fork Yaak River (K03YAKSR01) 18	1.01	66.4
Lower South Fork Yaak River (K03YAKSR02) 16	1.03	67.1

Table 4-27b. South Fork Yaak River FSI Summary

Site Name	FSI- EPT (>17)	% FSI Sensitive (>40)	FSI (>205)
Upper South Fork Yaak River (K03YAKSR03)	12	87	155
Middle South Fork Yaak River (K03YAKSR01)	11	37	155
Lower South Fork Yaak River (K03YAKSR02)	10	10	150

All three South Fork Yaak mainstem sections met primary biological indicator thresholds (RIVPACS and MMI), but scored below thresholds for most supplemental indicators. There were however, differences among the segments with some more impaired than others.

Upper South Fork Yaak River (K03YAKSR03)

South Fork Yaak below Smoot appears to be the least impaired of the group as it has a large percentage of sediment sensitive taxa (87%). However, the FSI and FSI-EPT are below the 50th percentile for streams in this ecoregion. Overall taxa richness and abundance are very low which could explain differences in the bioassessment metrics. This section has a taxa richness of 26 which is the lowest of all streams in the study. Fifty-two percent of the community is dominated

by three organisms, but all of these are somewhat sediment sensitive. Four taxa are very sediment sensitive and three of these have over 10 individuals present in the sample. Because this is the uppermost site in the watershed it is probable that the low sediment scores are a reflection of the very low taxa richness collected at this site.

Middle South Fork Yaak River (K03YAKSR01)

While this site met RIVPACS and MMI indicator thresholds, the FSI and FSI-EPT are below the 50th percentile for streams in this ecoregion. Only 37% of the community is sediment sensitive which is a decline from the upper Yaak site of 87% sediment sensitive. Taxa richness was below average for streams in this study but not as low as the upper South Fork Yaak section. Fifty-nine percent of the community is dominated by three organisms. One of these is somewhat sediment sensitive. This is the highest percent dominance for the streams in this study. There are 6 very sediment sensitive taxa and two of these, Claassenia sabulosa and Hesperoperla pacifica are semivoltine requiring more than one year for their life cycle.

Lower South Fork Yaak River (K03YAKSR02)

The lower South Fork Yaak met RIVPACS and MMI indicator thresholds, yet scored the lowest in all FSI metrics, indicating potential impairment most likely by sediment and other stressors such as organic enrichment and warmer water temperatures. The Hilsenhoff Index of Biological Integrity (HIBI) score, an indicator of nutrient enrichment, was the second highest when compared to all streams in this study and nearly double that of any of the other South Fork segments. The FSI score was below the 50th percentile for streams in this ecoregion and the FSI-EPT score was one taxon away from being below the 25th percentile for streams in this ecoregion. Only 10% of the community was sediment sensitive which is the lowest percent of any stream in the study. Fifty-three percent of the community is dominated by three organisms none of which are sediment sensitive, all belonging to the Chironomidae family. There appears to be a cumulative watershed effect of stressors with the lowest segment impacted by multiple stressors including fine sediment.

4.3.3.3 South Fork Yaak River Landscape-Scale Sediment Indicators

Supplemental indicators (%ECA, road and stream crossings – variables) were calculated at each sampling location using GIS derived data from the forest record. Table 4-28 displays the Landscape-Scale Sediment Indicators analyzed for South Fork Yaak River.

Table 4-28. Landscape-Scale Sediment Indicators for South Fork Yaak River

Site ID	Stream Name	% ECA Value	Stream Crossing Density	Road Density
		(<25%)	(<3 crossings/mi2)	(<3 mi/ mi2)
50	South Fork Yaak	2	1.3	0.8
68	South Fork Yaak	6	1.9	1.3
18	South Fork Yaak	23	2.1	2.0
16	South Fork Yaak (40,133 acres)	20	2.0	2.6

Percent Equivalent Clearcut Acres: ECA values for all sites met the indicator level of 25%, reflecting recovery that has occurred since timber harvest in the 1970s.

Stream Crossing Density: Stream crossing density did not exceed the indicator value in any of the basins above the sample points.

Road Density: Road densities did not exceed the indicator value in any of the basins above the sample points.

Road density and stream crossings values are a result of the roads built for timber harvest in the 1970s. ECAs, while approaching threshold levels in the lower watershed, are lower than historic levels and reflect recovery that has occurred. High substrate fines may indicate existing and legacy effects of roads and past harvest activity.

4.3.3.4 South Fork Yaak River Sediment Source Surveys

Sediment Source Surveys were conducted in the South Fork Yaak River watershed by the YHRP in the summer of 2004. Survey crews identified and assessed nearly all (118) road/stream crossings in the watershed. Thirty percent of all road/stream crossing sites were within GCMA and will be closed to motorized use for at least ten years. Survey crews also identified several sediment sources related to natural hillslope failure of glacial deposits and bank slumping and sloughing that was attributed to natural conditions. Anthropogenic non-road-related sediment sources identified by the YHRP do not appear to be significant sources of sediment to the South Fork Yaak River.

4.3.3.5 South Fork Yaak River Water Quality Impairment Summary

Table 4-29 provides a summary of Primary and Supplemental Indicators used for determining impairment condition for South Fork Yaak River.

Table 4-29. Sediment Impairment Data Evaluation - South Fork Yaak River

Sediment Impairment Indicator	Threshold Value	Available Data or Information			
In-Stream Sediment Indicators					
Width to Depth Ratio	Variable (Table 4-2)	All six sites evaluated met thresholds			
Entrenchment	Variable (Table 4-3)	Five of six sites met thresholds, only			
		1992 sample-site slightly exceeded			
% of Surface Fines <6 mm	<20%	Two of four 2003 sites exceed thresholds			
% of Surface Fines <2 mm	<20%	Two of four 2003 sites exceed thresholds			
% of Subsurface Fines <6mm	<28%				
Pfankuch Stream Channel Stability	<u>≥</u> "fair"	All five sites evaluated met thresholds			
Stream Channel Stability- Scouring/Deposition	<u>≥</u> "fair"	Four sites evaluated met thresholds			
Stream Channel Stability- Distribution and	≥ "fair"	Four sites evaluated met thresholds			
Stability of Channel Bottom Materials					
Biological Indicators					
MMI	<u>≥</u> 63	All three sites met thresholds			
RIVPACS	<u>≥</u> 0.80	All three sites met thresholds			
Fine Sediment Index-EPT	<u>≥</u> 17	All three sites exceeded thresholds			
Percentage of FSI-Sensitive Taxa	<u>≥</u> 40%	All three sites exceeded thresholds			
FSI	≥ 205	All three sites exceeded thresholds			
Landscape-Scale Sediment Indicators	Landscape-Scale Sediment Indicators				
% Equivalent Clear-Cut Area	<25%	Basins above all sites met thresholds			
Stream Crossing Density (#/mi2)	<3.0	Basins above all sites met thresholds			

Table 4-29. Sediment Impairment Data Evaluation – South Fork Yaak River

Sediment Impairment Indicator	Threshold Value	Available Data or Information
Total Road Density (miles/mi2)	<3.0	Basins above all sites met thresholds
Sediment Source Survey	Qualitative	118 road/stream crossing sites

Information contained in Table 4-29 was used to answer the four key questions relating to a sediment-impairment determination.

1. Are the fish/aquatic life beneficial uses impaired?

All three South Fork Yaak mainstem sections met primary biological indicators (RIVPACS, MMI) but exceeded FSI thresholds. The Lower South Fork Yaak below Beaver (near site 16) may also be impacted by nutrient enrichment or other reach-scale stressors, as evidenced in high HIBI score (4.01) and elevated RIVPACS score (1.03).

The percentage of surface fines <6mm and <2mm was well above the thresholds at two of the four sites on the South Fork Yaak mainstem channel (sites 50 and 18). Site 18 is immediately below Fowler Creek, which had a recorded value of 48% <2mm in 2003. At 17% fine sediment, the site below Zulu Creek (site 68) meets threshold levels, but the gradient at this site is over 5%, making it unlikely that deposition of fines would occur. Only at the lowest reach, at site 16, below the Beaver Creek confluence is the channel surface fines in a low range. It would appear that most of the South Fork has a fine sediment problem.

2. Have anthropogenic sources increased sediment erosion and/or delivery, contributing to or causing impairment?

None of the landscape-scale sediment indicators exceeded thresholds for the mainstem South Fork Yaak River, however sediment delivery at crossings has been documented by the YHRP sediment surveys and may be significant enough to result in an aquatic response. The watershed response variables bankfull width-to-depth and the entrenchment ratios are predominantly within thresholds.

South Fork site 50 below Smoot, that had the highest fine-sediment value (42% <2mm), is located immediately adjacent to a harvest unit that had riparian harvest. Field notes describe unstable banks where root wads have washed out or blown over as a result of the adjacent trees being harvested. This is the probable source of the excessive fine sediment. Field notes also describe mid-channel bars and many root wads and downed trees along the stream banks. The gradient of this reach is fairly flat (1.1% gradient), so much of the material remains in this portion of the channel. From this information it appears that forest management and historic timber harvest are at least contributing to an apparent impairment.

3. Is there a sediment supply problem contributing to impairment (i.e., is there too much or too little sediment in the stream)?

The percentage of surface fines <6mm and <2mm was well above the thresholds at sites 50 and 18 on the South Fork Yaak mainstem, with Fowler Creek potentially providing fine sediment to the South Fork site 18. The site below Zulu Creek (site 68) was within the threshold at 17%, but above reference conditions. The gradient at site 68 would

normally preclude this level of fine sediment. Only at the lowest reach, at site 16, below the Beaver Creek confluence is the channel surface fines in a low range. Even though the channel morphology variables evaluated in 2003 were within expected thresholds, surface fine sediment provides supporting evidence for an apparent sediment supply problem.

4. Is there an indication of an in-channel sediment transport problem contributing to or causing impairment?

As detailed in items 2 and 3 above, channel morphology information in itself does not suggest a sediment transport problem. The Pfankuch Stream Channel Stability Information, Stream Channel Stability – Scouring and/or Deposition Item, and the Stream Channel Stability – Distribution and Stability of Channel Bottom Materials Items also do not indicate sediment transport problems.

In summary, it appears that the historical activities within the basin have left a legacy of sediment that is still affecting beneficial uses. High channel surface fines at several locations and evidence of impacted biological communities provide evidence of impairment. Sediment Source Surveys identified very few non-natural instream sediment sources, but identified over 100 crossings that were contributing sediment to some degree. Based on this information, the South Fork Yaak River was listed as impaired from sediment on the 2006 303(d) List. A sediment TMDL for the South Fork Yaak River is presented in Section 6.

SECTION 5.0 YAAK TPA SEDIMENT SOURCE CHARACTERIZATION AND ASSESSMENT

As identified on Montana's 2006 Integrated 305(b)/303(d) Water Quality Report and summarized in Section 4.0, water bodies requiring sediment TMDLs include Seventeenmile Creek, Lap Creek, and South Fork Yaak River. Section 5.0 provides a description of natural and anthropogenic sediment sources within the Yaak TPA, explains assessment methods employed, and estimates numeric loads for all significant sediment source categories in Seventeenmile Creek, Lap Creek, and South Fork Yaak River.

5.1 Sediment Source Assessment and Load Estimates Summary

5.1.1 Natural Sources

Natural sources of sediment assessed in the Yaak TPA include those derived from bank erosion, mass wasting/hillslope failure, and natural upland erosion.

Sediment loads from natural sources were assessed using a variety of methods. WATSED modeling conducted by the KNF on South Fork Yaak River and Quartz Creek was used to provide estimates of natural background sediment loading for impaired water bodies, Seventeenmile Creek, Lap Creek, and South Fork Yaak River. Qualitative field reconnaissance (field photos and notes) data and observations by USFS, U.S. EPA, and Montana DEQ personnel were used in evaluating natural sediment loading conditions, and Field Sediment Source Surveys conducted by personnel under direction of the YHRP were used to further verify conditions and qualitative assessments.

Seventeenmile Creek, Lap Creek, and South Fork Yaak River and their tributaries were assessed for sediment sources in 2004, 2005, and 2006, respectively. All streams and tributaries were surveyed for sediment sources by walking streams from mouth to headwaters. In addition to stream crossing assessments, survey crews noted and surveyed all potentially significant near-stream sediment sources (bank erosion, hillslope failure/mass wasting) encountered. Detailed field notes provide descriptions, drawings, and measurements (where appropriate) of all sediment sources observed (see example field sheets in Appendix A).

5.1.2 Anthropogenic Sources

Anthropogenic sources of sediment assessed in the Yaak TPA include those derived from the following.

- Bank erosion
- Mass wasting/hillslope failure
- Upland erosion from management activities (timber harvest)
- Forest roads (stream crossings, parallel road segments, culvert failure)

Sediment loading derived from forest roads was estimated using the WEPP:Road model. Appendix B provides road sediment methods and results using WEPP. In addition to estimates of sediment loads from road crossings and road networks, sediment load at risk due to culvert failure at crossings was also evaluated.

Field Sediment Source Surveys and follow-up field reconnaissance visits by DEQ, EPA, and USFS were the predominant data sources used to assess not only the degree and extent of sediment loading from bank erosion but also mass wasting/hillslope failure. Field Sediment Source Surveys were conducted on Seventeenmile Creek, Lap Creek, and South Fork Yaak River and their tributaries in 2004, 2005, and 2006 respectively. All streams and tributaries were surveyed for sediment sources by walking streams from mouth to headwaters. In addition to stream crossing assessments, survey crews noted and surveyed all potentially significant near-stream sediment sources (bank erosion, hillslope failure/mass wasting) encountered. Detailed field notes provide descriptions, drawings, and measurements (where appropriate) of all sediment sources observed (see example field sheets in Appendix A).

While upland sediment sources were not specifically assessed through Field Sediment Source Surveys, delivery of sediment to streams from upland sources (skid trails, etc.) was noted where encountered and provides evidence of the significance of upland sediment inputs to streams. Additional information regarding age and distribution of timber harvest units, vegetative recovery rates, and present ECA was used to supplement upland sediment assessments.

5.1.3 Source Assessment Summary

A sediment loading summary for Seventeenmile Creek, Lap Creek, and South Fork Yaak River Watersheds is given in Table 5-1. Sediment derived from forest roads is the predominant anthropogenic sediment source throughout these watersheds. Sediment loads from upland erosion of forest soils, bank erosion, and mass wasting appear to be within naturally occurring levels and do not contribute significantly to anthropogenic sediment-related impairments. Section 5.2 below provides details regarding the source assessments and loading estimates given below in Table 5-1.

Table 5-1. Annual Sediment Loading Summary: Seventeenmile Creek, Lap Creek, and South Fork Yaak River watersheds

Watershed	Natural Sediment Loads	Anthropogenic Sediment Loads	
	Upland Erosion	Stream Crossings	Parallel Road
	Bank Erosion	(tons/yr)	Segments
	Mass Wasting		
Seventeenmile Creek	443	23.7	Not significant
Lap Creek	62	2.4	Not significant
South Fork Yaak River	445	21.3	Not significant

5.2 Sediment Source Assessment and Loading Estimates

The following section provides specific sediment loading assessment results for sediment-impaired water bodies, Seventeenmile Creek, Lap Creek, and South Fork Yaak River. Section 5.2 provides a description of natural and anthropogenic sediment sources for each impaired stream and their relative contribution to sediment impairment conditions.

5.2.1 Sediment Sources

Potentially significant sediment sources assessed in the Seventeenmile Creek watershed include:

- Bank erosion
- Mass wasting/hillslope failure
- Upland erosion
- Forest roads

5.2.1.1 Bank Erosion

Bank erosion refers to actively eroding stream banks and, for the purposes of this assessment, includes stream banks formed by bankfull processes as well as actively eroding hillslopes adjacent to streams. Bank erosion typically results in a variety of sediment size fractions delivered to the stream, which contribute to both suspended sediment load and bedload.

Field reconnaissance and cursory aerial photography review of Seventeenmile Creek, Lap Creek, and South Fork Yaak River conducted by EPA, USFS, and DEQ shows that, in general, riparian areas are well vegetated and functioning properly. Field Sediment Source Surveys document the preponderance of beaver dams, heavy vegetation, undercut banks, and large woody debris, good indicators of habitat complexity and functioning riparian conditions throughout Seventeenmile Creek, Lap Creek, and South Fork Yaak River Watershed. Lands within the Yaak TPA are predominantly managed as forest. However some livestock grazing does occur in the flatter lowlands of South Fork Yaak. With the exception of those impacts associated with forest roads, legacy effects to water quality from historic harvest activity were not evident.

Data on the extent and degree of bank erosion in the Yaak TPA was collected by the YHRP in the summers of 2004, 2005, and 2006. The entire lengths of Seventeenmile Creek, South Fork Yaak, and Lap Creek were surveyed for sediment inputs (bank erosion, hillslope failure, and mass wasting). In addition to mainstem segments, all tributaries that included road crossings were surveyed from the mouth upstream to the furthest road crossing. Tributaries without road crossings (North Fork Seventeenmile Creek, most of Flattail Creek, etc) were not surveyed.

Observations of bank erosion and hillslope erosion in Seventeenmile Creek, Lap Creek, and South Fork Yaak River were limited, and most occurrences appeared to be due to natural conditions. Of all the stream and tributary miles surveyed in the Seventeenmile Creek watershed (Figure 5-1), seven bank/hillslope erosion sites were recorded. Field notes at these locations indicate that these conditions are predominantly natural, resulting from sloughing of steep banks into the stream channel and undercutting of stream banks, natural conditions observed and verified in the field by DEQ and USFS personnel at several sites. The South Fork Yaak River

Watershed (Figure 5-2) contained six bank/hillslope erosion sites, four of which could be attributable to natural causes and two of unverified causes. Lap Creek contained no observed significant bank or hillslope erosion sites.

Bank erosion encountered in Seventeenmile Creek, Lap Creek, and South Fork Yaak River appears be naturally occurring. Figures 5-3 through 5-6 represent typical bank and hillslope erosion conditions identified in Field Sediment Source Surveys and found throughout these watersheds. Given the extensive coverage of Field Sediment Source Surveys and the relatively small number of bank and hillslope erosion sites encountered, it is concluded that erosion on streams and tributaries does not appear to be significantly elevated above naturally occurring levels. WATSED modeling estimates given below in Section 5.2.1.3 accommodate for a variety of hillslope erosion processes identified through Field Sediment Source Surveys, as the WATSED model estimates "natural sediment yields" from forested landscapes.

"Natural sediment yields of undisturbed watershed systems are derived primarily from streambank erosion of material supplied by creep and mass erosion processes inherent in the system..." (USFS, 1981)

For this reason, it is assumed that the natural sediment load derived from hillslope and bank erosion observed in Seventeenmile Creek, Lap Creek, 13.26*.06 and South Fork Yaak River is incorporated within the upland erosion estimates provide by the WATSED modeling results, and a specific sediment load estimate from bank erosion is not calculated.

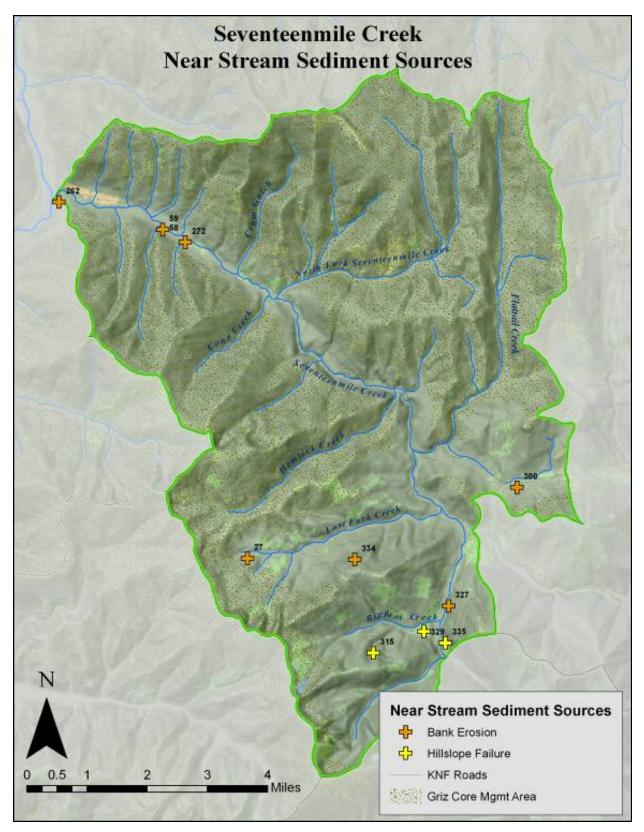


Figure 5-1. Seventeenmile Creek - Bank Erosion and Hillslope Failure Sites

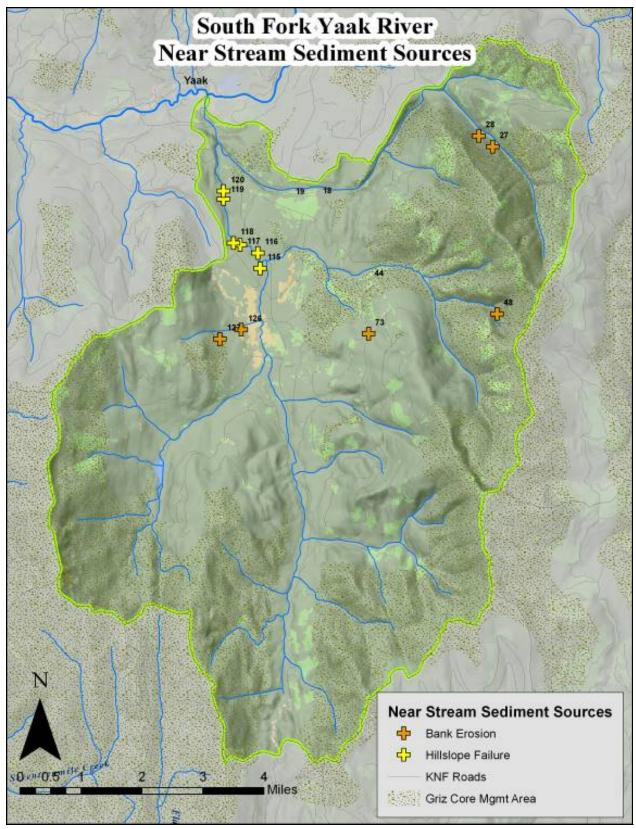


Figure 5-2. South Fork Yaak River - Bank Erosion and Hillslope Failure Sites





Figure 5-3. Natural Bank Erosion

Figure 5-4. Natural Bank Erosion

5.2.1.2 Mass Wasting /Hillslope Failure

Mass wasting and hillslope failure are used synonymously in this document and refer to bulk failure of adjacent streamside hillslopes. Mass wasting and hillslope failure typically result in a variety of sediment size fractions delivered to the stream. This contributes to both suspended sediment load and bedload.

Observations of hillslope failure/mass wasting were included in the YHRP Field Sediment Source Surveys. Locations of observed hillslope failure/mass wasting sites for Seventeenmile Creek and South Fork Yaak River are shown in Figures 5-1 and 5-2. Three hillslope failure sites within the Seventeenmile Creek watershed were identified. Two of those (315 and 329) were associated with steep unstable stream banks that are slumping into the creek, natural conditions throughout the Yaak TPA. Specifically, site 329 exhibited a "slumped load of angular rock into channel" and that streambanks were "composed of unstable crumbling bedrock." It was also noted that bank cutting was common in the area (YHRP, 2005). Six hillslope failure sites in the Lower South Fork Yaak River Watershed were identified. Sites are associated with failure of glacial till deposits and have been identified as natural sediment sources in sediment survey field notes (YHRP, 2004). Figures 5-5a and 5-5b show representative hillslope failure sites verified in Lower South Fork Yaak Watershed. Only a single hillslope failure site was encountered in the Lap Creek Watershed, and, according to field notes, was a natural occurrence associated with an uprooted tree that resulted in a minor local hillslope failure.

Agency personnel (USFS, EPA, DEQ) toured Seventeenmile Creek and South Fork Yaak River to ascertain the extent and degree of hillslope failure and mass wasting in the watershed, and, while agency personnel did not visit or verify all sites identified through Field Sediment Source Surveys, due to time constraints and difficulties accessing some sites, anthropogenic mass wasting and hillslope failure loads were not identified. Based on spatial extent of field data and professional judgment of agency resource managers, it is concluded that sediment loads to streams from hillslope failure or mass wasting events are not significantly elevated above

naturally occurring conditions, and specific numeric loads associated with this source category have not been calculated. WATSED modeling estimates presented in the following section include natural sediment loads from mass erosion (USFS, 1981).



Figure 5-5a. Hillslope Failure: Lower South Fork Yaak River



Figure 5-5b. Hillslope Failure: Lower South Fork Yaak River

5.2.1.3 Upland Erosion

Upland erosion refers to processes that deliver sediment to streams from upland areas and can be elevated above naturally-occurring conditions through management activities (road building, resource extraction, etc) that disturb forest floors and soils. Upland erosion estimates do not include sediment generated and delivered to streams from forest roads. Forest road sediment loads are addressed separately in Section 5.2.1.4 and detailed in Appendix B. Upland erosion estimates do, however, include mass erosion (USFS, 1981), and therefore modeled sediment yield estimates include natural mass wasting and hillslope failure processes described in the previous section.

Historically, the predominant land management activity within the Yaak TPA has been timber harvest and road building associated with timber harvest activities. Typically, the attenuation of sediment loads derived from post-harvest disturbed conditions to pre-harvest conditions occurs over a relatively short time frame. Disturbed areas (whether from natural forest fire or management activities) are vegetated relatively quickly by pioneer species (Rice et al, 1972, Elliot and Robichaud, 2001). Following a wildfire in eastern Oregon, Robichaud and Brown (1999) demonstrated that land surface erosion rates dropped ~90% the first year; after 4 years, surface erosion rates had returned to natural.

Major timber harvest and related road building activities in the Yaak TPA watershed occurred during the 1950s through the early 1990s. In the Seventeenmile Creek and Lap Creek Watersheds, over twenty years of vegetative recovery of forest floors and soils have effectively returned sediment loading from upland forest floor erosion to naturally occurring levels. More recent harvest has occurred within the South Fork Yaak Watershed (see Section 2.0).

Estimates of naturally occurring sediment loads from upland erosion were derived by utilizing WATSED (USFS, 1991) modeling results conducted by the Kootenai National Forest on adjacent watersheds (Quartz Creek, South Fork Yaak River) of varying sizes. Average annual unit loading results of these WATSED modeling runs are presented in Table 5-2.

Table 5-2. Estimated Annual Natural Upland Erosion Sediment Yield for WATSED-modeled Streams in the Yaak TPA

Watershed Name	Watershed Area (mi²)	Modeled natural annual average sediment yield (tons/mi²/yr)
Lamoka Creek	1.66	13.8
Quartz Creek	34.07	8.1
Lower Quartz Creek	13.47	10.7
Lower Quartz Creek Trib	0.97	18.6
W Fork Quartz Creek	13.7	9.0
Hennesy Creek	1.36	13.2
Upper Quartz Creek	1.33	12.8
Upper Quartz Creek Trib	2.18	11.6
WF Quartz Creek Trib	7.68	11.4
WF Quartz Creek Trib upper	4.36	7.8

As geology, topography and climactic regimes are similar among WATSED-modeled watersheds and watersheds of concern (Seventeenmile, South Fork Yaak, Lap), a regression equation was generated that related watershed size to estimated natural unit loading (tons/mi²/yr). Estimates of natural background unit loads for Seventeenmile Creek, South Fork Yaak River, and Lap Creek were generated from this regression equation (Figure 5-6, Table 5-3). Because modeling and validation of modeling results have not been conducted at a watershed scale for Seventeenmile Creek, Lap Creek, and South Fork Yaak River, values presented in Tables 5-2 and 5-3 should be considered only as relative estimates, and not actual loading values. As stated in previous sections, WATSED loading estimates have not separated out sediment loads from mass wasting and hillslope processes, but rather include them in the total estimate of natural sediment loading.

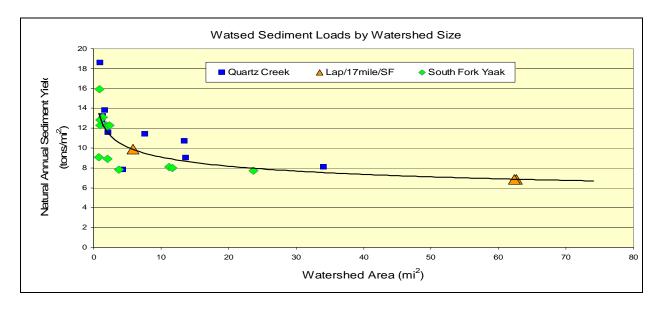


Figure 5-6. Natural Annual Sediment Yield vs. Watershed Size: Yaak TPA

Table 5-3. Estimated Annual Upland Erosion Sediment Loads: Lap Creek, South Fork Yaak River, Seventeenmile Creek

Watershed	Watershed Area (mi²)	Natural annual average sediment yield (tons/mi²/yr)	Estimated Annual Sediment Load (tons/yr)
Lap Creek	5.8	10.7	62
South Fork Yaak River	62.7	7.1	445
Seventeenmile Creek	62.4	7.1	443

5.2.1.4 Forest Roads

Sediment loads from forest roads include sediment derived from the following.

- Erosion of road surfaces, ditches and cut slopes delivered to streams at stream crossings (sediment loading at stream crossings).
- Erosion of road surfaces and fill slopes delivered to streams via overland flow along roads parallel to streams (sediment loading at parallel road segments).
- Erosion of road-fill sediment due to failure, improper sizing, installation or maintenance of culverts and culvert crossings.

Sediment Loading at Stream Crossings

Within the Yaak TPA, the character and condition of forest roads vary greatly. Motorized access has been restricted in many areas primarily in order to protect grizzly bear habitat. As a result, road conditions within the Seventeenmile Creek, Lap Creek, and South Fork Yaak River watersheds vary considerably due to amount of travel and vegetative recovery on road segments under access restrictions.

Many areas in the Yaak TPA have been designated as Grizzly Bear Core areas (Core), and motorized travel on these road networks is prohibited. Some Core areas have been closed for over a decade while other areas have recently been added to Core. Due to closures and the absence of motorized travel within Core and other travel-restricted areas, roads are typically well vegetated and in some instances have become overgrown with woody shrubs and trees. Several Core-area roads visited during field assessments were fully vegetated with a developing duff layer. Other closed roads had varying amounts of vegetative recovery that limited road erosion and delivery of sediment to streams. Figures 5-7 through 5-12 show the variety of road surfaces encountered during field assessments in the Yaak TPA.

The KNF maintains a roads database of USFS maintained roads within the forest boundary that categorizes road closures by Interagency Grizzly Bear Community (IGBC) classification of 1, 2, 3, or 4. Roads within Core areas generally fall into IGBC codes 1 and 3. IGBC code 2 roads were closed to public use, but accessible to USFS administrative and management use. IGBC code 4 roads are typically open to public use as the season permits. Consequently, sediment loading analysis must take into account the variability of factors influencing sediment generation and delivery from road surfaces to streams.

Sediment loads from road surfaces were modeled using the WEPP: Road model (see Appendix B). Based on a random sub-sample of ~17% of all road crossings in Seventeenmile Creek, Lap Creek, and South Fork Yaak River Watersheds, average sediment loads were developed for each road type (Table 5-4). Roads that are open for public use (IGBC code 4) deliver the highest sediment loads to streams. Sediment delivery from closed roads (IGBC code 1, 2, 3) varies according to the amount of vegetative recovery on road surfaces and is substantially less than that from open traveled roads (IGBC code 4). Mean sediment loads for each IGBC classification were extrapolated to all crossings in Seventeenmile Creek, Lap Creek, and South Fork Yaak River watersheds to estimate annual sediment loading from road crossings. Results by watershed and 7th code Hydrologic Unit Code (HUC) are given in Tables 5-5, 5-6, and 5-7.

Table 5-4. Mean Sediment Loads by IGBC Road Classification

KNF Road Classification	Number of Sites	Mean Sediment Load			
(IGBC)	Assessed	(tons/yr)			
1 – Impassible to Motorized Vehicles	4	0.001			
2 – Restricted/Legally Gated Admin Use	15	0.06			
3 – Barriered/Legally No Admin Use	10	0.11			
4 – Open During Bear Season	18	0.60			

Table 5-5. Seventeenmile Creek: Existing Annual Sediment Loads from Road Crossings

Seventeen Mile Creek Wa	itershed	No. of crossings by IGBC Code			Existing Annual Sediment Load by IGBC Code (tons/yr)					
HUC7_Name	Area (mi2)	1	2	3	4	1	2	3	4	TOTAL LOAD
Bridle Cr	1.7	1	0	0	0	0.001	0	0	0	0.00
Conn Cr	2.3	13	0	0	0	0.013	0	0	0	0.01
Crum Gulch	2.1	0	0	0	1	0	0	0	0.6	0.60
Grush Gulch	2.3	0	0	0	0	0	0	0	0	0.00
Mule Cr	1.7	6	0	0	0	0.006	0	0	0	0.01
Papoose Cr	2.5	0	0	0	0	0	0	0	0	0.00
Pelham Cr	0.5	4	0	0	0	0.004	0	0	0	0.00

Table 5-5. Seventeenmile Creek: Existing Annual Sediment Loads from Road Crossings

Seventeen Mile Creek Wa	tershed	No. of crossings by IGBC Code			Existing Annual Sediment Load by IGBC Code (tons/yr)					
			IGRC					Code (t	ons/yr)	
HUC7_Name	Area	1	2	3	4	1	2	3	4	TOTAL
	(mi2)									LOAD
Saddle Cr	1.2	0	0	0	0	0	0	0	0	0.00
Seventeenmile Cr L	10.3	4	0	0	13	0.004	0	0	7.8	7.80
Seventeenmile Cr NF	4.2	0	0	0	1	0	0	0	0.6	0.60
Sheepherder Cr	1.8	0	0	0	0	0	0	0	0	0.00
Big Foot Cr	3.0	0	5	0	5	0	0.3	0	3	3.30
Flattail Cr	10.3	0	2	6	6	0	0.12	0.66	3.6	4.38
Hemlock Cr	3.7	2	0	0	0	0.002	0	0	0	0.00
Lost Fork Cr-1	3.4	6	9	0	0	0.006	0.54	0	0	0.55
Lost Fork Cr-2	2.4	1	2	0	0	0.001	0.12	0	0	0.12
Seventeenmile Cr U-1	3.4	0	4	0	2	0	0.24	0	1.2	1.44
Seventeenmile Cr U-2	5.6	0	4	4	7	0	0.24	0.44	4.2	4.88
TOTALS	62.4	37	26	10	35	0.037	1.56	1.1	21	23.70

Table 5-6. South Fork Yaak River: Existing Annual Sediment Loads from Road Crossings

South Fork Yaak River Watershed			of cro			Existing Annual Sediment Load by IGBC				
		IGBC Code			Code (tons/yr)					
HUC7_Name	Area	1	2	3	4	1	2	3	4	TOTAL
	(mi2)									LOAD
Beaver Cr-1	3.9	1	0	1	0	0.001	0	0.11	0	0.11
Beaver Cr-2	4.4	1	0	1	4	0.001	0	0.11	2.4	2.51
Browning Cr	1.0	0	0	0	1	0	0	0	0.6	0.60
Can Cr	1.4	3	2	0	0	0.003	0.12	0	0	0.12
Clay Cr-1	4.3	0	0	1	0	0	0	0.11	0	0.11
Clay Cr-2	5.0	2	9	0	4	0.002	0.54	0	2.4	2.94
Dutch Cr	2.4	3	5	0	0	0.003	0.3	0	0	0.30
Fix Cr	0.9	0	1	1	0	0	0.06	0.11	0	0.17
Fowler Cr-1	3.7	2	0	4	0	0.002	0	0.44	0	0.44
Fowler Cr-2	5.3	0	0	8	2	0	0	0.88	1.2	2.08
Hartman Cr	1.3	0	0	3	1	0	0	0.33	0.6	0.93
Kelsey Cr	2.0	3	3	3	3	0.003	0.18	0.33	1.8	2.31
Smoot Cr	2.3	0	0	0	0	0	0	0	0	0.00
Yaak R SF	1.9	0	0	0	0	0	0	0	0	0.00
Yaak R SF-2	10.2	4	3	1	7	0.004	0.18	0.11	4.2	4.49
Yaak R SF Trib-1	1.5	0	0	0	0	0	0	0	0	0.00
Yaak R SF Trib-2	1.6	0	0	0	0	0	0	0	0	0.00
Yaak R SF Trib-3	1.1	9	0	0	0	0.009	0	0	0	0.01
Yaak R SF Trib-4	1.3	0	0	0	1	0	0	0	0.6	0.60
Yodkin Cr*	1.9	1	1	6	0	0.001	0.06	0.66	0	0.72
Zulu Cr-1	2.0	1	4	0	2	0.001	0.24	0	1.2	1.44
Zulu Cr-2	3.3	6	3	0	2	0.006	0.18	0	1.2	1.39
Totals	62.7	36	31	29	27	0.036	1.86	3.19	16.2	21.29

^{*}Recent (2007) road decommissioning has reduced the number of road crossings in Yodkin Creek watershed. The figures given here do not reflect this recent activity

Table 5-7. Lap Creek Existing Annual Sediment Loads from Road Crossings

South Fork Yaak River W	atershed	No. of crossings by IGBC Code			Existing Annual Sediment Load by IGBC Code (tons/yr)					
HUC7_Name	Area	1	2	3	4	1	2	3	4	TOTAL
_	(mi2)									LOAD
Lap Cr	5.8	6	0	16	1	0.006	0	1.76	0.6	2.37
Totals	5.8	6	0	16	1	0.006	0	1.76	.06	2.37



Figure 5-7. Closed Road (Core)



Figure 5-8. Closed Road (Core)



Figure 5-9. Closed Road (Core)



Figure 5-10. Closed Road (non-Core)





Figure 5-11. Open Road

Figure 5-12. Open Road

Sediment Loading at Parallel Road Segments

In the field, parallel road segments were selected based on best professional judgment while traveling roads on which specific crossings were selected for evaluation. Parallel segments were selected in a manner where road segments would not be duplicated in both the crossing and parallel sediment load calculations. It was determined in the field that parallel road segments were not a significant source of sediment loading unless the stream buffer was very small (less than 20 feet) due to the extremely dense forest vegetation and stream buffers. As a result, parallel segments were only assessed if located very near a stream and if evidence of sediment delivery was noted. Only two parallel segments were identified and assessed in the Yaak TPA, one in the South Fork of the Yaak River (Figure 5-13) and one in Upper Seventeenmile Creek (Figure 5-14). One parallel segment representative of the dense vegetation conditions and low sediment delivery was measured (SFY-4A-P). As well, one segment where the road was located very near the stream and delivery was comparatively high (USC-2A-P). The majority of parallel sites observed in the field contained buffer distances greater than 50 feet and were heavily vegetated with no evidence of sediment delivery to the stream. USC-2AP was the only parallel site where evidence of sediment loading was noted. Figures 5-13 and 5-15 are included to show differences in the typical buffer conditions of the two parallel segments.



Figure 5-13. Parallel Segment SFY-4A-P – Average Buffer Distance 70 feet



Figure 5-14. Parallel Segment USC-2A-P – Average Buffer Distance 10 feet

Field observations indicated that the vast majority of parallel road segments do not contribute sediment to streams, and buffer distances must be very small for sediment to reach adjacent stream channels. This conclusion was drawn based on observations in the three assessed subwatersheds only, the fact that nearly the entire road network (open roads) within these areas was traveled during fieldwork, and site USC-2A-P was the only site where evidence of delivery was noted. Also, a large portion of parallel road distance calculated in the GIS layers is present at road crossing locations and is accounted for in the crossing load calculations. As a result, parallel road segments are likely an insignificant contributor to overall sediment loading from the unpaved road network with isolated locations where roads are very close to streams. Because of the observed non-significance of sediment loading from parallel road segments, loads from parallel road segments were not calculated.

Culvert Assessment

'Culvert failure' is typically associated with rerouting of stream channels away from or out of culverts as a result of high flow events, and can result in the delivery of significant sediment loads to streams. For the purposes of this assessment, both culvert failure and lesser amounts of chronic sediment delivery to stream channels as a result of improper sizing, placement, or maintenance of road crossing culverts are considered. It is assumed that properly sized, installed, and maintained culverts are capable of passing flow and debris of all but the most severe events, and do not contribute sediment loads above what would be deemed 'naturally occurring.' Culvert conditions may range from 'failure' and associated acute road fill delivery to stream channels, or (more likely) culvert conditions may result in lesser amounts of chronic sediment delivery due to channel scour, road scour from overtopping, culvert undercutting, or road fill failure due to improper placement, undersizing, and/or lack of maintenance of culverts.

Evidence of chronic problems such as constriction, blockage, overtopping, misalignment, outlet drops, and undercutting is not uncommon at culvert crossings in the Seventeenmile, Lap and South Fork Yaak Watersheds (YHRP 2004-2006, Newgard pers comm). In some cases³ culvert

³ Lap Creek site 200, South Fork Yaak sites 55, 74 & 90, and Seventeenmile Creek sites 33, 37 & 61

failures in the Yaak TPA have resulted in road washouts that have delivered significant sediment loads to adjacent streams. In other cases, debris blockages at culvert inlets and evidence of culvert overtopping, undercutting, and scour demonstrate sediment delivery and the potential for more significant failure if culvert deficiencies and maintenance issues are not addressed. Ten percent of culverts assessed by the YHRP (n >200) had blockages of 25% or greater at the culvert inlet, and nearly half of these showed evidence of culvert overtopping (Figures 5-15 -5-17).

Constriction ratio (the ratio of culvert width to channel width) is used to evaluate the capabilities of culverts to pass high flows and associated debris. Culverts with widths less than bankfull stream widths were considered undersized and pose a potential risk of acute and chronic sediment delivery, channel scour, and debris accumulation, particularly under high flow conditions. Of the more than 180 culverts assessed for constriction, 67% had constriction ratios <0.7 and 24% had constriction ratios of <0.4.

As sediment delivery due to deficient culvert consists of a variety of processes, and is influenced by historical sizing and placement, and past and present maintenance and management, the development of sediment loading estimates due to culvert failure (chronic and acute) is problematic. Sediment load estimates from culvert failure, therefore, are not calculated. Rather, allocations provided to culvert failure in Section 6.0 reply on a performance-based approach following guidelines provided in the Inland Native Fish Strategy (INFISH, 1995).

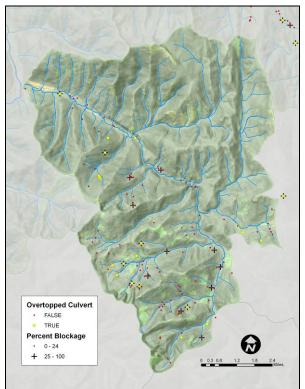


Figure 5-15. Seventeenmile Creek – Overtopped and Blocked Culverts

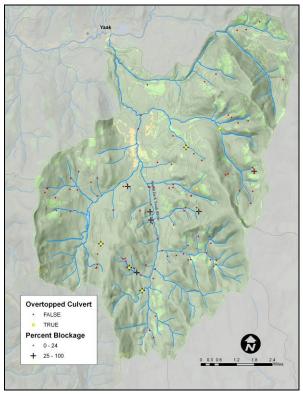


Figure 5-16. South Fork Yaak River - Overtopped and Blocked Culverts

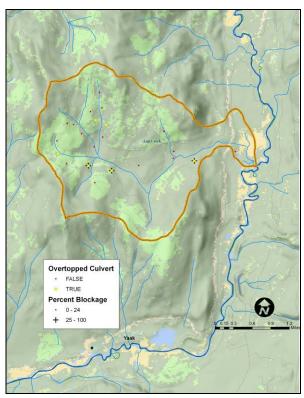


Figure 5-17. Lap Creek - Overtopped and Blocked Culverts

5.2.1.5 Water Yield and Peak Flow Increase

While not a specific 'source' of sediment, increases in water yields and peak flows due primarily to timber removal and road building, can influence sediment impairment conditions through increases in bedload movement and bank instability. The Forest Plan Water Yield Guidance (FPWYG) establishes an allowable peak flow increase based on the KNF Clearcut Equivalent Area Model (USFS, 1987, Appendix 18).

Peak flow increases in the Lap Creek, and South Fork Yaak met FPWYG thresholds (USFS, 1990) in 1990. Since 1990, no additional harvest has taken place in the Lap Creek Watershed, and harvest activity in the South Fork Yaak River watershed since 1990 has been in accordance with FPWYG. Recent PFI has not been calculated for the Seventeenmile Creek. However, little harvest has been conducted in the watershed since the early 1980s allowing vegetative recovery of past timber stands. As vegetative recovery of historic timber harvest areas continues, peak flow increases will attenuate.

Peak flow increases in the Seventeenmile Creek, Lap Creek, and South Fork Yaak River are due to legacy effects of past timber harvest, wildfire and road building. Recovery will continue to proceed in these areas. Maintaining PFI within the FPWYG constitutes a 'reasonable land, soil and water conservation practice" and will ensure that water yield increases from timber harvest activities do not impact beneficial uses.

In addition to calculated peak flow increases using the KNF Clearcut Equivalent Area Model, additional uncalculated PFI as a result of flow routing due to alterations in hillslope hydrology from forest roads has the potential to contribute to chronic conditions that are not mitigated through normal upland vegetative recovery. Forest roads have the potential to modify hydrology through the interception and rerouting of shallow subsurface flows (Megahan, 1972; Megahan & Clayton, 1983), potentially resulting in the capture of subsurface flows at roadcuts and subsequent routing of these flows to surface waters through roadside ditch systems (Megahan, 1972). Modification of natural flowpaths in the Yaak TPA due to high road densities in some subwatersheds (7th Code HUC) may contribute to channel alterations and increased sediment loading as a result of interception and rerouting. Subwatershed road densities provide an indicator as to the potential for significant road routing of shallow subsurface flows.

Several subwatershed road densities within Seventeenmile Creek, Lap Creek, and South Fork Yaak River are above 3.0, with the highest road densities present in Lost Fork Creek, Big Foot Creek, and Fix Creek (4.9, 4.5, and 4.5 miles/mile² respectively). Table 5-8 shows existing road densities for all 7th Code HUC subwatersheds in Seventeenmile Creek, Lap Creek, and South Fork Yaak River Watersheds, and may be used to further evaluate potential water routing and PFI concerns in these watersheds.

Table 5-8. Road Densities in the Seventeenmile Creek, Lap Creek, and South Fork Yaak River watersheds by 7th Code HUC

HUC 7 Name	Watershed	Road Density (mi/mi ²)
Lap Cr	Lap Creek	4.2
Seventeenmile Cr Upper 1	Seventeenmile Creek	3.4
Big Foot Cr	Seventeenmile Creek	4.5
Lost Fork Cr	Seventeenmile Creek	2.9
Lost Fork Cr	Seventeenmile Creek	4.9
Hemlock Cr	Seventeenmile Creek	1.4
Seventeenmile Cr Upper 2	Seventeenmile Creek	3.0
Flattail Cr	Seventeenmile Creek	1.5
Mule Cr	Seventeenmile Creek	2.0
Pelham Cr	Seventeenmile Creek	2.3
Conn Cr	Seventeenmile Creek	2.7
Bridle Cr	Seventeenmile Creek	0.1
Saddle Cr	Seventeenmile Creek	0.0
Seventeenmile Cr NF	Seventeenmile Creek	0.0
Seventeenmile Cr L	Seventeenmile Creek	1.0
Crum Gulch	Seventeenmile Creek	0.0
Grush Gulch	Seventeenmile Creek	0.0
Sheepherder Cr	Seventeenmile Creek	2.3
Papoose Cr	Seventeenmile Creek	0.0
Yaak R SF	South Fork Yaak River	1.0
Yaak R SF Trib	South Fork Yaak River	0.2
Yaak R SF Trib	South Fork Yaak River	0.7
Smoot Cr	South Fork Yaak River	0.0
Yaak R SF Trib	South Fork Yaak River	2.7
Clay Cr	South Fork Yaak River	0.9
Zulu Cr	South Fork Yaak River	3.4
Zulu Cr	South Fork Yaak River	1.0
Can Cr	South Fork Yaak River	3.6

Table 5-8. Road Densities in the Seventeenmile Creek, Lap Creek, and South Fork Yaak River watersheds by $7^{\rm th}$ Code HUC

HUC 7 Name	Watershed	Road Density (mi/mi ²)
Kelsey Cr	South Fork Yaak River	3.6
Clay Cr	South Fork Yaak River	3.4
Dutch Cr	South Fork Yaak River	4.2
Fix Cr	South Fork Yaak River	4.5
Yaak R SF Trib	South Fork Yaak River	2.1
Fowler Cr	South Fork Yaak River	3.4
Hartman Cr	South Fork Yaak River	3.4
Fowler Cr	South Fork Yaak River	3.0
Browning Cr	South Fork Yaak River	1.9
Yaak R SF	South Fork Yaak River	3.4
Beaver Cr	South Fork Yaak River	3.7
Beaver Cr	South Fork Yaak River	3.0
Yodkin Cr	South Fork Yaak River	1.7

SECTION 6.0 TOTAL MAXIMUM DAILY LOAD & LOAD ALLOCATIONS

6.1 Total Maximum Daily Load

A Total Maximum Daily Load is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards. TMDLs are a requirement of Section 303(d) of the CWA and Montana state law (MCA 75-5-703). To meet this requirement, DEQ must identify water bodies not meeting water quality standards and then establish TMDLs for those pollutants responsible for water quality impairment. A TMDL Plan is a quantitative assessment of water quality problems, contributing sources, and pollution reductions needed to attain water quality standards. The TMDL Plan specifies the amount of pollutant that must be reduced to meet water quality standards, allocates pollution control or management among sources in a watershed, and recommends a framework for taking actions needed to restore a water body.

The TMDL is defined as the sum of individual waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and natural background sources, and a margin of safety that considers seasonal variation and accounts for the uncertainty in the relationship between the pollutant loads and the quality of the receiving waterbody (40 Code of Federal Regulations [CFR] 130.2). Numerically, this definition is represented by the equation:

$TMDL = \Sigma WLA + \Sigma LA + MOS$

Where appropriate, allocations may be expressed by measures other than allowable numeric loads. Alternative approaches for the expression of load allocations are justified in EPA guidance, *Protocol for Developing Sediment TMDLs*.

"Although there are many ways to express TMDLs, the concept of allocation is central to the TMDL process because it reinforces the importance of identifying what sources need to be addressed to attain water quality standards. Therefore, sediment TMDLs should clearly provide for allocations by source of maximum allowable loads, needed load reductions, or, in some cases, source control actions." (EPA, 1999)

For waterbodies requiring TMDLs in the Yaak TPA (Seventeenmile Creek, Lap Creek, and South Fork Yaak River) TMDLs are expressed as a percent reduction of sediment loads from controllable anthropogenic sources. Percent reductions are based on estimates of anthropogenic sediment loading above 'naturally occurring' (ARM 17.30.602 (19)) conditions and are based on a combination of field assessments, sediment modeling, and best professional judgment of resource professionals.

As there are no point sources of sediment in the Yaak TPA, no wasteload allocations (WLA) are presented. Therefore, the TMDL is expressed as the sum of the load allocations (LAs) to natural background and forest roads - also represented as the percent reductions of all anthropogenic non-point sources (Table 6-1). Note that natural background loads presented in Table 6-1 are modeled estimates and incorporate natural bank & hillslope erosion and mass wasting/hillslope

failure. While not expressed separately in Table 6-1, individual allocations to these sediment source categories are provided below in Section 6.2. Allocations. Margin of safety considerations are addressed below in Section 6.3.

Table 6-1. Total Annual Sediment Loads: Seventeenmile Creek, Lap Creek, South Fork Yaak River

Watershed	Sediment Source Category	Existing (tons/yr)	TMDLs & Allocations (tons/yr)	Percent Reduction to meet TMDL
Seventeenmile Creek	Natural Background	443	443	0.0%
	Forest Roads	24	12	48.7%
	Total Load	467	455	2.6
Lap Creek	Natural Background	62	62	0.0%
	Forest Roads	2.4	1.1	52.3%
	Total Load	64.4	63.1	2.0
South Fork Yaak River	Natural Background	445	445	0.0%
	Forest Roads	21	12	42.6%
	Total Load	466	457	1.9

It must be noted that the natural background loads presented in Table 6-1 are estimated from similar adjacent watersheds using modeled approaches, and forest road loads are derived from extrapolation of field-assessment data. The difference in assessment methodologies used to estimate loads from these two source categories make cumulative load estimations and relative loading comparisons between the two sources difficult to verify without more extensive field data collection and validation. Regardless of the veracity of cumulative loading estimations, source assessments (Section 5.0) do confirm that the primary anthropogenic sediment source affecting sediment-impairment conditions in the Yaak TPA is sediment derived from unpaved forest roads. Consequently, reducing and controlling sediment and associated impacts from the forest road network using all reasonable conservation practices and BMP technologies will ensure that forest road loads are not elevated above 'naturally occurring' conditions (see Section 6.2.1).

The following sections provide allocations, in terms of percent reductions in sediment loading, to anthropogenic sources for sediment-impaired waterbodies, Seventeenmile Creek, Lap Creek, and South Fork Yaak River.

6.2 Load Allocations

This section identifies allocations required for the establishment of TMDLs in Seventeenmile Creek, Lap Creek, and the South Fork Yaak River. The goal is to ensure that the water quality targets (Section 4.0) are met and maintained through the allocation and reduction of anthropogenic sediment loads. By meeting load allocations, it is expected that standards will be met and, more importantly, beneficial uses are restored and/or protected. Load allocations are presented by sediment source category (forest roads, upland management, bank erosion, mass wasting) and should be applied at the 7th-Code HUC scale watersheds given in Appendix B in order to provide adequate beneficial use protection for tributary and mainstem waterbodies.

As defined in the Administrative Rules of Montana:

"...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." (ARM 17.30.623 (f))

Additionally, 'Naturally occurring' is defined as:

"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" (ARM 17.30.602 (19)).

Load allocations from anthropogenic sources are therefore based on the premise that some sediment from anthropogenic activity is acceptable as long as beneficial uses are maintained through the application of 'all reasonable land, soil, and water conservation practices.' Load allocations presented below provide percent reductions (where applicable) based on the application of reasonable and accepted conservation practices (DEQ, 2007, USDA, 1995) believed to maintain water quality to support all beneficial uses.

It is acknowledged that the numeric allocations presented herein are watershed-scale estimates. Site specific conditions are expected to vary from average loading values given in Section 5.0. As such, further site-specific analysis may show that road-sediment loading from some 7th-code watersheds are meeting their numeric allocation, while others are not. Where further analyses (consistent with methods employed herein) improve on existing knowledge of site-specific conditions, updated and site-specific data and information should be employed in refining loading estimations and/or pursuing management decisions regarding attainment and maintenance of TMDLs.

Meeting all allocations assumes that TMDLs are met, and the waterbody is subsequently meeting water quality standards for the pollutant of concern (sediment). However, due to the inherent uncertainties in watershed-wide loading estimates and their relative influence on water quality target attainment, long-term monitoring is required in order to evaluate the effectiveness of allocation implementation on the attainment of water quality standards (MCA 75-5-703 (7)). A framework long-term monitoring and implementation plan is given in Section 7.0.

Section 6.2 provides load allocations for anthropogenic sediment source categories identified in Section 5.0.

- Forest roads (stream crossings, parallel road segments, culvert failure)
- Upland erosion from forest management activities
- Bank erosion & mass wasting/hillslope failure
- Future development

6.2.1 Forest Roads Allocation

In the case of sediment derived from forest roads, a surrogate sediment loading condition is established that represents the application of 'all reasonable conservation practices', and is based on the following criteria:

- Contributing road length at BMPed crossings < 200 feet on open roads
- Road crossing density ≤ 1.5 crossings/mi² at the 7th Code HUC scale
- New culverts on unpaved forest roads are sized and installed to pass the 100-year flow (Q100) and associated debris (INFISH, 1995)
- Existing culverts are maintained, upgraded or removed (consistent with INFISH guidance) to limit sediment contributions from chronic failure.
- Road segments parallel to streams maintain all appropriate BMPs to minimize sediment loading to streams

The resultant numeric sediment load from the forest road network, (considering a contributing road length on open, traveled roads of ≤ 200 ft at BMPed stream crossings, a road crossing density ≤ 1.5 crossings/mile², culverts capable of passing the 100-year flow event, and application of all appropriate BMPs along parallel road segments) is considered a 'naturally occurring' (ARM 17.30.602 (19)) condition and provides a numeric basis for sediment allocations to forest road networks in the Yaak TPA. Based on these criteria, the **modeled numeric allowable unit load from the forest road network is 0.20 tons/year/mi2.**

It must be noted that the numeric allocation (allowable load) to forest roads is based on surrogate criteria and does not mandate specific management practices that must be employed for sediment reduction and management. For instance, it is not required that management actions adhere to specific contributing lengths or road densities, if it can be shown through site-specific analysis that numeric <u>load allocations</u> will not be exceeded.

Presently, there several 7th-code watersheds in the Yaak TPA with road crossing densities that exceed 1.5 that are meeting numeric allocations (Tables C-17-C-19, Appendix B), due to improved or revegetated roads. Likewise, there are also several 7th-code watersheds with low road crossing densities that exceed numeric allocations due to improperly maintained roads. As site-specific information in these watersheds is collected, existing loading determinations may be modified based on empirical site-specific data.

In order to estimate the acceptable sediment loading and subsequent load allocations from forest roads based on the above bulleted criteria, the criteria were applied to the existing modeled sediment loads given in Section 5.0 (see Tables 5-5, 5-6, 5-7, 5-8, and Appendix B). Tables 6-2, 6-3, and 6-4 present the subsequent load allocations, expressed as percent reductions, for sediment derived from unpaved forest roads.

Table 6-2. Forest Road Allocation: Stream Crossings							
Watershed	Existing Stream Crossing	Performance-based Stream	Stream Crossing				
	Load	Crossing Load	Allocation				
	(tons/yr)	(tons/yr)	(Percent Reduction)				
Seventeenmile Creek	23.7	12.16	49%				
Lap Creek	2.37	1.13	52%				
South Fork Yaak River	21.3	12.23	43%				

Table 6-3. Forest Road Allocation: Culvert Failure

Watershed	Existing Culvert	Performance-based Culvert Failure
	Failure Load	Allocation
Seventeenmile Creek	Not quantified	No loading from culvert failures (chronic and
Lap Creek		acute) where failure is a result of undersizing
South Fork Yaak River		(100-year flow), or improperly installed or
		maintained culverts.

Table 6-4. Forest Road Allocation: Parallel Road Segments

Watershed	Existing Parallel	Performance-based Parallel Segment
	Segment Load	Allocation
Seventeenmile Creek	Not quantified	No sediment loading increases other than
Lap Creek		potential minor predicted short-term increases
South Fork Yaak River		associated with full implementation of
		applicable BMP standards for forest road
		maintenance.

6.2.2 Upland Erosion from Management Activities Allocation

As presented in Section 5.2.1.3, with the exception of road-related sediment loading, present sediment loading from upland management activities does not appear to be elevated significantly above 'naturally occurring' conditions, therefore no percent reduction allocation is given for these sources. It is not reasonable to assume that there will be no future upland management activities within the Yaak TPA that produce sediment, therefore an allocation is required to account for existing and potential future sediment loading from this source category.

The allocation to sediment derived from upland erosion (from management activities) proposes no sediment loading increases associated with harvest or other upland management activities without implementation of applicable BMPs (DEQ, 2007, USDA, 1995), and all reasonable land, soil and water conservation practices. Application of BMPs and 'all reasonable land, soil, and water conservation practices' on existing and future management activities will ensure that sediment loading will remain within 'naturally occurring' conditions.

In addition to application of applicable BMPs, 'reasonable land, soil, and water conservation practices' applied to upland management activities include maintaining peak flow increases (PFI) within the Kootenai National Forest's FPWYG. Where natural conditions resulting from forest fire or other events increase peak flows above FPWYG, management actions that would result in further increases in peak flows should be severely restricted unless further analysis demonstrates that such increases would not be detrimental to stream channels, aquatic life, or result in further increases in sediment loading. It is incumbent on forest resource managers to demonstrate non-significance of such activities at a subwatershed (7th-Code HUC) scale for the protection of stream channels and aquatic resources.

Table 6-5. Upland Erosion Allocation: Forest Management Activities and Water Yield

Watershed	Existing	Performance- based Load	Allocation
	Load (tons/yr)	(tons/yr)	
Seventeenmile Creek	443	443	No sediment loading increases associated with harvest or other upland management activities without full implementation of applicable BMP standards, and all reasonable land, soil and water conservation practices Maintain PFI within FPWYG
Lap Creek	62	62	No sediment loading increases associated with harvest or other upland management activities without full implementation of applicable BMP standards, and all reasonable land, soil and water conservation practices Maintain PFI within FPWYG
South Fork Yaak River	445	445	No sediment loading increases associated with harvest or other upland management activities without full implementation of applicable BMP standards, and all reasonable land, soil and water conservation practices Maintain PFI within FPWYG

6.2.3 Bank Erosion & Mass Wasting/Hillslope Failure Allocation

As presented in Section 5.2.1.1 and 5.2.1.2, present sediment loading from bank erosion and mass wasting/hillslope failure does not appear to be elevated significantly above 'naturally occurring' conditions, therefore no percent reduction allocation is given for these sources. As with sediment derived from upland management sources, it is not reasonable to assume that there will be no future activities within the Yaak TPA that produce sediment from bank or hillslope erosion. A sediment allocation is therefore required to account for existing and potential future sediment loading from this source category.

The allocation to sediment derived from bank erosion and mass wasting proposes no future sediment loading increases associated with bank erosion or mass wasting/hillslope failure other than short-term increases that may be predicted and associated with full implementation of all applicable best management practices (DEQ, 2007, USDA, 1995). Full application of BMPs on all existing and future activities that may contribute to bank erosion and/or mass wasting will ensure that sediment loading will be maintained within 'naturally occurring' conditions through the application of 'all reasonable land, soil and water conservation practices'.

Table 6-6. Anthropogenic Bank Erosion and Mass Wasting Allocation

Watershed	Existing Load	Performance-	Allocation	
		based Load		
Seventeenmile Creek	Within	Within	No sediment loading increases associated with	
	'Naturally	'Naturally	anthropogenically-derived bank erosion or	
Lap Creek	Occurring'	Occurring'	mass wasting sources without full	
	Conditions	Conditions	implementation of all applicable BMP	
South Fork Yaak River			standards and all reasonable land, soil and	
			water conservation practices	

6.2.4 Future Development Allocation

It is not reasonable to assume that there will be no future development in the Yaak TPA. An allocation is therefore provided to account for potential future sediment loading related to developed lands not covered under previously addressed sediment source categories. This includes commercial and residential development and associated runoff from stormwater or land clearing activity. Maintenance of riparian buffers and application of all reasonable land, soil and water conservation practices during and after development will ensure that 'naturally occurring' conditions are maintained. This allocation proposes no sediment loading increases associated with future development other than potential minor, short-term increases that may be predicted and associated with full implementation of all applicable riparian BMP standards. Additionally, all applicable construction, storm water, 310 and SPA 124 permitting actions should address no increase above naturally occurring conditions, except for temporary exceedences.

Table 6-7. Future Development Allocation

Watershed	Future Allocation
Seventeenmile Creek	No increase in sediment loading linked to the removal of riparian vegetation buffers or
Lap Creek	linked to the loss of dynamic equilibrium due to stream encroachment within the stream migration zone. All applicable construction, storm water, and 310 Permitting BMP requirements shall be met.
South Fork Yaak River	-

6.3 Margin of Safety

Applying a margin of safety is a required component of TMDL development. The margin of safety (MOS) accounts for the uncertainty about the pollutant loads and the quality of the receiving water and is intended to protect beneficial uses in the face of this uncertainty. The MOS may be applied implicitly by using conservative assumptions in the TMDL development process or explicitly by setting aside a portion of the allowable loading (EPA, 1999). This plan addresses MOS implicitly in a variety of ways.

- Multiple targets addressing physical channel conditions are developed to address excess fines and other impairments.
- The suite of proposed supplemental indicators, including biological indicators, used to help verify beneficial use support determinations.

- The proposed supplemental indicators may also provide an early warning method to identify pollutant-loading threats, which may not otherwise be identified, if targets are not met.
- A large amount of data and assessment information were considered prior to finalizing any impairment determinations. Impairment determination was based on conservative assumptions that err on the side of keeping streams listed and developing TMDLs unless overwhelming evidence of use support was available.
- Consideration of seasonality (see below).
- The adaptive management approach evaluates target attainment and allows for refinement of load allocation, targets, modeling assumptions, and restoration strategies to further reduce uncertainties associated with TMDL development.
- Application of 'all reasonable land & soil water conservation practices' provides a performance-based evaluation of allocation objectives.

6.4 Seasonality

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

Specific examples of how seasonality has been addressed are listed below.

- Source assessment of sediment loading inherently incorporates runoff flows when erosion is greatest.
- Targets were developed with seasonality in mind. Fine sediment target data is collected in the summer, after flushing flows have passed. Macroinvertebrate and supplemental indicator data is collected during the summer months when these biological communities most accurately reflect stream conditions.
- Throughout this document, the data reviewed cover a range of years, seasons, and geographic area within the Yaak TPA
- Annual loading reductions presented in Section 6.2 are presented as Total Maximum Daily Loads (Appendix C) as a function of the annual hydrograph.

6.5 Uncertainty and Adaptive Management

Uncertainties in the accuracy of field data, applicable target values, source assessments, loading calculations, modeling assumptions, and other considerations are inherent when assessing and evaluating environmental variables for TMDL development. While uncertainties are an undeniable fact of TMDL development, mitigation and reduction of uncertainties through adaptive management approaches is a key component of ongoing TMDL implementation and evaluation. Uncertainties, assumptions, and considerations are addressed throughout this document and point to the need to refine analysis, conduct further monitoring, and address unknowns in order to develop better understanding of sediment impairment conditions and the processes that affect impairment. This process of adaptive management is predicated on the premise that targets, TMDLs, allocations, and the analyses supporting them are not static, but are processes subject to modification and adjustment as new information and relationships are understood.

Adaptive management addresses important considerations such as feasibility and uncertainty in establishment of targets. For example, despite implementation of all restoration activities, the attainment of targets may not be feasible due to natural disturbance such as forest fires, flood events, or landslides. Similarly, it is possible that the natural potential of some streams will preclude achievement of some targets. For instance, natural geologic and other conditions may contribute sediment at levels that cause a deviation from numeric targets associated with sediment. Conversely, some targets may be underestimates of the potential of a given stream, and it may be appropriate to apply more protective targets upon further evaluations. Supplemental indicators are used to help with these determinations. In light of all this, it is important to recognize that the adaptive management approach provides the flexibility to refine targets as necessary to ensure protection of the resource or to adapt to new information concerning target achievability.

Adaptive management also addresses uncertainties associated with allocations (percent reductions). Uncertainties and unknowns associated with sediment derived from forest roads are considerable and addressed thoroughly in Appendix B through the assertion of a variety of assumptions and considerations regarding road sediment load modeling and extrapolation of results. As further monitoring of water quality and source loading conditions is conducted, uncertainties associated with these assumptions and considerations may be mitigated and loading estimates may be refined to more accurately portray watershed conditions.

As part of this adaptive management approach, land use activities should be tracked. Increases in land use may trigger a need for additional monitoring. The extent of monitoring should be consistent with the extent of potential impacts and can vary from basic BMP assessments to a complete measure of target parameters above and below the project area before the project and after completion of the project. Cumulative impacts from multiple projects must also be a consideration. This approach will help track the recovery of the system and the impacts, or lack of impacts, from ongoing management activities in the watershed. Under these circumstances, additional targets and other types of water quality goals may need to be developed to address new stressors to the system depending on the nature of the activity.

Uncertainties in assessments and assumptions should not paralyze but should point to the need to be flexible in our understanding of complex systems and to adjust our thinking and analysis in response to this need. Implementation and monitoring recommendations presented in Section 7.0 provide a basic framework for reducing uncertainty and furthering understanding of these issues.

6.6 Total Maximum Daily Loading Expression

"In November 2006 EPA issued the Memorandum "Establishing TMDL "Daily" Loads in Light of the Decision by the U.S. Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. v. EPA et. al., No. 05-5015 (April 25, 2006) and Implications for NPDES permits," which recommends that all TMDLs and associated load allocations and wasteload allocations include a daily time increment in conjunction with other appropriate temporal expressions that may be necessary to implement the relevant water quality standard" (EPA, 2007).

In order to satisfy this recommendation from EPA, TMDL expressions have been developed and are presented in Appendix C.

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SECTION 7.0 TMDL IMPLEMENTATION AND MONITORING

7.1 TMDL Implementation and Monitoring Framework

This section presents a framework strategy to achieve load allocations and water quality targets through implementation of control actions and monitoring their effectiveness. Montana state law contains provisions that address evaluation of TMDL effectiveness through long-term water quality monitoring. As defined in (MCA 75-5-703 (7) (9):

- "(7) Once the control measures identified in subsection (6) have been implemented, the department shall...develop a monitoring program to assess the waters that are subject to the TMDL to determine whether compliance with water quality standards has been attained for a particular water body or whether the water body is no longer threatened. The monitoring program must be designed based on the specific impairments or pollution sources. The department's monitoring program must include long-term monitoring efforts for the analysis of the effectiveness of the control measures developed.
- (9) If the monitoring program ... demonstrates that the TMDL is not achieving compliance with applicable water quality standards within 5 years after approval of a TMDL, the department shall conduct a formal evaluation of progress in restoring water quality and the status of reasonable land, soil, and water conservation practice implementation to determine if:
- a. the implementation of a new or improved phase of voluntary reasonable land, soil, and water conservation practice is necessary;
- b. water quality is improving but a specified time is needed for compliance with water quality standards; or
- c. revisions to the TMDL are necessary to achieve applicable water quality standards."

Load allocations provided in Section 6.0 may be achieved through a variety of management and implementation actions. This document provides conceptual recommendations leaving the specific details to local stakeholders and resource managers. A timeframe for implementation and monitoring activities is not included herein because most implementation projects rely upon available funding and resources for such actions.

Allocations presented in Section 6.0 provide the basis for meeting sediment targets, and hence, water quality standards for sediment in the Yaak TPA. Some allocations (forest road allocations) call for reductions of source loads whereas other allocations (upland erosion, bank erosion, mass wasting) call for no increases above naturally occurring conditions through the continued maintenance of 'all reasonable land, soil and water conservation practices' (ARM 17.30.602 (19)) which, by definition, will ensure that water quality standards for sediment will be met.

Application of BMPs forms the foundation of management and implementation recommendations yet is only part of the overall strategy for meeting sediment allocations. The application of 'all reasonable land, soil and water conservation practices' is also to be followed in order to ensure attainment of sediment water quality standards. Application of BMPs and the application of 'all reasonable land, soil and water conservation practices' are not necessarily synonymous concepts. For instance, to ensure that water quality standards are achieved and maintained, it is reasonable that all applicable BMPs are applied in order to meet sediment allocations. However, it is not reasonable to increase road densities or stream crossing densities

where the sum of sediment loads from a fully 'BMPed' condition exceeds the ability of streams to maintain aquatic beneficial life uses. For this reason, BMPs are considered a *component* of 'all reasonable land, soil and water conservation practices', but not an endpoint in itself. In addition to BMP application, maintaining and/or reducing road densities and stream crossing densities at levels that do not cause water yield increases (that would exceed Forest Plan Water Yield Guidance, or cause deleterious impacts to stream channels or aquatic life) are considered 'reasonable land, soil and water conservation practices.'

In most cases, applying applicable BMPs to existing road networks will result in the necessary sediment reductions required to meet water quality standards. In some cases, however, a larger effort than solely implementing new BMPs may be required to address sources of impairment. In these cases BMPs are typically identified as a first effort, and an adaptive management approach will be used to determine if further restoration approaches are necessary to achieve water quality targets and load allocations (see MCA 75-5-703 (9)).

In addition to application of BMPs to reduce *existing* loads, on-going land management activities should employ 'all reasonable land, soil & water conservation practices' with the intent of meeting sediment allocations set forth in Section 6.0.

Within the Yaak TPA, sediment production and delivery to streams from forest road networks is currently the primary human caused sources of sediment impairment to water quality, and load reductions from forest road sources is the primary focus of implementation efforts. General goals of the following implementation and monitoring recommendations include the following.

- Meet and maintain sediment allocations for all impaired streams identified by the State of Montana within the Yaak TPA.
- Avoid conditions where additional water bodies within the Yaak TPA become impaired.
- Work with land stewards and other stakeholders in a cooperative manner to ensure implementation of water quality protection activities.
- Continue to monitor conditions in the watershed and track progress toward meeting water quality targets.

7.2 Agency and Stakeholder Coordination

Meeting allocations and achieving the targets set forth in this plan will require a coordinated effort between land management agencies and other important stakeholders, including county governments, conservations districts, private landowners, state and federal agency representatives, and individuals from conservation, recreation, and community groups with water quality interests in the Yaak River Watershed. DEQ supports activities that result in the implementation of recommendations contained herein and provides funding for water quality restoration activities through the DEQ's 319 funding program.

7.3 Implementation Strategies and Recommendations

7.3.1 Forest Roads & Culverts

The analyses conducted as part of TMDL development indicate that sediment derived from unpaved forest roads constitutes a controllable, chronic, and significant sediment source to streams. Sediment loads from unpaved forest roads are presently elevated above 'naturally occurring' conditions and pose a chronic impairment to aquatic life beneficial uses. Sediment road allocations are designed to maintain and/or reduce road-related sediment loads to 'naturally occurring' conditions through the application of 'all reasonable land, soil and water conservation practices'.

Within the context of this TMDL, a surrogate condition for 'all reasonable land, soil and water conservation practices' was chosen in order to estimate an allowable numeric sediment load from road networks. An allowable numeric sediment load per 7th code HUC was estimated using the following criteria*.

- Contributing road length at BMPed crossings < 200 feet on open roads
- Road crossing density ≤ 1.5 crossings/mi² at the 7th Code HUC scale
- New culverts on unpaved forest roads are sized and installed to pass the 100-year flow (Q100) and associated debris (USDA, 1995)
- Existing culverts are maintained and upgraded or removed (consistent with Inland Native Fish Strategy guidance) to limit sediment contributions from acute and chronic failure
- BMPs are maintained on all road segments parallel to in order to minimize sediment loading to streams

*The numeric loads calculated as a result of contributing road-length and road crossing density criteria are not a mandate to implement specific forest management practices such as requiring road densities or contributing road lengths. It is not required that management actions adhere to specific contributing lengths or road crossing densities if it can be shown through site-specific analysis that numeric load allocations will not be exceeded. In most instances in the Yaak TPA, it is likely that road allocations can be met through upgrade or improvement of 'problem sites' on existing road networks and stream crossings.

For instance, many subwatersheds with road crossing densities >1.5 are currently meeting road sediment allocations due to revegetated or improved road networks, while other watersheds with road crossing densities <1.5 are currently not meeting road sediment allocations due to BMP or contributing road-length deficiencies.

Numeric allocations establish allowable loading levels that, if realized, would presumably result in the attainment and maintenance of water quality standards for sediment. As such, the land, soil and water conservation practices above represent surrogate conditions that assist in establishing the potential for sediment reductions from unpaved forest roads through the application of all appropriate BMPs and an understanding of processes that may influence water routing and water yield increases. Standard BMPs and resource management practices designed to maintain water quality can be found in DEQ's Nonpoint Source Management Plan, Appendix A (DEQ, 2007) and in *Water Quality BMPs for Montana Forests* (Montana State University [MSU], 2001).

Achieving sediment load reductions from forest roads and culverts entails site specific assessments that evaluate the feasibility of various BMP methods. Each implementation site (crossing, culvert, etc...) will be unique and may require an approach that may or may not be feasible at other sites, therefore evaluation and implementation of control actions will be at the professional discretion and judgment of local land managers and implementation teams. Prioritization of implementation and load reduction activities should account for a variety of factors including but not limited to the following.

- Availability of resources
- Resource value at risk
- Aquatic resource considerations
- Level of disturbance associated with implementation activity
- Load reduction potential
- Existing management priorities
- Public and stakeholder input
- Other considerations relevant to attainment and maintenance of aquatic life beneficial uses

Detailed implementation plans should be developed that systematically address a variety of necessary components: further information and assessment needs, prioritization of implementation projects, identification of roles and responsibilities of involved partners, development of sampling and analysis plans, project effectiveness monitoring, data management and reporting, public and stakeholder involvement.

7.3.2 Additional Implementation Recommendations

This section includes a discussion of issues that are not currently primary limiting factors to water quality, but are a consideration for long-term watershed management, and attainment and maintenance of beneficial uses. All of the previous and following management issues are interrelated. Therefore, a long-term holistic approach to watershed management will provide the most effective results.

Upland Erosion and Timber Harvest

Excluding associated forest roads and culverts, which are addressed above, timber harvest currently is not significantly affecting water quality in the Yaak TPA. In order to ensure that beneficial uses are maintained, future harvest activities must maintain 'all reasonable land, soil and water conservation practices' in addition to Forestry BMPs (DEQ, 2007; MSU Extension Service, 2001). Additionally, peak flow increases should be maintained at levels within the KNF Forest Plan Water Yield Guidance in order to minimize effects on channel instability and potential increases in sediment loading.

Fish Passage

Appendix B presents the results of a fish-passage assessment conducted on all culverts in Seventeenmile Creek, Lap Creek and South Fork Yaak River where data was available (about 260 culverts). This evaluation of fish passage criteria provides a 'first-cut' evaluation of the ability of each culvert to allow for the passage of juvenile salmonids and represents a partial evaluation of aquatic life beneficial use determination. As presented in Table 3-4 (Section 3.0),

surface waters in the Yaak TPA are classified as B-1 waters and 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." Maintaining fish passage through culverts is one factor that contributes to suitability for the 'growth and propagation of salmonid fishes'.

While fish passage considerations are not specifically a sediment loading issue and not subject to TMDLs, they are considered when making beneficial use determinations for fish and associated aquatic life. Consequently, non-natural barriers to fish passage may be cause for a non-pollutant impairment listing. Restoration of fish passage through culverts is therefore an important component of restoring all beneficial uses in the Yaak TPA, and should be addressed in concert with necessary sediment loading reductions due to culvert failure (a sediment loading allocation). Further information and analysis of culvert fish passage can assist in prioritizing and planning for culvert upgrade and/or removal where appropriate.

Fish passage barrier restoration strategies may include but are not limited to the following.

- Locate and perform fish passage assessments on additional road crossings over stream segments where maintaining fish passage if a priority.
- Develop a priority list of barrier culverts for replacement.
- Conduct culvert replacement in consultation with KNF and FWP biologist to ensure protection of aquatic resources, and maintain proper conditions for the propagation of cold-water fish species.

7.4 Monitoring Recommendations

In addition to the application of BMPs and/or other management actions, monitoring is an equally important part of the implementation and restoration process. Monitoring of water quality is essential for the evaluation of water quality standards attainment and the success of implementation and control efforts. This section provides a framework monitoring strategy to assist in meeting the following goals.

- Evaluate the attainment of water quality targets
- Improve understanding of appropriate reference conditions for the Yaak TPA
- Evaluate effectiveness of implementation and restoration efforts.

The framework monitoring plan presented in this section is meant to provide a starting point for the development of more detailed and specific planning efforts regarding monitoring needs. It does not assign monitoring responsibility. It is expected that monitoring recommendations provided will assist local land managers, stakeholder groups, and federal and state agencies in developing appropriate monitoring plans to meet aforementioned goals.

7.4.1 Water Quality Target Monitoring & Evaluation

Primary water quality targets, supplemental indicators and water quality assessment framework are presented in Section 4.0. Target indicators and values have been developed through evaluation of appropriate reference conditions and their linkage to Montana's surface water

quality standards for sediment (see Section 3.0). Evaluation of water quality target attainment consists of two components.

- 1. Evaluation of the appropriateness of established water quality targets through additional 'reference stream' monitoring
- 2. Evaluation of target attainment

As primary water quality targets (bioassessment scores, width-to-depth ratios, percent surface fines, percent subsurface fines) are based primarily on reference conditions thought to be appropriate for streams in the Yaak TPA, further monitoring of the target/indicator parameters in reference streams is needed to help increase confidence that the TMDL targets and supplemental indicator values that best represent a translation of the narrative water quality standards for sediment (Section 3.0). The following methods may be used to assist in refining reference conditions in the Yaak TPA.

Primary Approach

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

Secondary Approach

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

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

Collection of additional reference data and information may assist in investigating specific uncertainties that exist regarding the application of target values in the Yaak TMDL. Percent surface fines and the link between surface fine sediment and threshold effects on macroinvertebrate communities is undetermined. Unpublished, non-peer reviewed reports (Relyea, 2005) suggest that a threshold of 20% surface fines <2mm may demonstrate impairment to aquatic macroinvertebrate populations, yet this supposition has not been verified. Additionally, reference data sets for width-to-depth ratios within the Yaak TPA are limited for some stream types (A, E, C, F). As target values posit a linkage between suggested percent fines and width-to-depth thresholds to impairment conditions, additional reference data on percent fines, macroinvertebrates, and width-to-depth ratios may assist in verifying and refining this relationship.

In addition to further reference data collection for validation of established water quality targets, collection of water quality target parameter data will assist in evaluation of target attainment. Sediment impairment determinations are based on a limited data set. Collection of primary target parameters (percent surface fines data, percent subsurface fines data, macroinvertebrates, and width-to-depth ratio) at various locations throughout the three impaired watersheds will allow a larger data set to be developed and may assist in the refinement of causal relationship affecting impairment conditions. DEQ recommends that primary target parameters be collected annually at several established monitoring sites in order to evaluate attainment of water quality targets over time.

7.4.2 Implementation and Restoration Monitoring & Evaluation

As defined by Montana State Law (MCA 75-5-703(9)), DEQ is required to evaluate progress toward meeting TMDL goals and satisfying water quality standards associated beneficial use support. If this evaluation demonstrates that water quality standards and beneficial use support have not been achieved, then DEQ is required to conduct a formal evaluation of progress in restoring water quality and the status of reasonable land, soil, and water conservations practice implementation to determine if any of the following is the case.

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

Implementation and restoration monitoring may include summaries of such items as the length of road upgraded to BMP standards, length of decommissioned roads, fish passage barriers corrected, or the estimated impact of these actions in terms of decreased pollutant loading or improved habitat. Specific details of the implementation and restoration monitoring should be coordinated with local stakeholders and DEQ before future restoration activities occur. To ensure that TMDL implementation is effective in achieving full support of beneficial uses, this monitoring should be closely integrated with target and reference monitoring discussed previously in this section.

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SECTION 8.0 PUBLIC INVOLVEMENT

Public and stakeholder involvement is a component of TMDL planning efforts. Stakeholders, including the US Environmental Protection Agency, KNF, Kootenai River Network, Yaak Headwaters Partnership Group, Lincoln County Conservation District, and the US Fish & Wildlife Service were kept abreast of the TMDL process and were provided opportunities to review and comment on technical documents. Stakeholder review drafts were provided to several agency representatives, conservation district and government representatives, and representatives from conservation and watershed groups.

An additional opportunity for public involvement is the 30-day public comment period. This public review period was initiated on November 19th, 2007 and extended to December 19th, 2007. A public meeting was conducted on Tuesday, December 4th, 2007 at the USFS Ranger Station in Troy, MT. In response to public comment requests, DEQ extended the public comment period to January 14th, 2008 and conducted a second public meeting in Troy, MT on Jan 7th.

Responses to written comments received during the public comment period are given in Appendix E.

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Acronyms

%ECA	Percent Equivalent Clear Cut Area
ARM	Administrative Rules of Montana
ASQs	Allowable Sale Quantities
BER	Board of Environmental Review
BMPs	Best Management Practices
CER	
CFR	
cfs	cubic feet per second
	Montana Department of Environmental Quality
	Equivalent Clear Cut Area
	Environmental Impact Statement
	Ephemeroptera, Plecoptera, and Trichoptera
	Forest Plan Water Yield Guidance
	Fine Sediment Index
	Grizzly Bear Core Management Area
	Geographic Information Systems
	Hilsenhoff Index of Biological Integrity
IGBC	Interagency Grizzly Bear Community
	Load Allocation
	Square Miles
	Multi-Metric Index
	Montana Natural Heritage Program
	Montana Permitting Discharge Elimination System
	Observed / Expected
	Peak Flow Increase
	Riffle Stability Index
	Sufficient Credible Data/Beneficial Use Determination
	Standard Deviation
IrA	TMDL Planning Area

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USFS	
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
W/D Ratio	
WLA	<u>*</u>
WQA	Water Quality Ac
YHRP	

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APPENDIX A FIELD SEDIMENT SOURCE SURVEYS

Yaak River TMDL Planning Area

Appendix A provides examples of the Field Sediment Source Survey data sheets. Field Sediment Source Surveys were conducted by the Yaak Headwaters Restoration Partnership in the Seventeenmile Creek, Lap Creek, and South Fork Yaak River Watersheds during the summers of 2004, 2005, and 2006.

Surve	shed 17 MILECK (MAIN) Tributary No. 136 vers LAWGON OWEN	Date_9/13/05
Fill ou inforn	t this form for each tributary. Use USGS green topographic maps to relation.	ecord the following
1. Me	asure bankfull width on lowest reach (above influence of confluence or a). Mark on map where measured. BFW =,	any depositional
2. Del road c	ineate and number tributaries that are not on stream layer. Survey strossing unless scour channel ends.	reams to uppermost
3. Sur condit	nmarize stream channel conditions. At a minimum note: overall chann on, permanent fish barriers, location of fish seen in small streams (man	el stability, riparian rk location on map).
53	OW S341 - CREEK CHANNEL IS SMALL DRY OVER IN STOTE MAKING IT VAGIVE AS THAN TOP OF USO CUT. YOU MILE DOWN AND CALANNEL BECOMES DISTINCT, LAR ROLWING LARGE OTRAPS FULL OF GRAVEL COR SMALL STRETCH OF BELROCK AND BOUNDER WITH SMALL FAIL THAT MAY CONSTITUTE JUST ABOVE 5344 LARGE GRAVEL FARS FEE COMMON. IN - CMP (30) HAS BEEN OVERTOFFEE IN I LAND DITCHES AND FILLSLOPE ERUSION CO	ROE WOOLY DEFA
B	An excessive amount of gravel + so	debris. Traps ilt. As Chemel ilizes somewhat. es full to buisting ook he low traps and is deposited one above horks

11/19/07

ROAD / STREAM CROSSING INVENTORY
MAP SITE NO. 336 W. RSHED 17 Mile Main TRIB NO. 136 SURVEYORS Owen Oakland DATE 9-8-05
Structure: Round CMP Squash CMP Arch Pipe Concrete Box Wood Culvert Buried Logs Bridge Ford None
Pinc Diameter Insthes Pipe L ength A Inlet Fill B Road Width Fipe L ength B ft Culvert Grade Culvert Grade
±43'
Scour channel above culvert? (Y/N) If yes, average bankfull channel width in riffle section above influence of culvert: 17 ft Is there flow at the culvert now? (Y/N) Streamflow: 100 gpm MEASURED or ESTIMATED If no, is there evidence of flow from the culvert? (Y/N)
Can you see through culvert? (Y/N) If no, apparent cause: SAG BLOCKED
Is outlet obstructed? (Y/N) If yes, cause(s) are: DENTED FILLED W/SEDIMENT BLOCKAGE AT OUTLET ——————————————————————————————————
Ditch draining into stream? NO ONE SIDE TWO SIDES Ditch length draining to stream: Left ft Right Is there water currently flowing in the ditch? (Y/N) Evidence of sediment being carried by ditch? (Y/N) Source(es): DITCH SCOUR CUTSLOPE SLUMPING ROADWAY RILLING WHEEL TRACK RUTTING OTHER:
Does water run off of road surface at stream crossing? (Y N) Cause?
Is sediment delivered to stream at this crossing? $(\overline{Y}/\overline{\textcircled{N}})$ Quantity? MINOR MODERATE SUBSTANTIAL
High Priority Maintenance Needs: Nove Healed.
INCLUDE SKETCHES AND COMMENTS ON BACK OF SHEET.
Photo Roll Number: Photo Numbers 6/23/05

INSTREAM SEDIMENT SOURCES*

Tributary Number 36 (Start a new page for each tributary.) Watershed 17 m 1411 LAWSON Surveyors Date 6/

Site Description and Comments (attach sketches of complex sites)	MINDER STUFFER WASHING NONG X 35"HX 30"DEEP. SILT & ROLK WASHING NOTO STABLING ATTHER WINN TON MANNER AND BUTTON & TOP NEALING MINDER & ACTIVE BOT MIL SLOPE UNSTABLE & ACTIVE	BANKEROSION. SO'LGX 12'HX7'DEEP. SILT BROCK FALLING INTO STREAM, ROCK PLESSVEC. AT BOTTON BUT TO ACTIVE DURING HEAVY RAINSF			
Sediment (Minor, Moderate, Substantial)	MINOR	MINOR			
Source Condition	EPISODIC	EPISODIC			
Source Type	HIIISLOPE FAILURE	BANK 7 EROSION	-		,
UTM GPS Coordinates	58 0587444 5391716	59 58 TOWN STREAM EROSION			
Map Site No.	20	29	*		

Fill out Road/Stream Crossing Inventory sheet for road crossings.

Source Type: Bank erosion, Channel scour, Road failure, Hillslope failure, Hillslope erosion, Skid road crossing Source Condition: Chronic (annual), Episodic (storms and floods), Healed (old site)

APPENDIX B UNPAVED ROAD SEDIMENT ASSESSMENT

Yaak River TMDL Planning Area

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1.0 Introduction

This report presents an assessment of sediment contributions from the unpaved road network within selected watersheds in the Yaak River TMDL Planning Area (TPA). This assessment was performed as part of the development of sediment TMDLs for 303(d) Listed stream segments with sediment as a documented impairment.

The Yaak TPA (USGS HUC ID #17010103) is located in the remote northwest corner of Montana in Lincoln County. The Yaak TPA extends into Canada along the northern Montana border and drains to the Kootenai River six miles downstream of the town of Troy. The 2006 303(d) List identifies three stream segments as impaired for sediment: Seventeenmile Creek, Lap Creek, and South Fork Yaak River. This road assessment addresses road sediment load estimations and reductions for Lap Creek, Seventeenmile Creek, and the South Fork Yaak River.

Objectives of the assessment include the following.

- Estimate existing annual sediment loads to streams derived from road crossings and contributing (parallel) road segments in the Yaak TPA, specifically in impaired watersheds, Seventeenmile Creek, Lap Creek, and South Fork Yaak River.
- Assess culvert condition and risk associated with chronic and acute culvert failure in the Yaak TPA, specifically in impaired watersheds, Seventeenmile Creek, Lap Creek, and South Fork Yaak River.
- Estimate potential sediment loading reductions from the forest road network in watersheds, Seventeenmile Creek, Lap Creek, and South Fork Yaak River.
- Assess fish passage capabilities at selected culvert locations within Seventeenmile Creek, Lap Creek, and South Fork Yaak River.

Roads located near stream channels can impact stream function through degradation of riparian vegetation, channel encroachment, and sediment loading. The degree of sediment loading is determined by a number of factors including road type, construction specifications, drainage, soil type, topography, and precipitation. Using a combination of GIS analysis, field assessment, and modeling, estimated sediment loads were using the *WEPP: Road* model. Existing sediment loads from roads were estimated, as were as potential sediment load reductions. Existing culverts were also assessed for fish passage and culvert failure risk using culvert data collected by the Yaak Headwaters Restoration Partnership (YHRP) in 2004 – 2006.

2.0 DATA COLLECTION

The Yaak Road Sediment assessment consisted of three primary tasks.

- 1. Selection of modeling approach and development of a Sampling and Analysis Plan (SAP)
- 2. Field assessments of road networks and culverts
- 3. Modeling of sediment loads and reduction potential

Additional information on assessment techniques is available in prior reporting for this project: *Road GIS Layers and Summary Statistics* (DEQ, 2007), and *Yaak Roads Assessment: Sampling and Analysis Plan* (DEQ, 2007).

2.1 Spatial Analysis

Using road layers provided by the Kootenai National Forest (KNF), road crossings and parallel segments in the road network were identified and classified by road type (Table B-1) relative to 7th code subwatershed.

Table B-1. Kootenai National Forest Road Type Classifications

IGBC Code	KNF Road Classification
1	Impassible to Motorized Vehicles
2	Restricted/Legally Gated Admin Use
3	Barriered/Legally No Admin Use
4	Open for Public Use

Crossings statistics were developed based on 7th code subwatershed for the three sediment listed watersheds to be addressed in this road assessment. There are 23 unpaved road crossings in the Lap Creek Watershed, 108 unpaved crossings in the Seventeenmile Watershed, and 123 unpaved crossings in the South Fork of the Yaak Watershed (Attachment A—Table B-8). Field assessment work focused on the unpaved road crossings in these three watersheds. No roads were assessed outside of Seventeenmile Creek, Lap Creek, or South Fork Yaak River Watersheds.

Over the past 15 years, many roads in the Yaak TPA have been closed and/or have had travel restrictions placed on them in order to preserve grizzly bear habitat. Roads within Grizzly Bear Core Management Area (Core) designation are closed to all motorized traffic, while other roads are closed to public use and are used minimally for administrative use only. These closures and travel restrictions have resulted in drastically different conditions on closed vs. open roads. Closed roads typically have vegetative growth over most if not all of the road surface, and in many instances woody vegetation dominates the (previous) travel corridor. Sediment production and delivery from these roads is substantially lower than that observed on open roads.

A random subset of unpaved crossing sites was generated for field assessment based on the proportion of total unpaved crossings within the Lap Creek, Seventeenmile Creek (upper and lower), and South Fork of the Yaak River Watersheds with approximately 20% of the crossings assessed (52 sites). Parallel road segments were identified as areas where roads encroach upon the stream channel, and total road lengths within 50-foot and 100-foot buffer zones were generated.

2.2 Field Data Collection

A total of 49 unpaved crossings and 2 unpaved parallel segments were randomly selected for field evaluation. Twenty six crossings were assessed in the South Fork of the Yaak River (21% of total), twenty one 21 were assessed in Seventeenmile Creek (19% of total), and two were assessed in Lap Creek (9% total). Due to limited field time and budget, some adjustments of the random GIS crossing selection were made, as many of these sites required significant hiking to reach. Crossings, at a lower percentage, were assessed in Lap Creek due to the fact that 22 of 23 crossings were in Core management areas requiring substantial effort and time to reach. An assumption was made that all crossings within Lap Creek Core areas are similar in condition to the assessed sites. Two crossings in the South Fork of Yaak had been decommissioned (culverts pulled and road grades obliterated) and were removed from the loading analysis.

In the field, parallel road segments were selected based on best professional judgment while traveling roads on which specific crossings were selected for evaluation. Parallel segments were selected in a manner where road segments would not be duplicated in both the crossing and parallel sediment load calculations. Two parallel segments were assessed in the Yaak TPA, one in the South Fork of the Yaak River and one in Upper Seventeenmile Creek. Based on field reconnaissance, it was determined in the field that parallel road segments were not a significant source of sediment loading unless the stream buffer was very small (less than 20 feet) due to the extremely dense forest vegetation and stream buffers. Extensive travel within Seventeenmile Creek and the South Fork Yaak River watersheds confirmed the non-significance of parallel segment contributions. As a result, parallel segments were only assessed if located very near a stream and if evidence of sediment delivery was noted. One parallel segment, representative of the dense vegetation conditions and low sediment delivery, was measured (SFY-4A-P), as well as one segment where the road was located very near the stream and delivery was high, relatively (USC-2A-P). Field data spreadsheets with detailed information on each road crossing and parallel segment are included in Attachment B.

2.3 Sediment Assessment Methodology

The road sediment assessment was conducted using the *WEPP:Road* forest road erosion prediction model (http://forest.moscowfsl.wsu.edu/fswepp/). WEPP:Road is an interface to the Water Erosion Prediction Project (WEPP) model (Flanagan and Livingston, 1995), developed by the USDA Forest Service and other agencies, and is used to predict runoff, erosion, and sediment delivery from forest roads. The model predicts sediment yields based on specific soil, climate, ground cover, and topographic conditions. Specifically, the following model input data was collected in the field: soil type, percent rock, road surface, road design, traffic level, and specific road topographic values (road grade, road length, road width, fill grade, fill length, buffer grade, and buffer length). In addition, supplemental data was collected on vegetation condition of the buffer, evidence of erosion from the road system, and potential for culvert failure.

Site specific climate profiles were created using data from the Western Regional Climate Center (http://www.wrcc.dri.edu). Due to the lack of available long-term precipitation stations in the Yaak TPA, one station from outside the planning area was selected to model the higher elevation

sites (>3,500 feet). The selected station, Burke 2 ENE, Idaho (101272), contained similar climate and elevation conditions as those encountered in the Yaak (48.9 inches annual precipitation; 4090 feet elevation). The Troy 18N, Montana (248395), station was used to model the lower elevation sites below 3,500 feet in elevation (35.60 inches annual precipitation; 2,720 feet elevation). Thirty year simulations were run for each unpaved road crossing segment.

Field assessment revealed that a large number of roads within Core management areas and roads with administrative or barriers to limit access were completely vegetated and contained significant downfall and understory on the road prism. The WEPP:Road model did not account for these road vegetation conditions; as a result, some adjustments were made to the model to more appropriately represent these types of roads. Attachment C contains a description of model adjustments, as recommended by the model author (Elliot, pers comm).

2.4 Mean Sediment Loads from Field Assessed Sites

Field assessment data and *WEPP:Road* modeling results were used to develop sediment loads based on various watershed criteria. A standard statistical breakdown of loads from the unpaved road network within each sediment-listed watershed was generated using an applicable dataset of field assessed sites. Mean load and contributing length, median load, maximum and minimum loads, and 25th and 75th percentile loads were calculated for unpaved road crossings within the three 6th code subwatersheds that were the basis of the field assessment. Mean sediment loads from unpaved road crossings were estimated at 0.18 tons/year in the South Fork of the Yaak River Watershed, 0.40 tons/year in the Seventeenmile Creek Watershed (0.47 tons/year – Upper, 0.27 tons/year-Lower), and 0.01 tons/year in the Lap Creek Watershed. A statistical summary of sediment loads for field assessed sites are included in Table B-2.

Table B-2. Sediment Load Summary for Field Assessed Sites by Listed Watershed

Statistical Parameter	South Fork Yaak River	Lower Seventeenmile	Upper Seventeenmile	Lap Creek	Total of Field Assessed
	7 ttulk 7 tt v 02	Creek	Creek		Crossings
Number of Sites (n)	24	7	14	2	47
Mean Contributing Length (ft)	290	316	365	300	317
Mean Load (tons/year)	0.18	0.27	0.47	0.01	0.27
Median Load (tons/year)	0.08	0.05	0.04	0.01	0.04
Maximum Load	1.24	1.05	2.89	0.011	2.89
(tons year)					
Minimum Load (tons/year)	0.0002	0.0006	0.0002	0.0003	0.0002
25th Percentile (tons/year)	0.003	0.015	0.028	N/A	0.01
75th Percentile (tons/year)	0.25	0.38	0.21	N/A	0.26

The sediment load summary shows large differences between minimum and maximum load values, as well as between mean and median values. These data suggest that a small number of high sediment load crossing sites impact the average values significantly. Mean sediment loads were calculated and classified based on KNF road types. Results are shown in Table B-3. Clearly, roads that have restricted use (IGBC classification 1, 2, and 3) have much lower sediment loading estimates than those that are open to public use (IGBC classification 4) due primarily to absence of motorized travel resulting in vegetative recovery on road surfaces.

Table B-3. Mean Stream Crossing Sediment Loads by Road Type

KNF Road Classification (IGBC)	Number of Sites Assessed	Mean Contributing Length (ft)	Mean Sediment Load (tons/yr)
1 – Impassible to Motorized Vehicles	4	170	0.001
2 – Restricted/Legally Gated Admin Use	15	268	0.06
3 – Barriered/Legally No Admin Use	10	207	0.11
4 – Open for Public Use	18	451	0.60

Two assessed crossing sites had been reclaimed by USFS with culverts removed and road grades obliterated (SFY-2B and 3B). As a result, these two crossings were not included in the road crossing loading analysis. Due to the small number of parallel road assessments observed and sampled in the field and the minimal impact noted, a mean parallel road segment load was not calculated. A summary of modeling results from field assessed sites is located in Attachment B.

3.0 UNPAVED ROAD NETWORK SEDIMENT ANALYSIS

Estimates of mean sediment loads from road crossings, parallel road segments, and culvert failure were extrapolated to all sites within the Seventeenmile Creek, Lap Creek, and South Fork Yaak River Watersheds.

3.1 Sediment Load from Road Crossings

Mean sediment loads from field assessed sites from each road type were used to extrapolate loads throughout the three impaired watersheds which are Seventeenmile Creek, Lap Creek and South Fork Yaak River. Mean loads for unpaved crossings (Table B-4) were applied to the total number of crossings within these three watersheds at the 7th code HUC scale. The total modeled sediment load from unpaved crossings in Seventeenmile Creek, Lap Creek, and South Fork Yaak River watersheds is 23.7, 2.37, and 21.29 tons/year respectively. The majority of sediment load is generated from crossings on roads open to public use (IGBC code-4). Road crossing sediment loading estimates for sediment-impaired watersheds, Seventeenmile Creek, Lap Creek, and South Fork Yaak River at the HUC 7 scale are given in (Attachment A—Tables B-9, B-10, and B-11).

It should be noted that sediment loading estimates are based on extrapolated model results and may not be accurate representations of actual sediment loading values. Sediment loading estimates are more appropriate as <u>relative</u> estimates and can provide resource managers with tools to allow for better prioritization and planning of restoration activities designed to reduce sediment loading.

3.2 Sediment Load from Parallel Road Segments

The two field-assessed parallel road segments in the Yaak TPA showed very different modeling results, with site SFY-4AP having a load of 0.02 tons/year and site USC-2AP having a load of 1.13 tons/year. Site SFY-4AP contained an average buffer distance of 70 feet and site USC-2AP had an average buffer distance of 10 feet. The majority of parallel sites observed in the field contained buffer distances greater than 50 feet and were heavily vegetated, with no evidence of sediment delivery to the stream. USC-2AP was the only parallel site where evidence of sediment loading was noted. Figures B-1 and B-2 are included to show differences in the typical buffer conditions of the two parallel segments assessed.



Figure B-1. Parallel Segment SFY-4A-P – Average Buffer Distance 70 feet



Figure B-2. Parallel Segment USC-2A-P – Average Buffer Distance 10 feet

Field observations within Seventeenmile Creek and the South Fork Yaak River Watersheds indicated that the vast majority of parallel road segments do not contribute significant sediment to streams, and buffer distances must be very small for impacts to occur. This conclusion was drawn based on observations in the three assessed subwatersheds only and the fact that nearly the

entire road network within these areas was traveled during fieldwork. Site USC-2A-P was the only site where evidence of delivery was noted. Also, a large portion of parallel road distance calculated in the GIS layers is present at road crossing locations and is accounted for in the crossing load calculations. As a result, parallel road segments are likely a minor contributor to overall sediment loading from the unpaved road network with isolated locations where roads are very close to streams. Due to the small buffer distance required to have a significant parallel impact, the use of GIS layers to identify these areas and extrapolate loads is not feasible since these layers are often not accurate to this level resolution.

3.3 Culvert Assessment

Culvert crossing assessment and analysis within the Yaak TPA was conducted in order to achieve the following.

- Assess the ability of existing culverts to allow fish passage
- Assess chronic and acute culvert failure

Data from a detailed culvert study conducted by the Yaak Headwaters Restoration Partnership (YHRP) from 2004 - 2006 was used to complete the analysis, along with data collected during the road sediment field assessment in June 2007. Global positioning system data from sites assessed during the road sediment assessment were compared to those collected at YHRP sites. Using a snap feature in GIS, road assessment sites were linked to the closest YHRP site. Sites located within 200-feet of each other were considered to be the same location, due to variations in measurement and GPS accuracy. These sites were then checked against maps provided by the YHRP to determine accuracy. Crossing sites with bridges and decommissioned sites were removed from the dataset, as were sites that contained missing or incomplete data.

3.3.1 Fish Passage at Culverts

The fish passage assessment provided herein should be considered a coarse filter that identifies culverts as having probable fish passage issues. These may be used as a starting point for prioritization of planning efforts designed to address culvert deficiencies within the Yaak TPA so that full support for aquatic life uses may be restored. It must be noted that this evaluation of fish passage through culverts aims to assess the capability of a culvert to allow juvenile fish passage and does not consider whether associated streams are fish-bearing or assess the fishery resource value. Further analysis should be conducted in order to properly prioritize and plan implementation activities in order to meet restoration goals.

For the purposes of this assessment, a culvert is considered to be a blockage to fish passage if it fails to allow passage of juvenile fish species (typically salmonids). In evaluating the ability of existing culverts to allow for fish passage, a variety of obstacles to fish passage were considered: constriction ratio, culvert gradient, and culvert outlet vertical barriers (perch). In order to quickly assess the ability of existing culverts to allow for fish passage, evaluation criteria for the Yaak TPA were adopted from USDA Forest Service Region 1 fish passage criteria (Figure B-3). The evaluation criteria classify culverts by type and establish thresholds for the following.

- culvert gradient
- stream constriction

• outlet drop (perch)

Each culvert is placed into one of the three classifications based on whether criteria are met or not.

- 1. **GREEN**: conditions that have a high certainty of providing juvenile fish passage.
- 2. RED: conditions that have a high certainty of not providing juvenile fish passage.
- 3. GREY: conditions are such that additional and more detailed analysis is required to determine juvenile fish passage ability.

Table B-4. USDA Forest Service Region 1 Juvenile Fish Passage Evaluation Criteria

Structure Type	GREEN	GREY	RED
Circular CMP ≤ 48" *	Culvert gradient <0.5%	Culvert gradient 0.5% to 1.0%	Culvert gradient > 1.0%
w/Spiral Corrugations	No perch	Perch < 4"	Perch > 4"
	Constriction ratio >0.70	Constriction ratio 0.5 to 0.70	Constriction ratio < 0.5

^{*} the predominant culvert type in the Yaak TPA

With the exception of mainstem segments of Seventeenmile Creek and South Fork Yaak River, most stream and culvert grades are greater than 1.0%, thereby placing nearly all culverts (97%) assessed in the red category based solely on culvert gradient. When the suite of criteria (culvert gradient, perch, constriction ratio) was considered, no culverts met the "green" classification.

Evaluation of individual criterion was conducted in order to assess the spatial distribution of culvert sites not meeting both individual criterion and the suite of criteria given in Table B-4. Figure B-4 shows the percent of culverts within Seventeenmile Creek, Lap Creek, and the South Fork Yaak River that currently do not meet individual passage criterion. Figures B-5 through B-7 display the distribution of this data throughout the three watersheds.

Juvenile salmonid fish passage evaluation criteria at flows less than bankfull flows for Region 1

(NOT INTENDED TO BE USED FOR DESIGNING NEW STRUCTURES)

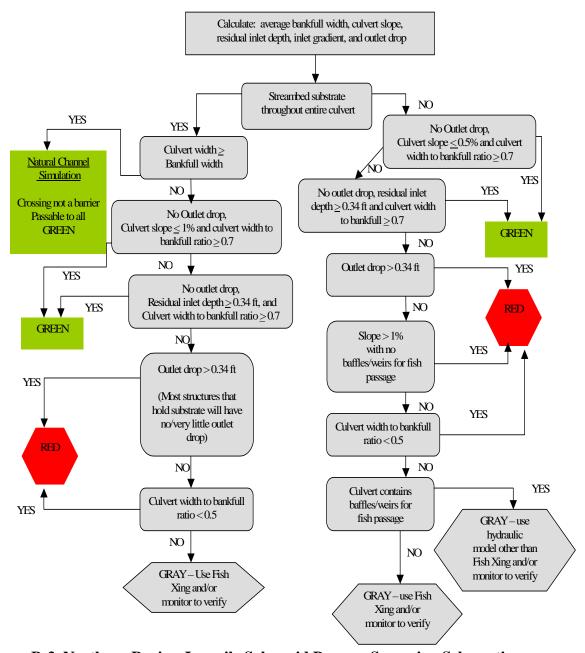


Figure B-3. Northern Region Juvenile Salmonid Passage Screening Schematic

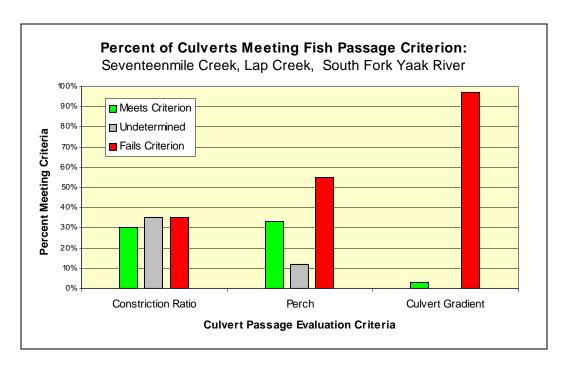


Figure B-4. Percent of Culverts Meeting Fish Passage Criterion

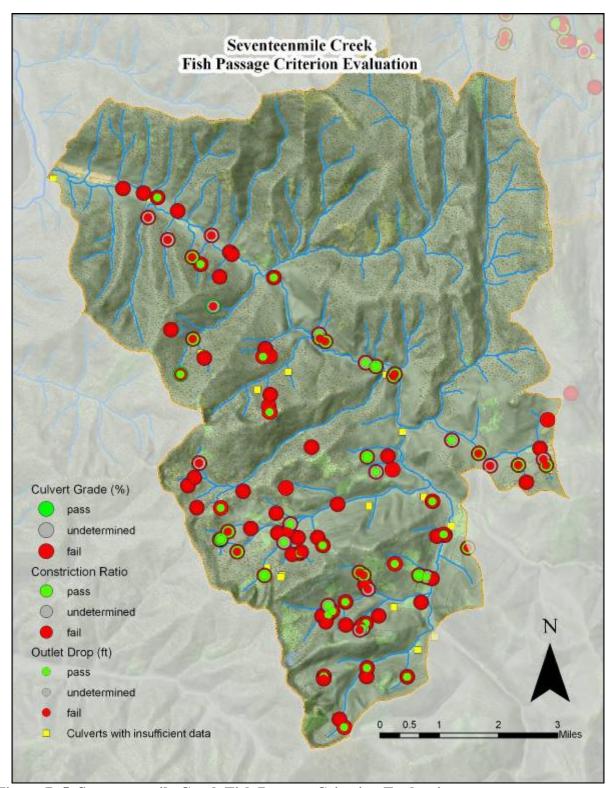


Figure B-5. Seventeenmile Creek Fish Passage Criterion Evaluation

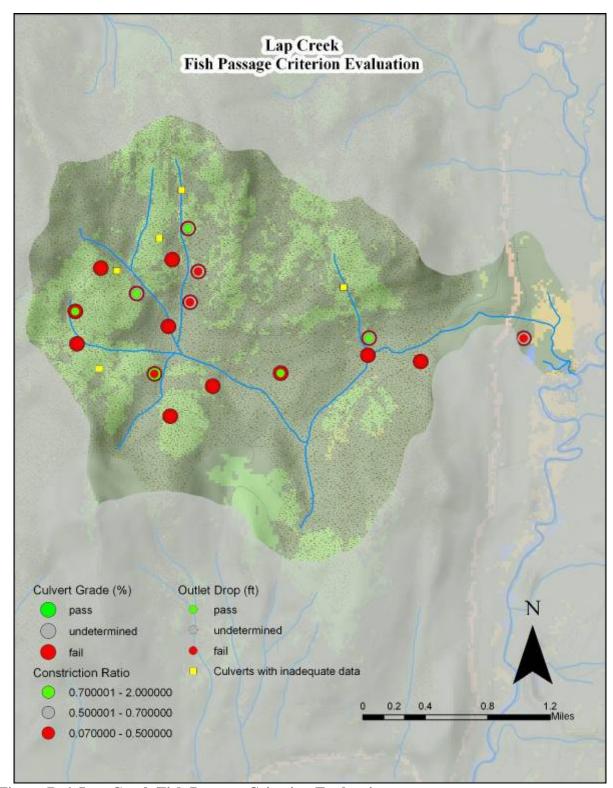


Figure B-6. Lap Creek Fish Passage Criterion Evaluation

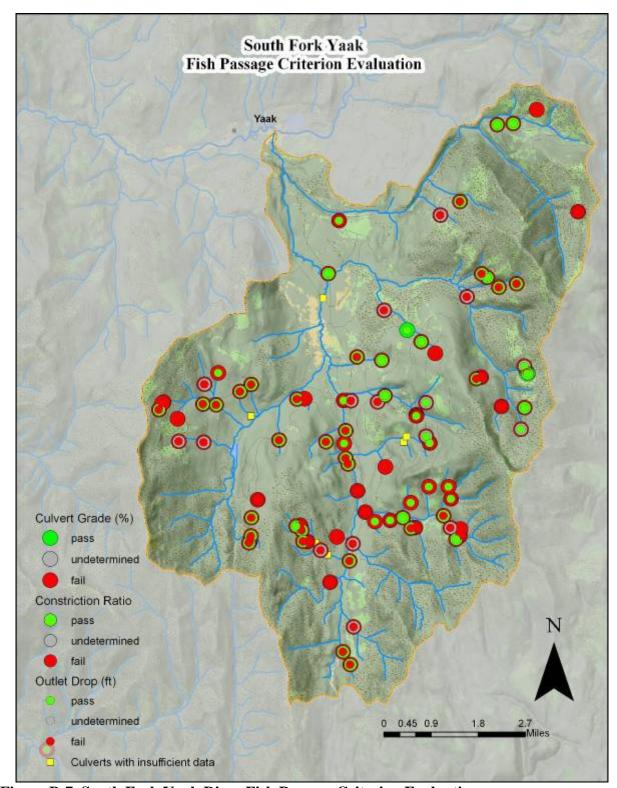


Figure B-7. South Fork Yaak River Fish Passage Criterion Evaluation

3.3.2 Culvert Failure Assessment

Culvert 'failure' is typically associated with rerouting of stream channels away from or out of culverts as a result of high flow events. For the purposes of this assessment, however, *culvert failure* is considered any significant sediment delivery to stream channels as a result of improper sizing, placement, or maintenance of road crossing culverts. It is assumed that properly sized, installed, and maintained culverts are capable of passing flow and debris of all but the most severe events, and do not contribute sediment loads above what would be deemed 'naturally occurring.' Culvert 'failure' may consist of rerouting of stream channels and associate acute road fill delivery to stream channels, or (more likely) culvert failure may result in lesser amounts of chronic sediment delivery due to channel scour, road scour from overtopping, culvert undercutting, or road fill failure due to improper placement, undersizing and/or lack of maintenance.

Evidence of chronic culvert failure such as constriction, blockage, overtopping, misalignment, outlet drops, and undercutting is not uncommon at culvert crossings in the Seventeenmile, Lap, and South Fork Yaak Watersheds (YHRP 2004-2006, Newgard pers comm). In some cases ¹ culvert failures in the Yaak TPA have resulted in road washouts that have delivered significant sediment loads to adjacent streams. In other cases, debris blockages at culvert inlets and evidence of culvert overtopping, undercutting and scour demonstrate sediment delivery and the potential for more significant failure if culvert deficiencies and maintenance issues are not addressed. Ten Percent of culverts assessed by the YHRP (n >200) had blockages of 25% or greater at the culvert inlet, and nearly half of these showed evidence of culvert overtopping (Figures B-8 -B-10).

Constriction ratio (the ratio of culvert width to channel width) is used to evaluate the capabilities of culverts to pass high flows and associated debris. Culverts with widths less than bankfull stream widths were considered undersized, and pose a potential risk of acute and chronic failure, channel scour, and debris accumulation, particularly under high flow conditions. Of the more than 180 culverts assessed for constriction, 67% had constriction ratios <0.7 and 24% had constriction ratios of <0.4.

As culvert failure (chronic and acute) consists of a variety of processes, and is influenced by historical sizing and placement, and also past and present maintenance and management, the development of sediment loading estimates due to culvert failure (chronic and acute) is problematic. Sediment load estimates from culvert failure, therefore, are not calculated; rather, allocations provided to culvert failure in Section 6.0 reply on a performance-based approach following guidelines provided in the Inland Native Fish Strategy (USDA, 1995).

¹ Lap Creek site 200, South Fork Yaak sites 55, 74 & 90, and Seventeenmile Creek sites 33, 37 & 61



Figure B-8. Seventeenmile Creek – Overtopped and Blocked Culverts

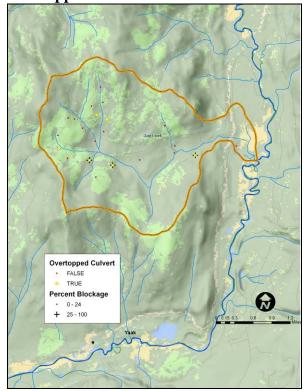


Figure B-10. Lap Creek - Overtopped and Blocked Culverts

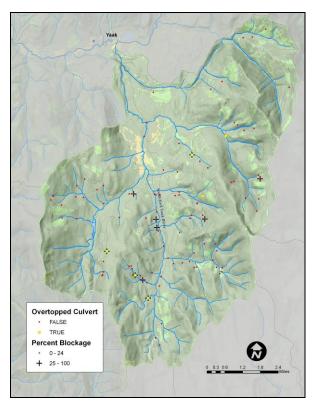


Figure B-9. South Fork Yaak River - Overtopped and Blocked Culverts

3.4 Total Estimated Road Network Sediment Load

Total existing sediment load from the road network in Seventeenmile Creek, Lap Creek, and South Fork includes sediment loads from road crossings and road parallel segments (Table B-5). Loads from parallel segments are not significant (see Section 3.2) and are therefore not calculated for the purposes of this assessment. Sediment loads from stream crossings is thought to be the most significant *chronic* source of sediment to streams as delivery of sediment can occur throughout the year in response to precipitation and snowmelt events.

Table B-5. Total Estimated Road Network Sediment Load

Watershed	Road Sedi	ment Sources	Total Load
	Stream Crossing	(tons/yr)	
	Load		
Seventeenmile Creek	23.7	NA	23.7
Lap Creek	2.37	NA	2.37
South Fork Yaak River	21.3	NA	21.3

4.0 SEDIMENT REDUCTIONS FROM ROADS

Sediment derived form the unpaved forest road network is the primary source of anthropogenic sediment loading in the Yaak TPA and has been identified as a cause of impairment of aquatic life uses.

As defined in ARM 17.30.623 (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."

"Naturally occurring" is defined as "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" (ARM 17.30.602 (19)).

Estimated sediment load reductions from the forest road network are based on the assumption that some sediment from roads is acceptable as long as beneficial uses are maintained through the application of "all reasonable land, soil and water conservation practices." In the case of sediment derived from forest roads, a surrogate sediment loading condition is established that represents the application of 'all reasonable conservation practices' and is based on the following criteria.

- Contributing road length at BMPed crossings < 200 feet on open roads
- Road crossing density ≤ 1.5 crossings/mi² at the 7th Code HUC scale
- New culverts on unpaved forest roads are sized and installed to pass the 100-year flow (Q100) and associated debris (INFISH, 1995)
- Existing culverts are maintained and upgraded (consistent with INFISH guidance) to limit sediment contributions from chronic failure.
- Road segments parallel to streams maintain all appropriate BMPs to minimize sediment loading to streams

The resultant numeric sediment load from the forest road network, considering 1) a contributing road length on open, traveled roads of ≤ 200 ft at BMPed stream crossings, 2) a road crossing density ≤ 1.5 crossings/mile², 3) culverts capable of passing the 100-year flow event, and 4) application of all appropriate BMPs along parallel road segments is considered a 'naturally occurring' (ARM 17.30.602 (19)) condition and provides a numeric basis for sediment allocations to forest road networks in the Yaak TPA. Based on these criteria, the **modeled numeric allowable unit load from the forest road network is 0.20 tons/year/mi².**

In order to estimate the acceptable sediment loading from forest roads based on these criteria, the aforementioned criteria were applied to the existing modeled sediment loads (see Attachment A—Tables B-12, B-13, and B-14) at the 7th code HUC level.

4.1 Contributing Road Length and Road Crossing Density Load Reductions

Sediment loads from contributing road length reductions were assessed by modeling a length reduction to 200 feet using the WEPP:Road forest road erosion prediction model. A contributing road length of 200 ft or less represents application of "reasonable conservation practices" on forest roads and may be achieved through a variety of BMPs, to be determined based on site-specific characteristics. Because the existing condition of roads within IGBC classifications 1, 2, and 3 are presently producing relatively little sediment, and the application of BMPs on these roads is limited by access considerations, contributing road length scenarios were only applied to roads that are currently open to public use (IGBC Code 4).

On IGBC Code 4 crossings where contributing road length exceeded 200 feet, contributing road lengths were reduced to the corresponding post-BMP scenario of 200 feet. No changes were made to crossing locations where the contributing road length was less than the 200 feet. Reduced mean sediment loads were then extrapolated to the watershed scale in the same manner in which the existing sediment loads were calculated. By reducing road segments to a maximum 200 foot contributing road length scenario, mean sediment loads were reduced from 0.60 tons/year to 0.13 tons/year for IGBC code 4 road crossings. Table B-6 shows the resultant loading values (in **bold**) based on these reductions.

Table B-6. Existing and BMP Mean Sediment Loads by KNF Road Type

KNF Road Classification	Existing C	Conditions	BMP Scenario			
(IGBC)	Mean Contributing	Mean Sediment	Mean Contributing	Mean Sediment Load (tons/yr)		
	Length (ft)	Load (tons/yr)	Length (ft)	Loud (tolls/y1)		
1 – Impassible to Motorized Vehicles	170	0.001	170	0.001		
2 – Restricted/Legally Gated Admin Use	268	0.06	268	0.06		
3 – Barriered/Legally No Admin Use	207	0.11	207	0.11		
4 – Open During Bear Season	451	0.60	200	0.13		

A road crossing density value of 1.5 crossings per square mile was applied to the reduced mean sediment loads given in Section 5.1. Watershed areas for all 7^{th} code HUCs were multiplied by 1.5, and the result was multiplied by the loading rate of 0.13 tons/mile² to obtain the allowable sediment load from road surfaces for each 7^{th} code HUC (Attachment A—Tables B-12, B-13, and B-14). Normalized to watershed area, the allowable load from road surfaces equates to \sim 0.20 tons/mi²/yr.

4.3 Sediment Load Reduction Summary

Estimated sediment load reductions from the forest road network are based on the assumption that some sediment from roads is acceptable as long as beneficial uses are maintained through the application of "all reasonable land, soil and water conservation practices." In the case of sediment derived from forest roads, a surrogate sediment loading condition is established that represents the application of 'all reasonable conservation practices' and is based on the following criteria.

- Contributing road length at BMPed crossings < 200 feet on open roads
- Road crossing density ≤ 1.5 crossings/mi² at the 7th Code HUC scale

- New culverts on unpaved forest roads are sized and installed to pass the 100-year flow (Q100) and associated debris (INFISH, 1995)
- Existing culverts are maintained and upgraded (consistent with INFISH guidance) to limit sediment contributions from chronic failure.
- Road segments parallel to streams maintain all appropriate BMPs to minimize sediment loading to streams

Because sediment loads from parallel road segments are not considered significant within Seventeenmile Creek, Lap Creek, and South Fork Yaak River, calculated reductions are not provided for this sediment source. Potential sediment load reductions summaries for stream crossings are given below in Table B-7.

Table B-7. Sediment Load Reduction Summary: Stream Crossings

Watershed	Existing Stream Crossing Load (tons/yr)	Reduced Stream Crossing Load (tons/yr)	Percent Reduction
Seventeenmile Creek	23.7	12.16	49%
Lap Creek	2.37	1.13	52%
South Fork Yaak River	21.3	12.23	43%

5.0 REFERENCES

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Elliott, William J, PE, PhD. Team Leader, Rocky Mountain Research Station, Moscow, ID. Personal Communication.

Nomograph Calculator for FHWA HDS 5, Hydraulic Design of Highway Culverts, Beta Version 1.5B.

ATTACHMENT A

Kootenai National Forest Road Types by 7th Code HUC

Table B-8. KNF Road Types by 7th Code HUC

HUC7_Name	HUC6_Name		IGBO	C Code		Total
		1	2	3	4	
Big Foot Cr	Upper Seventeenmile Creek	0	5	0	5	10
Flattail Cr	Upper Seventeenmile Creek	0	2	6	6	14
Hemlock Cr	Upper Seventeenmile Creek	2	0	0	0	2
Lost Fork Cr-1	Upper Seventeenmile Creek	6	9	0	0	15
Lost Fork Cr-2	Upper Seventeenmile Creek	1	2	0	0	3
Seventeenmile Cr U-1	Upper Seventeenmile Creek	0	4	0	2	6
Seventeenmile Cr U-2	Upper Seventeenmile Creek	0	4	4	7	15
Bridle Cr	Lower Seventeenmile Creek	1	0	0	0	1
Conn Cr	Lower Seventeenmile Creek	13	0	0	0	13
Crum Gulch	Lower Seventeenmile Creek	0	0	0	1	1
Mule Cr	Lower Seventeenmile Creek	6	0	0	0	6
Pelham Cr	Lower Seventeenmile Creek	4	0	0	0	4
Seventeenmile Cr L	Lower Seventeenmile Creek	4	0	0	13	17
Seventeenmile Cr NF	Lower Seventeenmile Creek	0	0	0	1	1
Saddle Cr	Lower Seventeenmile Creek	0	0	0	0	0
Grush Gulch	Lower Seventeenmile Creek	0	0	0	0	0
Sheepherder Cr	Lower Seventeenmile Creek	0	0	0	0	0
Papoose Cr	Lower Seventeenmile Creek	0	0	0	0	0
Seventeenmile Creek Totals		37	26	10	35	108
Beaver Cr-1	South Fork Yaak River	1	0	1	0	2
Beaver Cr-2	South Fork Yaak River	1	0	1	4	6
Browning Cr	South Fork Yaak River	0	0	0	1	1
Can Cr	South Fork Yaak River	3	2	0	0	5
Clay Cr-1	South Fork Yaak River	0	0	1	0	1
Clay Cr-2	South Fork Yaak River	2	9	0	4	15
Dutch Cr	South Fork Yaak River	3	5	0	0	8
Fix Cr	South Fork Yaak River	0	1	1	0	2
Fowler Cr-1	South Fork Yaak River	2	0	4	0	6
Fowler Cr-2	South Fork Yaak River	0	0	8	2	10
Hartman Cr	South Fork Yaak River	0	0	3	1	4
Kelsey Cr	South Fork Yaak River	3	3	3	3	12
Yaak R SF Trib-3	South Fork Yaak River	9	0	0	0	9
Yaak R SF Trib-4	South Fork Yaak River	0	0	0	1	1
Yaak R SF-2	South Fork Yaak River	4	3	1	7	15
Yodkin Cr	South Fork Yaak River	1	1	6	0	8
Zulu Cr-1	South Fork Yaak River	1	4	0	2	7
Zulu Cr-2	South Fork Yaak River	6	3	0	2	11
Yaak R SF	South Fork Yaak River	0	0	0	0	0
Yaak R SF Trib	South Fork Yaak River	0	0	0	0	0
Yaak R SF Trib	South Fork Yaak River	0	0	0	0	0
Smoot Cr	South Fork Yaak River	0	0	0	0	0
South Fork Yaak River Totals		36	31	29	27	123
Lap Cr Total		6	0	16	1	23

Table B-9. Seventeenmile Creek: Existing Annual Sediment Loads from Road Crossings

Seventeen Mile Creek Wa	itershed	No		ossing C Code	_	Exist	ting Anr	nual Sedi Code (t		ad by IGBC
HUC7_Name	Area (mi2)	1 2		3	4	1	1 2		4	TOTAL LOAD
Bridle Cr	1.7	1	0	0	0	0.001	0	0	0	0.00
Conn Cr	2.3	13	0	0	0	0.013	0	0	0	0.01
Crum Gulch	2.1	0	0	0	1	0	0	0	0.6	0.60
Grush Gulch	2.3	0	0	0	0	0	0	0	0	0.00
Mule Cr	1.7	6	0	0	0	0.006	0	0	0	0.01
Papoose Cr	2.5	0	0	0	0	0	0	0	0	0.00
Pelham Cr	0.5	4	0	0	0	0.004	0	0	0	0.00
Saddle Cr	1.2	0	0	0	0	0	0	0	0	0.00
Seventeenmile Cr L	10.3	4	0	0	13	0.004	0	0	7.8	7.80
Seventeenmile Cr NF	4.2	0	0	0	1	0	0	0	0.6	0.60
Sheepherder Cr	1.8	0	0	0	0	0	0	0	0	0.00
Big Foot Cr	3.0	0	5	0	5	0	0.3	0	3	3.30
Flattail Cr	10.3	0	2	6	6	0	0.12	0.66	3.6	4.38
Hemlock Cr	3.7	2	0	0	0	0.002	0	0	0	0.00
Lost Fork Cr-1	3.4	6	9	0	0	0.006	0.54	0	0	0.55
Lost Fork Cr-2	2.4	1	2	0	0	0.001	0.12	0	0	0.12
Seventeenmile Cr U-1	3.4	0	4	0	2	0	0.24	0	1.2	1.44
Seventeenmile Cr U-2	5.6	0	4	4	7	0	0.24	0.44	4.2	4.88
Totals	62.4	37	26	10	35	0.037	1.56	1.1	21	23.7

Table B-10. Lap Creek Existing Annual Sediment Loads from Road Crossings

South Fork Yaak River Watershed			No. of crossings by IGBC Code				Existing Annual Sediment Load by IGBC Code (tons/yr)					
HUC7_Name	Area (mi2)	1	2	3	4	1	2	3	4	TOTAL LOAD		
Lap Cr	6	0	16	1	0.006	0	1.76	0.6	2.37			
Totals	6	0	16	1	0.006	0	1.76	0.6	2.37			

Table B-11. South Fork Yaak River: Existing Annual Sediment Loads from Road Crossings

South Fork Yaak River W	atershed	No	of cro	ossings Code	-	Exist	ing Ann	ual Sedin Code (to		d by IGBC
HUC7_Name	Area (mi2)	1	2	3	4	1	2	3	4	TOTAL LOAD
Beaver Cr-1	3.9	1	0	1	0	0.001	0	0.11	0	0.11
Beaver Cr-2	4.4	1	0	1	4	0.001	0	0.11	2.4	2.51
Browning Cr	1.0	0	0	0	1	0	0	0	0.6	0.60
Can Cr	1.4	3	2	0	0	0.003	0.12	0	0	0.12
Clay Cr-1	4.3	0	0	1	0	0	0	0.11	0	0.11
Clay Cr-2	5.0	2	9	0	4	0.002	0.54	0	2.4	2.94
Dutch Cr	2.4	3	5	0	0	0.003	0.3	0	0	0.30
Fix Cr	0.9	0	1	1	0	0	0.06	0.11	0	0.17
Fowler Cr-1	3.7	2	0	4	0	0.002	0	0.44	0	0.44
Fowler Cr-2	5.3	0	0	8	2	0	0	0.88	1.2	2.08
Hartman Cr	1.3	0	0	3	1	0	0	0.33	0.6	0.93
Kelsey Cr	2.0	3	3	3	3	0.003	0.18	0.33	1.8	2.31
Smoot Cr	2.3	0	0	0	0	0	0	0	0	0.00
Yaak R SF	1.9	0	0	0	0	0	0	0	0	0.00
Yaak R SF-2	10.2	4	3	1	7	0.004	0.18	0.11	4.2	4.49
Yaak R SF Trib-1	1.5	0	0	0	0	0	0	0	0	0.00
Yaak R SF Trib-2	1.6	0	0	0	0	0	0	0	0	0.00
Yaak R SF Trib-3	1.1	9	0	0	0	0.009	0	0	0	0.01
Yaak R SF Trib-4	1.3	0	0	0	1	0	0	0	0.6	0.60
Yodkin Cr	1.9	1	1	6	0	0.001	0.06	0.66	0	0.72
Zulu Cr-1	2.0	1	4	0	2	0.001	0.24	0	1.2	1.44
Zulu Cr-2	3.3	6	3	0	2	0.006	0.18	0	1.2	1.39
Totals	62.7	36	31	29	27	0.036	1.86	3.19	16.2	21.3

Table B-12. Seventeenmile Creek Road Surface Sediment Loading Reductions

			Existing	Allowable	e Sediment Load	
HUC7_Name	Area Mi2	Crossing Density	Sediment Load (tons/yr)	200ft contributing road length BMPs (tons/yr)	200ft contributing road length BMPs & road crossing density of 1.5 mi2 (tons/yr)	Percent Reduction
Bridle Cr	1.7	0.6	0.00	0.001	0.32	
Conn Cr	2.3	5.7	0.01	0.013	0.45	
Crum Gulch	2.1	0.5	0.60	0.130	0.41	31.2%
Grush Gulch	2.3	0.0	0.00	0.000	0.45	
Mule Cr	1.7	3.6	0.01	0.006	0.32	
Papoose Cr	2.5	0.0	0.00	0.000	0.50	
Pelham Cr	0.5	8.7	0.00	0.004	0.09	
Saddle Cr	1.2	0.0	0.00	0.000	0.24	
Seventeenmile Cr L	10.3	1.6	7.80	1.694	2.01	74.2%
Seventeenmile Cr NF	4.2	0.2	0.60	0.130	0.81	
Sheepherder Cr	1.8	0.0	0.00	0.000	0.36	
Big Foot Cr	3.0	3.4	3.30	0.950	0.58	82.5%
Flattail Cr	10.3	1.4	4.38	1.560	2.02	54.0%
Hemlock Cr	3.7	0.5	0.00	0.002	0.71	
Lost Fork Cr-1	3.4	4.4	0.55	0.546	0.67	
Lost Fork Cr-2	2.4	1.2	0.12	0.121	0.47	
Seventeenmile Cr U-1	3.4	1.8	1.44	0.500	0.66	54.4%
Seventeenmile Cr U-2	5.6	2.7	4.88	1.590	1.09	77.7%
Seventeenmile Creek Total	62.4		23.70	7.247	12.16	48.7%

Table B-13. Lap Creek Road Surface Sediment Loading Reductions

				Existing	Allowable	e Sediment Load	
	HUC7_Name	Area Mi2	Crossing Density	Sediment Load (tons/yr)	200ft contributing road length BMPs (tons/yr)	200ft contributing road length BMPs & road crossing density of 1.5 mi2 (tons/yr)	Percent Reduction
Lap (Cr Total	5.8	4.0	2.37	1.896	1.13	52.4%

Table B-14. South Fork Yaak River Road Surface Sediment Loading Reductions

	Area	Crossing	Existing	Allowable	e Sediment Load	Percent
HUC7_Name	Mi2	Density	Sediment Load (tons/yr)	200ft contributing road length BMPs (tons/yr)	200ft contributing road length BMPs & road crossing density of 1.5 mi2 (tons/yr)	Reduction
Beaver Cr-1	3.9	0.5	0.11	0.111	0.77	
Beaver Cr-2	4.4	1.4	2.51	0.631	0.85	66.0%
Browning Cr	1.0	1.0	0.60	0.130	0.19	68.2%
Can Cr	1.4	3.7	0.12	0.123	0.27	
Clay Cr-1	4.3	0.2	0.11	0.110	0.84	
Clay Cr-2	5.0	3.0	2.94	1.062	0.98	66.8%
Dutch Cr	2.4	3.4	0.30	0.303	0.46	
Fix Cr	0.9	2.3	0.17	0.170	0.17	
Fowler Cr-1	3.7	1.6	0.44	0.442	0.72	
Fowler Cr-2	5.3	1.9	2.08	1.140	1.03	50.3%
Hartman Cr	1.3	3.2	0.93	0.460	0.25	73.4%
Kelsey Cr	2.0	6.1	2.31	0.903	0.38	83.4%
Smoot Cr	2.3	0.0	0.00	0.000	0.45	
Yaak R SF	1.9	0.0	0.00	0.000	0.37	
Yaak R SF-2	10.2	1.5	4.49	1.204	1.99	55.7%
Yaak R SF Trib-1	1.5	0.0	0.00	0.000	0.30	
Yaak R SF Trib-2	1.6	0.0	0.00	0.000	0.32	
Yaak R SF Trib-3	1.1	7.9	0.01	0.009	0.22	
Yaak R SF Trib-4	1.3	0.7	0.60	0.130	0.26	56.3%
Yodkin Cr	1.9	4.2	0.72	0.721	0.37	48.8%
Zulu Cr-1	2.0	3.5	1.44	0.501	0.39	72.8%
Zulu Cr-2	3.3	3.3	1.39	0.446	0.65	52.9%
South Fork Yaak Total	62.7	2.0	21.29	8.596	12.23	42.5%

ATTACHMENT B

WEPP: Road Modeling Results for Field Assessed Road Crossings

Yrs	Climate	Soil	Rock (%)	Surface, traffic	Design	Road grad	Road length	Road width	Fill grad	Fill length	Buff grad	Buff length	Precip	Rain runoff	Snow runoff	Sed road (lb/yr)	Sed profile	Comment
30	TROY(248395) +	silt loam	30%	graveled high	outsloped unrutted	(%) 2	243	15.5 ft	55%	1 ft	0.30%	1 ft	37.74 in	1.31 in	0.04 in	513.6	(lb/yr) 320.45	SFY-1AB
30	BURKE 2 ENE +	silt loam	75%	graveled none	outsloped rutted	4	89		75%	1 ft	0.30%	1 ft	48.90 in	1.42 in	0.04 in	41.21		SFY-2A
30	BURKE 2 ENE +	sandy loam	90%	graveled none	outsloped unrutted	6		13 ft	100%	1 ft	0.30%		48.90 in	1.42 in	0.25 in	89.68		SFY-3A
30	BURKE 2 ENE +	silt loam	50%	graveled high	outsloped unrutted	2	241	16 ft	85%	1 ft	0.30%		48.90 in	1.23 in	0.25 in	362.23		SFY-5A
30	Burke 2 ENE +	loam	10%	native none	outsloped unrutted	5	122		5%	119 ft	0.30%		48.90 in		0.23 in	2.19		SFY-6A - Road to Fillslope
30	BURKE 2 ENE +	silt loam	40%	graveled none	outsloped rutted	1	245		36%	1 ft	0.30%		48.90 in	1.54 in	0.12 in	108.46		SFY-7A
30	Burke 2 ENE +	loam	0%	native none	outsloped rutted	2	95		2%	92 ft	0.30%	1 ft	48.90 in	0.54 in	0.41 in	1.18		SFY-8A - Road to fillslope
30	Burke 2 ENE +	loam	0%	native none	outsloped rutted	2	480	10 ft	2%	477 ft	0.30%		48.90 in	0.42 in	0.10 in	0.98		SFY-9A Road to fillslope - added 2
30	Duike 2 EINE +	Ioaiii	070	native none	outstoped futted	2	400	1011	270	4//11	0.30%	1 11	46.90 III	0.42 111	0.09 111	0.98	1.39	segments
30	TROY(248395) +	silt loam	20%	graveled high	outsloped unrutted	4	250	24 ft	56%	1 ft	0.30%	1 ft	37.74 in	1.70 in	0.08 in	1080.37	805.62	SFY-10A
30	BURKE 2 ENE +	loam	10%	native none	insloped bare	4	140		65%	1 ft	0.30%	1 ft	48.90 in		8.69 in	138.87		SFY-11A
30	BURKE 2 ENE +	silt loam	10%	native none	insloped vegetated	2		22 ft	75%	1 ft	0.30%		48.90 in		9.91 in	313.96		SFY-12A
30	BURKE 2 ENE +	loam	60%	graveled low	outsloped rutted	7		24 ft	75%	1 ft	0.30%	1 ft	48.90 in	1.92 in	0.53 in	913.41		SFY-13A
	Burke 2 ENE +	silt loam	15%	native none	outsloped rutted	6		15 ft	42%	1 ft	0.30%		48.90 in		9.04 in	496.71		SFY-14A
		loam	0%	native none	outsloped rutted	1		13 It 11 ft	1%	44 ft	0.30%	1 ft	48.90 in	0.55 in	0.10 in	1.04	0.75	SFY-15A - Road to fillslope
30	BURKE 2 ENE +	silt loam	25%	graveled none	insloped vegetated	4		26 ft	40%	1 ft	0.30%	1 ft	48.90 in	1.80 in	0.10 iii 0.44 in	837.83		SFY-4B
30	BURKE 2 ENE +	silt loam	15%			0.50		20 ft 21 ft	40%	1 ft	0.30%	1 ft	48.90 in	2.73 in	6.67 in	47.48		SFY-5B
	BURKE 2 ENE +	silt loam	15%	native none	outsloped rutted	2.20		21 It 22 ft	40%		0.30%	1 ft		1.83 in	3.20 in	433.31		SFY-6B
30				native none	outsloped unrutted	3.50		15 ft		1 ft			48.90 in			1.62		
30	Burke 2 ENE +	silt loam	5%	native none	outsloped rutted				3.50	47 ft	0.30%		48.90 in	0.54 in	0.12 in			SFY-7B Road to fillslope
	BURKE 2 ENE +	silt loam	25%	graveled low	insloped bare	4.50	1250	25 ft	40%	1 ft	0.30%	1 ft	48.90 in	1.82 in	0.44 in	2692.42	2476.78	SFY-8B-LOW, used 1/2 length and doubled results
30	BURKE 2 ENE +	silt loam	15%	native none	outsloped rutted	5.70	255	41 ft	30%	1 ft	0.30%	1 ft	48.90 in	3.86 in	9.60 in	1464.97	1141.73	SFY-9B
30	BURKE 2 ENE +	silt loam	25%	native none	outsloped rutted	7.30	250	18 ft	12%	1 ft	0.30%	1 ft	48.90 in	4.15 in	10.05 in	783.93	612.32	SFY-10B
30	BURKE 2 ENE +	silt loam	20%	graveled high	outsloped unrutted	4.12	365	15 ft	30%	1 ft	0.30%	1 ft	48.90 in	1.46 in	0.30 in	784.52	467.77	SFY-11B - Reduce width to 15 fee
30	Burke 2 ENE +	silt loam	10%	native none	insloped vegetated	1	60	18 ft	1%	57 ft	0.30%	1 ft	48.90 in	0.51 in	0.13 in	1.75	1.45	SFY-12B Road to fillslope
30	Burke 2 ENE +	silt loam	5%	native none	outsloped unrutted	2	40	12 ft	1%	37 ft	0.30%	1 ft	48.90 in	0.60 in	0.16 in	1.2	0.33	SFY-13B Road to fillslope
verage	- South Fork of Yaa	k River					290.21									463.04	359.30	lb/yr
																0.23	0.18	tons/yr
30	BURKE 2 ENE +	silt loam	10%	native low	outsloped rutted	2	130	18 ft	51%	1 ft	0.30%	1 ft	48.90 in	3.05 in	6.32 in	72.96	59.89	LSC-1A
30	TROY(248395) +	silt loam	35%	graveled high	outsloped unrutted	3	225	38 ft	80%	1 ft	0.30%	1 ft	37.74 in	1.76 in	0.11 in	1329.31	1068.5	SML-1-B
30	TROY(248395) +	silt loam	20%	native low	outsloped unrutted	1		18 ft	55%	1 ft	0.30%	1 ft	37.74 in	1.75 in	0.70 in	185.94	90.59	SML-2B - Modeled - native, low
	TROY(248395) +	silt loam	25%	graveled low	outsloped unrutted	5	625	20 ft	30%	1 ft	0.30%	1 ft	37.74 in		0.08 in	599.18	441.55	SML-3B - Modeled gravel, low
30		silt loam		graveled high	outsloped unrutted	5		22 ft	40%		0.30%			1.68 in		2761.92		SML-4B
	Troy (248395) +	silt loam	0%	native none	outsloped unrutted	5		16 ft	5%	97 ft	0.30%		37.74 in		0.02 in	2.07		SML-5B Road to fillslope
	Troy (248395) +	silt loam	0%	native none	outsloped unrutted	2		25 ft	5%	47 ft	0.30%		37.74 in		0.04 in	2.87		SML-6B Road to fillslope
	- Lower Seventeenn				1		316.43									707.75	537.17	
																0.35		tons/yr
30	TROY (248395) +	silt loam	15%	native low	outsloped rutted	3	322	12 ft	48%	1 ft	0.30%	1 ft	37.74 in	3.89 in	3.77 in	275.65		USC-1A
	BURKE 2 ENE +	silt loam	5%	native low	outsloped rutted	3		20 ft	54%	1 ft	0.30%		48.90 in	3.55 in	7.93 in	2511.28	2213.34	
	BURKE 2 ENE +	loam	5%	native none	outsloped unrutted	5		22 ft	28%	1 ft	0.30%		48.90 in		4.47 in	93.05		USC-4A
	BURKE 2 ENE +	silt loam	5%	native low	outsloped rutted	5		19 ft	72%	1 ft	0.30%		48.90 in		8.03 in	4661.78		USC-5A
	BURKE 2 ENE +	loam	10%	native none	outsloped rutted	1.50		14 ft	45%	1 ft	0.30%		48.90 in	3.66 in	9.01 in	70.75		USC-6A
	BURKE 2 ENE +	silt loam	20%	native none	outsloped rutted	7		14 ft	64%		0.30%		48.90 in	3.56 in	7.29 in	594.02		USC-7A - Modeled 2 segments (inslope and outslope) and added
																		results
	BURKE 2 ENE +	silt loam	30%	native low	outsloped rutted	2		17 ft	64%	1 ft	0.30%		48.90 in		8.39 in	240.87		USC-8A
	Burke 2 ENE +	loam	5%	native none	outsloped unrutted	1		12 ft	1%	47 ft	0.30%		48.48 in		0.14 in	1.17		USC-9A Road to fillslope
	BURKE 2 ENE +	silt loam	70%	graveled low	outsloped rutted	1	345	13 ft	58%	1 ft	0.30%		48.90 in		0.41 in	73.45	73.23	USC-10A
	BURKE 2 ENE +	silt loam	50%	native low	insloped vegetated	5	1000		46%	1 ft	0.30%		48.90 in		10.22 in	6268.35	5772 65	USC-11A

Table B-15. WEPP. Road Modeling Results From Field Assessed Crossings

Yrs	Climate	Soil	Rock	Surface,	Design	Road	Road	Road	Fill	Fill	Buff	Buff	Precip	Rain	Snow	Sed road	Sed	Comment
			(%)	traffic		grad (%)	length	width	grad	length	grad	length		runoff	runoff	(lb/yr)	profile (lb/yr)	
30	BURKE 2 ENE +	loam	5%	native none	outsloped rutted	0.50	195	15 ft	50%	1 ft	0.30%	1 ft	48.90 in	3.65 in	9.03 in	83.24	58.28	USC-12A
30	BURKE 2 ENE +	loam	5%	native none	outsloped rutted	2	252	11 ft	60%	1 ft	0.30%	1 ft	48.90 in	3.85 in	9.54 in	113.31	82.08	USC-13A
30	Burke 2 ENE +	silt loam	80%	native none	outsloped rutted	6	294	14 ft	6%	291 ft	0.30%	1 ft	48.90 in	0.74 in	0.29 in	10.13	8.49	USC-14A Road to fillslope
30	BURKE 2 ENE +	loam	95%	graveled none	insloped vegetated	5	184	13 ft	32%	1 ft	0.30%	1 ft	48.90 in	1.91 in	0.51 in	88.62	63.22	USC-15A
verage	= Upper Seventeenr	nile Creek					365.36									1077.55	940.63	lb/yr
				·	_											0.54	0.47	tons/yr
30	Burke 2 ENE +	loam	50%	graveled none	outsloped rutted	5	450	19 ft	5%	447 ft	0.30%	1 ft	48.90 in	0.66 in	0.14 in	2.45	21.57	LC-1A, Road to fillslope
30	Troy (248395) +	loam	0%	native none	outsloped rutted	0.50	150	13 ft	5%	147 ft	0.30%	1 ft	37.74 in	0.57 in	0.02 in	1.3	6.62	LC-2A Road to fillslope
verage	- Lap Creek						300.00									1.88	14.10	lb/yr
																0.00	0.01	tons/yr
	venteenmile Average	e (Upper and														954.28	806.14	lb/yr
ower):																0.48	0.40	tons/yr
arallel	Segments Removed	from Model Re	sults															
30	Burke 2 ENE +	sandy loam	50%	graveled none	outsloped unrutted	3	140	13 ft	25%	3	40%	70	48.90 in	0.31 in	0.00 in	68.54	38.68	SFY-4A-P
30	Troy (248395) +	silt loam	7%	graveled low	outsloped rutted	7	800	20 ft	60%	20 ft	2%	10 ft	37.74 in	1.56 in	0.12 in	2877.54	2267.69	USC-2A-P
	-															1473.04	1153.19	lb/yr
																0.74	0.58	tons/yr
ecomm	nissioned Crossings I	Removed from	Results															
30	Burke 2 ENE +	silt loam	20%	native none	outsloped unrutted	22	91	30 ft	22%	88 ft	0.30%	1 ft	48.90 in	1.31 in	1.08 in	36.37	14.66	SFY-2B Road to fillslope
30	Burke 2 ENE +	silt loam	25%	native none	outsloped unrutted	22	137	44 ft	22%	134 ft	0.30%	1 ft	48.90 in	1.28 in	1.10 in	88.84	29.1	SFY-3B Road to fillslope

ATTACHMENT C

WEPP: Road Model Adjustments

WEPP: Road Model Adjustments

Heavily vegetated road conditions encountered in the Yaak TPA are not properly represented in the standard WEPP:Road assumption. As a result, William J. Elliott, author of the model, was consulted to determine how best to represent these roads within the confines of the model.

There are three traffic scenarios available in the model. For roads where vegetation has grown up on the edges, the no traffic scenario is most appropriate as this scenario grows a limited amount of vegetation on the road. It uses the same plant growth for the road that the high traffic used for the fillslope. The following table explains the model assumptions for the three traffic scenarios:

Traffic	High	Low	None
Erodibility	100%	25%	25%
Hydraulic Conductivity	100%	100%	100%
Vegetation on Road Surface	0	0	50%
Vegetation on fill	50%	50%	100% Forested
Buffer	Forested	Forested	Forested

Based on conversations with Dr. Elliott, it was not appropriate to use the forest buffer to describe the road as the hydraulic conductivity of the soil would be too high. However, the hydraulic conductivity of the fillslope would be reasonable to use to describe the road surface for a fully forested scenario. This means, for the fully vegetated/forested road surface scenario, minimize the road segment length, put the remainder of the road surface length and gradient into the fillslope box, and minimize the buffer length and gradient at stream crossings. This was the approach that was used in the modeling work, and is noted as "Road to Fillslope" in the comment column of **Attachment B**.

ATTACHMENT D

Field Assessment Site Location Data

Table B-16. Field Assessment Site Location Data

LOCATION ID	HUC_6TH CODE	X	Y	Z
LC-1A	Lap Creek	-115.6871	48.8820	3581.53
LC-2A	Lap Creek	-115.6867	48.8801	3441.08
SFY-10A	South Fork Yaak River	-115.6630	48.8125	3279.02
SFY-10B	South Fork Yaak River	-115.6272	48.7722	4538.75
SFY-11A	South Fork Yaak River	-115.5799	48.8409	4547.34
SFY-11B	South Fork Yaak River	-115.6384	48.7631	3921.30
SFY-12A	South Fork Yaak River	-115.5673	48.8232	5237.62
SFY-12B	South Fork Yaak River	-115.6410	48.7714	3882.53
SFY-13A	South Fork Yaak River	-115.6130	48.8202	4221.00
SFY-13B	South Fork Yaak River	-115.6410	48.7736	3868.06
SFY-14A	South Fork Yaak River	-115.6212	48.8158	4066.20
SFY-15A	South Fork Yaak River	-115.6121	48.7975	4036.13
SFY-1AB	South Fork Yaak River	-115.6553	48.7610	3460.90
SFY-2A	South Fork Yaak River	-115.7125	48.7622	4171.17
SFY-2B	South Fork Yaak River	-115.6014	48.7258	4496.05
SFY-3A	South Fork Yaak River	-115.7080	48.7587	4034.56
SFY-3B	South Fork Yaak River	-115.6073	48.7378	4510.31
SFY-4A-P	South Fork Yaak River	-115.7080	48.7587	4034.56
SFY-4B	South Fork Yaak River	-115.6168	48.7405	4707.21
SFY-5A	South Fork Yaak River	-115.6748	48.7625	3513.30
SFY-5B	South Fork Yaak River	-115.6158	48.7330	4289.23
SFY-6A	South Fork Yaak River	-115.6760	48.7522	3938.15
SFY-6B	South Fork Yaak River	-115.6097	48.7328	4262.25
SFY-7A	South Fork Yaak River	-115.6795	48.7481	3992.83
SFY-7B	South Fork Yaak River	-115.6269	48.7311	3937.32
SFY-8A	South Fork Yaak River	-115.6612	48.7510	3770.70
SFY-8B	South Fork Yaak River	-115.6377	48.7290	3834.79
SFY-9A	South Fork Yaak River	-115.6523	48.7473	3546.55
SFY-9B	South Fork Yaak River	-115.6210	48.7641	4659.94
LSC-1A	Lower Seventeenmile Creek	-115.7275	48.6398	3291.19
SML-1B	Lower Seventeenmile Creek	-115.8511	48.6794	2652.57
SML-2B	Lower Seventeenmile Creek	-115.7477	48.6454	3312.61
SML-3B	Lower Seventeenmile Creek	-115.7491	48.6468	3265.97
SML-4B	Lower Seventeenmile Creek	-115.7679	48.6598	2961.35
SML-5B	Lower Seventeenmile Creek	-115.8153	48.6717	2944.64
SML-6B	Lower Seventeenmile Creek	-115.8075	48.6670	3130.26
USC-10A	Upper Seventeenmile Creek	-115.7378	48.5768	4673.81
USC-11A	Upper Seventeenmile Creek	-115.7284	48.5515	5535.16
USC-12A	Upper Seventeenmile Creek	-115.7586	48.5975	4390.28
USC-13A	Upper Seventeenmile Creek	-115.7510	48.5968	4291.36
USC-14A	Upper Seventeenmile Creek	-115.7539	48.5999	4277.85
USC-15A	Upper Seventeenmile Creek	-115.7057	48.6092	3602.33
USC-1A	Upper Seventeenmile Creek	-115.7157	48.6246	3379.28
USC-2A-P	Upper Seventeenmile Creek	-115.7151	48.6238	3359.96
USC-3A	Upper Seventeenmile Creek	-115.6634	48.6203	4181.79
USC-4A	Upper Seventeenmile Creek	-115.6714	48.6183	4100.11

Table B-16. Field Assessment Site Location Data

LOCATION ID	HUC_6TH CODE	X	Y	Z
USC-5A	Upper Seventeenmile Creek	-115.6824	48.6178	3838.58
USC-6A	Upper Seventeenmile Creek	-115.6972	48.6236	3704.32
USC-7A	Upper Seventeenmile Creek	-115.7136	48.5817	3988.61
USC-8A	Upper Seventeenmile Creek	-115.7034	48.5718	4085.63
USC-9A	Upper Seventeenmile Creek	-115.7248	48.5865	4491.59

APPENDIX C DAILY SEDIMENT TMDLS

Introduction

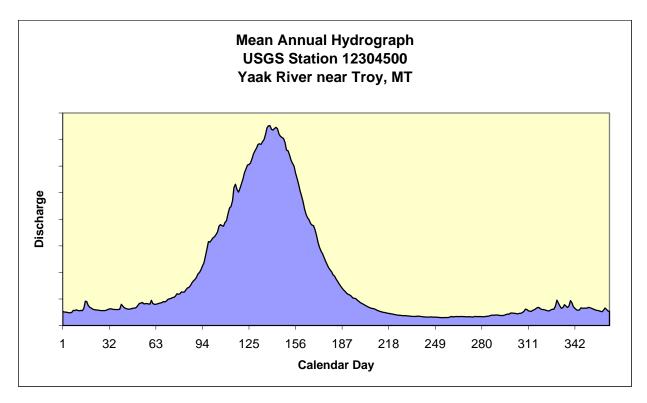
Originally, sediment loads for the Yaak TPA were calculated and applied as average annual sediment yields which is logically sound for this watershed for a few reasons.

- All significant sediment sources are nonpoint source runoff driven.
- Impacts to beneficial uses are predominantly from accumulative, chronic sediment loading, rather than daily acute exceedances of the narrative water quality standard for sediment.

Determining a daily allowable sediment load rate is problematic due to natural variation in daily sediment transport and depositional conditions, and the chronic nature of sediment impacts. Including daily loads and allocations, however, is a recent recommendation by EPA that the original scope of this TMDL project did not consider. This appendix provides estimates of allowable daily sediment loads and allocations for each major source type (natural background and forest roads). The analysis for providing the daily loads is limited because of project time constraints, the types of sources in the watershed, the validity of using annual load limits to protect beneficial uses, and this recent change in TMDL recommendations from the EPA.

The annual sediment loads described in the sediment source assessments (Section 5) are used as a primary basis for determining daily sediment loads for listed streams in the Yaak TPA. In order to estimate allowable daily loads, the annual load limits given in Table 6-1 were apportioned according to the average annual hydrograph for the Yaak River, estimated using mean annual flows from USGS station 12304500 (Yaak River near Troy, MT) given in Figure C-1. The annual hydrograph at this station approximates the timing and relative daily magnitude of flows in impaired watersheds Seventeenmile Creek, Lap Creek and the South Fork Yaak River. For each day, the percentage of the total annual flow was calculated and multiplied by the annual allowable load to obtain an average approximation of the allowable load for any single day or average flow condition. Because the hydrograph on Figure C-1 represents the average daily flow, each single day's allowable load also represents an average allowable load for that day. Actual loads on any given day may be in excess of the allowable load given due to a variety of natural and non-natural factors (timing of the annual hydrograph, weather patterns, storm events, or other natural and non-natural watershed disturbances), however, daily exceedances may not contribute to impairment conditions unless frequency and duration of non-natural loads, over time, is excessive.

Annual allocations given in Section 6.0 provide a more practical operational loading analysis than does an allowable daily load limit, nonetheless allowable daily loading estimates are provided in Tables C-1, C-2, and C-3 in order to satisfy EPA's daily loading recommendations.



 $\begin{tabular}{ll} Figure C-1. Mean Annual Hydrograph (relative discharge), Yaak River: USGS Station 12304500 \end{tabular}$

Table C-1. Seventeenmile Creek: Daily Load Allocations and TMDI

		Daily Load Allocation		
Calendar Day	% of Annual Flow	Natural Background	Roads	TMDL 17mile
1 2	0.086%	0.3816	0.0105	0.3920
2	0.083%	0.3658	0.0100	0.3758
3	0.082%	0.3629	0.0100	0.3729
4	0.081%	0.3572	0.0098	0.3670
5	0.078%	0.3457	0.0095	0.3552
6	0.077%	0.3428	0.0094	0.3522
7	0.080%	0.3557	0.0098	0.3655
8	0.093%	0.4102	0.0113	0.4215
9	0.091%	0.4031	0.0111	0.4141
10	0.096%	0.4260	0.0117	0.4377
11	0.092%	0.4088	0.0112	0.4200
12	0.090%	0.3988	0.0109	0.4097
13	0.092%	0.4074	0.0112	0.4186
14	0.091%	0.4016	0.0110	0.4127
15	0.104%	0.4619	0.0127	0.4746
16	0.149%	0.6584	0.0181	0.6765
17	0.146%	0.6484	0.0178	0.6661
18	0.122%	0.5393	0.0148	0.5541
19	0.111%	0.4920	0.0135	0.5055
20	0.106%	0.4705	0.0129	0.4834
21	0.100%	0.4418	0.0121	0.4539
22	0.097%	0.4289	0.0118	0.4407
23	0.096%	0.4232	0.0116	0.4348
24	0.094%	0.4174	0.0115	0.4289
25	0.094%	0.4145	0.0114	0.4259
26	0.091%	0.4045	0.0111	0.4156
27	0.091%	0.4031	0.0111	0.4141
28	0.091%	0.4031	0.0111	0.4141
29	0.091%	0.4031	0.0111	0.4141
30	0.093%	0.4131	0.0111	0.4244
31	0.098%	0.4346	0.0119	0.4466
32	0.101%	0.4461	0.0119	0.4583
33	0.101%	0.4533	0.0124	0.45657
34		0.4333	0.0124	0.4525
35	0.099%			0.4525
	0.098%	0.4332	0.0119	
36	0.098%	0.4346	0.0119	0.4466
37	0.097%	0.4318	0.0119	0.4436
38	0.097%	0.4318	0.0119	0.4436
39	0.100%	0.4432	0.0122	0.4554
40	0.130%	0.5752	0.0158	0.5910
41	0.119%	0.5250	0.0144	0.5394
42	0.108%	0.4805	0.0132	0.4937
43	0.104%	0.4590	0.0126	0.4716
44	0.101%	0.4490	0.0123	0.4613
45	0.100%	0.4432	0.0122	0.4554
46	0.101%	0.4461	0.0122	0.4583
47	0.104%	0.4604	0.0126	0.4731
48	0.106%	0.4705	0.0129	0.4834
49	0.106%	0.4705	0.0129	0.4834
50	0.110%	0.4891	0.0134	0.5026

Table C-1. Seventeenmile Creek: Daily Load Allocations and TMDL

	Cable C-1. Seventeenmile Creek: Daily Load Allocations and TMDL						
Calendar Day	% of Annual Flow	Natural Background	Roads	TMDL 17mile			
51	0.123%	0.5451	0.0150	0.5600			
52	0.135%	0.5981	0.0164	0.6146			
53	0.136%	0.6039	0.0166	0.6205			
54	0.141%	0.6240	0.0171	0.6411			
55	0.132%	0.5852	0.0161	0.6013			
56	0.133%	0.5895	0.0162	0.6057			
57	0.134%	0.5953	0.0163	0.6116			
58	0.132%	0.5838	0.0160	0.5998			
59	0.131%	0.5795	0.0159	0.5954			
60	0.154%	0.6828	0.0187	0.7015			
61	0.134%	0.5938	0.0163	0.6101			
62	0.130%	0.5752	0.0158	0.5910			
63	0.130%	0.5752	0.0158	0.5910			
64	0.132%	0.5852	0.0161	0.6013			
65	0.135%	0.5996	0.0165	0.6160			
66	0.138%	0.6096	0.0167	0.6264			
67	0.139%	0.6168	0.0169	0.6337			
68	0.146%	0.6469	0.0178	0.6647			
69	0.144%	0.6383	0.0175	0.6558			
70	0.149%	0.6598	0.0181	0.6779			
71	0.160%	0.7072	0.0194	0.7266			
72	0.163%	0.7215	0.0198	0.7413			
73	0.165%	0.7315	0.0201	0.7516			
74	0.170%	0.7531	0.0207	0.7737			
75	0.172%	0.7617	0.0209	0.7826			
76	0.179%	0.7932	0.0218	0.8150			
77	0.194%	0.8578	0.0235	0.8813			
78	0.191%	0.8463	0.0232	0.8695			
79	0.194%	0.8578	0.0235	0.8813			
80	0.205%	0.9065	0.0249	0.9314			
81	0.204%	0.9037	0.0248	0.9285			
82	0.205%	0.9065	0.0249	0.9314			
83	0.218%	0.9654	0.0265	0.9919			
84	0.229%	1.0141	0.0278	1.0420			
85	0.232%	1.0299	0.0283	1.0582			
86	0.243%	1.0787	0.0296	1.1083			
87	0.260%	1.1533	0.0317	1.1849			
88	0.272%	1.2049	0.0331	1.2380			
89	0.281%	1.2436	0.0341	1.2778			
90	0.294%	1.3024	0.0358	1.3382			
91	0.314%	1.3928	0.0382	1.4310			
92	0.323%	1.4330	0.0393	1.4723			
93	0.340%	1.5061	0.0413	1.5475			
94	0.363%	1.6065	0.0441	1.6506			
95	0.382%	1.6926	0.0441	1.7391			
96	0.424%	1.8791	0.0516	1.9307			
97	0.466%	2.0655	0.0567	2.1222			
98	0.512%	2.2664	0.0622	2.3286			
99	0.508%	2.2520	0.0618	2.3138			
100	0.521%	2.3094	0.0634	2.3728			
101	0.534%	2.3668	0.0650	2.4317			
101	0.33470	2.3000	0.0050	4.4317			

Table C-1. Seventeenmile Creek: Daily Load Allocations and TMDL

Calendar Day	% of Annual Flow	Natural Background	Roads	TMDL 17mile
102	0.541%	2.3955	0.0658	2.4612
103	0.554%	2.4528	0.0673	2.5202
104	0.570%	2.5246	0.0693	2.5939
105	0.605%	2.6823	0.0736	2.7560
106	0.615%	2.7254	0.0748	2.8002
107	0.609%	2.6967	0.0740	2.7707
108	0.605%	2.6823	0.0736	2.7560
109	0.628%	2.7828	0.0764	2.8591
110	0.638%	2.8258	0.0776	2.9034
111	0.680%	3.0123	0.0827	3.0949
112	0.716%	3.1700	0.0870	3.2571
113	0.725%	3.2131	0.0882	3.3013
114	0.761%	3.3709	0.0925	3.4634
115	0.761%	3.7295	0.1024	3.8318
116	0.861%	3.8155	0.1024	3.9203
117	0.829%	3.6721	0.1047	3.7729
118	0.813%	3.6004	0.0988	3.6992
119	0.835%	3.7008	0.1016	3.8024
120	0.865%	3.8299	0.1016	3.9350
120	0.894%	3.9590	0.1031	4.0676
121				4.2445
	0.933%	4.1311	0.1134	
123	0.955%	4.2315	0.1162	4.3477
124	0.978%	4.3319	0.1189	4.4508
125	0.981%	4.3463	0.1193	4.4656
126	0.991%	4.3893	0.1205	4.5098
127	1.017%	4.5040	0.1236	4.6277
128	1.046%	4.6331	0.1272	4.7603
129	1.065%	4.7192	0.1295	4.8487
130	1.081%	4.7909	0.1315	4.9224
131	1.104%	4.8913	0.1343	5.0256
132	1.107%	4.9057	0.1347	5.0403
133	1.104%	4.8913	0.1343	5.0256
134	1.120%	4.9631	0.1362	5.0993
135	1.133%	5.0204	0.1378	5.1582
136	1.166%	5.1639	0.1417	5.3056
137	1.205%	5.3360	0.1465	5.4825
138	1.217%	5.3934	0.1480	5.5414
139	1.217%	5.3934	0.1480	5.5414
140	1.195%	5.2930	0.1453	5.4383
141	1.192%	5.2786	0.1449	5.4235
142	1.201%	5.3217	0.1461	5.4677
143	1.208%	5.3503	0.1469	5.4972
144	1.198%	5.3073	0.1457	5.4530
145	1.166%	5.1639	0.1417	5.3056
146	1.153%	5.1065	0.1402	5.2467
147	1.146%	5.0778	0.1394	5.2172
148	1.140%	5.0491	0.1386	5.1877
149	1.114%	4.9344	0.1354	5.0698
150	1.069%	4.7335	0.1299	4.8635
151	1.065%	4.7192	0.1295	4.8487
152	1.039%	4.6045	0.1264	4.7308

Table C-1. Seventeenmile Creek: Daily Load Allocations and TMDL

Calendar Day	% of Annual Flow	Natural Background	Roads	TMDL 17mile
153	1.007%	4.4610	0.1225	4.5835
154	0.988%	4.3749	0.1201	4.4950
155	0.971%	4.3032	0.1181	4.4213
156	0.929%	4.1168	0.1130	4.2298
157	0.897%	3.9733	0.1091	4.0824
158	0.861%	3.8155	0.1047	3.9203
159	0.822%	3.6434	0.1000	3.7434
160	0.790%	3.5000	0.0961	3.5960
161	0.754%	3.3422	0.0917	3.4339
162	0.709%	3.1414	0.0862	3.2276
163	0.677%	2.9979	0.0823	3.0802
164	0.657%	2.9119	0.0799	2.9918
165	0.644%	2.8545	0.0784	2.9328
166	0.622%	2.7541	0.0756	2.8297
167	0.612%	2.7110	0.0744	2.7854
168	0.609%	2.6967	0.0740	2.7707
169	0.583%	2.5819	0.0709	2.6528
170	0.547%	2.4242	0.0665	2.4907
170	0.505%	2.2377	0.0614	2.2991
172	0.476%	2.1086	0.0579	2.1665
173		2.1080		
	0.453%		0.0551	2.0633
174	0.437%	1.9365	0.0532	1.9896
175	0.414%	1.8360	0.0504	1.8864
176	0.392%	1.7356	0.0476	1.7833
177	0.372%	1.6496	0.0453	1.6948
178	0.353%	1.5635	0.0429	1.6064
179	0.340%	1.5061	0.0413	1.5475
180	0.327%	1.4488	0.0398	1.4885
181	0.309%	1.3684	0.0376	1.4060
182	0.301%	1.3354	0.0367	1.3721
183	0.283%	1.2551	0.0345	1.2896
184	0.269%	1.1920	0.0327	1.2247
185	0.254%	1.1260	0.0309	1.1569
186	0.241%	1.0658	0.0293	1.0950
187	0.228%	1.0084	0.0277	1.0361
188	0.217%	0.9611	0.0264	0.9874
189	0.208%	0.9209	0.0253	0.9462
190	0.198%	0.8750	0.0240	0.8990
191	0.191%	0.8449	0.0232	0.8681
192	0.187%	0.8277	0.0227	0.8504
193	0.180%	0.7961	0.0219	0.8179
194	0.169%	0.7502	0.0206	0.7708
195	0.166%	0.7373	0.0202	0.7575
196	0.165%	0.7301	0.0200	0.7502
197	0.156%	0.6914	0.0190	0.7104
198	0.148%	0.6555	0.0180	0.6735
199	0.141%	0.6240	0.0171	0.6411
200	0.136%	0.6010	0.0165	0.6175
201	0.131%	0.5795	0.0159	0.5954
202	0.125%	0.5551	0.0152	0.5704
203	0.120%	0.5336	0.0146	0.5482

Calendar Day	% of Annual Flow	Natural Background	Roads	TMDL 17mile
204	0.115%	0.5092	0.0140	0.5232
205	0.110%	0.4891	0.0134	0.5026
206	0.107%	0.4719	0.0130	0.4849
207	0.104%	0.4619	0.0127	0.4746
208	0.104%	0.4561	0.0127	0.4687
209	0.099%	0.4404	0.0123	0.4525
210	0.095%	0.4188	0.0121	0.4303
211	0.090%	0.3988	0.0113	0.4097
212	0.090%	0.3873	0.0109	0.3979
213	0.085%	0.3744	0.0103	0.3847
214	0.081%	0.3600	0.0103	0.3699
215	0.081%	0.3543	0.0099	0.3640
216	0.079%	0.3486	0.0097	0.3581
217	0.076%	0.3357	0.0092	0.3449
218	0.074%	0.3285	0.0090	0.3375
219	0.073%	0.3213	0.0088	0.3301
220	0.071%	0.3141	0.0086	0.3228
221	0.069%	0.3070	0.0084	0.3154
222	0.067%	0.2984	0.0082	0.3065
223	0.065%	0.2898	0.0080	0.2977
224	0.063%	0.2811	0.0077	0.2889
225	0.063%	0.2783	0.0076	0.2859
226	0.062%	0.2740	0.0075	0.2815
227	0.061%	0.2682	0.0074	0.2756
228	0.060%	0.2668	0.0073	0.2741
229	0.061%	0.2697	0.0074	0.2771
230	0.059%	0.2625	0.0072	0.2697
231	0.059%	0.2596	0.0071	0.2668
232	0.057%	0.2539	0.0070	0.2609
233	0.056%	0.2496	0.0069	0.2564
234	0.056%	0.2467	0.0068	0.2535
235	0.055%	0.2453	0.0067	0.2520
236	0.056%	0.2467	0.0068	0.2535
237	0.057%	0.2525	0.0069	0.2594
238	0.057%	0.2525	0.0069	0.2594
239	0.056%	0.2482	0.0068	0.2550
240	0.055%	0.2424	0.0067	0.2491
241	0.053%	0.2367	0.0065	0.2432
242	0.053%	0.2338	0.0064	0.2402
243	0.052%	0.2295	0.0063	0.2358
244	0.051%	0.2281	0.0063	0.2343
245	0.052%	0.2295	0.0063	0.2358
246	0.052%	0.2324	0.0064	0.2388
247	0.052%	0.2295	0.0063	0.2358
248	0.051%	0.2266	0.0062	0.2329
249	0.051%	0.2281	0.0063	0.2343
250	0.051%	0.2252	0.0062	0.2314
251	0.050%	0.2223	0.0061	0.2284
252	0.049%	0.2152	0.0059	0.2211
253	0.049%	0.2152	0.0059	0.2211
254	0.048%	0.2123	0.0058	0.2181

Calendar Day	% of Annual Flow	Natural Background	Roads	TMDL 17mile
255	0.049%	0.2152	0.0059	0.2211
256	0.049%	0.2166	0.0059	0.2225
257	0.049%	0.2152	0.0059	0.2211
258	0.049%	0.2180	0.0060	0.2240
259	0.053%	0.2352	0.0065	0.2417
260	0.056%	0.2467	0.0068	0.2535
261	0.052%	0.2309	0.0063	0.2373
262	0.055%	0.2424	0.0067	0.2491
263	0.055%	0.2438	0.0067	0.2505
264	0.054%	0.2410	0.0066	0.2476
265	0.055%	0.2424	0.0067	0.2491
266	0.055%	0.2438	0.0067	0.2505
267	0.055%	0.2438	0.0067	0.2505
268	0.054%	0.2410	0.0066	0.2476
269	0.054%	0.2381	0.0065	0.2446
270	0.053%	0.2367	0.0065	0.2432
271	0.054%	0.2381	0.0065	0.2446
272	0.054%	0.2395	0.0066	0.2461
273	0.052%	0.2324	0.0064	0.2388
274	0.052%	0.2295	0.0063	0.2358
275	0.055%	0.2438	0.0067	0.2505
276	0.055%	0.2438	0.0067	0.2505
277	0.055%	0.2424	0.0067	0.2491
278	0.054%	0.2410	0.0066	0.2476
279	0.054%	0.2410	0.0066	0.2476
280	0.054%	0.2410	0.0066	0.2476
281	0.054%	0.2381	0.0065	0.2446
282	0.054%	0.2395	0.0066	0.2461
283	0.056%	0.2496	0.0069	0.2564
284	0.057%	0.2510	0.0069	0.2579
285	0.058%	0.2582	0.0009	0.2653
286	0.062%	0.2768	0.0071	0.2844
287	0.063%	0.2811	0.0077	0.2889
288	0.063%	0.2783	0.0077	0.2859
289	0.064%	0.2826	0.0078	0.2903
290	0.064%	0.2840	0.0078	0.2918
291	0.064%	0.2826	0.0078	0.2903
291	0.062%	0.2826	0.0078	0.2800
292	0.061%	0.2723	0.0073	0.2771
293	0.061%	0.2697	0.0074	0.2771
294	0.063%	0.2811	0.0074	0.2889
293	0.066%	0.2941	0.0077	0.2889
290	0.070%	0.2941	0.0081	0.3198
297	0.069%	0.3113	0.0083	0.3139
299	0.075%	0.3342	0.0092	0.3434
300	0.077%	0.3400	0.0093	0.3493
301	0.075%	0.3328	0.0091	0.3419
302	0.074%	0.3299	0.0091	0.3390
303	0.073%	0.3213	0.0088	0.3301
304	0.071%	0.3156	0.0087	0.3242
305	0.075%	0.3313	0.0091	0.3404

Calendar Day	% of Annual Flow	Natural Background	Roads	TMDL 17mile
306	0.075%	0.3313	0.0091	0.3404
307	0.079%	0.3514	0.0096	0.3611
308	0.086%	0.3816	0.0105	0.3920
309	0.100%	0.4432	0.0122	0.4554
310	0.098%	0.4332	0.0119	0.4451
311	0.090%	0.3988	0.0109	0.4097
312	0.088%	0.3887	0.0107	0.3994
313	0.086%	0.3816	0.0105	0.3920
314	0.094%	0.4145	0.0114	0.4259
315	0.096%	0.4275	0.0117	0.4392
316	0.103%	0.4576	0.0126	0.4701
317	0.109%	0.4834	0.0133	0.4967
318	0.111%	0.4906	0.0135	0.5040
319	0.102%	0.4533	0.0124	0.4657
320	0.098%	0.4346	0.0119	0.4466
321	0.097%	0.4318	0.0119	0.4436
322	0.096%	0.4232	0.0116	0.4348
323	0.092%	0.4088	0.0112	0.4200
324	0.090%	0.3973	0.0109	0.4082
325	0.090%	0.3973	0.0109	0.4082
326	0.096%	0.4246	0.0117	0.4362
327	0.099%	0.4404	0.0121	0.4525
328	0.099%	0.4389	0.0120	0.4510
329	0.119%	0.5250	0.0120	0.5394
330	0.155%	0.6856	0.0188	0.7045
331	0.136%	0.6039	0.0166	0.6205
332	0.119%	0.5279	0.0145	0.5424
333	0.105%	0.4633	0.0127	0.4760
334	0.109%	0.4848	0.0133	0.4981
335	0.127%	0.5637	0.0155	0.5792
336	0.119%	0.5279	0.0145	0.5424
337	0.110%	0.4891	0.0134	0.5026
338	0.118%	0.5236	0.0144	0.5379
339	0.152%	0.6742	0.0185	0.6927
340	0.132%	0.6139	0.0169	0.6308
341	0.114%	0.5063	0.0139	0.5202
342	0.105%	0.4647	0.0128	0.4775
343	0.096%	0.4275	0.0117	0.4392
344	0.093%	0.4131	0.0117	0.4244
345	0.096%	0.4232	0.0116	0.4348
346	0.108%	0.4777	0.0110	0.4908
347	0.106%	0.4676	0.0131	0.4805
348	0.106%	0.4676	0.0128	0.4805
349	0.100%	0.4719	0.0128	0.4849
350	0.107%	0.4662	0.0138	0.4790
351	0.113%	0.4920	0.0128	0.5055
352	0.111%	0.4920	0.0133	0.4937
353	0.105%	0.4662	0.0132	0.4790
354	0.101%	0.4490	0.0123	0.4613
355	0.098%	0.4332	0.0123	0.4451
356	0.094%	0.4332	0.0119	0.4259

Calendar Day	% of Annual Flow	Natural Background	Roads	TMDL 17mile
357	0.092%	0.4074	0.0112	0.4186
358	0.090%	0.3988	0.0109	0.4097
359	0.087%	0.3844	0.0106	0.3950
360	0.085%	0.3744	0.0103	0.3847
361	0.093%	0.4117	0.0113	0.4230
362	0.107%	0.4719	0.0130	0.4849
363	0.099%	0.4404	0.0121	0.4525
364	0.089%	0.3930	0.0108	0.4038
365	0.087%	0.3873	0.0106	0.3979

Table C-2. Lap Creek: Daily Load Allocations and TMDL						
Calendar Day	% of Annual Flow	Natural Background	Roads	TMDL Lap		
1	0.086%	0.0544	0.0010	0.0553		
2	0.083%	0.0521	0.0009	0.0531		
3	0.082%	0.0517	0.0009	0.0526		
4	0.081%	0.0509	0.0009	0.0518		
5	0.078%	0.0493	0.0009	0.0501		
6	0.077%	0.0489	0.0009	0.0497		
7	0.080%	0.0507	0.0009	0.0516		
8	0.093%	0.0585	0.0010	0.0595		
9	0.091%	0.0574	0.0010	0.0585		
10	0.096%	0.0607	0.0011	0.0618		
11	0.092%	0.0583	0.0010	0.0593		
12	0.090%	0.0568	0.0010	0.0578		
13	0.092%	0.0581	0.0010	0.0591		
14	0.091%	0.0572	0.0010	0.0583		
15	0.104%	0.0658	0.0012	0.0670		
16	0.149%	0.0938	0.0017	0.0955		
17	0.146%	0.0924	0.0017	0.0940		
18	0.122%	0.0769	0.0014	0.0782		
19	0.111%	0.0701	0.0013	0.0714		
20	0.106%	0.0670	0.0012	0.0682		
21	0.100%	0.0630	0.0011	0.0641		
22	0.097%	0.0611	0.0011	0.0622		
23	0.096%	0.0603	0.0011	0.0614		
24	0.094%	0.0595	0.0011	0.0605		
25	0.094%	0.0591	0.0011	0.0601		
26	0.091%	0.0576	0.0010	0.0587		
27	0.091%	0.0574	0.0010	0.0585		
28	0.091%	0.0574	0.0010	0.0585		
29	0.091%	0.0574	0.0010	0.0585		
30	0.093%	0.0589	0.0011	0.0599		
31	0.098%	0.0619	0.0011	0.0630		
32	0.101%	0.0636	0.0011	0.0647		
33	0.102%	0.0646	0.0012	0.0658		
34	0.099%	0.0628	0.0011	0.0639		
35	0.098%	0.0617	0.0011	0.0628		
36	0.098%	0.0619	0.0011	0.0630		
37	0.097%	0.0615	0.0011	0.0626		
38	0.097%	0.0615	0.0011	0.0626		
39	0.100%	0.0632	0.0011	0.0643		
40	0.130%	0.0820	0.0015	0.0834		
41	0.119%	0.0748	0.0013	0.0762		
42	0.108%	0.0685	0.0012	0.0697		
43	0.104%	0.0654	0.0012	0.0666		
44	0.101%	0.0640	0.0011	0.0651		
45	0.100%	0.0632	0.0011	0.0643		
46	0.101%	0.0636	0.0011	0.0647		
47	0.101%	0.0656	0.0011	0.0668		
48	0.104%	0.0670	0.0012	0.0682		
49	0.106%	0.0670	0.0012	0.0682		
50	0.110%	0.0697	0.0012	0.0082		

Calendar Day	% of Annual Flow	Natural Background	Roads	TMDL Lap
51	0.123%	0.0777	0.0014	0.0791
52	0.135%	0.0852	0.0015	0.0868
53	0.136%	0.0861	0.0015	0.0876
54	0.141%	0.0889	0.0016	0.0905
55	0.132%	0.0834	0.0015	0.0849
56	0.132%	0.0840	0.0015	0.0855
57	0.134%	0.0848	0.0015	0.0863
58	0.132%	0.0848	0.0015	0.0847
59	0.131%	0.0832	0.0015	0.0847
60	0.151%	0.0820	0.0013	0.0990
61	0.134%	0.0973	0.0017	0.0990
62	0.130%	0.0820	0.0015	0.0834
63	0.130%	0.0820	0.0015	0.0834
64	0.132%	0.0834	0.0015	0.0849
65	0.135%	0.0854	0.0015	0.0870
66	0.138%	0.0869	0.0016	0.0884
67	0.139%	0.0879	0.0016	0.0895
68	0.146%	0.0922	0.0017	0.0938
69	0.144%	0.0910	0.0016	0.0926
70	0.149%	0.0940	0.0017	0.0957
71	0.160%	0.1008	0.0018	0.1026
72	0.163%	0.1028	0.0018	0.1047
73	0.165%	0.1042	0.0019	0.1061
74	0.170%	0.1073	0.0019	0.1092
75	0.172%	0.1085	0.0019	0.1105
76	0.179%	0.1130	0.0020	0.1151
77	0.194%	0.1222	0.0022	0.1244
78	0.191%	0.1206	0.0022	0.1228
79	0.194%	0.1222	0.0022	0.1244
80	0.205%	0.1292	0.0023	0.1315
81	0.204%	0.1288	0.0023	0.1311
82	0.205%	0.1292	0.0023	0.1315
83	0.218%	0.1376	0.0025	0.1400
84	0.229%	0.1445	0.0026	0.1471
85	0.232%	0.1468	0.0026	0.1494
86	0.243%	0.1537	0.0028	0.1565
87	0.260%	0.1643	0.0029	0.1673
88	0.272%	0.1717	0.0031	0.1748
89	0.281%	0.1772	0.0031	0.1804
90	0.294%	0.1856	0.0032	0.1889
91	0.314%	0.1985	0.0036	0.2020
92	0.323%	0.2042	0.0037	0.2079
93	0.340%	0.2042	0.0037	0.2185
94	0.363%	0.2140	0.0038	0.2330
95	0.382%	0.2412	0.0041	0.2350
96	0.424%	0.2412	0.0048	0.2726
97		0.2944	0.0048	0.2726
98	0.466% 0.512%			0.2996
		0.3230	0.0058	
99	0.508%	0.3209	0.0057	0.3267
100	0.521%	0.3291	0.0059	0.3350
101	0.534%	0.3373	0.0060	0.3433

Calendar Day	% of Annual Flow	Natural Background	Roads	TMDL Lap
102	0.541%	0.3414	0.0061	0.3475
103	0.554%	0.3495	0.0063	0.3558
104	0.570%	0.3598	0.0064	0.3662
105	0.605%	0.3822	0.0068	0.3891
106	0.615%	0.3884	0.0070	0.3953
107	0.609%	0.3843	0.0069	0.3912
108	0.605%	0.3822	0.0068	0.3891
109	0.628%	0.3966	0.0071	0.4037
110	0.638%	0.4027	0.0072	0.4099
111	0.680%	0.4293	0.0077	0.4369
112	0.716%	0.4517	0.0081	0.4598
113	0.725%	0.4579	0.0082	0.4661
114	0.761%	0.4804	0.0086	0.4890
115	0.842%	0.5315	0.0095	0.5410
116	0.861%	0.5437	0.0097	0.5535
117	0.829%	0.5233	0.0094	0.5327
118	0.813%	0.5131	0.0092	0.5223
119	0.835%	0.5274	0.0094	0.5368
120	0.865%	0.5458	0.0098	0.5555
121	0.894%	0.5642	0.0101	0.5743
122	0.933%	0.5887	0.0105	0.5992
123	0.955%	0.6030	0.0108	0.6138
124	0.978%	0.6173	0.0110	0.6284
125	0.981%	0.6173	0.0110	0.6305
126	0.991%	0.6255	0.0111	0.6367
127	1.017%	0.6419	0.0112	0.6533
128	1.046%	0.6602	0.0118	0.6721
129	1.065%	0.6725	0.0120	0.6846
130	1.081%	0.6827	0.0122	0.6950
131	1.104%	0.6970	0.0125	0.7095
132	1.107%	0.6991	0.0125	0.7116
133	1.104%	0.6970	0.0125	0.7095
134	1.120%	0.7073	0.0127	0.7199
135	1.133%	0.7154	0.0128	0.7282
136	1.166%	0.7359	0.0132	0.7491
137	1.205%	0.7604	0.0136	0.7740
138	1.217%	0.7686	0.0138	0.7823
139	1.217%	0.7686	0.0138	0.7823
140	1.195%	0.7543	0.0135	0.7678
141	1.192%	0.7522	0.0135	0.7657
142	1.201%	0.7584	0.0136	0.7719
143	1.208%	0.7625	0.0136	0.7761
144	1.198%	0.7563	0.0135	0.7699
145	1.166%	0.7359	0.0132	0.7491
146	1.153%	0.7277	0.0130	0.7407
147	1.146%	0.7236	0.0130	0.7366
148	1.140%	0.7195	0.0129	0.7324
149	1.114%	0.7032	0.0126	0.7158
150	1.069%	0.6746	0.0121	0.6866
151	1.065%	0.6725	0.0120	0.6846
152	1.039%	0.6562	0.0117	0.6679

Calendar Day	% of Annual Flow	Allocations and TNI Natural Background	Roads	TMDL Lap
153	1.007%	0.6357	0.0114	0.6471
154	0.988%	0.6235	0.0112	0.6346
155	0.971%	0.6132	0.0112	0.6242
156	0.929%	0.5867	0.0105	0.5972
157	0.897%	0.5662	0.0103	0.5764
158	0.861%	0.5437	0.0097	0.5535
159	0.822%	0.5192	0.0093	0.5285
160	0.790%	0.4988	0.0089	0.5077
161	0.754%	0.4763	0.0085	0.4848
162	0.709%	0.4477	0.0080	0.4557
163	0.677%	0.4272	0.0076	0.4349
164	0.657%	0.4272	0.0074	0.4224
165	0.644%	0.4150	0.0074	0.4141
	0.622%	0.3925	0.0073	0.3995
166	1 1			
167	0.612%	0.3863	0.0069	0.3933
168	0.609%	0.3843	0.0069	0.3912
169	0.583%	0.3679	0.0066	0.3745
170	0.547%	0.3455	0.0062	0.3516
171	0.505%	0.3189	0.0057	0.3246
172	0.476%	0.3005	0.0054	0.3059
173	0.453%	0.2862	0.0051	0.2913
174	0.437%	0.2760	0.0049	0.2809
175	0.414%	0.2616	0.0047	0.2663
176	0.392%	0.2473	0.0044	0.2518
177	0.372%	0.2351	0.0042	0.2393
178	0.353%	0.2228	0.0040	0.2268
179	0.340%	0.2146	0.0038	0.2185
180	0.327%	0.2065	0.0037	0.2102
181	0.309%	0.1950	0.0035	0.1985
182	0.301%	0.1903	0.0034	0.1937
183	0.283%	0.1789	0.0032	0.1821
184	0.269%	0.1699	0.0030	0.1729
185	0.254%	0.1605	0.0029	0.1633
186	0.241%	0.1519	0.0027	0.1546
187	0.228%	0.1437	0.0026	0.1463
188	0.217%	0.1370	0.0025	0.1394
189	0.208%	0.1312	0.0023	0.1336
190	0.198%	0.1247	0.0022	0.1269
191	0.191%	0.1204	0.0022	0.1226
192	0.187%	0.1179	0.0021	0.1201
193	0.180%	0.1134	0.0020	0.1155
194	0.169%	0.1069	0.0019	0.1088
195	0.166%	0.1051	0.0019	0.1069
196	0.165%	0.1040	0.0019	0.1059
197	0.156%	0.0985	0.0018	0.1003
198	0.148%	0.0934	0.0017	0.0951
199	0.141%	0.0889	0.0016	0.0905
200	0.136%	0.0856	0.0015	0.0872
201	0.131%	0.0826	0.0015	0.0841
202	0.125%	0.0791	0.0014	0.0805
203	0.120%	0.0760	0.0014	0.0774

Calendar Day	% of Annual Flow	Allocations and TNI Natural Background	Roads	TMDL Lap
204	0.115%	0.0726	0.0013	0.0739
205	0.110%	0.0720	0.0013	0.0710
206	0.110%	0.0673	0.0012	0.0685
207	0.104%	0.0678	0.0012	0.0670
	0.104%			
208		0.0650	0.0012	0.0662
209	0.099%	0.0628	0.0011	0.0639
210	0.095%	0.0597	0.0011	0.0608
211	0.090%	0.0568	0.0010	0.0578
212	0.087%	0.0552	0.0010	0.0562
213	0.085%	0.0534	0.0010	0.0543
214	0.081%	0.0513	0.0009	0.0522
215	0.080%	0.0505	0.0009	0.0514
216	0.079%	0.0497	0.0009	0.0506
217	0.076%	0.0478	0.0009	0.0487
218	0.074%	0.0468	0.0008	0.0476
219	0.073%	0.0458	0.0008	0.0466
220	0.071%	0.0448	0.0008	0.0456
221	0.069%	0.0437	0.0008	0.0445
222	0.067%	0.0425	0.0008	0.0433
223	0.065%	0.0413	0.0007	0.0420
224	0.063%	0.0401	0.0007	0.0408
225	0.063%	0.0397	0.0007	0.0404
226	0.062%	0.0390	0.0007	0.0397
227	0.061%	0.0382	0.0007	0.0389
228	0.060%	0.0380	0.0007	0.0387
229	0.061%	0.0384	0.0007	0.0391
230	0.059%	0.0374	0.0007	0.0381
231	0.059%	0.0370	0.0007	0.0377
232	0.057%	0.0362	0.0006	0.0368
233	0.056%	0.0356	0.0006	0.0362
234	0.056%	0.0352	0.0006	0.0358
235	0.055%	0.0350	0.0006	0.0356
236	0.056%	0.0352	0.0006	0.0358
237	0.057%	0.0360	0.0006	0.0366
238	0.057%	0.0360	0.0006	0.0366
239	0.056%	0.0354	0.0006	0.0360
240	0.055%	0.0345	0.0006	0.0352
241	0.053%	0.0337	0.0006	0.0343
242	0.053%	0.0333	0.0006	0.0339
243	0.052%	0.0327	0.0006	0.0333
244	0.051%	0.0325	0.0006	0.0331
245	0.052%	0.0327	0.0006	0.0333
246	0.052%	0.0331	0.0006	0.0337
247	0.052%	0.0327	0.0006	0.0333
248	0.051%	0.0323	0.0006	0.0329
249	0.051%	0.0325	0.0006	0.0331
250	0.051%	0.0321	0.0006	0.0327
251	0.050%	0.0317	0.0006	0.0323
252	0.049%	0.0307	0.0005	0.0312
253	0.049%	0.0307	0.0005	0.0312
254	0.048%	0.0303	0.0005	0.0308

Calendar Day	% of Annual Flow	Natural Background	Roads	TMDL Lap
255	0.049%	0.0307	0.0005	0.0312
256	0.049%	0.0309	0.0006	0.0314
257	0.049%	0.0307	0.0005	0.0312
258	0.049%	0.0311	0.0006	0.0316
259	0.053%	0.0335	0.0006	0.0341
260	0.056%	0.0352	0.0006	0.0358
261	0.052%	0.0329	0.0006	0.0335
262	0.055%	0.0345	0.0006	0.0352
263	0.055%	0.0347	0.0006	0.0354
264	0.054%	0.0343	0.0006	0.0350
265	0.055%	0.0345	0.0006	0.0352
266	0.055%	0.0347	0.0006	0.0354
267	0.055%	0.0347	0.0006	0.0354
268	0.054%	0.0343	0.0006	0.0350
269	0.054%	0.0339	0.0006	0.0345
270	0.053%	0.0337	0.0006	0.0343
271	0.054%	0.0339	0.0006	0.0345
272	0.054%	0.0341	0.0006	0.0347
273	0.052%	0.0331	0.0006	0.0337
274	0.052%	0.0327	0.0006	0.0333
275	0.055%	0.0347	0.0006	0.0354
276	0.055%	0.0347	0.0006	0.0354
277	0.055%	0.0347	0.0006	0.0354
278	0.054%	0.0343	0.0006	0.0352
279	0.054%	0.0343	0.0006	0.0350
280	0.054%	0.0343	0.0006	0.0350
281	0.054%	0.0339	0.0006	0.0345
282	0.054%	0.0339	0.0006	0.0347
283	0.056%	0.0341	0.0006	0.0362
284	0.057%	0.0358	0.0006	0.0364
285	0.058%	0.0358	0.0007	0.0375
286	0.062%	0.0395	0.0007	0.0402
287	0.063%	0.0393	0.0007	0.0402
288	0.063%	0.0397	0.0007	0.0404
289	0.064%	0.0403	0.0007	0.0410
290	0.064%	0.0405	0.0007	0.0410
291	0.064%	0.0403	0.0007	0.0412
292	0.062%	0.0403	0.0007	0.0395
293	0.061%	0.0384	0.0007	0.0393
294 295	0.061% 0.063%	0.0384 0.0401	0.0007 0.0007	0.0391 0.0408
				0.0427
296	0.066%	0.0419	0.0008	
297	0.070%	0.0444	0.0008	0.0452
298	0.069%	0.0435	0.0008	0.0443
299	0.075%	0.0476	0.0009	0.0485
300	0.077%	0.0484	0.0009	0.0493
301	0.075%	0.0474	0.0008	0.0483
302	0.074%	0.0470	0.0008	0.0479
303	0.073%	0.0458	0.0008	0.0466
304	0.071%	0.0450	0.0008	0.0458
305	0.075%	0.0472	0.0008	0.0481

	Table C-2. Lap Creek: Daily Load Allocations and TMDL						
Calendar Day	% of Annual Flow	Natural Background	Roads	TMDL Lap			
306	0.075%	0.0472	0.0008	0.0481			
307	0.079%	0.0501	0.0009	0.0510			
308	0.086%	0.0544	0.0010	0.0553			
309	0.100%	0.0632	0.0011	0.0643			
310	0.098%	0.0617	0.0011	0.0628			
311	0.090%	0.0568	0.0010	0.0578			
312	0.088%	0.0554	0.0010	0.0564			
313	0.086%	0.0544	0.0010	0.0553			
314	0.094%	0.0591	0.0011	0.0601			
315	0.096%	0.0609	0.0011	0.0620			
316	0.103%	0.0652	0.0012	0.0664			
317	0.109%	0.0689	0.0012	0.0701			
318	0.111%	0.0699	0.0013	0.0712			
319	0.102%	0.0646	0.0012	0.0658			
320	0.098%	0.0619	0.0011	0.0630			
321	0.097%	0.0615	0.0011	0.0626			
322	0.096%	0.0603	0.0011	0.0614			
323	0.092%	0.0583	0.0010	0.0593			
324	0.090%	0.0566	0.0010	0.0576			
325	0.090%	0.0566	0.0010	0.0576			
326	0.096%	0.0605	0.0011	0.0616			
327	0.099%	0.0628	0.0011	0.0639			
328	0.099%	0.0625	0.0011	0.0637			
329	0.119%	0.0748	0.0013	0.0762			
330	0.155%	0.0977	0.0017	0.0995			
331	0.136%	0.0861	0.0015	0.0876			
332	0.119%	0.0752	0.0013	0.0766			
333	0.105%	0.0660	0.0012	0.0672			
334	0.109%	0.0691	0.0012	0.0703			
335	0.127%	0.0803	0.0014	0.0818			
336	0.119%	0.0752	0.0013	0.0766			
337	0.110%	0.0697	0.0012	0.0710			
338	0.118%	0.0746	0.0013	0.0759			
339	0.152%	0.0961	0.0017	0.0978			
340	0.139%	0.0875	0.0016	0.0891			
341	0.114%	0.0722	0.0013	0.0734			
342	0.105%	0.0662	0.0012	0.0674			
343	0.096%	0.0609	0.0011	0.0620			
344	0.093%	0.0589	0.0011	0.0599			
345	0.096%	0.0603	0.0011	0.0614			
346	0.108%	0.0681	0.0012	0.0693			
347	0.106%	0.0666	0.0012	0.0678			
348	0.106%	0.0666	0.0012	0.0678			
349	0.107%	0.0673	0.0012	0.0685			
350	0.105%	0.0664	0.0012	0.0676			
351	0.111%	0.0701	0.0013	0.0714			
352	0.108%	0.0685	0.0012	0.0697			
353	0.105%	0.0664	0.0012	0.0676			
354	0.101%	0.0640	0.0011	0.0651			
355	0.098%	0.0617	0.0011	0.0628			
356	0.094%	0.0591	0.0011	0.0601			

Calendar Day	% of Annual Flow	Natural Background	Roads	TMDL Lap
357	0.092%	0.0581	0.0010	0.0591
358	0.090%	0.0568	0.0010	0.0578
359	0.087%	0.0548	0.0010	0.0558
360	0.085%	0.0534	0.0010	0.0543
361	0.093%	0.0587	0.0011	0.0597
362	0.107%	0.0673	0.0012	0.0685
363	0.099%	0.0628	0.0011	0.0639
364	0.089%	0.0560	0.0010	0.0570
365	0.087%	0.0552	0.0010	0.0562

Calendar Day	% of annual flow	er: Daily Load Allocat Natural Background	Roads	TMDL South Fork
1	0.086%	0.3833	0.0105	0.3938
2	0.083%	0.3674	0.0103	0.3775
3	0.082%	0.3645	0.0100	0.3746
4	0.082%	0.3588	0.0099	0.3686
5	0.078%	0.3473	0.0095	0.3568
6	0.077%	0.3444	0.0095	0.3538
7	0.080%	0.3573	0.0093	0.3672
8	0.093%	0.3373	0.0098	0.3072
9	0.093%	0.4049	0.0113	0.4234
10		0.4279	0.0111	
	0.096%			0.4397
11	0.092%	0.4107	0.0113	0.4219
12	0.090%	0.4006	0.0110	0.4116
13	0.092%	0.4092	0.0112	0.4205
14	0.091%	0.4034	0.0111	0.4145
15	0.104%	0.4640	0.0128	0.4767
16	0.149%	0.6614	0.0182	0.6795
17	0.146%	0.6513	0.0179	0.6692
18	0.122%	0.5418	0.0149	0.5567
19	0.111%	0.4942	0.0136	0.5078
20	0.106%	0.4726	0.0130	0.4856
21	0.100%	0.4438	0.0122	0.4560
22	0.097%	0.4308	0.0118	0.4427
23	0.096%	0.4251	0.0117	0.4367
24	0.094%	0.4193	0.0115	0.4308
25	0.094%	0.4164	0.0114	0.4279
26	0.091%	0.4063	0.0112	0.4175
27	0.091%	0.4049	0.0111	0.4160
28	0.091%	0.4049	0.0111	0.4160
29	0.091%	0.4049	0.0111	0.4160
30	0.093%	0.4150	0.0114	0.4264
31	0.098%	0.4366	0.0120	0.4486
32	0.101%	0.4481	0.0123	0.4604
33	0.102%	0.4553	0.0125	0.4678
34	0.099%	0.4424	0.0122	0.4545
35	0.098%	0.4351	0.0120	0.4471
36	0.098%	0.4366	0.0120	0.4486
37	0.097%	0.4337	0.0119	0.4456
38	0.097%	0.4337	0.0119	0.4456
39	0.100%	0.4452	0.0122	0.4575
40	0.130%	0.5778	0.0159	0.5937
41	0.119%	0.5274	0.0145	0.5419
42	0.119%	0.4827	0.0133	0.4960
43	0.104%	0.4611	0.0133	0.4738
44	0.104%	0.4510	0.0127	0.4634
45	0.100%	0.4452	0.0124	0.4575
46	0.100%	0.4481	0.0122	0.4604
46 47	0.101%	0.4625	0.0123	0.4752
48				
	0.106%	0.4726	0.0130 0.0130	0.4856
49	0.106%	0.4726		0.4856

Calendar Day	% of annual flow	Natural Background	Roads	TMDL South Fork
51	0.123%	0.5475	0.0150	0.5626
52	0.135%	0.6008	0.0165	0.6174
53	0.136%	0.6066	0.0167	0.6233
54	0.141%	0.6268	0.0172	0.6440
55	0.132%	0.5879	0.0162	0.6040
56	0.133%	0.5922	0.0163	0.6085
57	0.134%	0.5980	0.0164	0.6144
58	0.132%	0.5864	0.0161	0.6026
59	0.131%	0.5821	0.0160	0.5981
60	0.154%	0.6859	0.0188	0.7047
61	0.134%	0.5965	0.0164	0.6129
62	0.130%	0.5778	0.0159	0.5937
63	0.130%	0.5778	0.0159	0.5937
64	0.130%	0.5879	0.0162	0.6040
65	0.135%	0.6023	0.0166	0.6188
66	0.138%	0.6124	0.0168	0.6292
67	0.138%	0.6124	0.0170	0.6366
68	0.139%	0.6498	0.0170	0.6677
69	0.144%	0.6412	0.0176	0.6588
70	0.149%	0.6628	0.0170	0.6810
70	0.149%	0.7104	0.0195	0.7299
72	0.163%	0.7248	0.0199	0.7447
73	0.165%	0.7349	0.0202	0.7550
74	0.170%	0.7565	0.0202	0.7773
75	0.172%	0.7651	0.0208	0.7861
76	0.172%	0.7968	0.0210	0.7801
	0.174%	0.7908	0.0219	0.8853
78	0.191%	0.8501	0.0234	0.8735
	0.191%	0.8616	0.0234	0.8853
80	0.194%	0.9106	0.0250	0.8833
81	0.204%	0.9100	0.0230	0.9327
82	0.205%	0.9106	0.0250	0.9327
83	0.203%	0.9106	0.0250	0.9337
84	0.218%	1.0187	0.0280	1.0467
85	0.232%	1.0346	0.0284	1.0630
86	0.243%	1.0835	0.0298	1.1133
87	0.260%	1.1585	0.0318	1.1903
88	0.272%	1.2103	0.0333	1.2436
89	0.281%	1.2492	0.0343	1.2836
90	0.294%	1.3083	0.0360	1.3443
91	0.314%	1.3991	0.0385	1.4376
92	0.323%	1.4394	0.0396	1.4790
93	0.340%	1.5129	0.0416	1.5545
94	0.363%	1.6138	0.0444	1.6581
95	0.382%	1.7002	0.0467	1.7470
96	0.424%	1.8876	0.0519	1.9394
97	0.466%	2.0749	0.0570	2.1319
98	0.512%	2.2766	0.0626	2.3392
99	0.508%	2.2622	0.0622	2.3244
100	0.521%	2.3198	0.0638	2.3836
101	0.534%	2.3775	0.0653	2.4428

Calendar Day	% of annual flow	r: Daily Load Allocat Natural Background	Roads	TMDL South Fork
102	0.541%	2.4063	0.0661	2.4724
103	0.554%	2.4639	0.0677	2.5316
104	0.570%	2.5360	0.0697	2.6057
105	0.605%	2.6945	0.0741	2.7685
106	0.615%	2.7377	0.0752	2.8129
107	0.609%	2.7089	0.0744	2.7833
108	0.605%	2.6945	0.0741	2.7685
109	0.628%	2.7953	0.0768	2.8721
110	0.638%	2.8385	0.0780	2.9166
111	0.680%	3.0259	0.0832	3.1090
112	0.716%	3.1844	0.0875	3.2719
113	0.725%	3.2276	0.0887	3.3163
114	0.761%	3.3861	0.0931	3.4791
115	0.842%	3.7463	0.1030	3.8493
116	0.861%	3.8328	0.1053	3.9381
117	0.829%	3.6887	0.1014	3.7900
118	0.813%	3.6166	0.0994	3.7160
119	0.835%	3.7175	0.1022	3.8197
120	0.865%	3.8472	0.1022	3.9529
120	0.894%	3.9768	0.1093	4.0861
121	0.933%	4.1497	0.1140	4.2638
123	0.955%	4.2506	0.1168	4.2636
123				4.3074
	0.978%	4.3515	0.1196	
125	0.981%	4.3659	0.1200	4.4859
126	0.991%	4.4091	0.1212	4.5303
127	1.017%	4.5244	0.1243	4.6487
128	1.046%	4.6541	0.1279	4.7820
129	1.065%	4.7405	0.1303	4.8708
130	1.081%	4.8126	0.1323	4.9448
131	1.104%	4.9134	0.1350	5.0485
132	1.107%	4.9278	0.1354	5.0633
133	1.104%	4.9134	0.1350	5.0485
134	1.120%	4.9855	0.1370	5.1225
135	1.133%	5.0431	0.1386	5.1817
136	1.166%	5.1872	0.1426	5.3297
137	1.205%	5.3601	0.1473	5.5074
138	1.217%	5.4177	0.1489	5.5666
139	1.217%	5.4177	0.1489	5.5666
140	1.195%	5.3169	0.1461	5.4630
141	1.192%	5.3025	0.1457	5.4482
142	1.201%	5.3457	0.1469	5.4926
143	1.208%	5.3745	0.1477	5.5222
144	1.198%	5.3313	0.1465	5.4778
145	1.166%	5.1872	0.1426	5.3297
146	1.153%	5.1296	0.1410	5.2705
147	1.146%	5.1007	0.1402	5.2409
148	1.140%	5.0719	0.1394	5.2113
149	1.114%	4.9566	0.1362	5.0929
150	1.069%	4.7549	0.1307	4.8856
151	1.065%	4.7405	0.1303	4.8708
152	1.039%	4.6252	0.1271	4.7524

Calendar Day	% of annual flow	Natural Background	Roads	TMDL South Fork
153	1.007%	4.4812	0.1232	4.6043
154	0.988%	4.3947	0.1208	4.5155
155	0.988%	4.3227	0.1208	4.4415
156	0.929%	4.1353	0.1137	4.2490
			·	
157	0.897%	3.9913	0.1097	4.1009
158	0.861%	3.8328	0.1053	3.9381
159	0.822%	3.6598	0.1006	3.7604
160	0.790%	3.5158	0.0966	3.6124
161	0.754%	3.3573	0.0923	3.4495
162	0.709%	3.1555	0.0867	3.2423
163	0.677%	3.0114	0.0828	3.0942
164	0.657%	2.9250	0.0804	3.0054
165	0.644%	2.8674	0.0788	2.9462
166	0.622%	2.7665	0.0760	2.8425
167	0.612%	2.7233	0.0748	2.7981
168	0.609%	2.7089	0.0744	2.7833
169	0.583%	2.5936	0.0713	2.6649
170	0.547%	2.4351	0.0669	2.5020
171	0.505%	2.2478	0.0618	2.3096
172	0.476%	2.1181	0.0582	2.1763
173	0.453%	2.0172	0.0554	2.0727
174	0.437%	1.9452	0.0535	1.9987
175	0.414%	1.8443	0.0507	1.8950
176	0.392%	1.7435	0.0479	1.7914
177	0.372%	1.6570	0.0455	1.7026
178	0.353%	1.5706	0.0432	1.6137
179	0.340%	1.5129	0.0432	1.5545
180	0.327%	1.4553	0.0410	1.4953
			·	
181	0.309%	1.3746	0.0378	1.4124
182	0.301%	1.3415	0.0369	1.3783
183	0.283%	1.2608	0.0347	1.2954
184	0.269%	1.1974	0.0329	1.2303
185	0.254%	1.1311	0.0311	1.1622
186	0.241%	1.0706	0.0294	1.1000
187	0.228%	1.0129	0.0278	1.0408
188	0.217%	0.9654	0.0265	0.9919
189	0.208%	0.9250	0.0254	0.9505
190	0.198%	0.8789	0.0242	0.9031
191	0.191%	0.8487	0.0233	0.8720
192	0.187%	0.8314	0.0228	0.8542
193	0.180%	0.7997	0.0220	0.8217
194	0.169%	0.7536	0.0207	0.7743
195	0.166%	0.7406	0.0204	0.7610
196	0.165%	0.7334	0.0202	0.7536
197	0.156%	0.6945	0.0191	0.7136
198	0.148%	0.6585	0.0181	0.6766
199	0.141%	0.6268	0.0172	0.6440
200	0.136%	0.6037	0.0166	0.6203
201	0.131%	0.5821	0.0160	0.5981
202	0.131%	0.5576	0.0153	0.5729
203	0.120%	0.5360	0.0133	0.5507

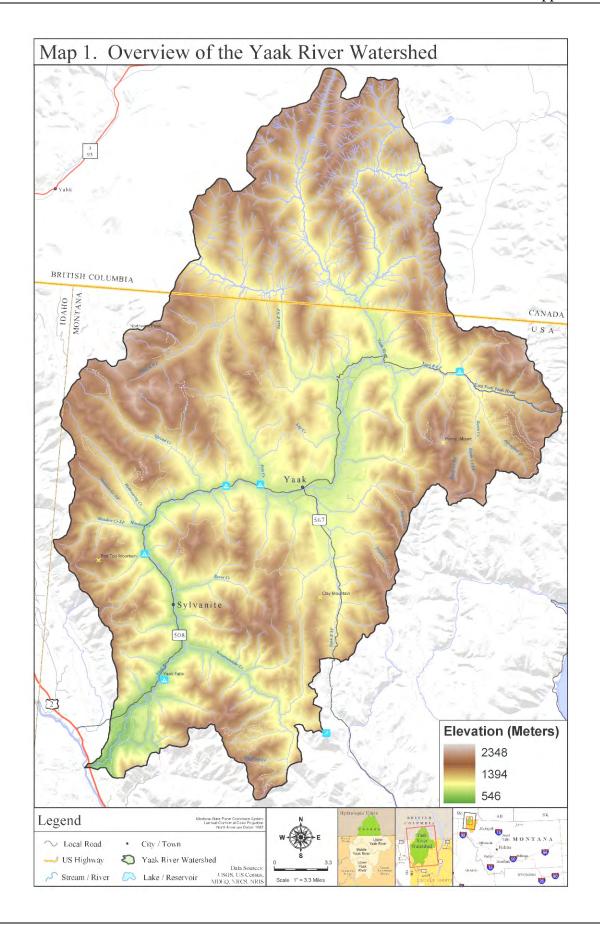
Calendar Day	% of annual flow	r: Daily Load Allocat Natural Background	Roads	TMDL South Fork
204	0.115%	0.5115	0.0141	0.5256
205	0.110%	0.4913	0.0135	0.5048
206	0.107%	0.4741	0.0130	0.4871
207	0.104%	0.4640	0.0128	0.4767
208	0.103%	0.4582	0.0126	0.4708
209	0.099%	0.4424	0.0122	0.4545
210	0.095%	0.4207	0.0116	0.4323
211	0.090%	0.4006	0.0110	0.4116
212	0.087%	0.3890	0.0107	0.3997
213	0.085%	0.3761	0.0103	0.3864
214	0.081%	0.3617	0.0099	0.3716
215	0.080%	0.3559	0.0098	0.3657
216	0.079%	0.3501	0.0096	0.3598
217	0.076%	0.3372	0.0093	0.3464
218	0.074%	0.3372	0.0093	0.3390
219	0.073%	0.3228	0.0091	0.3316
220	0.071%	0.3228	0.0089	0.3242
221	0.069%	0.3083	0.0087	0.3168
222	0.067%	0.2997	0.0083	0.3079
223	0.065%	0.2997	0.0082	0.2991
224	0.063%	0.2824	0.0080	0.2902
225	0.063%	0.2824	0.0078	0.2902
226		0.2752		0.2828
227	0.062%		0.0076	
	0.061%	0.2694	0.0074	0.2769
228	0.060%	0.2680	0.0074	0.2754
229	0.061%	0.2709	0.0074	0.2783
230	0.059%	0.2637	0.0072	0.2709
231	0.059%	0.2608	0.0072	0.2680
232	0.057%	0.2550	0.0070	0.2620
233	0.056%	0.2507	0.0069	0.2576
234	0.056%	0.2478	0.0068	0.2546
235	0.055%	0.2464	0.0068	0.2532
236	0.056%	0.2478	0.0068	0.2546
237	0.057%	0.2536	0.0070	0.2606
238	0.057%	0.2536	0.0070	0.2606
239	0.056%	0.2493	0.0069	0.2561
240	0.055%	0.2435	0.0067	0.2502
241	0.053%	0.2377	0.0065	0.2443
242	0.053%	0.2349	0.0065	0.2413
243	0.052%	0.2305	0.0063	0.2369
244	0.051%	0.2291	0.0063	0.2354
245	0.052%	0.2305	0.0063	0.2369
246	0.052%	0.2334	0.0064	0.2398
247	0.052%	0.2305	0.0063	0.2369
248	0.051%	0.2277	0.0063	0.2339
249	0.051%	0.2291	0.0063	0.2354
250	0.051%	0.2262	0.0062	0.2324
251	0.050%	0.2233	0.0061	0.2295
252	0.049%	0.2161	0.0059	0.2221
253	0.049%	0.2161	0.0059	0.2221
254	0.048%	0.2133	0.0059	0.2191

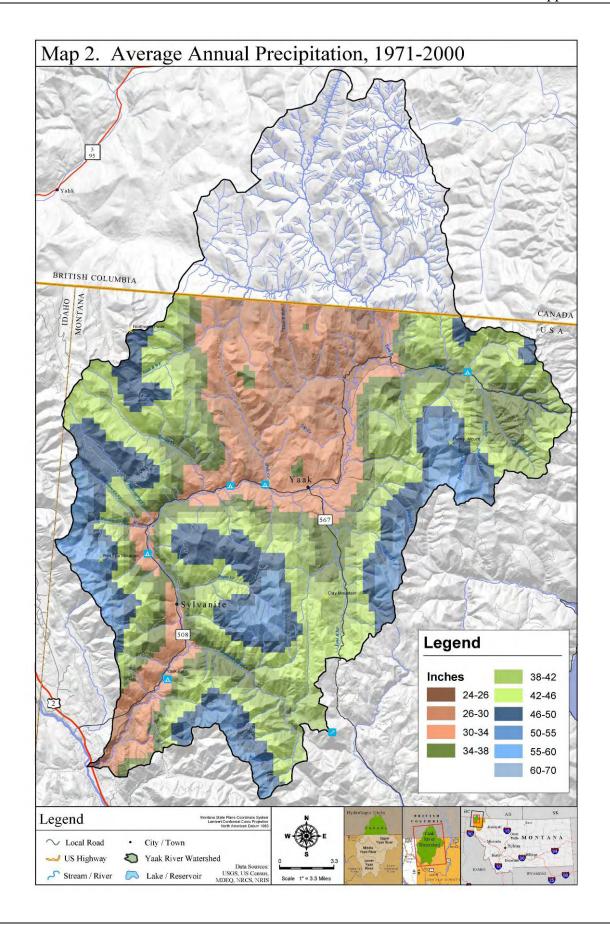
Calendar Day	% of annual flow	Natural Background	Roads	TMDL South Fork
255	0.049%	0.2161	0.0059	0.2221
256	0.049%	0.2176	0.0060	0.2236
257	0.049%	0.2161	0.0059	0.2221
258	0.049%	0.2190	0.0060	0.2250
259	0.053%	0.2363	0.0065	0.2428
260	0.056%	0.2478	0.0068	0.2546
261	0.052%	0.2320	0.0064	0.2384
262	0.055%	0.2435	0.0067	0.2502
263	0.055%	0.2450	0.0067	0.2517
264	0.054%	0.2421	0.0067	0.2487
265	0.055%	0.2435	0.0067	0.2502
266	0.055%	0.2450	0.0067	0.2517
267	0.055%	0.2450	0.0067	0.2517
268	0.054%	0.2421	0.0067	0.2487
269	0.054%	0.2392	0.0066	0.2458
270	0.053%	0.2377	0.0065	0.2443
271	0.054%	0.2392	0.0066	0.2458
272	0.054%	0.2406	0.0066	0.2472
273	0.052%	0.2334	0.0064	0.2398
274	0.052%	0.2305	0.0063	0.2369
275	0.055%	0.2450	0.0067	0.2517
276	0.055%	0.2450	0.0067	0.2517
277	0.055%	0.2435	0.0067	0.2502
278	0.054%	0.2421	0.0067	0.2487
279	0.054%	0.2421	0.0067	0.2487
280	0.054%	0.2421	0.0067	0.2487
281	0.054%	0.2392	0.0066	0.2458
282	0.054%	0.2406	0.0066	0.2472
283	0.056%	0.2507	0.0069	0.2576
284	0.057%	0.2522	0.0069	0.2591
285	0.058%	0.2594	0.0071	0.2665
286	0.062%	0.2781	0.0076	0.2857
287	0.063%	0.2824	0.0078	0.2902
288	0.063%	0.2795	0.0077	0.2872
289	0.064%	0.2839	0.0078	0.2917
290	0.064%	0.2853	0.0078	0.2931
291	0.064%	0.2839	0.0078	0.2917
292	0.062%	0.2738	0.0075	0.2813
293	0.061%	0.2709	0.0074	0.2783
294	0.061%	0.2709	0.0074	0.2783
295	0.063%	0.2824	0.0078	0.2902
296	0.066%	0.2954	0.0081	0.3035
297	0.070%	0.3127	0.0086	0.3213
298	0.069%	0.3069	0.0084	0.3153
299	0.075%	0.3357	0.0092	0.3450
300	0.077%	0.3415	0.0094	0.3509
301	0.075%	0.3343	0.0092	0.3435
302	0.074%	0.3314	0.0091	0.3405
303	0.073%	0.3228	0.0089	0.3316
304	0.071%	0.3170	0.0087	0.3257
305	0.075%	0.3328	0.0091	0.3420

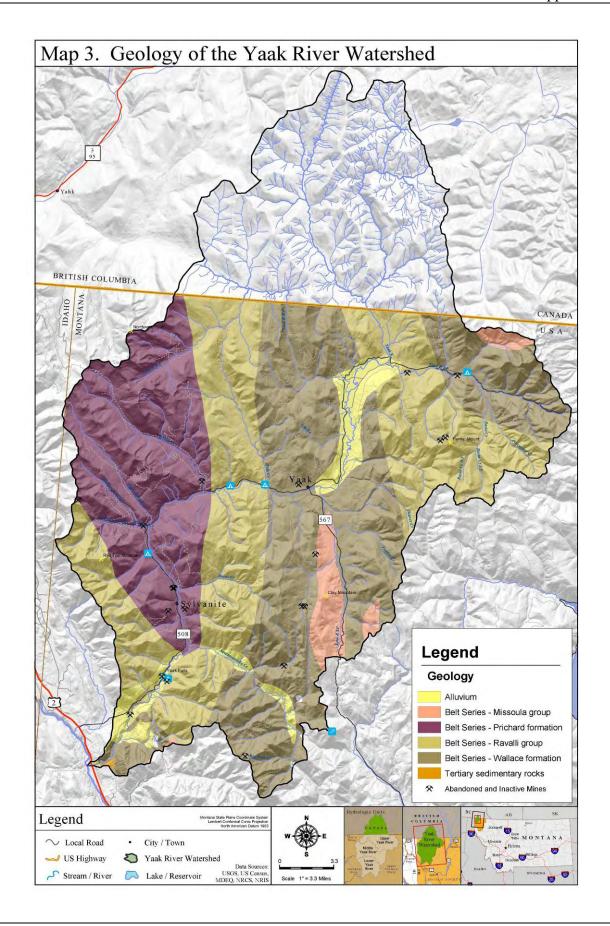
Calendar Day	% of annual flow	Natural Background	Roads	TMDL South Fork
306	0.075%	0.3328	0.0091	0.3420
307	0.079%	0.3530	0.0097	0.3627
308	0.086%	0.3833	0.0105	0.3938
309	0.100%	0.4452	0.0122	0.4575
310	0.098%	0.4351	0.0120	0.4471
311	0.090%	0.4006	0.0110	0.4116
312	0.088%	0.3905	0.0107	0.4012
313	0.086%	0.3833	0.0105	0.3938
314	0.094%	0.4164	0.0114	0.4279
315	0.096%	0.4294	0.0118	0.4412
316	0.103%	0.4596	0.0126	0.4723
317	0.109%	0.4856	0.0133	0.4989
318	0.111%	0.4928	0.0135	0.5063
319	0.102%	0.4553	0.0125	0.4678
320	0.098%	0.4366	0.0120	0.4486
321	0.097%	0.4337	0.0120	0.4456
322	0.096%	0.4251	0.0117	0.4367
323	0.092%	0.4231	0.0117	0.4219
323	0.090%	0.3991	0.0113	0.4219
325	0.090%	0.3991	0.0110	0.4101
326	0.096%	0.4265	0.0110	0.4382
327	0.099%			
	0.099%	0.4424	0.0122	0.4545
328		0.4409	0.0121	0.4530
329	0.119%	0.5274	0.0145	0.5419
330	0.155%	0.6887	0.0189	0.7077
331	0.136%	0.6066	0.0167	0.6233
332	0.119%	0.5302	0.0146	0.5448
333	0.105%	0.4654	0.0128	0.4782
334	0.109%	0.4870	0.0134	0.5004
335	0.127%	0.5663	0.0156	0.5818
336	0.119%	0.5302	0.0146	0.5448
337	0.110%	0.4913	0.0135	0.5048
338	0.118%	0.5259	0.0145	0.5404
339	0.152%	0.6772	0.0186	0.6958
340	0.139%	0.6167	0.0169	0.6336
341	0.114%	0.5086	0.0140	0.5226
342	0.105%	0.4668	0.0128	0.4797
343	0.096%	0.4294	0.0118	0.4412
344	0.093%	0.4150	0.0114	0.4264
345	0.096%	0.4251	0.0117	0.4367
346	0.108%	0.4798	0.0132	0.4930
347	0.106%	0.4697	0.0129	0.4826
348	0.106%	0.4697	0.0129	0.4826
349	0.107%	0.4741	0.0130	0.4871
350	0.105%	0.4683	0.0129	0.4812
351	0.111%	0.4942	0.0136	0.5078
352	0.108%	0.4827	0.0133	0.4960
353	0.105%	0.4683	0.0129	0.4812
354	0.101%	0.4510	0.0124	0.4634
355	0.098%	0.4351	0.0120	0.4471
356	0.094%	0.4164	0.0114	0.4279

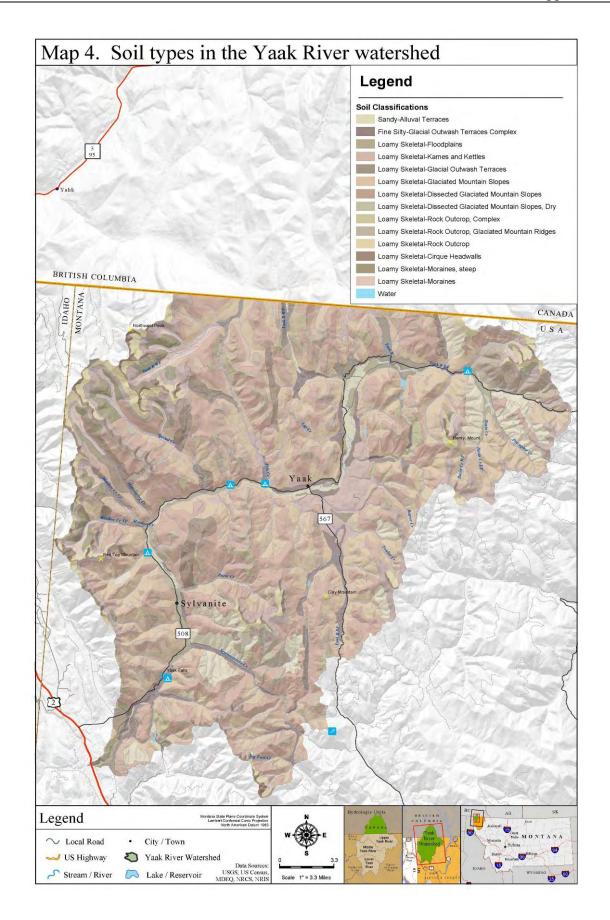
Calendar Day	% of annual flow	Natural Background	Roads	TMDL South Fork
357	0.092%	0.4092	0.0112	0.4205
358	0.090%	0.4006	0.0110	0.4116
359	0.087%	0.3862	0.0106	0.3968
360	0.085%	0.3761	0.0103	0.3864
361	0.093%	0.4135	0.0114	0.4249
362	0.107%	0.4741	0.0130	0.4871
363	0.099%	0.4424	0.0122	0.4545
364	0.089%	0.3948	0.0109	0.4057
365	0.087%	0.3890	0.0107	0.3997

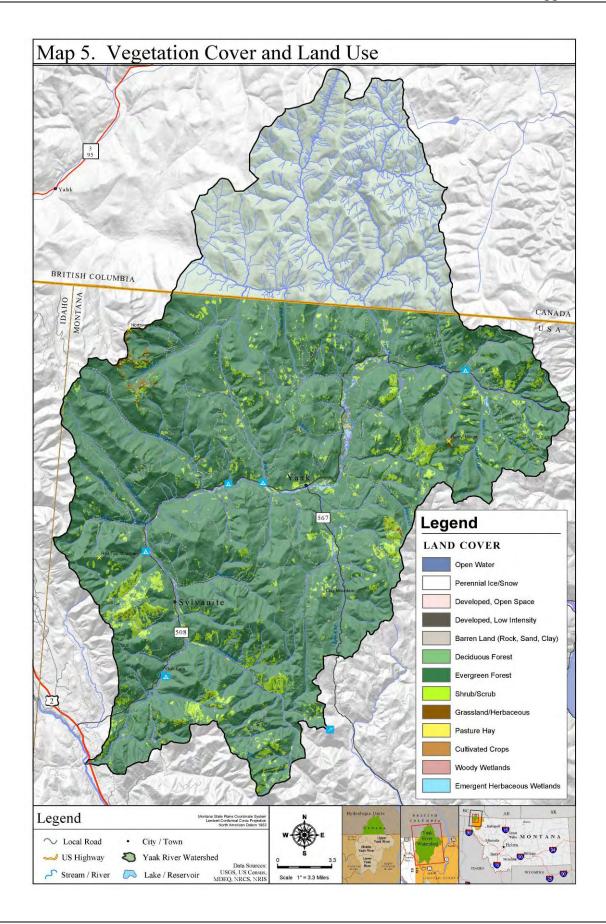
APPENDIX D MAPS

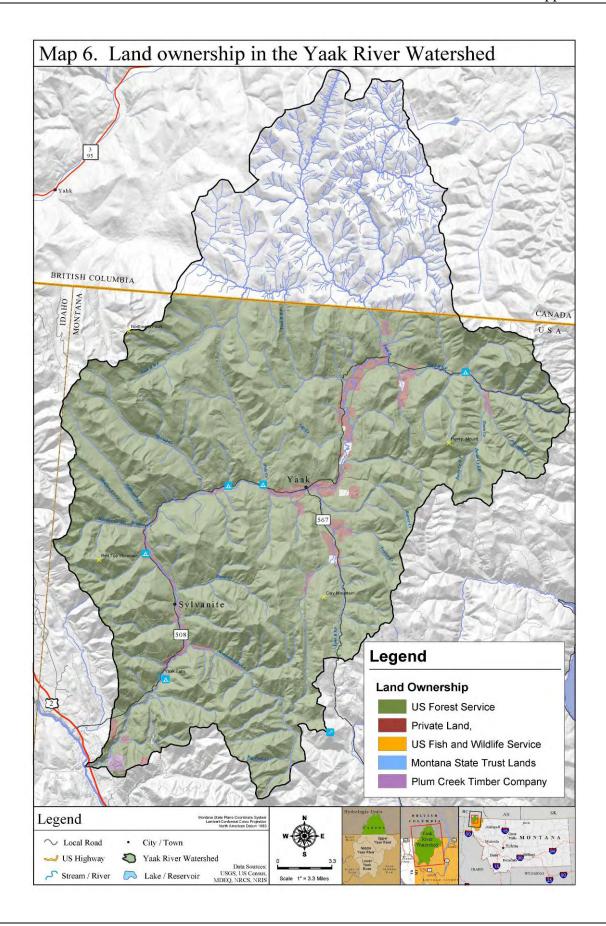


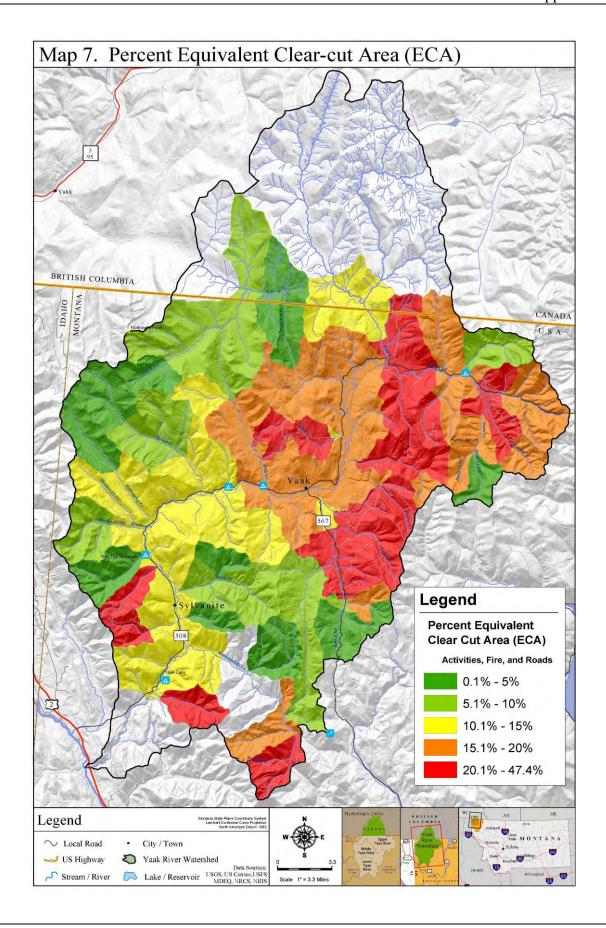


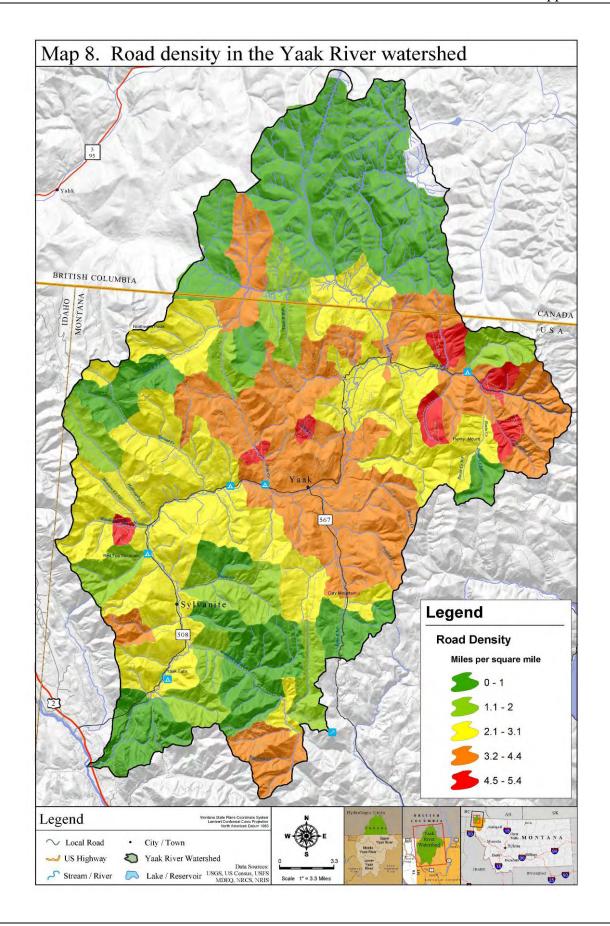












APPENDIX E RESPONSES TO PUBLIC COMMENTS

As described in **Section 8.0**, the formal public comment period for the Yaak Watershed Total Maximum Daily Loads (TMDL) extended from November 19th, 2007 through December 19th, 2007. A public meeting was conducted on Tuesday, December 4th, 2007 at the USFS Ranger Station in Troy, MT. In response to public comment requests, DEQ extended the public comment period to January 14th, 2008 and conducted a second public meeting in Troy, MT on Jan 7th.

Twelve individual comments letters were submitted to DEQ during the public comment period, eleven during the initial public comment period, and one letter during the extended period. Excerpts from comment letters are provided below. Where appropriate, the DEQ has compiled comment with like topics and provided response to the general topic. Responses prepared by DEQ follow each of the comments/topics. Original comment letters are held on file at the DEQ and may be viewed upon request.

Comment #1:

Several (6) individuals expressed concern that they were not adequately informed of the TMDL process and requested an extension of the public comment period and an additional public meeting. Excerpts include:

Comment #1a:

Just this past Sunday I learned about the Yaak river sediment report. I was told by a neighbor who learned of it Friday night after some meeting had occurred regarding this problem. After talking to several people who leave in the Yaak, none of them knew of the problem or the meeting about it. I was told the meeting notice was in one of the local papers, but I do not get the paper, nor do many others up here. With a problem of this magnitude, I would think a responsible government agency would think beyond the box, finding a way to notify the residents of the infected area; a simple mailer to the Troy Post Office Boxes and Rural Mail Boxes would have easily gotten the word out.

Comment #2a:

The public comments on the DEQ's Yaak Watershed Study are due December 19. An article alerting the public to this Study and the date that comments are due appeared in the Western News just today, December 14! I looked at the Study on the internet and there is absolutely no way that anyone in the public, especially this time of year, could possibly review the document and understand what it says in 30 days.

I request that the DEQ delay any further action on this document until the end of summer after the public has an opportunity to participate. The land involved is national forest and the public has a legal right under the National Environmental Policy Act and National Forest Management Act to participate in such studies and to be fully informed, early and often. This right has not been provided by either the Forest Service or the DEQ."

Comment #3a:

The Yaak Rod and Gun Club had its' annual Christmas party last Sunday and thirty two members were present. At the meeting, a report of your activities was given. The group was totally surprised that any work was going on and what recommendations were being made. Apparently, you did have an ad in the paper about a meeting, but we do not think you did nearly enough to let the public know what's happening in our own backyard. Witness the fact that only three or four people knew about the meeting.

We find it difficult to argue your scientific findings in a forum like this. We think you need to have another "public" meeting where local people have the opportunity to ask questions and voice their opinions. The USFS has done an excellent job of this and it has helped their cause rather than hinder it. We look forward to your response on this request.

Comment #1 Response:

In regards to comments on DEQ's public involvement process, the Department follows guidelines and process adopted by the state legislature for consultation associated with TMDL development. Regrettably, in some cases the processes the state employs does not meet expectations of all, as is evidenced in the Yaak.

State Law (MCA 75-5-702(9)(a)) establishes a <u>statewide TMDL advisory group</u> that serves in a consultation capacity set forth under law. Additionally, "the department shall provide public notice of meetings of the statewide TMDL advisory group and shall solicit, document, and consider public comments provided during the deliberations of the

advisory group. (MCA 75-5-702(10)). Minutes of the statewide TMDL advisory group are posted at the website: http://deq.mt.gov/wqinfo/TMDL/advisory_group.asp

The fourteen member *statewide TMDL advisory group* represents a broad base of water related interest groups in Montana. The groups represented are agriculture (livestock and farming), conservation or environmental interest, water-based recreationists, the forestry industry, municipalities, point source dischargers, mining, federal land management agencies, state trust land management agencies, supervisors of soil and water conservation districts for counties both west and east of the continental divide, the hydroelectric industry, and fishing related businesses.

Public announcement and public meetings addressing specific TMDL planning areas (the Yaak TMDL Planning Area, for instance) are not required under state law, and the department conducts such public review and comment processes under internal guidance. This guidance does not typically provide for the solicitation of *individuals* within TMDL planning areas, but solicits watershed advisory groups and Conservation Districts for information on sources that may be contributing to water quality impairment. The department relies on the *statewide TMDL advisory group*, as well as local Conservation Districts and watershed advisory groups to notify and inform constituents regarding local and regional TMDL activity. As the major landholder and land management agency in the Yaak TMDL Planning Area, the department also relied on the USFS to notify prospective watershed advisory groups within the watershed. With the exception of wastewater treatment plant construction grants and NPDES permits, TMDLs and other similar Clean Water Act planning related activities are exempt from requirements of the National Environmental Policy Act (Clean Water Act - Section 511(c)(1)).

During TMDL development, DEQ provided draft documents to the Lincoln Conservation District, the Kootenai National Forest, the US Fish & Wildlife Service, and representatives of the Kootenai River Network and the Yaak Headwaters Partnership Group for review and comment: only the USFS/Kootenai National Forest provided technical and editorial feedback on draft documents that were distributed.

The 30-day public comment process is intended as the venue for general public comments. Generally, members of public are not solicited for review of TMDL technical documents, but are provided an opportunity to comment during the departments 30-day Public Comment Period. In the case of the Yaak TMDL, a public meeting was scheduled for Dec 4th in Troy and public notice was posted in the Western News on Nov 30th. In response to public comments received, DEQ extended the public comment period four weeks (Jan 14th) and scheduled a second public meeting on Jan 7th in Troy. Public notice of this second public meeting ran in the Western News from Dec 26th through Jan 11th, 2008 and was posted at local markets and post offices. A single comment on the Yaak TMDL was received during the public comment period extension.

The Department acknowledges that initial efforts in the Yaak were inadequate to reach some landowners and interested parties, and is pursuing improvements to the process to ensure that interested parties receive adequate notification of opportunities for comment

and/or review, especially in rural areas. Comments received during the Yaak public comment period are seriously considered and the draft TMDL document has undergone substantial revision to address public and stakeholder concerns.

Comment #2:

At the second public meeting (Jan 7th, 2008), the following comments was received in reference to the meeting:

There is a real need for education. There is no understanding relative to the Restoration Plan. A few people have diverted the entire process: we have tried in two hours to reconstruct science.

Comment #2 Response:

DEQ appreciated the comment and agrees with the idea that education and understanding of restoration options is a key component to local implementation of water quality improvements.

Comment #3:

Page 9, last paragraph, "Major soil types in The Yaak Watershed are shown in **Map 4** of **Appendix E**. Sedimentation is an issue in the Yaak Watershed, and two of the major soil materials on the area that are particularly susceptible to erosion and sedimentation are the decomposed granitics and the glacial lakebed sediments. When disturbed, sediment coming from these landforms can increase significantly over natural levels (Kootenai National Forest EIS, 1987)."

This is misleading as very little of the watershed is actually granitics or sedimentary. The vast majority of the landtypes in the watershed are stable and only moderately erosive.

Comment #3 Response:

The document has been amended and clarified to better reflect geologic and soil conditions (Section 2.1.5).

Comment #4:

Page 11, first paragraph, "Various studies have estimated that the westslope cutthroat trout now only occupies between 19-27% of its historic range in Montana (Van Eimeren, 1996). Cutthroat trout have declined due to habitat loss caused by poor grazing practices, historic logging practices, mining, agriculture, residential development, the lingering impact of forest roads, dewatering, and dams. Non-native species have also taken a huge toll on westslope cutthroat trout (Novinger and Rahel, 1999). Hybridization with rainbow trout and even other non-native cutthroat trout subspecies is another reason for the decline in population. Consequently, genetically pure westslope cutthroat trout only exist in an estimated 2-4% of their historic stream distribution (McIntyre and Rieman, 1995)."

The citations used in this text are out of date. A 2002 status review of the westslope cutthroat coauthored by Montana Fish Wildlife and Parks and the US Fish and Wildlife Service does not support this text.

Comment #4 Response:

The document has been amended using figures and estimates provided in Shepard et al, 2003 (Section 2.2.1).

Comment #5:

Page 17, "Most of the road closures in the Yaak Watershed are due to concerns for the grizzly bear population, and road decommissioning efforts in the watershed are driven by concerns for water quality and native fish (Newgard, pers comm)."

The Forest Plan would be a better source. There are multiple resource concerns and access management that drive decisions to close roads.

Comment #5 Response:

The text has been removed from the document.

Comment #6:

Page 19, first paragraph, "In 1987, forest plans for the Kootenai National Forest established allowable sale quantities (ASQs) for the maximum amount of timber that could be harvested from the forest. Timber production since 1987 has been well below the ASQs, due to a number of factors, including a shift in management focus increasingly from timber production to wildlife habitat, watershed concerns, litigation, appeals, deferrals, and changes in management area designation (KNF 1997). Timber volume sold from the forest has declined from 200 million board feet (mmbf) per year to about 50 mmbf per year from 1998 to 2001 (USFS, 2003)." This text does not reflect what has been harvested in the Yaak, but rather across the forest which consists of more than 2 million acres of national forest system lands.

Comment #6 Response:

The document has been amended to provide clarification that the figures provided are for the entire Kootenai National Forest (Section 2.3.1).

Comment #7:

Page 19, second paragraph, "Forest Service timber sales are now geared toward very large operations because larger sales are perceived as more cost effective; as a result, many small mills can not accommodate the sale or compete with the larger timber companies. Stimson and Riley Creek Timber Companies have mills near the Yaak Watershed in Fortine and Moyie Springs, respectively."

This text is not true, as the forest provides numerous sales to smaller business and presently the Small Business Administration set aside for this forest is 58%. Also, Stimson does not own a mill in Fortine. Plum Creek operates a mill in Ksanka, MT.

Comment #7 Response:

The text has been removed from the document.

Comment #8:

Page 31, the use of % Surface Fines as a primary sediment indicator is not appropriate. It is well established in the literature that macroinvertebrate community diversity and species richness is highly correlated to fines in the sediment and the subsequent embeddedness that reduces the interstitial habitats. It is also well documented that fines in the sediments affect fry

survival and emergence. It is also well established in the literature that surface fines has no correlation to subsurface fines and is not even a potential surrogate for % subsurface fines. For these reasons we recommend dropping surface fines as an indicator for all streams.

Page 32, the use of equivalent clearcut acres (ECA), stream crossing density, and road density as sediment indicators, even supplemental indicators, is not appropriate. This forest and other agencies have used these measures as indicators of potential risk to watersheds as they are correlated to development and management. We request they be dropped as indicators.

Comment #8 Response:

The percent surface fines measures utilized in the draft document have been used in a variety of technical documents and TMDLs in Montana and elsewhere as indicators of impact to aquatic communities. As cited in the document and stated in your comment, literature has established the relationship between fine sediment accumulation and impacts to macroinvertebrates, fish and associated aquatic life. DEQ does not suggest that surface fines measures be used as a surrogate for subsurface fines, but should be used in conjunction with subsurface fines to evaluate impacts to aquatic communities. Typically, levels of subsurface fines are associated with use-support evaluation for salmonid-type fish (specifically fry emergence and survival), whereas levels of surface fines are associated with use-support evaluation of macroinvertebrate communities and other biological effects typical of increasing fine sediment accumulations.

To avoid confusion regarding comparison of methods used in beneficial use support evaluation, Figure 4-3 and the associated discussion of surface fines correlation to subsurface fines has been removed from the document. While data collected on the Kootenai National Forest shows a general correlation between surface fines and subsurface fines, additional research would be desirable to establish relationships between the two measures.

Comment #9:

Page 37, bullet items, "Hill et al. (2000) found that percent fines <2mm negatively correlated with periphyton biomass in mid-Atlantic streams. Zweig et al. (2001) in their work on four Missouri streams determined that taxa richness significantly linearly decreased with increasing deposited sediment in 3 of 4 streams." These two citations should not be included as they come from distinctly different ecosystems from dissimilar areas of the country. The remaining citations support the thesis of the text.

Comment #9 Response:

The citations provided support the contention that increasing fine sediment has detrimental effects on aquatic life, and specifically cites various regions to illustrate that the general relationship is common among various ecosystems.

Comment #10:

Page 49, fourth paragraph, "Forest management (timber harvest) was significant in the upper watershed between the 1950's and early 1980's. Since harvest, Grizzly Bear Core Management Area (GCMA) designation." This language is confusing as the term management area is a

designation under the Forest Plan. There is grizzly bear core habitat identified based on access, but there is no designation of core as a management area under the Forest Plan. This change needs to be made in Figures 4-4, 9, & 13. References to GMCA need to be changed to Grizzly Bear Core which is the appropriate designation under grizzly bear management direction per the US Fish and Wildlife Service.

Comment #10 Response:

The document has been amended to include the proper designation terms provided.

Comment #11:

Page 56, last paragraph, "Stream Crossing Density: Stream crossing densities for each site were at or below the indicator value of 3.0 crossings per square mile at all sampling sites located along the mainstem of Seventeenmile Creek.

Road Density: The road density threshold was exceeded at the upper mainstem site (52), but was well under at the other sites and for the portion of the basin above that site." This text is either misleading or indicates a misapplication of these measures. These measures are for relative comparisons and represent the entire area of a watershed, typically at the 6^{th} code hydrologic unit.

Comment #11 Response:

DEQ utilizes and evaluates data and statistics for stream crossing density and road density in a variety of ways. In order to assist in evaluation of water quality conditions at each sampling site, landscape-scale influences such as stream crossing and road density numbers in the Yaak TMDL were calculated by USFS hydrologists and consider all contributing watershed area *above each sampling site*.

Road crossing densities and road densities by 6th and 7th code HUC are given in Section 5.0 for a general comparison of landscape indicators at the subwatershed scale and are used to assist in allocation sediment loads to subwatersheds.

Comment #12:

Page 58 & 59, "Primary biological indicators (MMI and RIVPACS) do not suggest impairment ... Current bankfull width-to-depth and the entrenchment ratios also do not suggest sediment transport problem contributing to or causing impairment. Pfankuch Stream Channel Stability Information collected at 20 sites over a 10 year period (SUM), Stream Channel Stability-Scouring and/or Deposition Item, and the Stream Channel Stability-Distribution and Stability of Channel Bottom Materials Items also do not indicate sediment transport problem contributing to or causing impairment."

The determination of impairment is made in direct contradiction to both biological and physical data indicating otherwise. The impairment determination is based on % Surface Fines which is arguably a meaningless measure, particularly since subsurface fines are within the threshold established for non-impairment based on reference conditions. This document points out that % surface fines is suspect as an indicator of any impairment at page 113, "Unpublished, non-peer reviewed reports (Relyea, 2005) suggest that a threshold of 20% surface fines <2mm may demonstrate impairment to aquatic macroinvertebrate populations, yet this supposition has not been verified." All of the data cited regarding negative effects to fry emergence are for

subsurface fines. The absence of a correlation between surface fines and subsurface fines is further illustrated in Figure 4-3 which displays a regression of surface fines against subsurface fines. The regression results in an r^2 of 0.5689 indicating little if any correlation between the two. Both the macroinvertebrate measures and subsurface fines support non-impairment. We would conclude the data does not support the need for a TMDL on Seventeenmile Creek.

Comment #12 Response:

2006 use-support (i.e. impairment) determinations are made previous to and independent of TMDL development. Use-support determinations are made by the DEQ Monitoring Section through a separate process and reported biennially in the state of Montana's Integrated 305(b)/303(d) Water Quality Report. Waterbodies identified in this report have passed a rigorous Sufficient and Credible Data review process to determine whether adequate data and information exists to make a beneficial-use support decision. In establishing and reporting on use-support decisions in the 2006 Integrated Report, DEQ conducted a formal 60-day public comment period to solicit comments related to beneficial-use support determinations. Comments related to beneficial-use support determinations for specific water bodies should be submitted through this process. For more information on the State's water quality assessment process and reporting of beneficial-sue support decisions, please refer to Montana's 2006 Integrated 305(b)/303(d) Water Quality Report at http://www.deq.mt.gov/CWAIC.

Hydrologists and watershed personnel from the Kootenai National Forest and the EPA participated in the establishment of water quality indicators, collection and review of water quality data, and evaluation of data results. What is presented in Section 4.0 is a summary of data and information used to make impairment determinations, but is not the DEQ's official assessment record of beneficial-use support. Please see http://www.deq.mt.gov/CWAIC for detailed assessment record sheets.

DEQ does not view percent surface fines as a meaningless measure as multiple studies have established the relationship between excessive surface fines and the associated detrimental effects on aquatic life. The document points out that the 20% threshold for surface fines as a determiner of impairment has not been independently verified, however the DEQ contends that percent surface fines are appropriate indicators for the evaluation of fine sediment accumulation on aquatic use support. Surface fine values in Seventeenmile Creek were considerably above reference surface fines (Section 4.2.2.3) at multiple sampling sites, suggesting that fine sediment accumulation may be impairing aquatic potential at these sites. Further data collection, evaluation of reference conditions, and continued water quality sampling will help in evaluating future beneficial-use support for Seventeenmile Creek.

Comment #13:

Page 66, last paragraph, "Sediment Source Surveys were conducted in Lap Creek by the Yaak Headwaters Partnership Group in the summer of 2006. Survey crews identified and assessed nearly all (22) road/stream crossings in the watershed: 14 of 22 of crossings were in the Upper Lap watershed (above site 53). With the exception of where Lap Creek crosses the main Yaak River road, all road/stream crossing sites were within Grizzly Core Management Area (GCMA)

and have been closed to motorized use for more than ten years. Since closure, vegetative growth on many Lap Creek roads has drastically reduced sediment contributed to streams." Why is there no discussion regarding the results of the sediment surveys, particularly since the text points out the roads are revegetated?

It is difficult to determine from the text whether the instream sediment and bedload originated from outside the stream channel which is inferred by the text but never really substantiated. There is also some indication that the condition of subsurface flow is a natural condition. Based on the biological metrics exceeding threshold values the Forest supports the determination that Lap Creek is impaired and should have a sediment TMDL developed; however, that determination should not be based on % surface fines, road density, and stream crossing density.

Comment #13 Response:

Available data on channel form and processes in Lap creek is limited. Impairment determinations in Lap Creek were based on a suite of indicators (including biologic metrics) using a 'weight-of-evidence' approach. These indicators include, but are not limited to % surface fines, road and stream-crossing density. That is, landscape-scale indicators (road density, stream crossing density) were considered in conjunction with instream data in beneficial use support determinations, but are not sole indicators of impairment. The results of sediment surveys are discussed in Section 5.0, but do not include extensive information on road condition other than at stream crossings.

Comment #14:

Page 79, item 2, "South Fork site 50 below Smoot that had the highest fine-sediment value (42% <2mm) is located immediately adjacent to a harvest unit that had riparian harvest. Field notes describe unstable banks where root wads have washed out or blown over as a result of the adjacent trees being harvested. This is the probable source of the excessive fine sediment," based on the map in Figure 4-13 the harvest in question occurred prior to 1980. Additionally, the photo in Figure 4-14 does not support the conclusion that the previous harvest is continuing to contribute to sediment in South Fork Yaak River. It is more likely the sediment is a function of the low gradient in this stream reach and would be there regardless of human activity.

Comment #14 Response:

Field assessment of site 50 was conducted by USFS hydrologists, and the descriptions and causal mechanisms reported in the draft document reflect their assessment of the condition of site 50. Photographs and maps presented herein likely do not capture true site conditions or provide the resolution or detail necessary to overcome site assessment conclusions by qualified personnel.

Comment #15:

Page 79, the summary of effects ignores the activities on private land which include agriculture, developments, and silviculture. Page 83, second paragraph, "Livestock grazing and agricultural activities - impacts typically associated with impacted bank conditions - are relatively insignificant in the Yaak TPA as the watershed is predominantly managed as forest and grazing areas are minimal in extent." This statement is not accurate for the South Fork

Yaak which has two large blocks of private land with agricultural impacts in the downstream portion of the watershed.

Comment #15 Response:

The document has been amended to acknowledge developed and livestock-use lands in the lower South Fork Yaak watershed. Development and other near-stream sources are also acknowledged in the allocation presented in Section 6.0.

Comment #16:

Page 97, second paragraph, "Within the Yaak TPA, the FPWYG establishes an allowable peak flow increase of 14%, based on the Kootenai National Forest Clearcut Equivalent Area Model." This is not accurate as there are ranges of recommended peak flows given in the Forest Plan. Recommended peak flows are based on numerous watershed characteristics. The text appears to take our Forest Plan direction out of context. We recommend dropping this statement.

Page 97, fourth paragraph, "Maintaining PFI below the FPWYG of 14% constitutes a 'reasonable land, soil and water conservation practice" and will ensure that water yield increases from timber harvest activities do not impact beneficial uses." This statement in essence sets a standard which goes beyond the Kootenai NF Forest Plan and would limit any future management in the watersheds named in this document. We recommend deleting this statement.

Comment #16 Response:

The goal of establishing acceptable peak flow increases on forested lands is to avoid channel impacts as a result of high flows associated with denudation and vegetative removal. DEQ believes the *Forest Plan Water Yield Guidance* establishes processes for determining PFI that are protective of streambank and stream channel health, and recommends that rather than establishing a blanket 14% PFI, acceptable PFIs shall be in accordance with the guidance for evaluating PFI as provided in the FPWYG. The document has been amended to remove the 14% PFI threshold, instead relying on more detailed analysis provided by FPWYG to ascertain allowable PFIs (Section 5.2.1.5).

Comment #17:

Page 98, last paragraph, "Road density thresholds are not developed for the purposes of this TMDL; however, efforts should be emplaced to reduce road densities in order to mitigate unnatural flow routing conditions, and new road construction should be done in a manner that minimizes road density and consequent deleterious effects." This text appears extraneous to the subject, provides a personal opinion and should be deleted, especially if 'Road density thresholds are not developed for the purposes of this TMDL.'

Comment #17 Response:

It is well established in the literature that increases in road densities in forested landscapes can result in deleterious effects to aquatic resources, through increases in sediment delivered to streams via runoff from road surfaces and interception and subsequent surface routing of shallow subsurface flows. Reducing or mitigating the effects of high road densities and the disruption of natural flow paths is promoted in both

the State of Montana's Non-Point Source Management Plan (DEQ, 2007) and in USFS guidance (USDA, 1995). Section 6.0 has been edited to clarify the DEQ's position regarding road densities, their influence on water quality conditions and forest management implications.

Comment #18:

The statement on Page 110, first paragraph, "For instance, to ensure that water quality standards are achieved and maintained, it is reasonable that all applicable BMPs are applied in order to meet sediment allocations. However, it is not reasonable to increase road densities or stream crossing densities where the sum of sediment loads from a fully 'BMPed' condition exceeds the ability of streams to maintain aquatic beneficial life uses," is problematic as it describes the current state of the three Yaak watersheds discussed in this document where two measures typically used to identify potential risk have been misapplied as measures of sediment load. This statement appears to be a moratorium on future road construction and management in the three watersheds in question.

Again, the sediment load identified for the three streams in question relies on events that have yet to occur as identified throughout Chapter 5 and the following from page 108, second paragraph, "Sediment production and delivery to streams from forest roads and potential culvert failure are currently the primary human caused sources of sediment impairment to water quality in the Yaak TMDL Planning Area." The text following that on page 110, "In addition to BMP application, maintaining and/or reducing road densities and stream crossing densities at levels that do not cause water yield increases that would exceed Forest Plan Water Yield Guidance, or cause deleterious impacts to stream channels or aquatic life are considered 'reasonable land, soil and water conservation practices.' That is, in some cases a larger effort than solely implementing new BMPs may be required to address sources of impairment," would indicate the State has made the interpretation that road densities beyond 3.0 mi/mi² and stream crossings in excess of 1.5 crossings/mi² are in violation of the Kootenai Forest Plan and the Clean Water Act.

Page 11, first paragraph, "It is not the intent of this TMDL to dictate forest management practices by requiring specific implementation activities, but to establish reasonable conditions that would result in the attainment and maintenance of water quality standards for sediment. As such, the land, soil and water conservation practices above represent surrogate conditions that assist in establishing the potential for sediment reductions from unpaved forest roads through the application of appropriate BMPs and an understanding of processes that may influence water routing and water yield increases. In addition to these conditions, 'all reasonable land soil and water conservation practices' may also those activities that act to maintain beneficial uses and can include:

Limiting or reducing road densities and road crossing densities Decommissioning roads (especially those that threaten water quality) Pulling culverts on decommissioned roads."

In closing, unless the DEQ reconsiders, and this forest strongly believes it should, including road densities and stream crossing densities as measures of impairment and potential culvert failures as allocated 'sediment loads' this TMDL does in fact dictate forest management

activities within the three watersheds addressed by this TMDL and potentially across a much broader landscape, regardless of intent.

Comment #18 Response:

In making impairment determinations or when evaluating or defining a potential problem, interpretation of sediment standards must include consideration of both human caused sources of sediment loading along with in-stream impacts such as percent fines increases. The use of landscape scale variables as a supplemental indicator, in conjunction with instream measures is a critical approach in defining the potential cause of in-stream impacts. EPA sediment TMDL guidance (EPA, 1999) suggests a variety or suite of targets be used to evaluate stream condition and specifically recommends hillslope indicators such as Equivalent Roaded Acreage (USDA, 1988), percent impervious or disturbed land, or other appropriate hillslope or landscape indicators.

EPA's Protocol for Developing Sediment TMDLs (1999) states, "Not all TMDL indictors must focus on the waterbody... Riparian and hillslope indicators provide additional indicators of environmental conditions associated with designated or existing use protection; however, they should be used to compliment instream indicators and not as substitutes for instream indictors."

DEQ has amended Section 6.0 and Section 7.0 to clarify DEQ's position regarding forest management activities and how allocations may affect these management activities. Allocations given do not preclude management activity on forest lands, but state that management activity should be conducted in accordance with "all reasonable land, soil and water conservation practices."

The numeric allocation (allowable load) to forest roads is based on surrogate criteria and does not mandate specific management practices that must be employed for sediment reduction and management. For instance, it is not required that management actions adhere to specific contributing lengths or road densities, if it can be shown through site-specific analysis that numeric load allocations given will not be exceeded. For instance, there are several 7th-code watersheds in the Yaak TPA with road crossing densities that exceed 1.5 crossings/mile² that are meeting numeric allocations (Tables C-17-C-19, Appendix B), due to improved or revegetated roads. Likewise, there are also several 7th-code watersheds with low road crossing densities that exceed numeric allocations due to improperly maintained roads. As site-specific information in these watersheds is collected, existing loading determinations may be modified based on empirical site-specific data. In most instances in the Yaak TPA, it is likely that road allocations can be met through upgrade or improvement of 'problem sites' on existing road networks and stream crossings. Please see Sections 5.0 and 6.0 for more detail explanations of the implications of sediment allocations on management activity.

Comment #19:

It seems to me that a small, very, very, small minority of concerned citizens had input of questionable 'facts' that adversely affects the majority. Sediment runoff is not a problem in this area. Rather this 'fact' is another "spotted owl" gambit to serve the agenda of this small vocal minority of gadflies who earn their living through dissension. Please find a way to learn from a broad base of knowledgeable local citizens.

Comment #19 Response:

Recent field work and analysis (Section 5 and Appendix C) documents *specific* sediment contributions to waterways from the unpaved forest road network that are chronic and controllable. These sediment contributions can be easily remedied by maintenance and Best management Practices to reduce sediment contributions to acceptable and sustainable levels. Please see response to comment #1 regarding the public involvement process.

Comment #20:

I am writing to comment on the watershed quality on the Yaak River drainage. I am specifically very familiar with and very interested in the 17 Mile Creek drainage. I have been a resident land owner in the 17 Mile valley for 34 years and have observed decreasing water quality in that watershed over that period of time. I think this is clearly due to road building and logging activities specifically.

The 17 Mile Creek Forest Service road traverses an area on the north side of the creek at various distances from the stream bed itself. There are several areas of chronic slumping involving the upper cut bank and the road bed itself. It appears particularly prominent in areas with a clay soil type. Repeated damage to the road in these areas has required the Kootenai National Forest to spend a considerable amount of money over the past decade just to keep the road passable. This road ended up being closed for an entire season pending repair of a large area where to road itself sloughed off the hill.

To summarize the situation as I see it; this Forest Service road is used only for pleasure driving, and is used as a loop by mostly local residents. I believe a significant amount of sediment into the creek is occurring due to the activities on this road. It is clear to me that sediment into the watershed would be reduced and a considerable amount of tax dollars saved if a portion of this road comprising approximately five miles of this road would be closed and rehabilitated.

Comment #20 Response:

DEQ agrees that chronic delivery of sediment from the unpaved forest road network in the Yaak poses a threat to water quality, and supports activities that would reduce sediment loading and hazard risk. Typically, the majority of sediment loading from forest road systems occurs at a minority of sites (Table C-2, Appendix C) and can be reduced using a variety of methods. It appears the condition described may be a priority candidate for sediment control and hazard risk reduction actions.

Prioritizing and implementing sediment control actions will require a coordinated effort between land management agencies and other important stakeholders, including county

governments, conservations districts, private landowners, state and federal agency representatives, and individuals from conservation, recreation, and community groups with water quality interests in the Yaak River Watershed (Section 7.0).

Comment #21:

The TMDL suggests that there is a need to better define reference conditions for streams in the Yaak watershed to know the range of natural conditions. This is a recommendation that the YVFC strongly supports and would like to see the existing data complemented by additional data collection and analysis on these reference streams. Better understanding the reference conditions in the Yaak will allow agencies working in the Yaak to recognize how far the current conditions have moved from the natural sediment load.

Furthermore, we would like to see that the current data is used to determine that there are not additional impaired streams throughout the watershed. A larger data base, created for the entire watershed, would assist in determining the health of streams not previously listed. We would like to see the TMDL recommend that monitoring occur throughout the watershed to determine that other watersheds are maintaining fisheries and appropriate sediment loads.

We support the monitoring recommendations on Lap Creek, South Fork and Seventeenmile to establish a baseline condition. This will allow agencies to evaluate the effectiveness of restoration activities and identify areas where additional work is needed to meet the water quality targets.

Comment #21 Response:

It is the intent of the Clean Water Act and the Montana Water Quality Act to assess and evaluate water quality condition of state waters, and to maintain beneficial uses and water quality standards. As such, it is the department's goal to continue monitoring and assessment activities in the Yaak watershed and the region as resources and priorities permit.

Evaluation of data and information for use in beneficial-use support decisions is conducted by the DEQ's Monitoring Section, and reported biennially in the state of Montana's *Integrated 305(b)/303(d) Water Quality Report*. Please refer to this report at http://www.deq.mt.gov/CWAIC for information on submittal of data for evaluation pursuant to beneficial use support determinations for water bodies within the Yaak TMDL Planning Area. DEQ thanks you for your support.

Comment #22:

In section 2.3.1 Population and Land Use History, it states, "Many residents of the Yaak consider the area to be one of the last wild places in the lower 48, and actively work to protect the area from the effects of roads and timber harvest. Many in the community work in the timber industry yet have very strong feelings about forest management and preservation. This includes protection of the endangered wildlife species that live in the forest (Eureka Chamber of Commerce)." This statement is not representative of the majority, is straight from the Yaak Valley Forest Council Website, and should either be reworded or removed.

Comment #22 Response:

The document has been edited, and the aforementioned language removed from the document.

Comment #23:

This section does not address, nor does any section of this report, address the RS 2477 roads contained in this watershed. If RS 2477 roads exist, they can only be closed by eminent domain. Since this report does not address RS 2477 roads, it is unknown whether any of the roads that have been cited as a source of pollution are RS 2477.

Comment #23 Response:

The TMDL document does not make any road closure recommendations. Other than the specific road-sediment field sampling sites identified in Appendix C (Table C-20, Table C-21), sediment load estimates and applicable load reductions are not provided per road segment, but are extrapolated from field-sampled sites and applied at the 7th code HUC watershed level (see Section 5.2.1.4 and Appendix C). Evaluation and calculation of sediment loading from any particular road segment would require additional site-specific data and information.

Comment #24:

Sediment levels – There is little, if any, historical data that lends a baseline standard from which to determine if sediment levels have increased. Due to this, the WATSED model was used to determine sediment levels.

In Lands Council, et. al., v. United States Forest Service, the Ninth Circuit Court of Appeals determined the WATSED model to be flawed: "We agree that the WATSED model did contain faulty analysis". "The government concedes that the WATSE model does not include relevant variables in determining total sedimentation of the watershed and that WATSED does not have variable to predict the effects of large-scale, high intensity, short-term peak flows."

In light of this information, the data used in this study that originated from the use of the WATSED model is held to be flawed and removed form consideration.

This study has little or no historic data and the aquatic life diversity, nor any historical quantitative data. Again, modeling was used to determine "what should" be in these streams as opposed to actual condition.

Again, in Lands Council, et. al. v. United states Forest Service, the Ninth Circuit Court found;

'The Lands Council next challenges the Forest Service's analysis of disturbed soil conditions. Under the Forest Plan and the applicable Regional Soil Quality Standard, the Forest Service cannot allow an activity that would create detrimental soil conditions in fifteen percent of the project area. 20 The Lands Council's claims that the methodology that the Forest Service used to calculate the amount of soil that was in a detrimental state was insufficiently reliable because the Forest Service never sampled the soil in the activity area. Instead, based on samples from throughout the Forest, and aerial photographs, the Forest Service estimated the quality of the soils in the Project area using a spreadsheet model.

[9] This methodology has previously been called into question. In a similar case, the United States District Court for the Eastern District of Washington considered the exact same methodology and concluded that its use was impermissible: The shortcomings in the USFS analysis are all directly tied to the fact that they did not take the time to walk the areas that they planned to harvest. Instead, based on assumptions [from general data from the IPNF soils], geological maps, and aerial photographs, they estimated the condition of each unit, tried to determine which units might exceed established standards, and projected potassium levels.

same problem exists: The Forest Service did not walk, much less test, the land in the activity area. The Forest Service concedes that it did not test much of the activity area, but argues that because it tested similar soils within the Forest, and similar soils act the same way, then the methodology is sound. Moreover, the Forest Service argues that we owe its technical expertise deference. See Marsh, 490 U.S. at 378.

[10] The Forest Service, granted appropriate deference, still does not demonstrate the required reliability of the spreadsheet model. We are asked to trust the Forest Service's internal conclusions of the reliability of the spreadsheet model when the Forest Service did not verify the predictions of the spreadsheet model. Under the circumstances of this case, the Forest Service's basic scientific methodology, to be reliable, required that the hypothesis and prediction of the model be verified with observation. The predictions of the model, which may be reliable across the entire Forest, were not verified with on the ground analysis. The Forest Service, and consequently the public at large, has no way to know whether the projection of the Project area's soils was reliable. Was the Forest Service "dead on" or "dead wrong?" The Final Environmental Impact Statement is inadequate to tell. Our conclusion that such unverified modeling is insufficient is similar to the holding in Kettle Range, because in that case the court noted that some of model's input was based on data about the soils throughout the Forest. 148 F. Supp. 2d at 1126-27. The failure of the Forest Service in that case, as well as here, was that the soils analysis was based entirely on the model with no on-site inspection or verification. Therefore, we hold that Forest Service's reliance on the spreadsheet models, unaccompanied by on-site spot verification of the model's predictions, violated NFMA.'

I assert that the above situation is in play. That not all of the area in question was walked by agency personnel, that assumption through modeling were applied, spreadsheet information form other areas used and that the end result was an inaccurate picture of the condition that actually exists."

Comment #24 Response:

DEQ understands the limitations of WATSED and other models when attempting to estimate sediment loads on a watershed scale. WATSED has been used and approved by EPA in a variety of TMDLs in order to estimate general or relative loading estimates.

In the Yaak TMDL analysis, WATSED results were not used to make impairment determinations or provide basis for allocations or load reductions. WATSED results were used to estimate relative natural background sediment loading, but were not a final determiner of watershed condition. Analysis and evaluation of watershed condition relied heavily on field observations, field assessments, and contracted data collection & road loading analyses. The sizes of the affected watersheds, as well as time and budget constraints preclude detailed field assessment of all lands and waters within the Yaak TMDL Planning Area. Agency personnel did conduct field assessments in each affected watershed and assessed sediment loading from road systems, assessed degree of natural bank erosion and hillslope process, and evaluated field data and landscape-scale data to determine watershed condition, loading estimates and sediment load reduction potentials.

Comment #25:

The TMDL process does not allow for a finding of "indeterminate". This needs to be addressed and changed.

Comment #25 Response:

It is assumed that a 'finding of "indeterminate" refers to the beneficial-use support (impairment) determination made by the DEQ. Beneficial-use Support determinations are made by the DEQ Monitoring Section through a separate process and reported biennially in the state of Montana's *Integrated 305(b)/303(d) Water Quality Report*. Waterbodies identified in this report have passed a rigorous Sufficient and Credible Data review process to determine whether adequate data and information exists to make a beneficial-use support decision. The streams identified in Yaak Watershed TMDL contained data and information determined to be sufficient for making beneficial use support determinations.

During TMDL development, however, additional data may be collected consequent to the beneficial-use support determination reported in the *Integrated 305(b)/303(d) Water Quality Report*. Where new or additional data suggests modifications to the reported beneficial-sue support determination, DEQ may defer TMDL development pending further evaluation of data and information. This was not the case in the Yaak as discussed above. For more information on the State's water quality assessment process and reporting of beneficial-use support decisions, please refer to Montana's 2006 *Integrated 305(b)/303(d) Water Quality Report* at http://www.deq.mt.gov/CWAIC.

Comment #26:

The TMDL process, as explained, does not allow for public comment on the final product prior to its being submitted to EPA. This is totally unacceptable. After the public comment review of this draft document, everything in the document COULD be changed, and the public would have no recourse. This situation is totally unacceptable and needs to be revised.

Comment #26 Response:

DEQ does not conduct an additional public comment review period after written comments have been received and addressed unless there have been substantial modifications to the TMDL that would significantly impact stakeholders in a way that was not addressed within the original draft document or during the public comment period.

DEQ does make available the final edited EPA-submittal document to individual stakeholders or members of the public if they request a copy.

Comment #27a:

The Yaak Valley Forest Council has played a large role in the gathering of data for this study. The end result of this study could well recommend closure of Forest Roads. One of "stated" mission is to "protect roadless areas". The use of any data that was collected by the YVFC, and referred to in this study, either directly or indirectly, opens this watershed study to bias.

Comment #27b:

Natural progression in any water shed is for the water to erode a stream bed out of the earth if the water flow is large enough. Why are you wasting my tax dollars making computer models and utilizing data gathered by groups with an agenda such as the Yaak Headwaters Restoration Partnership? This group consists of individuals from the Yaak Forest Council which is an environmental group opposed to commercial logging and wants much more wilderness. Having people with a preconceived agenda like this gather data doesn't make sense, period.

Comment #27 Response:

The DEQ reviewed and evaluated a variety of data to assist in the development of TMDLs in the Yaak watershed. The Yaak Headwaters Restoration Partnership (YHRP), of which the Yaak Valley Forest Council is a participating organization, coordinated sediment source surveys which were conducted by YVFC personnel under direction and training from the Kootenai National Forest and the Montana Dept of Fish Wildlife & Parks. The assessments were all done within existing roaded areas, and were conducted independent of TMDL development.

DEQ understands the need to carefully review and evaluate all data sources. The DEQ and Kootenai National Forest evaluated the data collected under direction of the YHRP, verified its validity with on-site visits and found the information to be relevant and accurate.

Comment #28a:

Using a computer model to analyze the sedimentation and environmental quality of a stream can have many mistakes, as nature doesn't follow any particular pattern that can be repeated for data generation as was done in this document. I suggest that you get out of your office and walk up a Lap creek road and use some common sense to determine if, for example, the culverts are adding sediment to the creek. It doesn't take a genius to see if the roads are washing out and ruining a stream bed.

On page 82, Table 5-1 of the document you state that your model shows an average of 70 tons of sediment added to Lap Creek each year due to culverts. I want you to come up to the Yaak and show me where 46.7 yards of sediment, calculated using 3000 Lbs/Yard, is being washed away from the Lap Creek road system each year due to culvert failure. This represents approximately 5 dump truck loads of dirt being dumped into Lap Creek because of culverts each year. The Lap Creek road system has been in place for at least 20 years and this would represent a total of 100 dump truck loads of dirt washed away from this road system in this time, this is not happening.

Comment #28b*:

The computer model just won't work here. I would suggest you have some minor and inexpensive repairs in mind as I suggested. Give it a very high score and take it off the 303(d) list.

*note that this comment was the conclusion of a detailed multi-page data review provided by the commenter.

Comment #28c:

Page 82, Table 5-1 would indicate that the sediment contributed by culvert failures is almost equivalent to predicted natural sedimentation rates for each watershed. This number is treated as real but in fact is a hypothetical number that does not reflect conditions on the ground. We recommend either describing it accurately and putting this number in context or dropping it from the table.

Comment #28d:

Sections 6.2.1 and 6.2.2, as written preclude future Forest Service management in the three listed drainages as the projected load allocations are not only theoretical but unattainable. If DEQ is going to establish 1.5 stream crossings/mi² culverts designed to accommodate Q₁₀₀ flows, and no peak flow increase above 14% as 'reasonable land, soil, and water conservation practices,' then natural resource management across a much larger landscape is at risk. The crux of this TMDL and load allocation is flawed as it is based on the theoretical 'load generated by potential 'culvert failures', which have not occurred and likely will not occur given the stable nature of both the watersheds and roads in question.

Comment #28e:

Page 110, second paragraph, "Sediment production and delivery to streams from forest roads and potential culvert failure are currently the primary human caused sources of sediment impairment to water quality in the Yaak TMDL Planning Area." Again, the forest disagrees with the use of a potential sediment source generating theoretical sediment loads as a measure of pollutant contributed to any watershed.

Comment #28 Response:

DEQ has reevaluated the methodologies used in deriving the loading numbers generated in the draft report and modified its analysis and discussion regarding culvert failure in the Yaak watershed. Culvert blowouts and chronic sediment delivery from culvert failure have been documented recently (YHRP, 2004-2006) in the Yaak watershed, however factors influencing chronic and acute sediment delivery from culverts are complex and variable, making numeric loading estimations uncertain. Impacts from culverts, however, do exist and pose a chronic threat of sediment loading where culverts are undersized, misaligned or not maintained.

Culvert calculations and allocations have been adjusted to reflect actual acute and chronic sediment delivery conditions observed in the Yaak. While loading estimates provided in the original draft were based on load-at-risk estimates and not actual observed delivery to streams, culvert failures have indeed occurred and have been documented in Yaak Headwaters Restoration Partnership sediment assessments. Additionally, where roads have been placed into storage or CORE, lack of culvert and road maintenance on these road segments has contributed to deteriorating conditions and creates further potential for catastrophic failure of culverts. Blockages were observed at many culverts, and in many instances, evidence of culvert overtopping and/or scour was observed, providing direct evidence of sediment delivery that can easily be remediated through simple manual methods.

As maintenance and upgrades on the road and culvert system are conducted, Lap Creek will be reevaluated to determine whether implementation or site-specific assessments have resulted in changes to water quality determination in Lap Creek. DEQ welcomes the thoroughness of your review, and has modified the document to better reflect on-the-ground conditions.

Please see Section 5.0 and 6.0 for changes to the culvert assessment discussion.

Comment #29:

Lap Creek has never been a watershed that supports fish so this should not be an issue when determining the sediment load in this creek. Nitrates are natural and are generated by the decomposition of wood etc. Don't try and put fish where they have never been historically.

Comment #29 Response:

Montana water quality standards state that waters are to be "maintained suitable for...growth and propagation of salmonid fishes and associated aquatic life" (ARM 17.30.623). This protection applies not only to salmonid fishes, but also to macroinvertebrate and periphyton communities. Sediment accumulations can detrimentally affect all faunal aquatic communities, and water quality indicators and allocations have been chosen that represent conditions that protect and maintain the beneficial uses of that water body. Salmonid fish have been observed in Lap Creek by the author & contributors, and are documented in Montana Fish Wildlife & Parks surveys (see Table 2-3).

Comment #30a:

Why is the Yaak water shed not meeting your standards and documents like the Yaak River Watershed being generated? It is my belief that you want to decommission more roads and further restrict us from using our public lands. The closed roads in the Yaak generate vegetation quite quickly and you can not make a case that the decommissioning of roads in this area helps the watershed in any fashion.

Comment #30b:

Please, please do not take away more access than has been removed already! Monitoring responsible use makes sense - closing off remaining recreational use of the public lands that we co-own would be like robbery. It might be an asset to monitoring responsible use by training local volunteers and equipping them with radio contact devices for enlisted volunteers. Or could a cell phone tower be constructed on top of Mt. Baldy to cover a large amount of the area by private cell phone use to report violators? Please extend the comment period and consider seriously the responses gathered.

Comment #30 Response:

Regarding DEQ's authority and statutory requirements to evaluate water quality standards and develop appropriate TMDLs, Montana state law (MCA 75-7-702-703) directs the DEQ to assess the state's water bodies and develop TMDLs for all impaired or threatened water bodies. Section 3.0 presents information and background on all

applicable federal and state regulatory requirements and statutes relating to TMDL development.

DEQ understands the concern regarding removal of access. It is not the intent of the TMDL to close roads or restrict access. It is the intent of the TMDL to assess sources contributing to water quality impairment and provide reductions necessary to meet water quality standards. It is the belief of the DEQ that the required reductions may be met through improvements and BMPs on existing 'problem' sites. Monitoring road usage and violation however, is beyond the scope of the TMDL document. DEQ suggests contacting the USFS with these suggestions.