Little Salmon River
Subbasin Assessment and TMDL



Department of Environmental Quality

February 2006

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Little Salmon River TMDL

February 2006

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Abbreviations, Acronyms, and Symbols

§303(d)	Refers to section 303 subsection (d) of the Clean Water Act, or a list of impaired water bodies required by this section
µ	micro, one-one thousandth
§	Section (usually a section of federal or state rules or statutes)
AU	assessment unit
AWS	agricultural water supply
BLM	United States Bureau of Land Management
BMP	best management practice
BOR	United States Bureau of Reclamation
BURP	Beneficial Use Reconnaissance Program
C	Celsius
CFR	Code of Federal Regulations (refers to citations in the federal administrative rules)
cfs	cubic feet per second
cm	centimeters
CWA	Clean Water Act
CWE	cumulative watershed effects
DEQ	Department of Environmental Quality
DO	dissolved oxygen
DWS	domestic water supply
EPA	United States Environmental Protection Agency
F	Fahrenheit
GIS	Geographical Information Systems

HUC Hydrologic Unit Code

IDAPA Refers to citations of Idaho administrative rules

IDFG Idaho Department of Fish and Game

IDL Idaho Department of Lands

IDWR Idaho Department of Water Resources

INFISH the federal Inland Native Fish Strategy

km kilometer

km^2 square kilometer

LA load allocation

LC load capacity

m meter

m^3 cubic meter

mi mile

mi^2 square miles

MGD million gallons per day

mg/L milligrams per liter

mm millimeter

MOS margin of safety

NA not assessed

NB natural background

NPDES National Pollutant Discharge Elimination System

NRCS Natural Resources Conservation Service

NTU nephelometric turbidity unit

PCR primary contact recreation

ppm part(s) per million

QA quality assurance

QC quality control

RDI DEQ's River Diatom Index

RFI DEQ's River Fish Index

RCA riparian conservation area

RMI DEQ's River Macroinvertebrate Index

SBA subbasin assessment

SCR secondary contact recreation

SFI DEQ's Stream Fish Index

SHI DEQ's Stream Habitat Index

SMI DEQ's Stream Macroinvertebrate Index

SRW special resource water

SS salmonid spawning

STATSGO State Soil Geographic Database

TDS total dissolved solids

TMDL total maximum daily load

TP total phosphorus

TS total solids

TSS total suspended solids

U.S. United States

U.S.C. United States Code

USDA United States Department of Agriculture

USFS United States Forest Service

USGS United States Geological Survey

WAG Watershed Advisory Group

WBAG *Water Body Assessment Guidance*

WBID water body identification number

WLA wasteload allocation

WQLS water quality limited segment

WQS water quality standard

Executive Summary

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the CWA are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters whenever possible. Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list of impaired waters, currently every two years. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards.

This document addresses water bodies in the Little Salmon River Subbasin that have been placed on what is known as the "§303(d) list" as well as other water bodies in the watershed.

This subbasin assessment and TMDL analysis has been developed to comply with Idaho's TMDL schedule. This assessment describes the physical, biological, and cultural setting; water quality status; pollutant sources; and recent pollution control actions in the Little Salmon River Subbasin located in central Idaho. The first part of this document, the subbasin assessment, is an important first step leading into the TMDL. The starting point for this assessment was Idaho's current §303(d) list of water quality limited water bodies.

The subbasin assessment portion of this document examines the current status of §303(d) listed waters and defines the extent of impairment and causes of water quality limitation throughout the subbasin (Table A). The loading analysis quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition of meeting water quality standards.

Subbasin at a Glance

The Little Salmon River Watershed (Figure A) lies entirely in central Idaho and comprises about 576 square miles. The Little Salmon River originates at about 6,280 feet off of Blue Bunch Ridge. The watershed is 45 miles long and ranges from 0.5 to 22 miles wide. Located at the 45th parallel, the watershed is about 500 miles inland from the Pacific Ocean. The river flows north for 51 miles to its confluence with the Salmon River at river mile 86.7 at Riggins (IDWR 2001). US Highway 95 parallels most of the Little Salmon River.

This watershed lies within Hydrologic Unit Code (HUC) 17060210.

Table A. Idaho 2002 §303(d)[1] listed water bodies, water body description, and pollutant of concern, Little Salmon River Watershed.

Water Body Name	Assessment Unit ID Number	2002 §303(d) Boundaries	Pollutants	Listing Basis
Little Salmon River	17060210SL001_02	Round Valley Creek to Mouth	Sediment	EPA
Little Salmon River	17060210SL007_05	5th Order	Unknown	EPA
Little Salmon River	17060210SL007_04	4th Order	Temperature	EPA
Big Creek	17060210SL009_02a	1st and 2nd Order	Unknown	DEQ
Elk Creek	17060210SL016_03	Little Elk Creek to Mouth	Sediment	USFS
Indian Creek	17060210SL001_03	Source to Mouth	Sediment	EPA
Shingle Creek	17060210SL002_02a	2nd Order	Sediment	EPA
Brundage Reservoir	17060210SL011L-0L	Reservoir	Temperature	EPA

[1]Refers to a list created in 1998 of water bodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection "d" of the Clean Water Act.

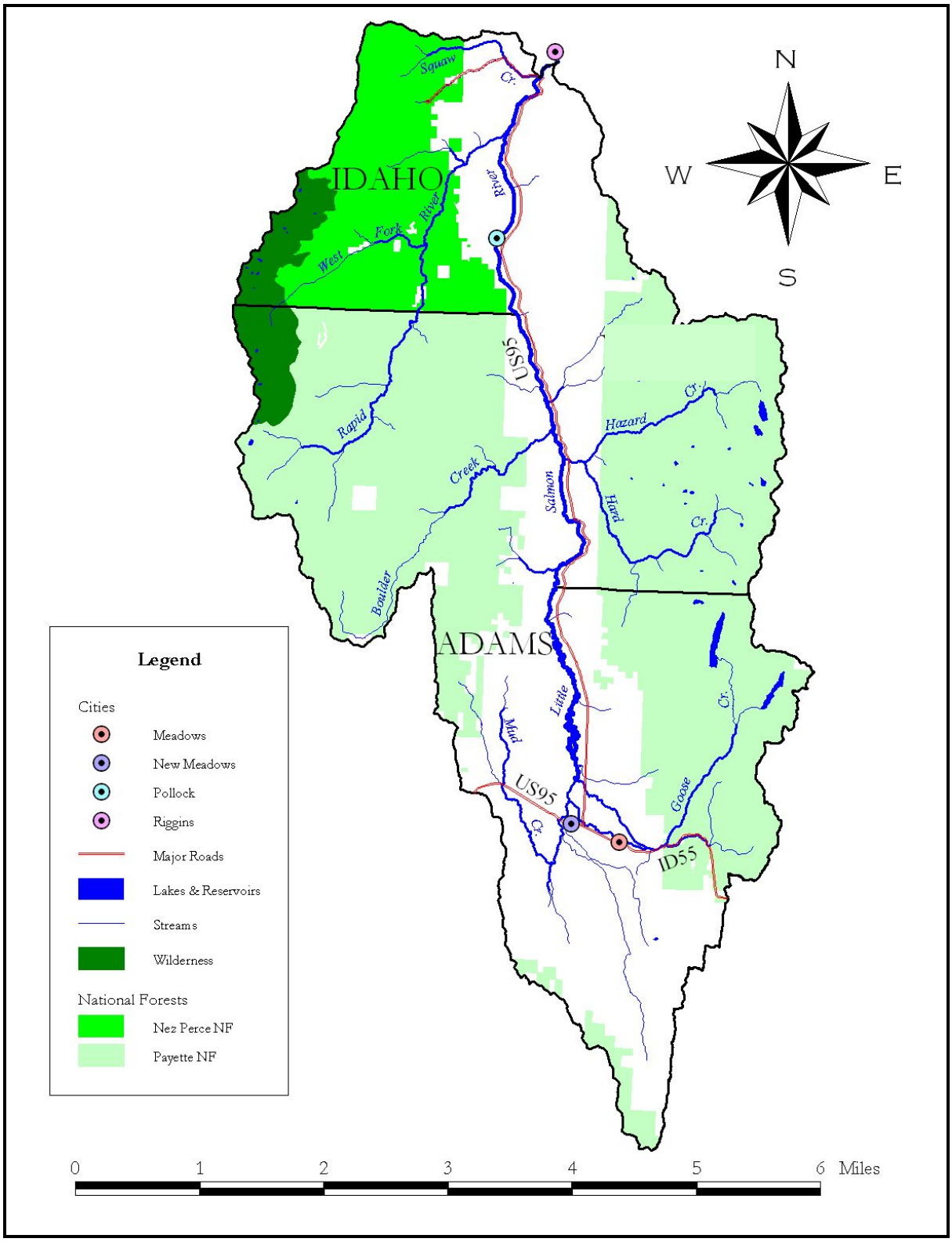


Figure A. Little Salmon River Watershed

Key Findings

TMDLs were developed for two 303(d) listed streams: the Little Salmon River (5th order assessment unit) and Big Creek (Table B): Other subbasin assessment outcomes are shown in Table C.

All streams in the watershed for which DEQ obtained information are described in section 2. Many of these streams were not on the 303(d) list of impaired waters and did not require TMDLs. The streams discussed in section 2, but not included in the executive summary because they were not on the 303(d) list and are not proposed for listing are: Mud Creek, Three Mile Creek, Four Mile Creek, Six Mile Creek, Martin Creek, Round Valley Creek, Hazard Creek, Boulder Creek, Rattlesnake Creek, Fall Creek, Denny Creek, Hat Creek, Sheep Creek, Lockwood Creek, Squaw Creek, and Rapid River. If there was enough information for these streams that a call regarding beneficial use support could be made, that was done and if there was not information to make a decision regarding beneficial use support (e.g the lower reaches of Three Mile Cree, Four Mile Creek, and Martin Creek) then that is stated.

TMDLs

The **Little Salmon River** from Big Creek to Round Valley Creek was found to have beneficial uses impaired by temperature, nutrients, and bacteria. TMDLs were developed for these pollutants. The Little Salmon River from Vicks Creek to Big Creek was found to have beneficial uses impaired by temperature. A TMDL was developed for this pollutant.

Potential natural vegetation (shade) was used as a surrogate for temperature because this would achieve natural background conditions. The temperature targets are based on IDAPA 58.01.02.200.09 which states that “when natural background conditions exceed any applicable water quality criteria set forth in Sections 21, 250, 251 or 253, the applicable water quality criteria shall not apply; instead pollutant levels shall not exceed the natural background conditions. In laymen’s terms, the temperature targets are based on a natural riparian plant cover condition over the stream. In this TMDL, the potential natural vegetation cover represents the loading capacity of the streams in terms of minimum heat load. This analysis contains an implicit margin of safety as all streams are assumed to be at potential natural vegetation when in reality natural cover can be more variable due to natural forces. Existing vegetative cover represents the existing load of heat to the streams.

The load capacity for nutrients was calculated using a target of 0.075 mg/L total phosphorus. This target was determined to prevent excessive algal growth.

Bacteria concentrations were in violation of the state standard for both primary and secondary contact recreation. A TMDL was developed based on the state standard that waters designated for primary and secondary contact recreation not contain *E. coli* bacteria significant to the public health in concentrations exceeding a geometric mean of 126 E. coli organisms/100mL.

The **Little Salmon River from Round Valley Creek to the mouth** showed support of beneficial uses. However, DEQ was unable to analyze the effect of coarse sediment in the system. Several government agencies including USBR and the BLM have pointed out that coarse sediment transported as part of the 1997 flood is potentially reducing salmonid spawning in places and leading to channel aggradation. DEQ proposes to list the Little Salmon River from Round Valley Creek to the mouth for habitat alteration and delist for sediment. This listing is on the basis of DEQ Beneficial Use Reconnaissance Program (BURP) scores that did not indicate impairment and low suspended sediment data. However, the listing for habitat alteration is in recognition that the system was changed due to the construction of the highway and the channel remains constricted, leading to potential coarse sediment loading problems. The state of Idaho's antidegration policy applies in this case and existing uses must be maintained and protected from any activities that would result in human caused excess sediment delivery to the system.

Big Creek was listed for an unknown pollutant. Elevated nutrient and bacteria levels were found in the creek. TMDLs were developed for nutrients and bacteria. The load capacities were based on the same targets (0.075 mg/L total phosphorus and a geometric mean of 126 cts/100 mL of E. coli) as the Little Salmon River TMDL.

Elk Creek, Indian Creek, and **Shingle Creek** were all listed for sediment. Beneficial uses were fully supported in these watersheds and TMDLs are not necessary.

Brundage Reservoir was monitored weekly for temperature from early July through Mid-August 2005. Monitoring occurred in late afternoon and early evening when reservoir temperatures would be highest. No violations of the cold water temperature standard were seen. Brundage Reservoir is proposed for delisting for temperature.

Goose Creek was assessed as part of DEQ's Beneficial Use Reconnaissance Program (BURP) and was found to have impaired beneficial uses. Goose Creek is proposed for listing on the 303(d) list for an unknown pollutant. Lack of flow may be a causal factor in impairment of beneficial uses for Goose Creek. Therefore, a TMDL was not developed at this time. DEQ did not have the time during the writing of this TMDL to characterize the flows in Goose Creek to determine if intermittence was impairing beneficial uses.

Table B. Streams and Pollutants for which TMDLs Were Developed

Stream	Pollutant(s)
Little Salmon River (5th Order –Big Creek to Round Valley Creek)	Temperature, bacteria, nutrients
Little Salmon River (4th Order-Vicks Creek to Big Creek)	Temperature
Big Creek	Bacteria, nutrients

Table C. Summary of Assessment Outcomes for 2002 303(d) List

Waterbody Segment (assessment unit)	Pollutant	TMDL(s) Completed	Recommended Changes to §303(d) List
Little Salmon River (SL007_04)	Temperature	Temperature	None
Little Salmon River (SL007_05)	Unknown	Temperature, bacteria, nutrients	None
Little Salmon River (SL001_2)	Sediment	None	Delist for sediment List for habitat alteration
Big Creek (SL009_02a)	Unknown	Bacteria, nutrients	None
Elk Creek (SL016-03)	Sediment	None	Delist for sediment
Indian Creek (SL01-03)	Sediment	None	Delist for sediment
Shingle Creek (SL002-02a)	Sediment	None	Delist for sediment
Brundage Reservoir (SL011L-0L)	Temperature	None	Delist for temperature
Goose Creek (SL010_04)	Unknown	None	List for an unknown pollutant

Public Participation

DEQ has complied with the WAG consultation requirements set forth in Idaho Code § 39-3611. A WAG was officially formed in May 2004 for the Little Salmon River TMDL. DEQ provided the WAG with information concerning applicable water quality standards, water quality data, monitoring, assessments, reports, procedures, and schedules. The Little Salmon River WAG was officially recognized by DEQ in May of 2004. The group met regularly over the course of the development of the TMDL in New Meadows. In 2005, the WAG met January 31st, April 5th, June 14th, August 23rd, September 15th and December 8th. In 2004, the WAG met on May 17th , July 12th and September 15th.

DEQ utilized the knowledge, expertise, experience and information of the WAG in developing this TMDL. DEQ also provided the WAG with an adequate opportunity to participate in drafting the TMDL, reviewing draft versions of the TMDL and suggesting changes to the document.

Concern from some WAG members was expressed at the high reductions required for Big Creek for bacteria. In particular, those WAG members wondered if these reductions were

possible. A WAG member pointed out that the E. coli present from the largely grass fed cows in the Meadows Valley area are far less virulent then the strains of E. coli that are excreted from grain fed cows.

At the end of the September 15, 2005 meeting of the Little Salmon River WAG, the WAG members present voted their approval to go out for public comment with the Little Salmon River TMDL. A public meeting was held on November 10th, 2005. The three WAG members present at a meeting on February 9, 2006 voted their approval to submit the final draft to EPA. Since a majority was not present, a majority vote was solicited by DEQ by mail and email. A majority vote was obtained on February 22nd .

One WAG voting member voted against submitting the TMDL to EPA because he felt that the sections on Mud Creek, Three Mile Creek, Four Mile Creek, Six Mile Creek and Martin Creek were impaired for beneficial uses and that additional data needed to be collected to ascertain whether on not this is the case. He stated that there had been significant discussion of these creeks and whether or not they were impaired but additional monitoring was not conducted during the course of TMDL development.

He stated that Kirk Campbell from the Idaho Department of Agriculture in his report "Little Salmon River Year Two Water Quality Report April 2005 through October 2005" that beneficial uses are impaired from data he collected on the Four Mile Creek site as well as other sites to be higher amounts than what meets the state tolerances. Mr. Campbell also stated at the December 2005 WAG meeting that Four Mile Creek was impaired rather than undetermined. The WAG member stated at that meeting that Leslie Freeman from DEQ would check into the alternatives of listing Three Mile, Four Mile and Martin Creek. That has not been done to this member's satisfaction.

The WAG member went on to state that these creeks are likely to be elevated nutrient/bacteria/temperature transporting streams that flow into the Little Salmon River as described by Kirk Campbell in his report on Four Mile Creek because of their similarity.

Also, DEQ did not include information in the TMDL on proposed monitoring in 2006 of Four Mile, Three Mile, Martin, Squaw and Six Mile Creeks (monitoring that was supported by a vote of the WAG). The member also stated that DEQ did not clearly delineate that lack of information prevented the agency from making a beneficial use support status call on the lower reaches of these creeks (see section 2 for more details on these specific streams). In addition, 2005 monitoring information was not presented in the TMDL.

The Idaho Department of Agriculture will monitor those streams if they can obtain access to them from the landowners in 2006. The WAG member emphasized that documentation of whether or not access was granted by landowners needed to occur in the TMDL in order to lend credibility to the document. Four Mile Creek was monitored sporadically in 2005 and not enough data was collected to determine whether the creek was impaired or unimpaired. This past and future monitoring will help delineate nutrient/bacteria loading to the system for the purposes of implementation planning for the mainstem Little Salmon River. If

information regarding beneficial use impairment is gathered during this monitoring, it may be submitted to DEQ for 303(d) (integrated report) listing.

1. Subbasin Assessment – Watershed Characterization

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the CWA, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list (a "§303(d) list") of impaired waters. Currently this list must be published every two years. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. (In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.)

This document addresses the water bodies in the Little Salmon River Subbasin that have been placed on Idaho's current §303(d) list.

The overall purpose of the subbasin assessment (SBA) and TMDL is to characterize and document pollutant loads within the Little Salmon River Subbasin. The first portion of this document, the SBA, is partitioned into four major sections: watershed characterization, water quality concerns and status, pollutant source inventory, and a summary of past and present pollution control efforts (Sections 1 – 4). This information will then be used to develop a TMDL for each pollutant of concern for the Little Salmon River Subbasin (Section 5).

1.1 Introduction

In 1972, Congress passed the Federal Water Pollution Control Act, more commonly called the Clean Water Act. The goal of this act was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Water Environment Federation 1987, p. 9). The act and the programs it has generated have changed over the years, as experience and perceptions of water quality have changed.

The CWA has been amended 15 times, most significantly in 1977, 1981, and 1987. One of the goals of the 1977 amendment was protecting and managing waters to insure "swimmable and fishable" conditions. This goal, along with a 1972 goal to restore and maintain chemical, physical, and biological integrity, relates water quality with more than just chemistry.

Background

The federal government, through the U.S. Environmental Protection Agency (EPA), assumed the dominant role in defining and directing water pollution control programs across the country. The Department of Environmental Quality (DEQ) implements the CWA in Idaho, while the EPA oversees Idaho and certifies the fulfillment of CWA requirements and responsibilities.

Section 303 of the CWA requires DEQ to adopt water quality standards and to review those standards every three years (EPA must approve Idaho's water quality standards). Additionally, DEQ must monitor waters to identify those not meeting water quality standards. For those waters not meeting standards, DEQ must establish a TMDL for each pollutant impairing the waters. Further, the agency must set appropriate controls to restore water quality and allow the water bodies to meet their designated uses.

These requirements result in a list of impaired waters, called the "§303(d) list." This list describes water bodies not meeting water quality standards. Waters identified on this list require further analysis. A SBA and TMDL provide a summary of the water quality status and allowable TMDL for water bodies on the §303(d) list. The Little Salmon River TMDL provides this summary for the currently listed waters in the Little Salmon River Subbasin.

The SBA section of this document (Sections 1 – 4) includes an evaluation and summary of the current water quality status, pollutant sources, and control actions in the Little Salmon River Subbasin to date. While this assessment is not a requirement of the TMDL, DEQ performs the assessment to ensure impairment listings are up to date and accurate. The TMDL is a plan to improve water quality by limiting pollutant loads. Specifically, a TMDL is an estimation of the maximum pollutant amount that can be present in a water body and still allow that water body to meet water quality standards (Water quality planning and management, 40 CFR Part 130). Consequently, a TMDL is water body- and pollutant-specific. The TMDL also allocates allowable discharges of individual pollutants among the various sources discharging the pollutant.

Some conditions that impair water quality do not receive TMDLs. The EPA does consider certain unnatural conditions, such as flow alteration, human-caused lack of flow, or habitat alteration, that are not the result of the discharge of a specific pollutant as "pollution." However, TMDLs are not required for water bodies impaired by pollution, but not by specific pollutants. A TMDL is only required when a pollutant can be identified and in some way quantified.

Idaho's Role

Idaho adopts water quality standards to protect public health and welfare, enhance the quality of water, and protect biological integrity. A water quality standard defines the goals of a water body by designating the use or uses for the water, setting criteria necessary to protect those uses, and preventing degradation of water quality through antidegradation provisions. The state may assign or designate beneficial uses for particular Idaho water bodies to support. These beneficial uses are identified in the Idaho water quality standards and include the following:

- Aquatic life support–cold water, seasonal cold water, warm water, salmonid spawning, modified
- Contact recreation–primary (swimming), secondary (boating)

- Water supply–domestic, agricultural, industrial
- Wildlife habitats
- Aesthetics

The Idaho legislature designates uses for water bodies. Industrial water supply, wildlife habitats, and aesthetics are designated beneficial uses for all water bodies in the state. If a water body is unclassified, then cold water and primary contact recreation are used as additional default designated uses when water bodies are assessed.
A subbasin assessment entails analyzing and integrating multiple types of water body data, such as biological, physical/chemical, and landscape data to address several objectives:

- Determining the degree of designated beneficial use support of the water body (i.e., attaining or not attaining water quality standards).
- Determining the degree of achievement of biological integrity.
- Compile descriptive information about the water body, particularly the identity and location of pollutant sources.
- Determining the causes and extent of the impairment when water bodies are not attaining water quality standards.

1.2 Physical and Biological Characteristics

The Little Salmon River basin (Figure 1) covers 576 square miles in northeastern Adams and southwestern Idaho Counties and coincides with US Geological Survey (USGS) Hydrologic Unit Code (HUC) 17060210. The Little Salmon River originates at about 6,280 feet off of Blue Bunch Ridge. The watershed is 45 miles long and ranges from 0.5 to 22 miles wide. Located at the 45th parallel, the watershed is about 500 miles inland from the Pacific Ocean. The river flows north for 51 miles to its confluence with the Salmon River at river mile 86.7 at the city of Riggins (IDWR 2001). US Highway 95 parallels most of the Little Salmon River.

Several major tributaries enter the Little Salmon River at the southern end of the basin in Meadows Valley. Mud Creek and its tributaries originate between 4,600 and 5,600 feet above sea level on Brush Mountain at the western edge of the basin. Big Creek originates at 6,600 feet above sea level and flows north towards New Meadows. Goose Creek originates on the east side of the valley at elevations above 7,000 feet and has reservoirs used for irrigation in Meadows Valley. In the valley, Goose Creek splits into the East and West Branches that flow into the Little Salmon River north of New Meadows.

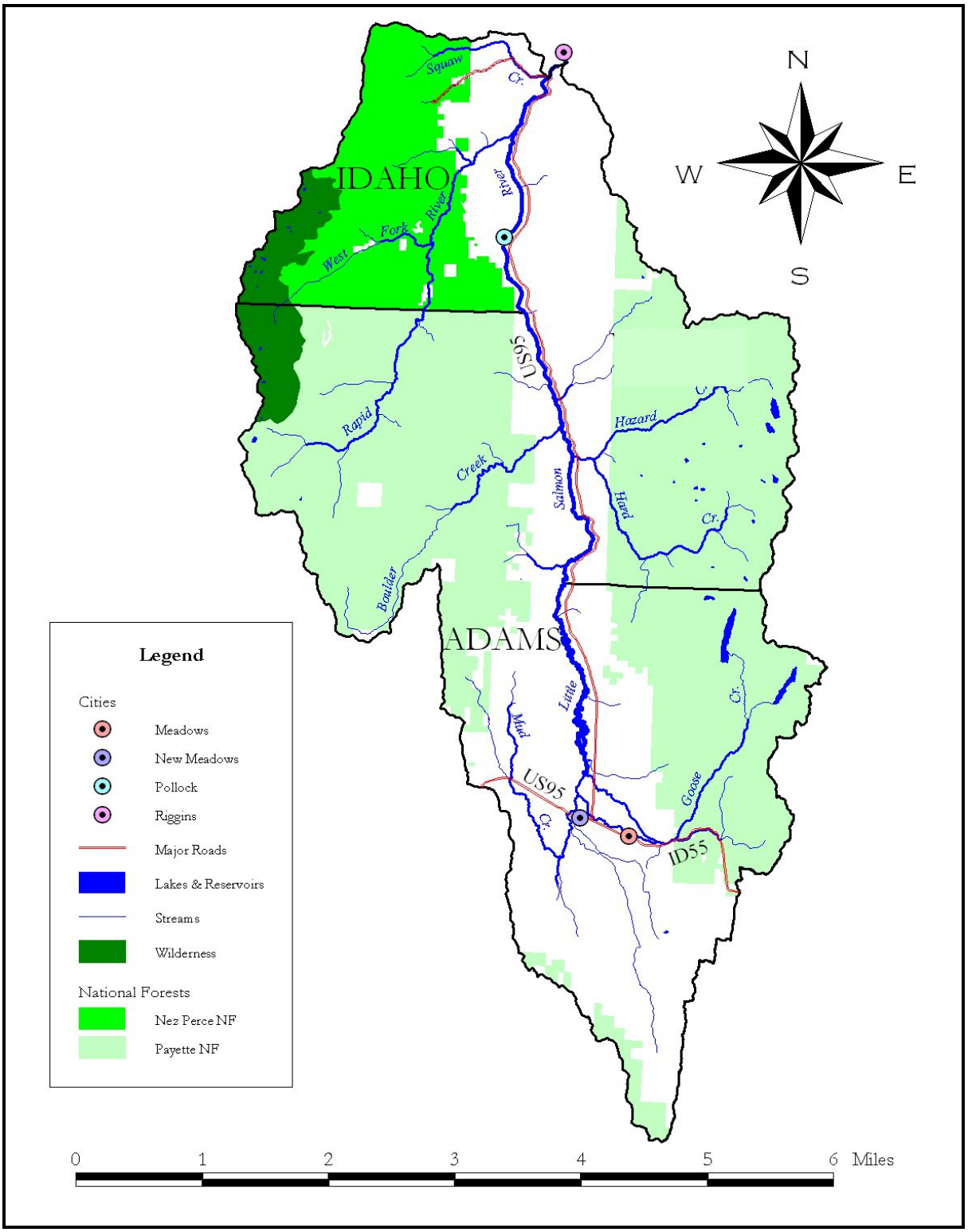


Figure 1. Little Salmon River Basin.

Farther downstream, Three Mile, Four Mile, Six Mile and Martin Creeks flow into the Little Salmon River from the east. Round Valley Creek flows in from the west and generally marks

the end of the Meadows Valley and the beginning of the canyon. Hazard Creek flows in from the eastern side and Boulder Creek from the western side in the canyon reach. Both streams originate above 7,000 feet in elevation. Numerous small tributaries also enter the river in this canyon stretch.

Rapid River enters from the west into the Little Salmon River at river mile 4 and originates in the Hells Canyon Wilderness/Recreation Area at elevations above 9,000 feet. Shingle Creek is a northern tributary to Rapid River. Squaw Creek also enters the Little Salmon River at river mile l.1. It originates at approximately 7,200 feet in elevation.

The following subsections discuss climate, geology, soils, topography, land cover, and fisheries in the Little Salmon Watershed.

Climate

The Little Salmon River basin is characterized by warm, dry summers and cold, moist winters. Most of the precipitation falls as snow with the greatest amounts of snow occurring on the eastern side of the basin. Climate varies with altitude. The lower elevations (i.e. the area near Riggins) are semi-arid while the higher elevations are sub-humid (IDWR 2001).

Average annual precipitation ranges from less than 20 inches at Riggins to more than 50 inches at Brundage Mountain. Annual runoff averages 18 inches (BLM 2000). Table 1 shows general climate statistics for the watershed, and Figure 2 shows precipitation contours for the Little Salmon River Watershed.

Table 1. Climatological summary data, 1961-1988 (IWRB 2001)

Climate Factor	New Meadows	Riggins
Elevation (feet)	3,870	1,760
Annual Precipitation (inches)	24.8	16.5
Annual Snowfall (inches)	86.4	7.7
Average January Precipitation (inches)	3.4	1.2
Average July Precipitation (inches)	0.7	0.8
Average January Minimum Temperature (°F)	7.4	27.4
Average January Maximum Temperature (°F)	30	41.1
Average July Minimum Temperature (°F)	41.7	58.4
Average July Maximum Temperature (°F)	83.9	92.3
Lowest Temperature (1961-90) (°F)	-45	-10
Highest Temperature (1961-90) (°F)	104	115

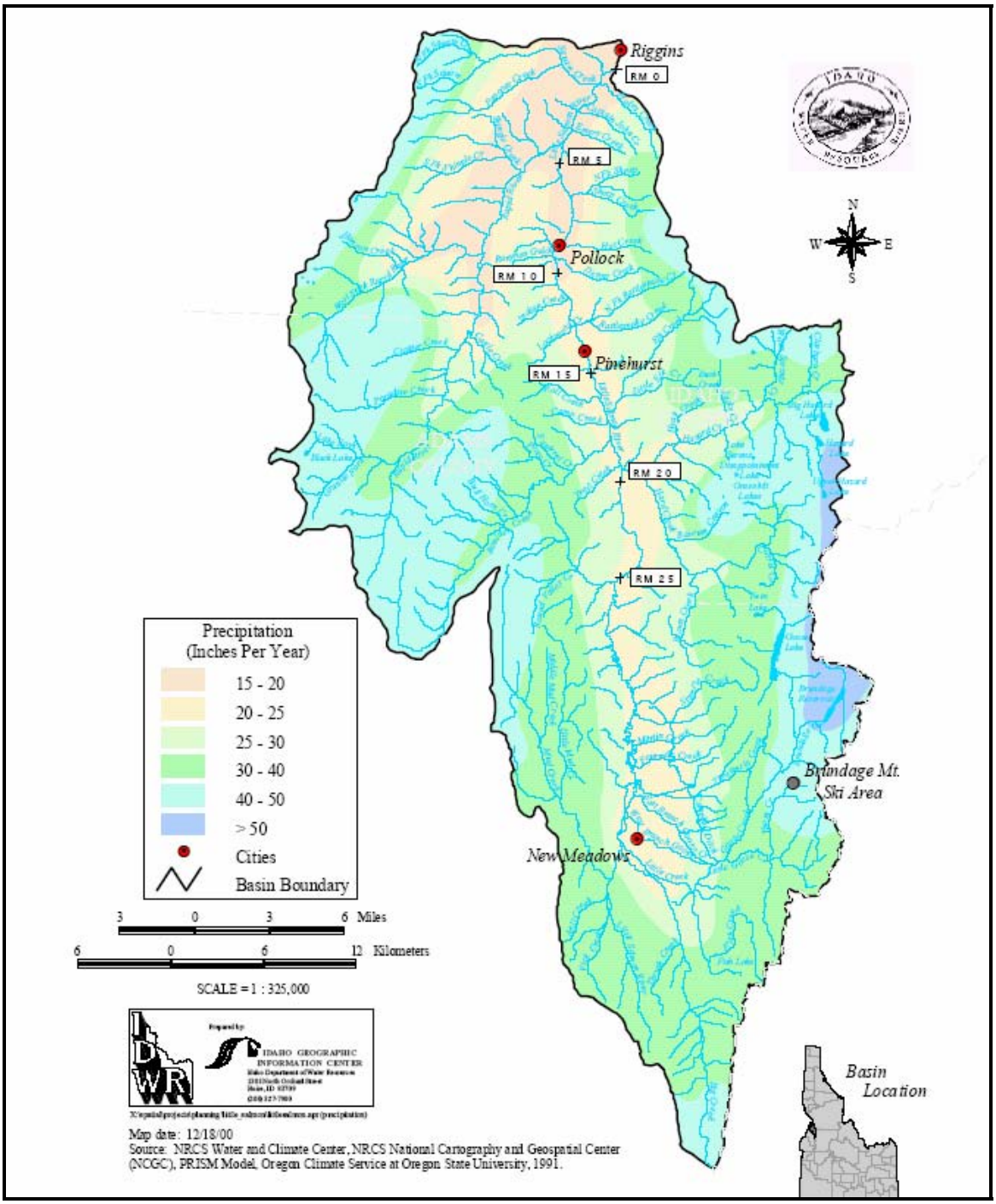


Figure 2. Little Salmon River Basin Precipitation Contours.

Geology

The Little Salmon River watershed comprises two geologic provinces: the Northern Rocky Mountain province in the east and the Columbia Intermontane province in the west. The Northern Rocky Mountain province contains the Idaho Batholith, a Cretaceous (75-100 million years ago) rock formation formed by upwelling magma that cooled as granite. The Columbia Intermontane province is characterized by Columbia Basin basalt flows, which are 14-17 million years old. The Little Salmon River is essentially the boundary between the two and marks the boundary between an ancient North American continental plate and an oceanic plate.

The topography in the western part of the watershed is a result of block faulting and glacial erosion. In the east, volcanic processes and subsequent faulting and erosion created the landscape of high mountains and deep intermontane valleys. The central portion of the watershed is filled with sheets of Columbia Basin basalt. These sheets have also undergone significant folding and faulting. Figure 3 shows the geologic characteristics of the watershed.

Alluvial sediments and gravels fill the fault valleys (New Meadows Valley and Little Salmon River Canyon). Meadows Valley was formed as a result of a fault block dropping below the surrounding terrain. Major faults are located on the eastern side of the basin, approximating the Adams-Valley county line and passing through the Brundage Mountain area. In the southern end of the basin, a major fault passes through Rock Flat and Thorn Creek and continues along Goose Creek and the large rift valley west of the Hazard lakes. Finally, a third fault can be found on the eastern edge of Meadows Valley, demarcating the little Salmon River Canyon.

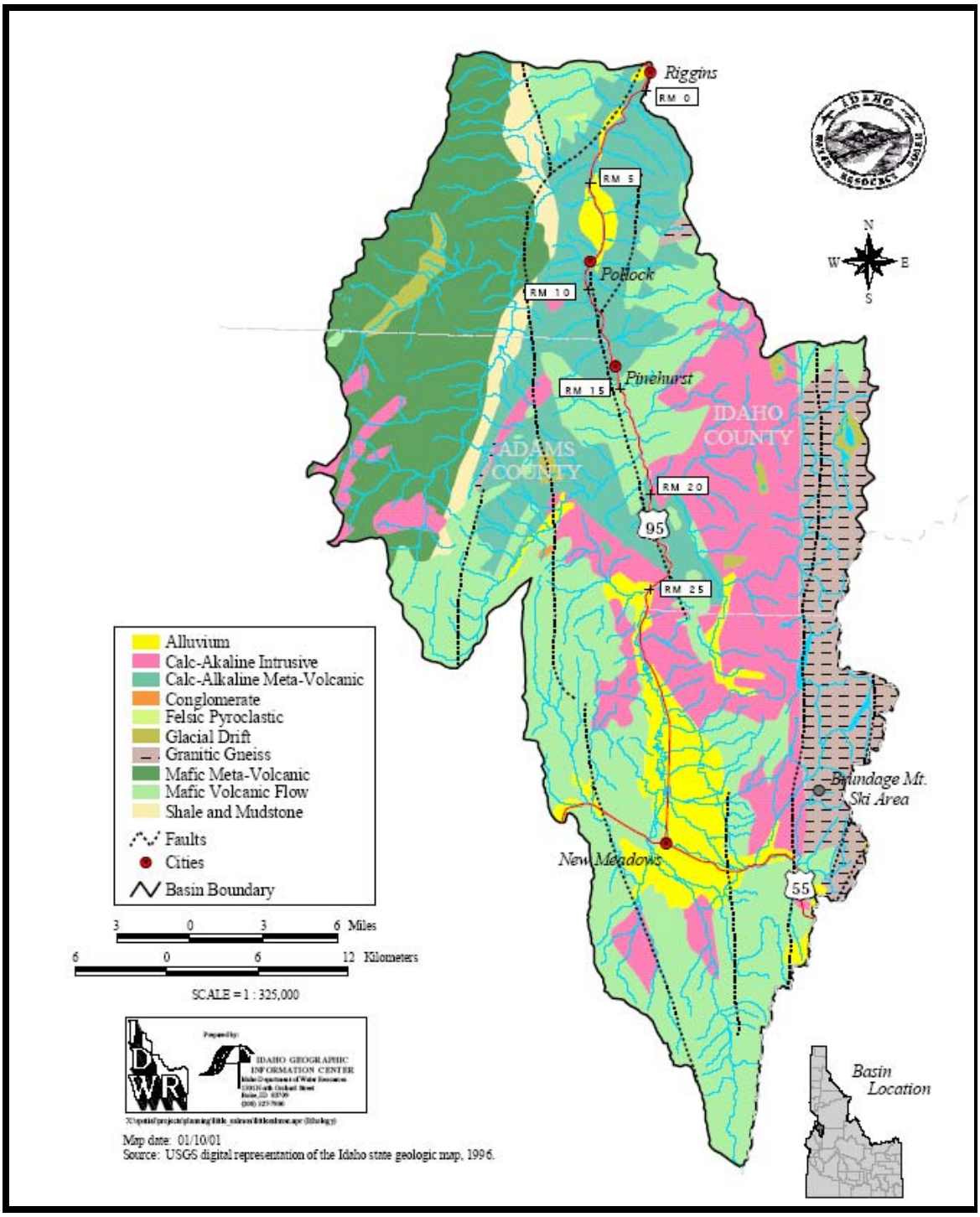


Figure 3. Little Salmon River Basin Geology.

Soils

The soils associated with the upper Meadows Valley tend to have seasonally high water tables. Some soils may remain wet due to irrigation while others naturally stay wet. Shallow soils in the valley are alluvial gravels, clay and boulders. These meadow alluvial soils are very deep and poorly drained. There are also soils that are well drained as shown in Table 2. Infiltration rates for all soils range from moderate to very slow. Alluvial soils range in depth from a few feet to about 30 feet before reaching bedrock material. Table 2 is a description of soil attributes, and Figure 4 shows the location of major soils in the basin.

The most common soils within the Little Salmon River subbasin are border zone and volcanic soils. Border zone geologic groups occur on the borders of the Idaho Batholith with scattered outcrops throughout the region, consisting of granitic rocks, gneisses, schists, quartzites, and other metamorphic rocks throughout the region. Soil textures are medium to coarse and are generally highly erodible. Volcanic soils consist of various basalt formations that occur throughout the subbasin. Basalt produces a medium-to-fine textured soil with low-to-medium erodibility.

Table 2. Soil characteristics of the Little Salmon River Basin.

Component Name	Texture[1]	Drainage[2]	Infiltration[3]
Andic Cryochrepts	SIL	W	B
Archabal	L	W	B
Blackwell	CL	VP	D
Bluebell	CB-L	W	C
Bluesprin	CBV-L	W	C
Demast	L	W	B
Dystic Cryochrepts	GR-L	W	B
Gaib	GRV-L	W	D
Gestrin	L	MW	B
Jugson	COSL	SE	C
Klickson	CB-L	W	B
Lithic Haploxerolls	GR-LS	W	D
McCall	CBV-SL	SE	B
Naz	SL	W	B
Quartzburg	COSL	SE,E	C
Rock Outcrop	UWB	[4]	D
Suloaf	CB-SIL	W	B
Swede	L	W	B
Tannahill	CB-L	W	B
Ticanot	CBV-L	W	D
Typic Dystrochrepts	L	W	[4]
Vay Family	SIL	W	B

Texture[1]: CB-cobbly, CBV-very cobbly, CL-clay loam, COSL-coarse sandy loam, GR-gravelly, GRV-very gravelly, L-loam, LS-loamy sand, SIL-silt loam, SL-sandy loam, UWB-unweathered bedrock
Drainage[2]: E-excessively, SE-somewhat excessively, W-well, MW-moderately well, P-poor, VP-very poor.
Infiltration Rate[3]: B-moderate, C-slow, D-very slow
[4]Values not available or not applicable.

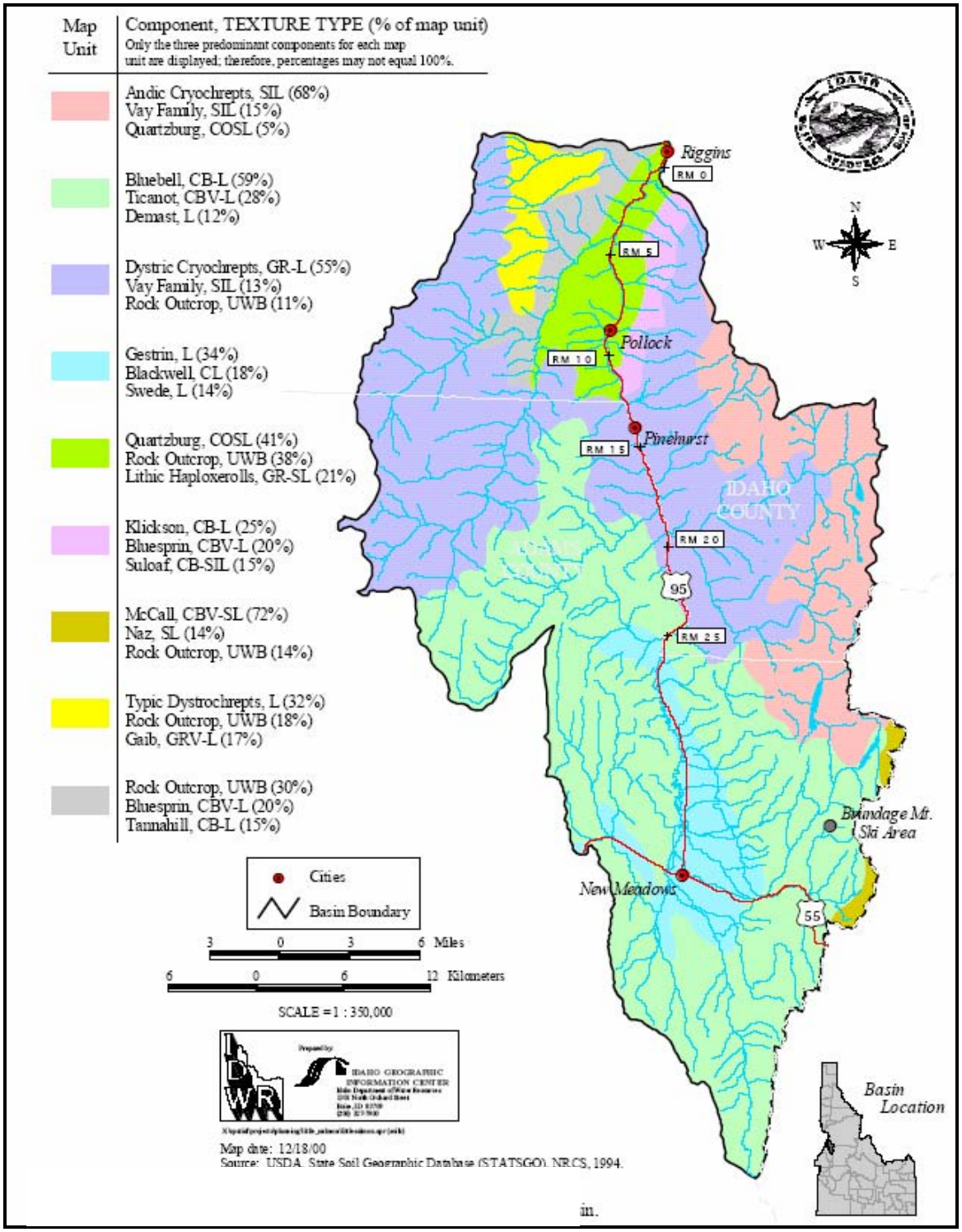


Figure 4. Little Salmon River Basin Soils.

Topography

Elevations in the watershed range from 9,393 feet to 1,760 feet. The mean elevation is 5,430 feet. The uplands portion of the watershed is characterized by steep, deeply incised slopes with gradients of 60% or more. Mid-elevations are typically steep v-shaped drainages. The upper half of the watershed is a meadow area surrounded by forested slopes, with the Little Salmon River meandering through the meadow area (Figure 5). About midway in the watershed, the character of the watershed changes as the Little Salmon River enters a canyon below Round Valley Creek. As the river elevation drops from the upper meadows, the river gradient increases and flows through a narrow and steep sloped canyon for approximately five miles. From Hazard Creek downstream to the confluence with the Salmon River, the gradient lessens and the landscape becomes more arid.

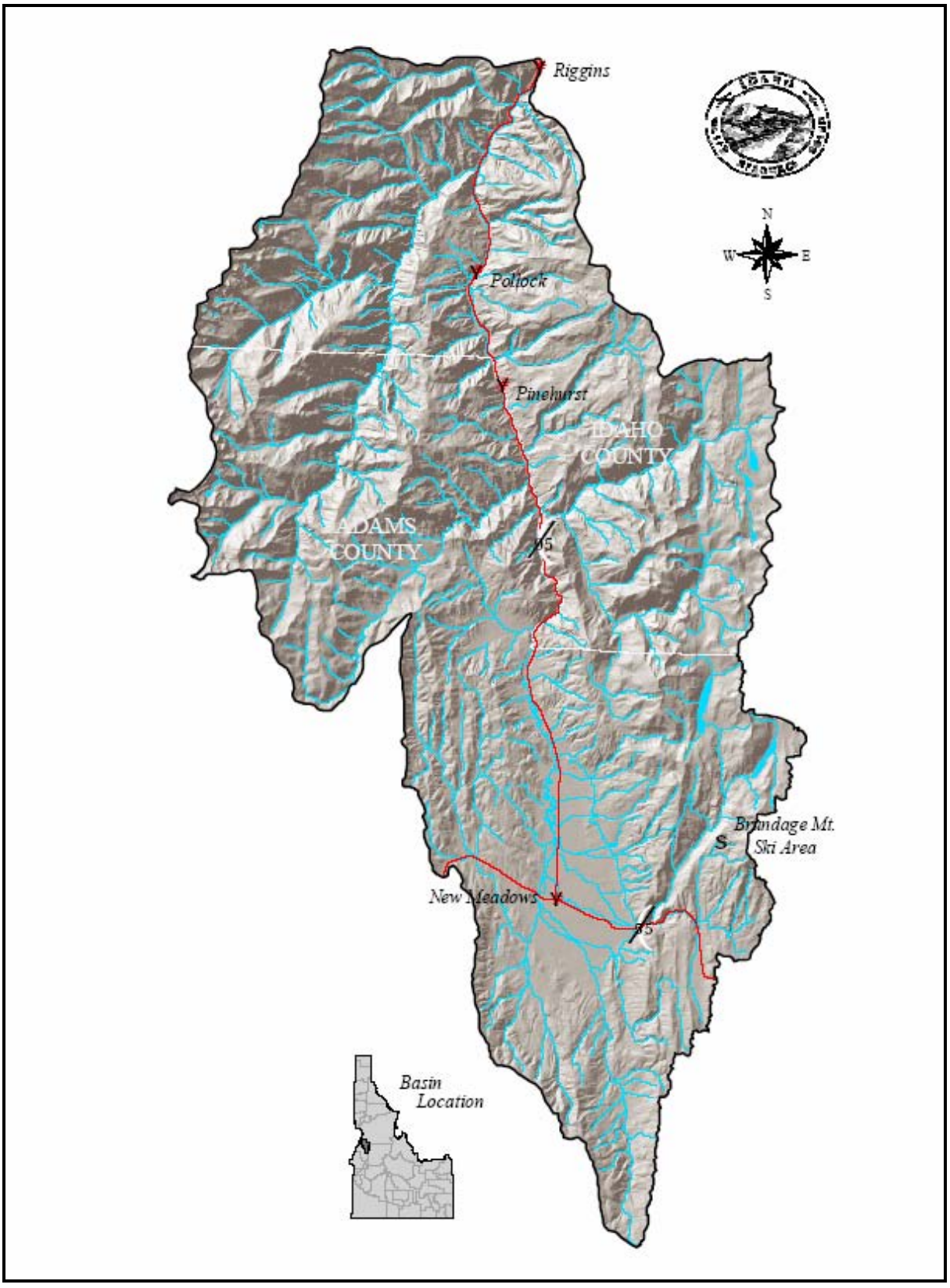
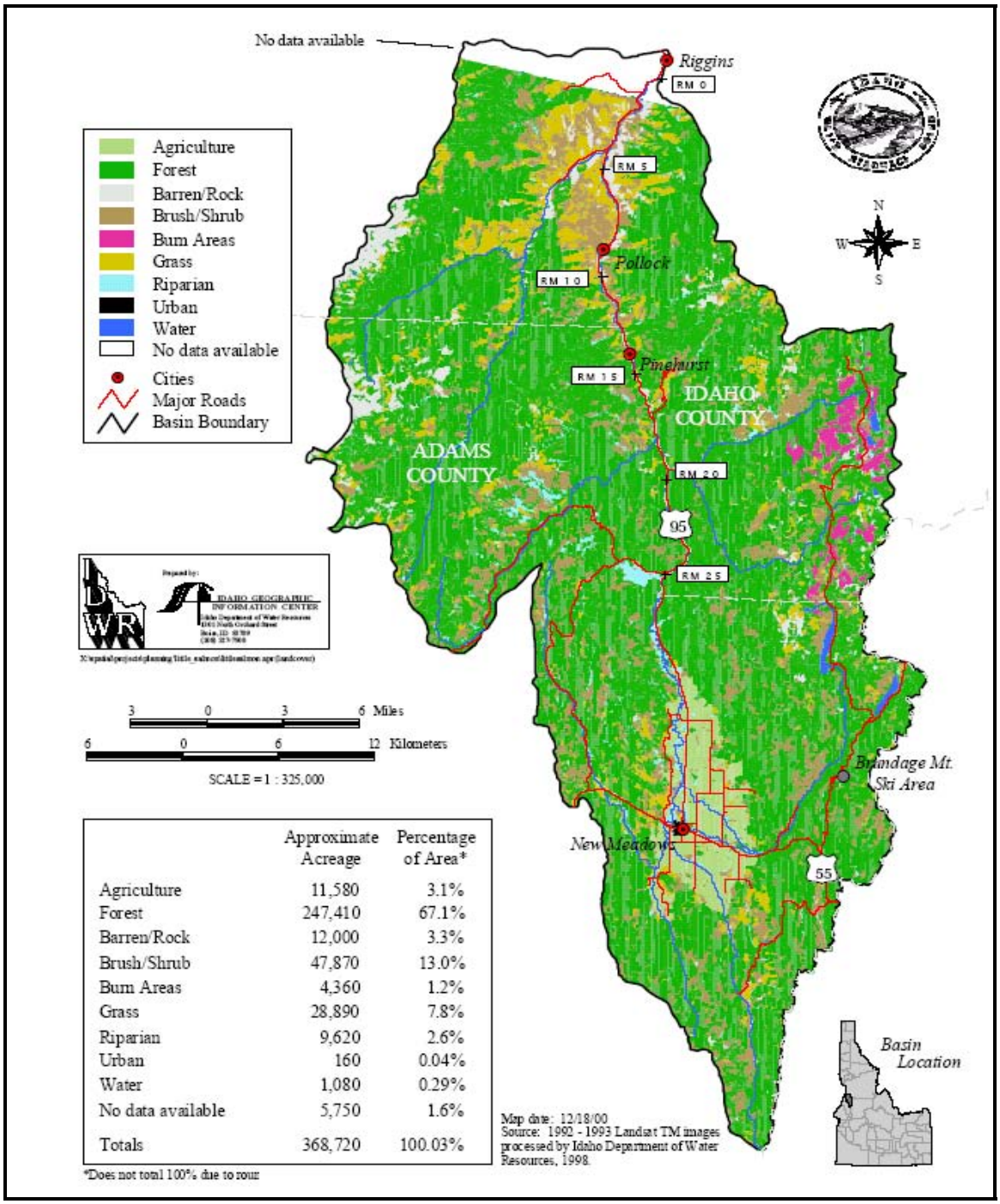


Figure 5. Little Salmon River Basin Topography.

Land Cover

Over two-thirds of the watershed is forested and one-fifth is rangeland. All of Meadows Valley and some locations in the lower basin are rangeland and pasture. Figure 6 shows the vegetative cover in the watershed.



	Approximate Acreage	Percentage of Area*
Agriculture	11,580	3.1%
Forest	247,410	67.1%
Barren/Rock	12,000	3.3%
Brush/Shrub	47,870	13.0%
Burn Areas	4,360	1.2%
Grass	28,890	7.8%
Riparian	9,620	2.6%
Urban	160	0.04%
Water	1,080	0.29%
No data available	5,750	1.6%
Totals	368,720	100.03%

*Does not total 100% due to roun

Figure 6. Little Salmon River Basin Land Cover.

Fisheries

Seventeen fish species are present in the Little Salmon River watershed. Fifteen of these species are native and three are introduced (Table 3). Anadromous species- fish that live part of their lives in salt water but return to fresh water to spawn -include Chinook salmon, steelhead and Pacific lamprey (BLM 2000).

Table 3. Fish species in Little Salmon River watershed (IDWR 1998).

Fish Species	Status	Distribution
ANADROMOUS		
Spring/Summer Chinook (Onchorhyncus tshawytscha)	Threatened	Mainstem LSR and lower tributaries below River mile 24
Steelhead (Onchorhyncus mykiss)	Threatened	Mainstem LSR and lower tributaries below river mile 24
Pacific lamprey (Lampetra tridentate)	State endangered species	Uncommon, mainstem LSR and possibly in accessible lower tributaries below River Mile 24 (BLM 2000)
NATIVE RESIDENT SPECIES		
Redband trout (O. mykiss)	Common, USFWS species of special concern. Proposed for federal listing.	Throughout watershed
Bull trout (Salvelinus confluentus)	Threatened	Mainstem LSR below river mile 24, Rapid River, Boulder Creek, lower Hazard and Hard Creeks
Westslope cutthroat (O. clarki lewisi)	Depressed	Trail Creek, Squaw Creek, Boulder Creek, Rapid River, mainstem LSR, Lower Hazard and Hard Creeks, and Big Creek
Kokanee (O. nerka)	Present	Goose lake
Mountain whitefish (Prosopium williamsoni)	Present	Mainstem river and lower tributaries
Northern pikeminnow (Ptychocheilus oregonensis)	Present	Mainstem river and lower tributaries
Redside shiner (Richardsonius balteatus)	Present	Unknown, likely common
Suckers (sp.) (Catostomus sp.)	Present	Unknown, likely common
Longnose dace (Rhinichthys cataractae)	Present	Unknown, likely common
Leopard dace (Rhinichthys falcatus)	Present	Unknown, likely common
Speckled dace (R. osculus)	Present	Unknown
Sculpin (Cottus sp.)	Present	Unknown, likely common
INTRODUCED RESIDENT SPECIES		
Rainbow trout (O. mykiss)	Present	Throughout watershed
Brook trout (Salvelinus fontinalis)	Present	Throughout watershed

Fish and Habitat

Anadromous and fluvial fish are generally limited to the area downstream of the barrier falls located at river mile 24.7 below where Round Valley Creek enters the river. Fluvial fish are those fish species that spend their entire lives in streams and migrate to smaller streams to spawn.

An account of a trip through the Little Salmon River valley in 1879 stated the following: "That salmon did not come into the valley because of rapids and falls below apparently prevented them" (BLM 2000). Nez Perce Elders report that historically the Nez Perce tribe had fished for Salmon above Little Salmon Falls, specifically in the Goose Creek drainage. Currently, anadromous fish are not present above the barrier falls although evidence suggests that historically they were present. While there have been anecdotal reports of steelhead spawning above the falls that use has not been documented by Idaho Fish and Game or any other agency. It may be that at some flows, steelhead are able to get above the barrier flows, but generally they are found below the falls.

It is not clear exactly when fish passage was no longer possible. Table 4 shows periodicity information for salmonid fishes downstream of the fish passage barriers. Table 5 shows periodicity information for the Little Salmon River watershed upstream of fish passage barriers and for Elk and Hazard Creeks, upstream from fish passage barriers present on those creeks. These charts are meant only to indicate periodicity; these fish are not necessarily present in all creeks in the watershed.

Table 4. Periodicity information for Little Salmon River watershed, downstream of fish passage barriers.

Species/ Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chinook Spring Adults					X	X	X	X	X			
Chinook Spring Spawning							X	X	X			
Chinook Spring Incubation	X	X					X	X	X	X	X	X
Chinook Spring Rearing	X	X	X	X	X	X	X	X	X	X	X	X
Chinook Spring Smolt Emigration			X	X	X	X						
Steelhead Adults	X	X	X	X	X	X				X	X	X
Steelhead Spawning			X	X	X	X						
Steelhead Incubation				X	X	X	X					
Steelhead Rearing	X	X	X	X	X	X	X	X	X	X	X	X
Steelhead Smolt Emigration			X	X	X	X						
Bull Trout Adults	X	X	X	X	X	X	X	X	X	X	X	X
Bull Trout Spawning								X	X			
Bull Trout Incubation								X	X	X	X	X
Bull Trout Rearing	X	X	X	X	X	X	X	X	X	X	X	X
Cutthroat Trout Adults	X	X	X	X	X	X	X	X	X	X	X	X
Cutthroat Trout Spawning				X	X	X						
Cutthroat Trout Incubation				X	X	X	X					
Cutthroat Trout Rearing	X	X	X	X	X	X	X	X	X	X	X	X
Redband Trout Adults	X	X	X	X	X	X	X	X	X	X	X	X
Redband Trout Spawning				X	X	X						
Redband Trout Incubation				X	X	X	X					
Redband Trout Rearing	X	X	X	X	X	X	X	X	X	X	X	X

(IDWR 2004)

Table 5. Periodicity information for Little Salmon River, Hazard Creek and Elk Creek, upstream from fish passage barriers.

Species/ Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Redband Trout Adults	X	X	X	X	X	X	X	X	X	X	X	X
Redband Trout Spawning				X	X	X						
Redband Trout Incubation				X	X	X	X					
Redband Trout Rearing	X	X	X	X	X	X	X	X	X	X	X	X
Brook Trout Adults	X	X	X	X	X	X	X	X	X	X	X	X
Brook Trout Spawning									X	X		
Brook Trout Incubation	X	X							X	X	X	X
Brook Trout Rearing	X	X	X	X	X	X	X	X	X	X	X	X

(IDWR 2004)

All tributary streams that are accessible (i.e. do not have barriers to fish passage) below the Little Salmon River barrier falls are used for steelhead rearing. Steelhead spawning and rearing is most prevalent in the larger tributaries of Rapid River, Boulder Creek and Hazard Creek. Adult steelhead have been observed in Squaw Creek, Sheep Creek, Denny Creek, Hat Creek, Lockwood Creek, Rattlesnake Creek, Elk Creek, and Trail Creek. These small, steep gradient tributaries provide suboptimal spawning habitat and juvenile rearing, but the mouth areas of these streams or lower reach segments (downstream from barriers) may provide limited juvenile rearing habitat for spring Chinook salmon (BLM 2000).

Welsh et al. (1965) reported that no known passage by salmon exists above the Little Salmon River barrier falls. Idaho County Free Press (April 11, 1929) reported that the state game department “blasted” a side channel at the falls for fish passage. A 1939 DOT survey map shows this fish ladder on the west side of the LSR, i.e., between the river and the highway. Ineffective fish passage facilities construction was completed at the falls by the Civilian Conservation Corps during the 1930’s (Welsh et al. 1965). Welsh (2005) later reported that the fish ladder at the upper falls appeared passable to upstream migrating anadromous fish. However, anadromous fish have not been documented in the Meadows Valley. Only anecdotal reports of steelhead exist. Streams and rivers providing spawning and rearing for spring/summer Chinook salmon include the Little Salmon and Rapid Rivers, and Boulder,

Hazard, and Hard Creeks. Mainstem Little Salmon River tributary streams that provide potential rearing habitat at the mouth and/or lower reach area only (below barrier) include Squaw, Sheep, Hat, Denny, Lockwood, Rattlesnake, Elk, and Trail Creeks. These streams provide sub-optimal rearing habitat in the upper reaches because of steep stream gradients, barriers, and small size.

Bull Trout

Important bull trout spawning and rearing streams include Rapid River and Boulder Creek. Fluvial bull trout migrate out of the subbasin into the Lower Salmon River for wintering and subadult/adult rearing. The Little Salmon River below the barrier falls (river mile 24.7) is used by bull trout for subadult and adult rearing and as a migration corridor.

Rapid River and its tributaries provide important spawning and rearing habitat for fluvial bull trout. This drainage is considered a key refugia watershed for bull trout and probably is the only watershed in west-central Idaho that supports a stable fluvial bull trout population.

Rapid River contains a sizable spawning run of bull trout that has ranged from 91-461 fish in the last 20 years. In 2004, the count was 240 bull trout and in 2005 the count was 242 bull trout. Counts are based on records from the Rapid River Chinook hatchery located about 1.7 kilometers above the mouth of the stream. In typical years, the bull trout spawning migration spans the period from mid-May through mid-August with the majority of bull trout passing the weir at the Rapid River fish hatchery by mid-July. Peak spawning period for bull trout occurs during late August and early September in the upper reaches of Rapid River and some tributaries (upstream of Paradise Creek). Once these fish have spawned they immediately return to the Little and Lower Salmon Rivers. Boulder Creek is also an important bull trout watershed. Boulder Creek and its tributaries (Bull Horn Creek, Cold Springs Creek, Pony Creek, Squirrel Creek, Twin Forks Creek, Ant Basin Creek and Star Creek) provide spawning and rearing habitat.

The Hard/Hazard Creek watershed is considered of medium importance for bull trout and is used for subadult and adult rearing downstream from impassable natural barriers (BLM 2000). Rapid River, Boulder Creek, and Hard Creek were identified as having local populations of bull trout, while Hazard Creek was identified as having a potential local population (USFWS 2002).

Steelhead Trout

Steelhead, the anadromous form of rainbow (redband) trout, are distributed within the Upper Columbia River basin as two genetically distinct subspecies, coastal and inland. Each subspecies has two major forms, winter-run and summer-run, although coastal steelhead are predominately winter-run and inland steelhead are summer-run. Winter-run fish enter freshwater three to four months prior to spawning, and summer run steelhead enter freshwater nine to ten months prior to spawning. Only summer-run steelhead occur in the Little Salmon River basin. Summer-run steelhead are described as either “A” run or “B” run, based on the time of passage over Bonneville Dam. Steelhead passing Bonneville Dam

before August 25 are called “A” run and those that pass over Bonneville Dam on or after August 25th are called “B” run steelhead.

Adult summer-run steelhead ascend the Columbia River from May through October, and winter-run fish from November through April (Fulton 1970). Most steelhead remain in salt water for one to four years, with both age and length at maturity at least partially dependent on length of ocean residence (BLM 2000).

Both summer-run and winter-run steelhead spawn from March to June, typically as runoff starts to occur but prior to peak streamflow. Incubation and emergence are temperature dependent and variable. Emergence is generally complete by mid-July even in the highest elevation streams. Juveniles remain in fresh water for varying periods ranging from two to three or more years depending on water temperature and growth rates. Steelhead inhabit a wide range of diverse habitats, rearing, overwintering, and migrating through streams ranging from steep, low-order tributaries up to mainstem rivers. Habitat requirements of steelhead vary by season and life stage. Steelhead distribution and abundance may be influenced by water temperature, stream size, flow, channel morphology, riparian vegetation, cover type and abundance, and substrate size and quality.

Life stages are closely linked to habitat characteristics. Steelhead spawn in sorted gravels in both mainstem rivers and tributaries. Incubation success is influenced by fine sediment, temperature, and flow. After emergence, fry typically move into shallow and low-velocity channel areas. As fish become larger, they start to inhabit areas with deeper water, a wider range of velocities, and larger substrate.

Like other anadromous fish, the status and distribution of steelhead are determined by a large number of factors. Ocean and passage conditions, habitat conditions, harvest, and the use of hatchery fish all play a major role in the condition of the remaining populations. Steelhead populations in the Little Salmon River watershed like the rest of the Inner Columbia River Basin are depressed.

Within the Little Salmon River subbasin steelhead trout use occurs in the lower portion of the subbasin and tributaries, downstream from barriers located at river mile 24 in the Little Salmon River. Streams and rivers providing important spawning and rearing for steelhead trout include Rapid River, Boulder Creek, Hazard Creek, Hard Creek, and the Little Salmon River. Other Little Salmon River mainstem tributary streams providing spawning and rearing habitat for steelhead trout include Squaw Creek, Sheep Creek, Hat Creek, Denny Creek, Lockwood Creek, Rattlesnake Creek, Elk Creek, and Trail Creek. Adult steelhead trout have been documented in these streams.

Primary steelhead use of these streams is often associated with the mouth area or a small stream segment or lower reach, before steep gradients/cascades or a barrier restricts upstream fish passage. These streams generally provide sub-optimal spawning and rearing habitat because of steep stream gradients, barriers, low flows, limited spawning gravels, and small size.

Little Salmon River subbasin steelhead populations are at all time lows. The highest number of intercepted adult natural spawning steelhead trout counted at the Rapid River weir was 162 in 1993, and the lowest counted was 10 in 1999. In 2004, 185 steelhead were intercepted at the weir.

Chinook Salmon

Throughout their lifecycle, Chinook salmon, an anadromous species, live within a variety of habitats. Adult spring Chinook salmon enter the Columbia River in early spring, pass Bonneville Dam and reach the Snake River by late April.

They arrive in the Little Salmon River basin from late May to early July, and spawn from August to mid-September. Fry emerge from February to April, rear through the summer in the natal stream , and then migrate downstream into a mainstem river or large tributary to overwinter, depending on habitat conditions. Smolts pass Lower Granite Dam from late April through June on their seaward migration (BLM 2000).

Habitat requirements of Chinook salmon vary by season and life stage, and the fish occupy a diverse range of habitats. Distribution and abundance of Chinook salmon may be influenced by cover type and abundance, water temperature, substrate size and quality, channel morphology, and stream size.

Cover is essential for adult Chinook salmon prior to spawning, especially for early migrants that remain in tributaries for several months prior to spawning. Temperature influences both the suitability of spawning habitat and timing of spawning. Survival and emergence success of Chinook salmon embryos is also influenced by fine sediment and flow. Other factors that reduce egg-to-fry survival include redd disturbance, bottom scour, and microbial infection.

After emergence, fry concentrate in shallow, slow water near stream margins with cover. As fry grow, they occupy deeper pools with submerged cover during the day and shallower inshore habitat at night. Elevated suspended sediment concentrations may result in damaged gills, reduced feeding, avoidance of sedimented areas, suppressed production, and increased mortality. Fine sediment deposition can also reduce habitat capacity. Key habitat factors for juvenile rearing include streamflow, pool morphology, cover, and water temperature. Juveniles tend to be most abundant in low gradient, meandering stream channels.

Streams and rivers providing spawning and rearing for spring/summer Chinook salmon include the Little Salmon River, Rapid River, Boulder Creek, Hazard Creek, and Hard Creek. Mainstem Little Salmon River tributary streams that provide potential rearing habitat at the mouth and/or lower reach area only (below barrier) include Squaw Creek, Sheep Creek, Hat Creek, Denny Creek, Lockwood Creek, Rattlesnake Creek, Elk Creek, and Trail Creek. These streams provide sub-optimal rearing habitat because of steep stream gradients, barriers, and small size.

Current numbers of naturally spawning spring/summer Chinook salmon in the Little Salmon River subbasin are at all time lows, similar to the rest of the Columbia River Basin and the overall trend is downward. The highest number of intercepted adult natural spawning Chinook salmon counted at the Rapid River weir was 12, 770 Spring Chinook in 2001, and the lowest counted was 4 in 1997. In 2004, 112 summer Chinook were counted and 2,805 spring Chinook. In 2005, 60 summer Chinook were counted and 1,681 Spring Chinook.

Subwatershed Characteristics

The following sections describe general characteristics related more specifically to water.

Hydrology

The Little Salmon River flows in a northerly direction. Major tributaries in the southern end of the basin include Mud Creek, Big Creek and the east and west branches of Goose Creek (Figure 7). The Little Salmon River is a low gradient river as it flows through Meadows Valley. Further north, but still in the Meadows Valley, Three Mile Creek, Four Mile Creek, and Six Mile Creek flow into the Little Salmon River from the east. At the end of Meadows Valley, Round Valley Creek flows in from the west. Moderately to very sinuous and occasionally braided in the Meadows Valley region, the Little Salmon River becomes less sinuous downstream of the falls at river mile 24. The river is constricted by both the road and canyon walls in this section. In the canyon section of the Little Salmon River, Hazard Creek and Boulder Creek are major tributaries and three miles above the mouth, Rapid River joins the Little Salmon River. Other canyon tributaries include Elk Creek, Squaw Creek, Indian Creek and numerous other first and second order streams.

Highway 95 was built in 1938 and then realigned in 1964. Past highway construction and maintenance has resulted in channel, riparian, and floodplain encroachment. It appears that Highway 95 channel encroachment in the vicinity of the barrier falls may contribute to the problem of fish passage in these areas (BLM 2000). In 1997, bridge repair in the canyon section resulted in minor channel changes localized around bridge sites. General highway repair work in this section after the 1997 flood also resulted in constriction of the channel in places. Table 6 shows average runoff figures for the basin.

Table 6. Estimated average annual runoff.

Location	Drainage Area (mi^2)	Estimated Average Annual Runoff (cfs)[1]
Little Salmon above Round Valley Creek	188	244
Rapid River (mouth)	126	172
Hazard Creek (mouth)	86	144
Little Salmon at Riggins	584	762

[1]Cubic feet per second

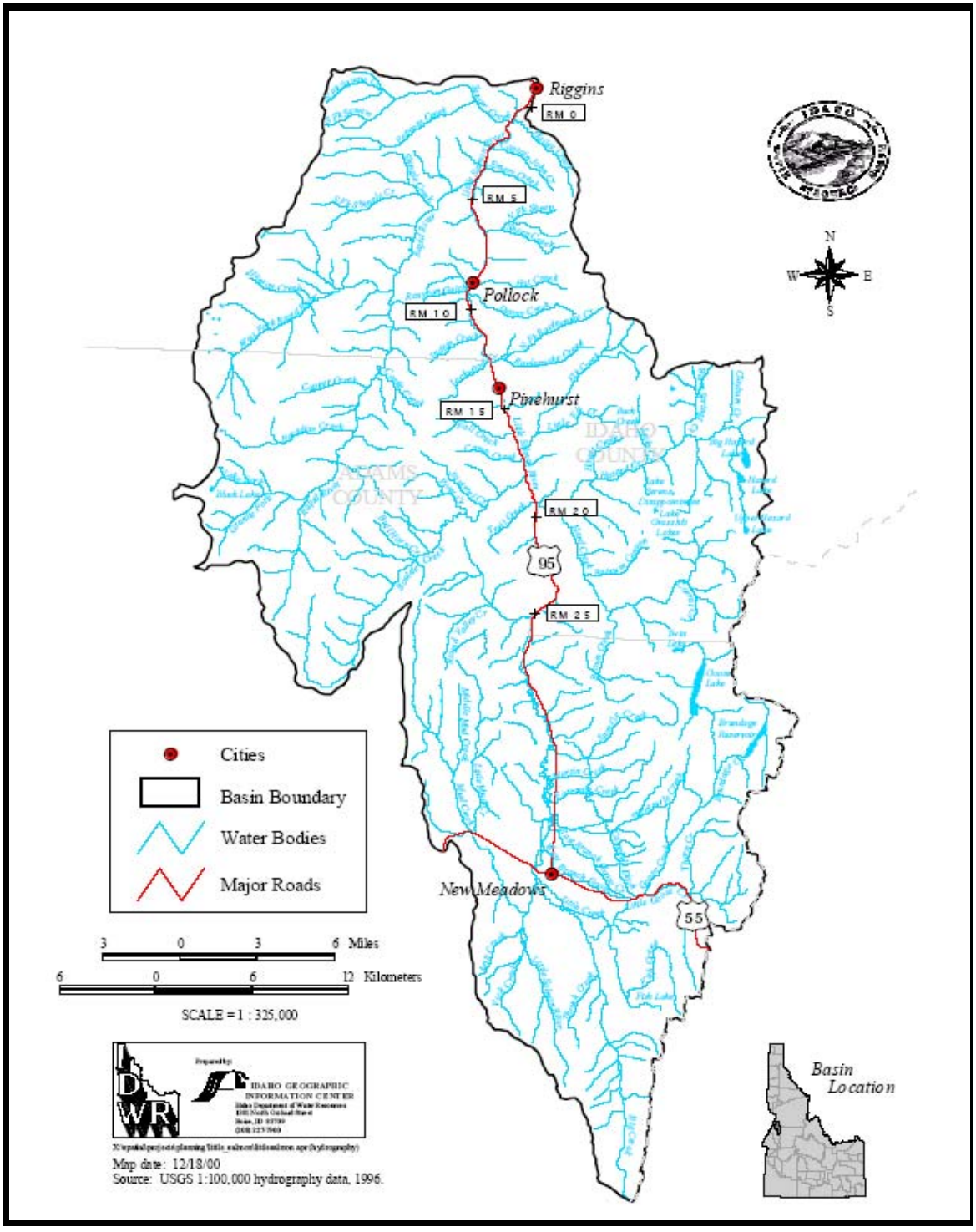


Figure 7. Little Salmon River Basin Hydrology.

Ground Water

Information on ground water is limited. Ground water development for domestic and municipal uses has occurred in the New Meadows, Pinehurst, Pollock and Riggins areas. The New Meadows area ground water is found at depths ranging from 20 feet to 550 feet and is characterized by alluvial deposits and basalt. Well yields range from 15-20 gallons per minute for domestic wells to over 400 gallons per minute for municipal wells. Aquifer recharge comes from the Little Salmon River, Big Creek, Little Creek and the West Branch of Goose Creek (IDWR 2001).

The Pinehurst and Pollock areas consist of shallow alluvial aquifers. Deeper groundwater is associated with fractures in the basalt underlying the alluvium. Well yields range from 2 to 15 gallons per minute. Recharge to these alluvial aquifers is primarily from the Little Salmon River while recharge to the deeper ground water is from surrounding creeks and precipitation.

Geothermal Water

In 1980, the IDWR investigated geothermal resources in Idaho and determined that there were no geothermal wells or springs in the Idaho county portion of the Little Salmon River watershed. However, several springs and wells were located in the Adams County portion. Krigbaum Hot Springs, located along Goose Creek, flows from two separate vents at 568 gallons per minute at temperatures of 104 and 108 degrees F. A geothermal well at Zim's Hot Springs, a commercial hot springs resort north of New Meadows, flows at approximately 36 gallons per minute at a temperature of 166 degrees F. Other geothermal wells and springs exist in the Little Salmon River corridor in Adams County. Temperatures range from 79 to 167 degrees F.

Zim's Hot Springs reports that operation of the pool has not changed since the 1970s. Hot springs water is mixed with 2500 gallons of cooler water to be used in the pool. When the water is discharged from the pool, it flows into a cooling pond separated from the Little Salmon River by approximately 20 acres of land. There is no discrete channel from the cooling pond to the river. In the summer, the discharge does not keep the cooling pond full; in fact, the pond dries up at times.

Water Use

Irrigation for livestock pastures and hay production primarily occurs in the upper Meadows Valley. The majority of irrigation in the basin using surface water is accomplished using gravity delivery systems. Gravity systems operate by means of a physical barrier in the streams that divert water into a canal or ditch. Smaller lateral ditches run from the main ditch to specific properties, where several smaller ditches may divert water from the lateral ditch. Water is diverted by the use of dirt and/or rock, canvas dams or small headgates. Water floods over the ground and either percolates down into the ground or runs off down gradient.

Nearly all irrigation in this basin uses surface water. About 92 percent of the irrigated acres are located upstream of the confluence of Round Valley Creek and the Little Salmon River. The majority of these 18,500 acres are irrigated with water from Twin Granite, Goose Lake

and Brundage Reservoirs (IDWR 1998). These three reservoirs are in the headwaters of Goose Creek and its tributary, Brundage Creek.

Many of these acres are irrigated from more than one source. Water from storage reservoirs and a source located closer to the irrigated acres may be used to supplement each other, depending on water availability and site concerns. Generally, irrigation water from storage facilities is not used until later in the season when stream flows have decreased. Due to varied irrigation patterns, it is difficult to determine how much water is diverted from specific tributaries (BLM 2000). Using IDWR estimation methodology, the upper end of the basin (upstream from Round Valley Creek) uses about 72,000 acre-feet of water a year for irrigation (BLM 2000).

About 8 percent, or 700 acres, of the irrigated acres in the basin are downstream of the confluence of Round Valley Creek and the Little Salmon River. IDWR water-right records indicate approximately 700 acres of irrigation from various surface water sources in the subbasin south of Pollock (IDW R 1998). Ninety-three percent of these acres are irrigated from water diverted from drainages on the west side of the basin (Rapid River, Shingle Creek, Papoose Creek, and Squaw Creek). Using IDWR estimation methodology, the volumetric use is estimated at about 2,800 acre-feet a year in this portion of the basin (BLM 2000).

Stream Characteristics

This next section describes Rosgen stream types which is a classification method for streams, the concept of stream order, and the general vegetation types that are seen in the areas around streams in the Little Salmon River watershed.

Rosgen Stream Types

The Rosgen Stream Classification system is useful in describing general stream characteristics like channel shape, channel patterns (e.g. braided), valley types that a stream is found in, etc. Based on the geomorphologic characteristics of streams, the Rosgen classification scheme delineates expected ranges for width/depth ratios, entrenchment, substrate materials, sinuosity, and gradient. When dealing with streams impaired by sediment, the Rosgen Stream Classification system is an important tool in determining whether a stream is stable or not and whether that instability is leading to contribution of excess sediment to the stream.

General stream classes are broken out by an A-G lettering scheme which can be further subdivided in each letter grouping by numbers (e.g. C1, C2...C6). The numbers refer to the dominant bed material (1= bedrock, 2 = boulder, 3= cobble, 4=gravel, 5= sand, and 6 = silt-clay). The following section is an overview of the geomorphic stream categories found throughout the watershed (Figure 8).

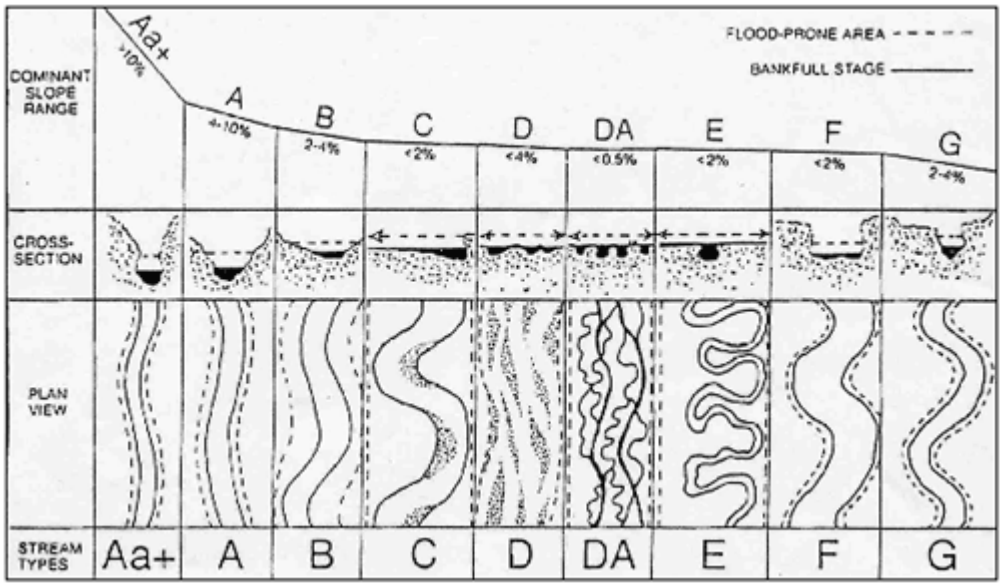


Figure 8. Rosgen Stream Characteristics.

Tributaries to the Little Salmon River downstream of the falls are generally steep gradient streams with Rosgen A and B type characteristics. Tributary streams in the watershed originate in either granitic or basaltic parent material. Due to the different topographical attributes and parent material throughout the basin, stream channel characteristics are highly variable throughout the watershed. Headwater streams and smaller tributary streams are typically A2 and A3 channel types (Rosgen 1996) because they course through steeper terrain. These are steep-gradient, low-sinuosity, confined channels with high sediment transport capacity. Channel gradients are greater than 4 percent and have a cascading, step/pool morphology. These streams have low width-to-depth ratios.

B3 and B4 channels, which are moderate gradient and are moderately confined, are found downstream of these reaches in less steep areas. These streams usually have relatively stable channels and are also efficient at sediment transport.

Type B streams generally occupy stable channels with moderately stable banks. These streams tend to occur in narrow, gently sloping valleys in areas of moderate relief. They may be moderately entrenched in low-gradient channels. Channel gradients typically range from 2-4 percent, but may be lower or higher. Width-to-depth ratios are moderate, and bed forms are predominantly riffle with infrequently spaced pools.

Moderate gradient and moderately to well-confined type B channels are predominantly associated with mainstem and tributary reaches within moderate relief landforms.

The meadow reaches of the mainstem Little Salmon River are C4 and C5 stream channel types, characterized by low gradient, a wide floodplain, and low sediment transport capacity. Type C streams typically occupy low gradient (less than 2 percent) alluvial channels with broad, well-defined floodplains located in broad valleys. These streams are slightly entrenched within a well-defined meandering channel. Generally, they have a riffle-pool bed morphology with point bars typically developed at meander bends.

Stream types for larger tributary streams in the upper reach above Round Valley Creek are commonly B2, B3, and G2. These are coarse substrate, high-energy channels that are moderately to well-confined (BLM 2000).

Stream Order

Stream order is a hierarchical ordering of streams based on the degree of branching. A first-order stream is an unforked or unbranched stream. Higher order streams result from the joining of two streams of the same order (Figure 9).

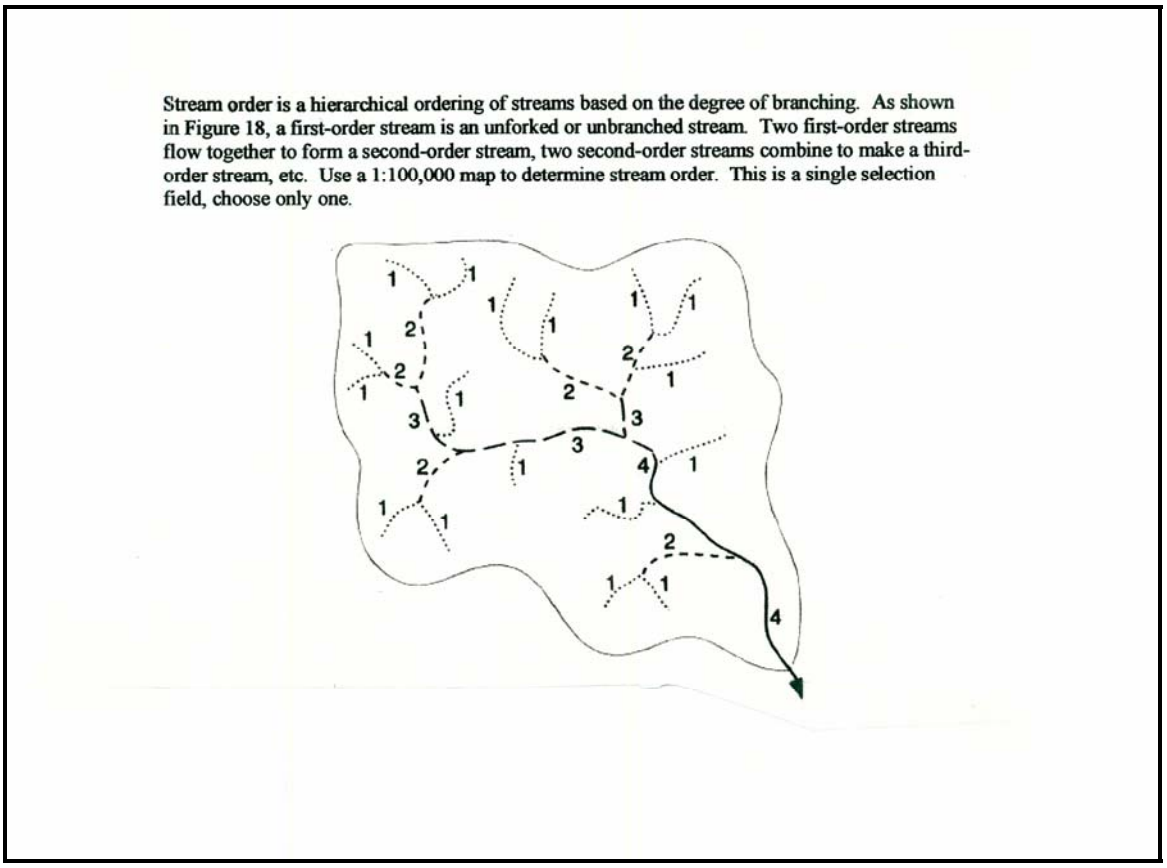


Figure 9. Stream Order.

Riparian Vegetation

The riparian vegetation along the Little Salmon River is generally dominated by black cottonwood (Populus trichocarpa), willows (Salix sp.), red-osier dogwood (Cornus stolonifera), syringa *(Philadelphus lewisi*i), horsetail *(Equisetum* sp.), black hawthorne *(Crataegus douglasi*i), and alder *(Alnus* sp.). Along the lower reaches of the Little Salmon River, willow, Douglas hackberry *(Celtis douglasi*i), and poison ivy *(Rhus radican*s) are common. The meadow riparian areas associated with the upper valley are commonly dominated by willows and sedges *(Carex* sp.).

Many of the tributary streams have a narrow riparian vegetation zone confined by steep canyon walls. Common riparian species include red-osier dogwood, syringa, willows, alder,

water birch, ocean spray, and blue elderberry. It is often common for conifer species to occur in the riparian areas, the higher elevation riparian areas may have grand fir, Engelmann spruce, subalpine fir, and lodgepole pine. The lower elevation riparian areas may have Douglas fir, ponderosa pine and grand fir.

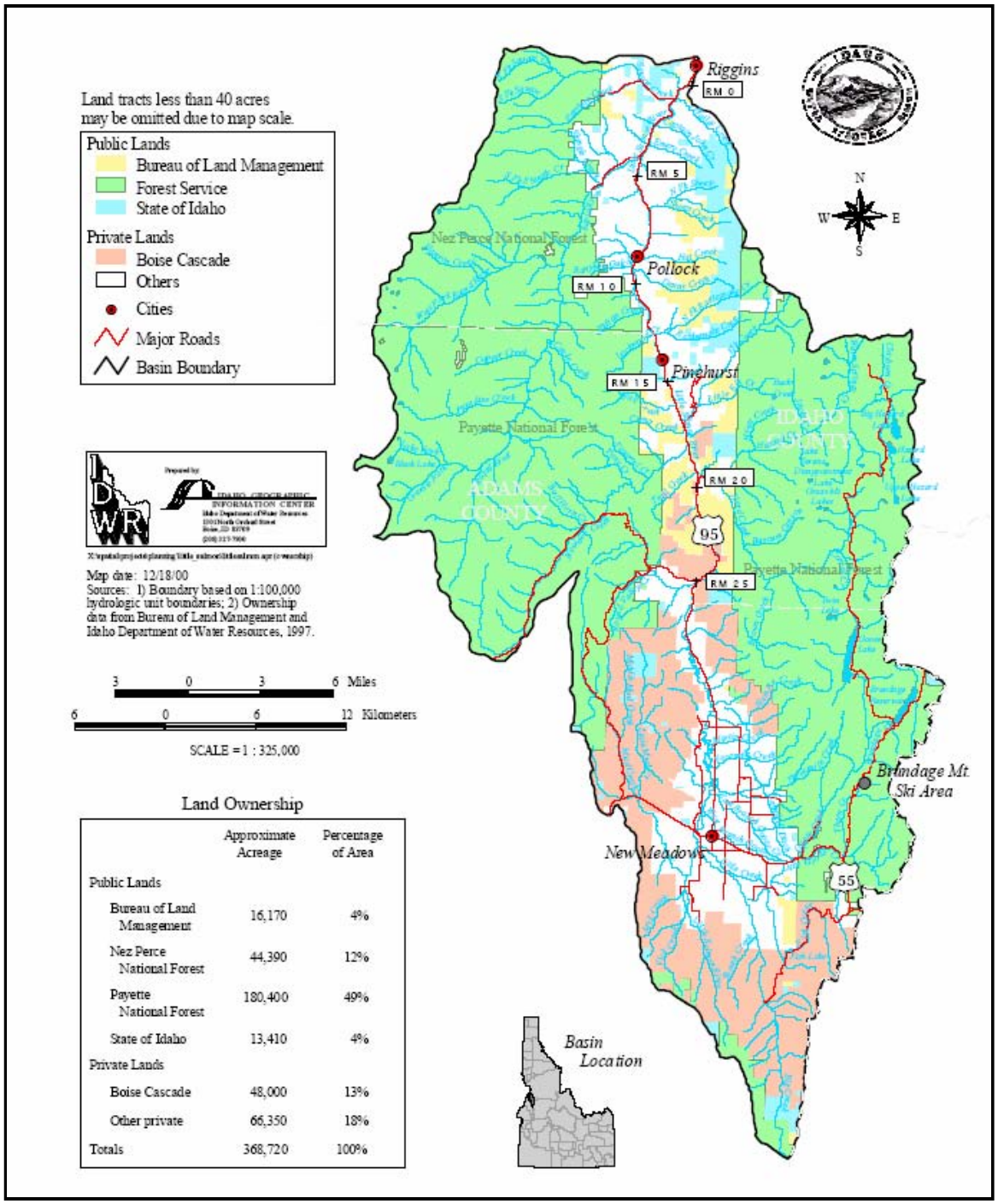
Current Meadows Valley riparian vegetation is not historically what was there. The streams were shaded by large cottonwoods and willows. Government farm programs in the 1950s and 1960s encouraged the reduction of shrubs and willows to increase cattle grazing capacity. Sinuous sections were channelized to expedite water movement and drainage. These channel alterations were common, and the cost of alteration was at times subsidized by the government, to reduce wetlands unsuitable for grazing and also for flood control. Some remnants of historic riparian vegetation do exist and a Wetlands Reserve Program is reclaiming some wetland areas (Manwaring, personal communication, 2005).

1.3 Cultural Characteristics

Water quality is influenced by both natural and human factors. This section provides an overview of the cultural characteristics that affect water quality. The economy, land use, infrastructure and development history of an area all can affect water quality. The Little Salmon River watershed has a long history of natural resource use including mining, timber harvest, and ranching activities that have influenced patterns of settlement and water resource activities.

Land Ownership, Cultural Features, and Population

About 68 percent of the Little Salmon River basin is public land (Figure 10). Federal agencies manage about 241,152 acres. State and local governments manage 12,228 acres. Private ownership, totaling 115,200 acres, is clustered primarily along the Little Salmon River and at the southern (upstream) end of the basin. The Nez Perce Tribe owns a small parcel, less than 5 acres, near Rapid River (IWRB 2001).



Land Ownership

	Approximate Acreage	Percentage of Area
Public Lands		
Bureau of Land Management	16,170	4%
Nez Perce National Forest	44,390	12%
Payette National Forest	180,400	49%
State of Idaho	13,410	4%
Private Lands		
Boise Cascade	48,000	13%
Other private	66,350	18%
Totals	368,720	100%

Figure 10. Little Salmon River Basin Land Ownership.

The Little Salmon River basin lies within portions of Idaho and Adams Counties; therefore, data from either county represents only a portion of the basin. Census county divisions (CCDs) more accurately represent the profile of the basin. The two CCDs substantially within the basin are the New Meadows CCD (Adams County) and the Riggins CCD (Idaho County). Together these two CCDs contain 1,642 square miles and comprise the most highly

populated portion of the Little Salmon River basin. The area has experienced low to moderate population growth in the last decade (Figure 11).

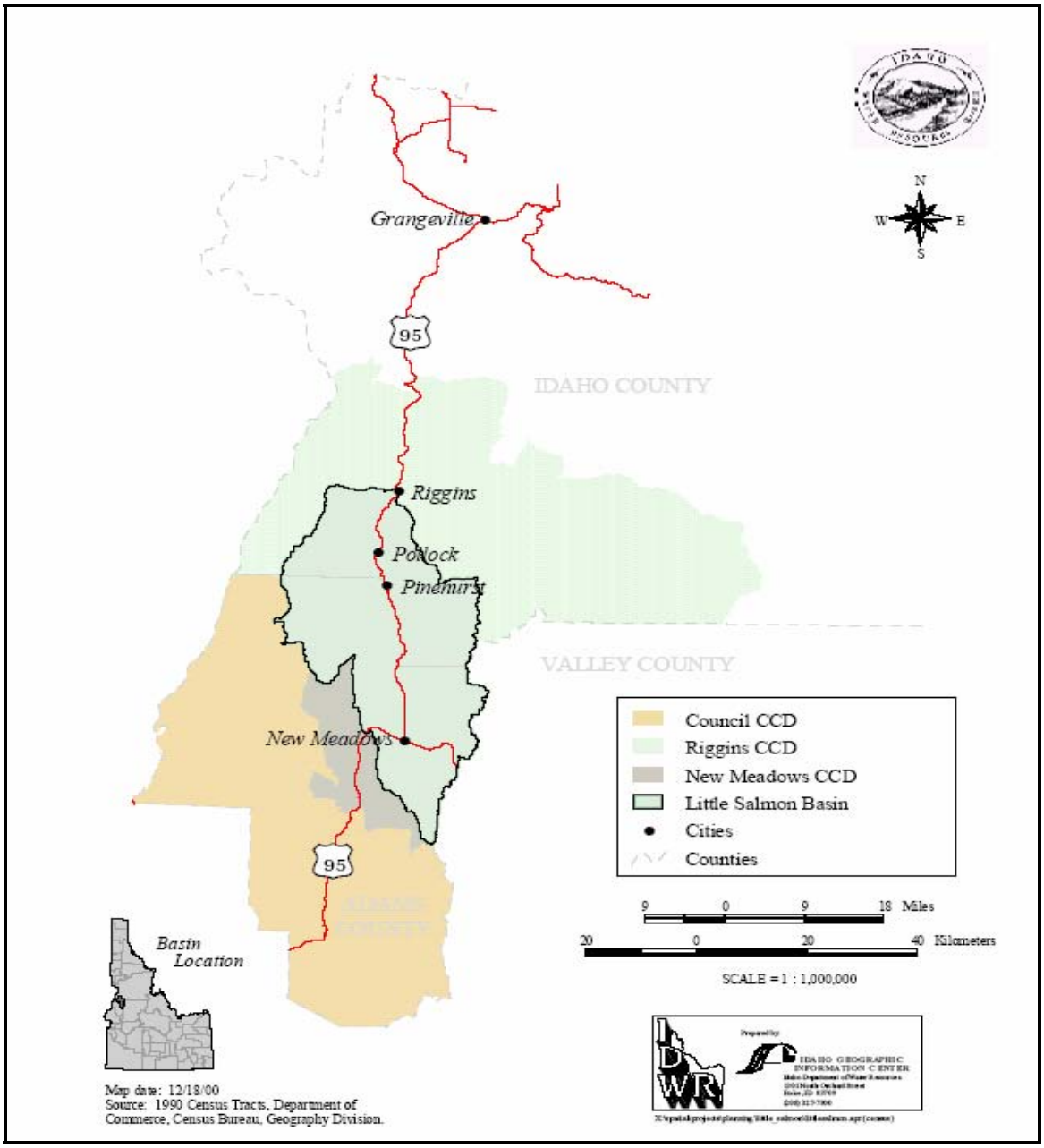


Figure 11. Little Salmon Basin Census Districts.

Population increases in the two counties have also occurred due to the general population growth in the state and the desire for second homes in recreational areas (Figure 12). Seasonal or occasional housing is an important characteristic of the basin and distinguishes it from the state as a whole. Estimates put seasonal housing at between 17 and 19 percent of all housing in the Riggins and New Meadows CCDs, respectively. Those percentages are higher than the rest of the state. Although the Little Salmon River basin is growing in population,

the two largest towns in the basin have not gained in population. The implication may be that more homes are being constructed in the outlying areas. The full-time residential population of the Little Salmon River basin was estimated to be 2,695 in Year 2000.

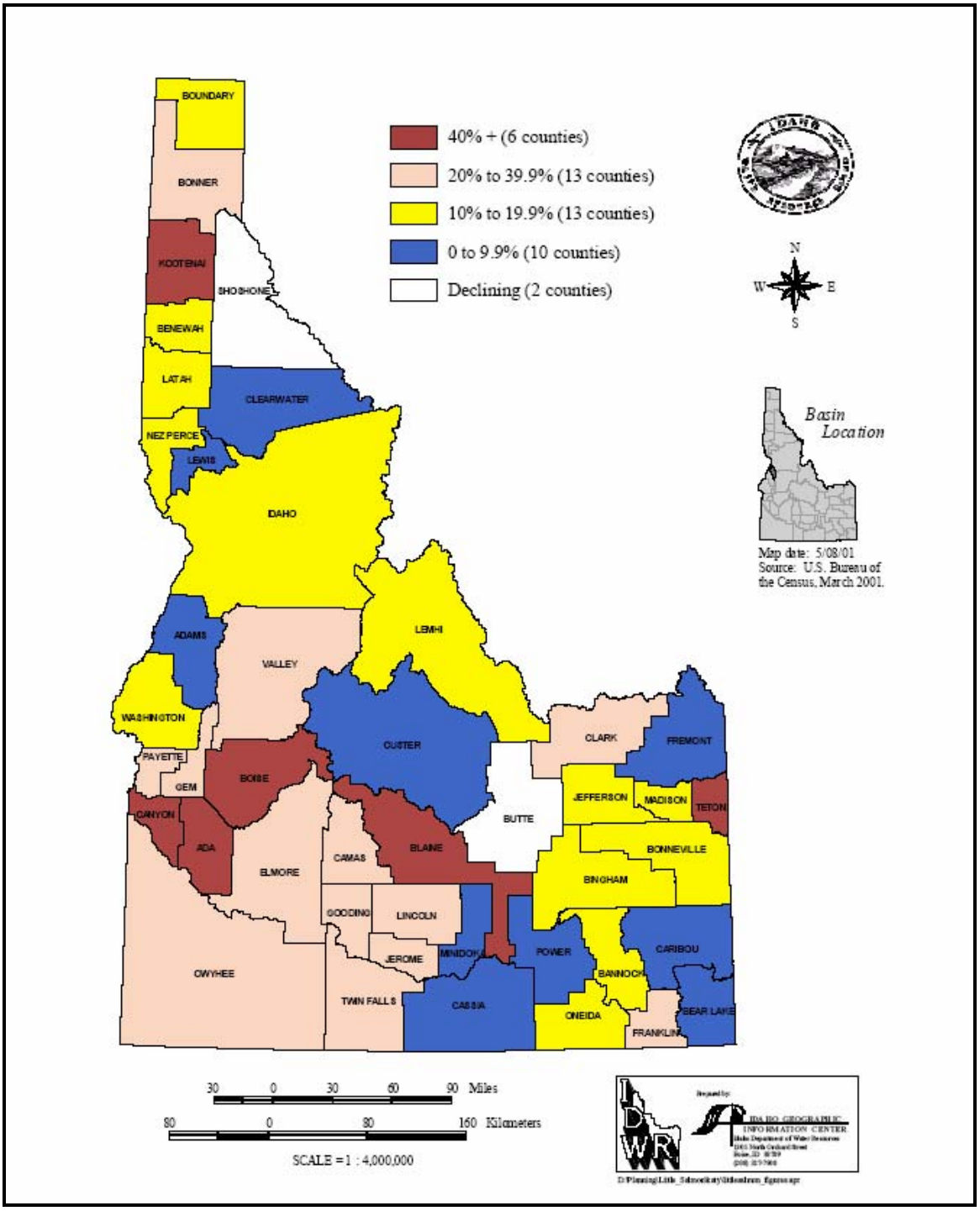


Figure 12. Idaho Population Growth by County (2001).

Land Use

More than two-thirds of the basin is forested with conifers, mixed timber stands, and aspens. More than one-fifth is rangeland, most of which is grazed. All of the Meadows Valley and some locations in the lower basin are pastureland (Figure 13).

Historically, timber harvest and ranching have been the primary land uses in the basin. Recently, land use has been undergoing noticeable change due to the decline of the logging industry and the increase in residential development around the periphery of Meadows Valley. Several housing subdivisions of 5 to approximately 100 acres have been developed on property previously used for logging and grazing. Private timber holdings are being intensely logged and then subdivided and sold for development. The economy is diversifying and becoming more dependent on tourism to replace jobs lost through reduced forest harvest and mill closure. In the last decade, float and power boating, salmon and steelhead fishing, and tourism have increased as part of the local economy. The annual value to the basin from fishing and related recreation jobs is about equal to the economic value of crops in the basin.

Most agricultural activity in the subbasin is associated with grazing. Sheep and cattle graze primarily in the summer months in the higher elevation of the subbasin. The most concentrated grazing occurs in the irrigated pastures of the valley floor around New Meadows (BLM 2000).

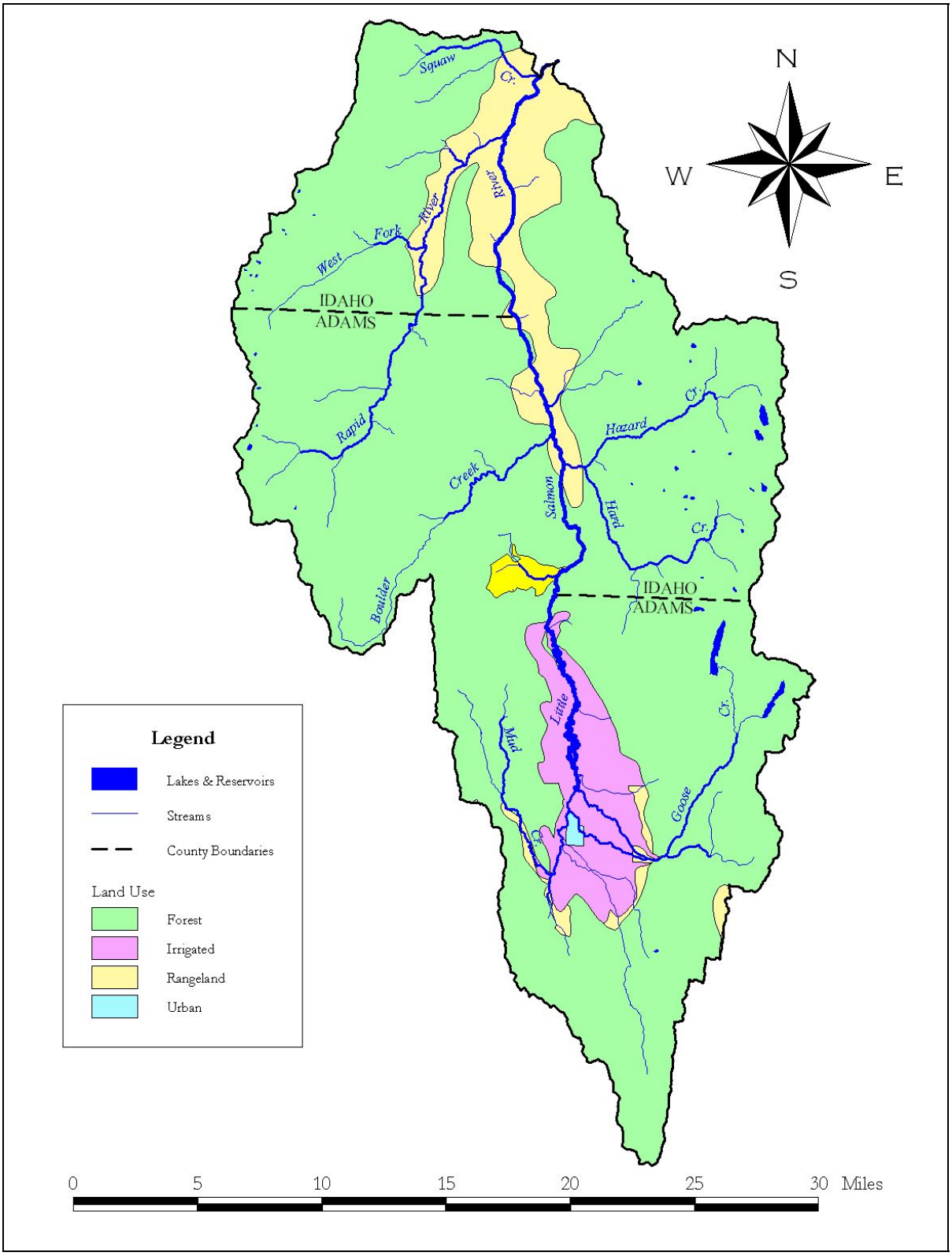


Figure 13. Little Salmon River Land Use.

History

Humans have occupied the Little Salmon River Basin during the past 800 to 1000 years. The Nez Perce and the Shoshone-Bannock Tribes both occupied the basin and its surrounding mountains. The Little Salmon River and its tributaries are still an important tribal fishery.

The acquisition of horses in the early 18th century resulted in the Nez Perce and Shoshone Bannock developing societal changes as the tribes increased their areas of travel. Both of these tribes were wealthy because of the resource abundance of the central Idaho mountains and valleys and their use of horses for travel, hunting, and defense.

Changes came again with the influx of euro-americans in the 19th century. Conflicts with new settlers arose over access to lands and streams. The federal government became involved and the tribes entered into treaty negotiations during the middle part of the 19th century. The Nez Perce tribe ceded tribal lands in the Treaty of 1855; however, the tribe reserved all rights not expressly granted to the United States. The tribe's reserved rights included the exclusive use and benefit of the area located within the boundaries of the 1855 Nez Perce Reservation, the exclusive right of taking fish in all its usual and accustomed places throughout its aboriginal area, including the Little Salmon River, the right to erect temporary buildings for curing fish, the right to hunt, to gather roots and berries, and pasture horses and cattle. The Nez Perce Reservation boundaries were further reduced by the 1863 Nez Perce Treaty and Cession Agreement in 1893.

In 1879, the Circle C Ranch, once one of the largest ranches in the country, was founded in the Meadows Valley by Charles Campbell. Other cattle and sheep ranches were also developed. During 1888, 67 ranches were reported in the Little Salmon River basin.

Support services were grouped into small towns and villages. The town of Meadows was supplanted by the city of New Meadows when railroad lines were built into the valley in 1911. The town of Riggins was established by ranchers, but timber extraction and mining also became important economic activities. Cattle and sheep ranchers lived in permanent structures on lands outside of the towns. Rugged terrain and the need to tend to livestock and homes limited travel of the new settlers both within and outside of the basin.

A road was built to connect Riggins with Meadows Valley in the early 1900s, and, by the 1920s, the road was graveled (IWRB 2001) (Figure 14).

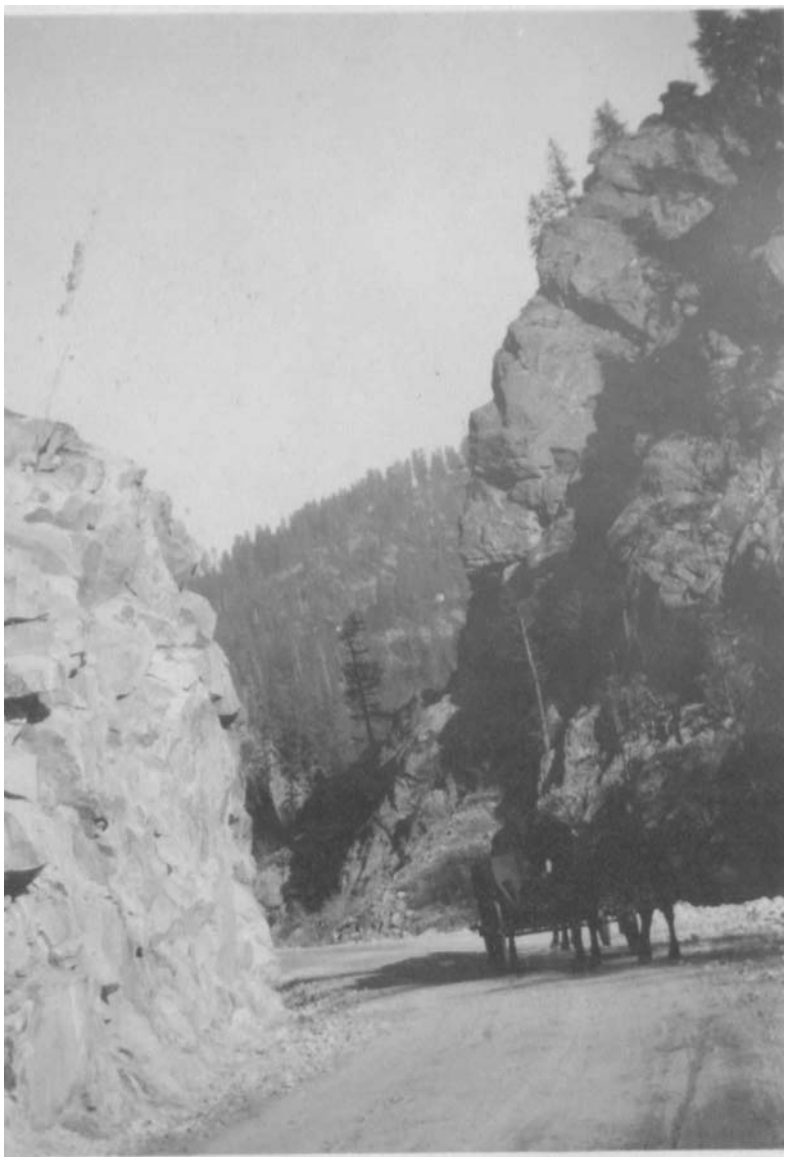


Figure 14. Travel before Highway 95 Construction.

Economics

Major employers of basin residents are the agricultural sector (including forestry, fishing, and mining), service sectors (business, repair, personal, entertainment, recreational, and professional services), retail trade, and manufacturing. The Little Salmon River basin experiences a high unemployment rate compared to the rest of the state, but recently the unemployment rate has been declining. Between 1980 and 1990 unemployment fell from 38 percent to 15 percent in the New Meadows CCD, and from 24 percent to 12 percent in the Riggins CCD. In the state during that time period, unemployment fell from 7.9 to 6 percent. Table 7 shows the estimated annual economic values for recreation and resource based activities.

Table 7. Summary of estimated annual economic values for fishing, livestock, crops, mining, and timber sectors to the Little Salmon River basin area.

Economic Activity	Estimated Annual Value (Millions of Dollars)
Timber – potential value	3.6 – 4.8
Timber – actual sales	2.4 to 3.2
Livestock	1.6
Fishing	0.8 – 1.1*
Crops	0.65
Mining	0.6

* Reading 1996, 1999

Timber production in the Pacific Northwest and in the Little Salmon watershed has been on the decline in the last 15 years. Local long term timber industry professionals summarize the decline of the industry as a "lack of supply" of timber from federal lands due to land management policies. According to the US Forest Service, "There has been a significant change in timber supply behavior throughout the western U.S. caused by a harvest policy shift on public forests…In the early 1990s, interior national forests also began reducing harvests due to salmon protection, environmental appeals of timber sales, and a shift to ecosystem management" (USFS 2003).

Recreation

The Little Salmon River watershed is an important recreational resource for year-round activities. The area is a unique mix of rivers, streams, high mountain lakes, rugged canyons, alpine meadows and forests. Activities focused on the river include camping, fishing, kayaking, and canoeing. In addition to river-related activities, the following activities are available: golf, all-terrain vehicle (ATV) riding, guided trips, hiking and backpacking, horseback riding, hunting, biking, and rock climbing.

The Little Salmon River is well known for Chinook salmon runs which draw avid anglers between the months of April and August. According to the Idaho Department of Fish and Game file data, the average number of angler hours per season has been 72,159 in the last five years, resulting in an average catch of 6,020 salmon during the season. Of that number, approximately 324 were wild salmon that were caught and released. The success of the season depends greatly on the salmon run, with the year 2001 being the most successful harvest numbering 11,482 fish caught.

The Riggins area is the gateway to famous recreational areas that border the Little Salmon River watershed. The Frank Church River of No Return Wilderness lies to the east of the watershed. Skiing is available to the south at Brundage Mountain. To the southwest of Riggins lies the Rapid River Salmon Hatchery, constructed in 1964 by Idaho Power Company to preserve Chinook salmon that had been blocked out of natural spawning streams.

Hells Canyon National Recreation Area (HCNRA) borders the Little Salmon River drainage to the west. Most of the HCNRA drains into the Snake River; however, Seven Devils Campground and Black Lake Campground/Trailhead are in the Little Salmon River drainage. Heaven's Gate Overlook and Windy Saddle Campground/Trailhead are on the ridge between the two drainages. Shingle Creek and Papoose campgrounds are under the supervision of the Nez Perce National Forest.

Although there are no state parks in the area, the Payette National Forest oversees developed campsites at Hazard Campground on Hazard Lake, Grouse Campground near Goose Lake, and Last Chance Campground on Goose Creek. Packer John Park, a county day use park, is located on Goose Creek. Private campsites and recreational vehicle sites are also available.

2. Subbasin Assessment – Water Quality Concerns and Status

This section discusses water quality data and the relationship to beneficial use support in more detail for each particular assessment unit. Since assessment units often encompass several streams, individual streams and their associated watersheds may be discussed separately from the rest of the assessment unit. The uniform use of assessment units began in mid-2004 and further explanation of what an assessment unit is provided below. Figure 15 shows the general boundaries of assessment units: these units may be further broken up by stream order, which are discussed for those particular streams/assessment units in Section 2.4. Streams that are not on the 303(d) list are included in this section for informational purposes even though they do not have impaired beneficial uses. This report presents all information that DEQ was able to gather regarding water bodies in the watershed, because this information allows the reader to gain a good understanding of the whole watershed.

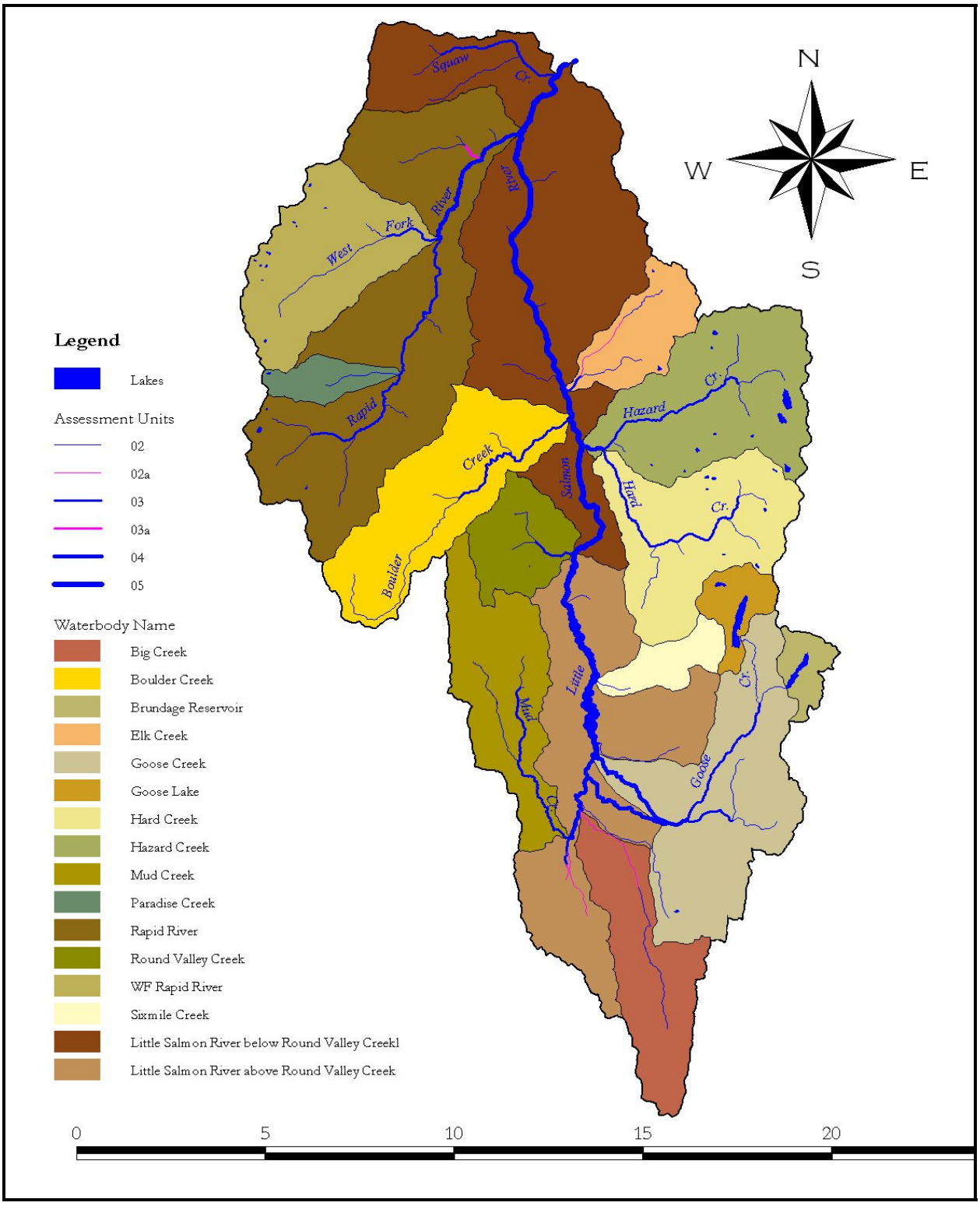


Figure 15. Little Salmon River Watershed Assessment Units.

2.1 Water Quality Limited Assessment Units Occurring in the Subbasin

The Little Salmon River watershed contains several water quality limited assessment units. Table 8 summarizes these assessment units. See Figure 1 for general location of listed stream assessment units. This section will discuss which sections are water quality limited and the potential pollutants that are causing beneficial use impairment.

Section 303(d) of the CWA states that waters that are unable to support their beneficial uses and that do not meet water quality standards must be listed as water quality limited waters. Subsequently, these waters are required to have TMDLs developed to bring them into compliance with water quality standards.

About Assessment Units

Assessment units (AUs) are groups of similar streams that have similar land use practices, ownership, or land management. Stream order, however, is the main basis for determining AUs—although ownership and land use can change significantly, the AU remains the same. AUs now define all the waters of the state of Idaho. These units and the methodology used to describe them can be found in the WBAGII (Grafe et al 2002).

Using assessment units to describe water bodies offers many benefits, the primary benefit being that all the waters of the state are now defined consistently. In addition, using AUs fulfills the fundamental requirement of EPA's 305(b) report, a component of the Clean Water Act wherein states report on the condition of all the waters of the state. Because AUs are a subset of water body identification numbers, there is now a direct tie to the water quality standards for each AU, so that beneficial uses defined in the water quality standards are clearly tied to streams on the landscape.

However, the new framework of using AUs for reporting and communicating needs to be reconciled with the legacy of 303 (d) listed streams. Due to the nature of the court-ordered 1994 303(d) listings, and the subsequent 1998 303(d) list, all segments were added with boundaries from "headwater to mouth." In order to deal with the vague boundaries in the listings, and to complete TMDLs at a reasonable pace, DEQ set about writing TMDLs at the watershed scale (HUC), so that all the waters in the drainage are and have been considered for TMDL purposes since 1994.

The boundaries from the 1998 303(d) listed segments have been transferred to the new AU framework, using an approach quite similar to how DEQ has been writing SBAs and TMDLs. All AUs contained in the listed segment were carried forward to the 2002 303(d) listings in Section 5 of the Integrated Report. AUs not wholly contained within a previously listed segment, but partially contained (even minimally), were also included on the 303(d) list. This was necessary to maintain the integrity of the 1998 303(d) list and to maintain continuity with the TMDL program. When assessing new data that indicate full support, only the AU that the monitoring data represents will be removed (de-listed) from the 303(d) list (Section 5 of the Integrated Report.).

Listed Waters

Table 8 shows the pollutants listed and the basis for listing for each §303(d) listed AU in the subbasin. Not all of the water bodies will require a TMDL, as will be discussed later. However, a thorough investigation, using the available data, was performed before this conclusion was made. This investigation, along with a presentation of the evidence of non-compliance with standards for several other tributaries, is contained in the following sections.

Table 8. 2002 §303(d) Segments in the Little Salmon River Subbasin.

Water Body Name	Assessment Unit ID Number	2002 §303(d) Boundaries	Pollutants	Listing Basis
Little Salmon River	17060210SL001_02	Round Valley Creek to Mouth	Sediment	EPA
Little Salmon River	17060210SL007_05	5th Order	Unknown	EPA
Little Salmon River	17060210SLO07_04	4th order	Temperature	EPA
Big Creek	17060210SL009_02a	1st and 2nd Order	Unknown	DEQ
Elk Creek	17060210SL016_03	Little Elk Creek to Mouth	Sediment	USFS
Indian Creek	17060210SL001_03	Source to Mouth	Sediment	EPA
Shingle Creek	17060210SL002_02a	2nd Order	Sediment	EPA
Brundage Reservoir	17060210SL011L-0L		Temperature	EPA

2.2 Applicable Water Quality Standards

Idaho adopts both narrative and numeric water quality standards to protect public health and welfare, enhance the quality of water, and protect biological integrity. By designating the beneficial use or uses for water bodies, Idaho has created a mechanism for setting criteria necessary to protect those uses and prevent degradation of water quality through anti-degradation provisions. According to IDAPA 58.01.02.050 (02)a "wherever attainable, surface waters of the state shall be protected for beneficial uses which includes all recreational use in and on the water surface and the preservation and propagation of desirable species of aquatic biota." Beneficial use support is determined by DEQ through its water body assessment process. Table 9 contains a listing of the designated beneficial uses for each listed segment. Table 10 contains a listing of the beneficial uses of assessed, non §303(d) listed streams. Table 11 is a summary of the water quality standards associated with the beneficial uses. For streams with no designated beneficial uses, cold water aquatic life and recreation are presumed to be beneficial uses. The following discussion focuses on beneficial uses and the water quality criteria, both narrative and numeric, applicable to each of the listed water bodies. A more detailed explanation of the numeric water quality targets developed as

an interpretation of the narrative standards for nutrients and sediment can be found later in this section.

Beneficial Uses

Idaho water quality standards require that surface waters of the state be protected for beneficial uses, wherever attainable (IDAPA 58.01.02.050.02). These beneficial uses are interpreted as existing uses, designated uses, and presumed uses as briefly described in the following paragraphs. The *Water Body Assessment Guidance*, second edition (Grafe et al. 2002) gives a more detailed description of beneficial use identification for use assessment purposes.

Existing Uses

Existing uses under the CWA are "those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards." The existing in-stream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.050.02, .02.051.01, and .02.053). Existing uses include uses actually occurring, whether or not the level of quality to fully support the uses exists. A practical application of this concept would be to apply the existing use of salmonid spawning to a water body that could support salmonid spawning, but salmonid spawning is not occurring due to other factors, such as dams blocking migration.

Designated Uses

Designated uses under the CWA are "those uses specified in water quality standards for each water body or segment, whether or not they are being attained." Designated uses are simply uses officially recognized by the state. In Idaho these include uses such as aquatic life support, recreation in and on the water, domestic water supply, and agricultural uses. Water quality must be sufficiently maintained to meet the most sensitive use. Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life or salmonid spawning. Designated uses are specifically listed for water bodies in Idaho in tables in the Idaho water quality standards (see IDAPA 58.01.02.003.27 and .02.109-.02.160).

Presumed Uses

In Idaho, most water bodies listed in the tables of designated uses in the water quality standards do not yet have specific use designations. These undesignated uses are to be designated. In the interim, and absent information on existing uses, DEQ presumes that most waters in the state will support cold water aquatic life and either primary or secondary contact recreation (IDAPA 58.01.02.101.01). To protect these so-called "presumed uses," DEQ will apply the numeric cold water criteria and primary or secondary contact recreation criteria to undesignated waters. If in addition to these presumed uses, an additional existing use, (e.g., salmonid spawning) exists, because of the requirement to protect levels of water quality for existing uses, then the additional numeric criteria for salmonid spawning would additionally apply (e.g. intergravel dissolved oxygen, temperature). However, if for example, cold water aquatic life is not found to be an existing use, a use designation to that effect is

needed before some other aquatic life criteria (such as seasonal cold) can be applied in lieu of cold water criteria (IDAPA 58.01.02.101.01).

A special resource water (SRW) has been designated as such because it has one of the following characteristics:

1. The water is of outstanding high quality, exceeding both criteria for primary contact recreation and cold water aquatic life

2. The water is of unique ecological significance

3. The water possesses outstanding recreational or aesthetic qualities

4. Intensive protection of the quality of the water is in paramount interest of the people of Idaho

5. The water is a part of the National Wild and Scenic River System, is within a State or National Park or wildlife refuge and is of prime or major importance to that park or refuge or;

6. Intensive protection of the quality of water is necessary to maintain an existing but jeopardized beneficial use.

Table 9. Little Salmon River Subbasin beneficial uses of §303(d) listed streams.

Water Body	Uses[a]
Little Salmon River	CW, SS, PCR, DWS, SRW
Big Creek	Undesignated
Brundage Reservoir	Undesignated
Elk Creek	Undesignated
Indian Creek	Undesignated
Shingle Creek	Undesignated

[a] CW – cold water, SS – salmonid spawning, PCR – primary contact recreation, SCR – secondary contact recreation, AWS – agricultural water supply, DWS – domestic water supply, SRW-special resource water

Table 10. Little Salmon River Subbasin beneficial uses of assessed, non-§303(d) listed streams.

Water Body	Uses[a]
Boulder Creek	Undesignated[b]
Goose Creek	Undesignated
Goose Lake	Undesignated
Hard Creek	Undesignated
Hazard Creek	Undesignated
Mud Creek	Undesignated
Paradise Creek	Undesignated
Rapid River	CW, PCR, SS, DWS, SRW
W. Fork Rapid River	Undesignated
Round Valley Creek	Undesignated

[a] CW – cold water, SS – salmonid spawning, PCR – primary contact recreation, SCR – secondary contact recreation, AWS – agricultural water supply, DWS – domestic water supply, SRW-special resource water
[b] undesignated assessment units are presumed to support cold water aquatic life and recreational uses

Criteria to Support Beneficial Uses

Beneficial uses are protected by a set of criteria, which include *narrative* criteria for pollutants such as sediment and nutrients and *numeric* criteria for pollutants such as bacteria, dissolved oxygen, pH, ammonia, temperature, and turbidity (IDAPA 58.01.02.250) (Table 11).

Excess sediment is described by narrative criteria (IDAPA 58.01.02.200.08): "Sediment shall not exceed quantities specified in Sections 250 and 252 or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determinations of impairment shall be based on water quality monitoring and surveillance and the information utilized as described in Subsection 350."

Narrative criteria for excess nutrients are described in IDAPA 58.01.02.200.06, which states: "Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses."

Narrative criteria for floating, suspended, or submerged matter are described in IDAPA 58.01.02.200.05, which states: "Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This matter does not include suspended sediment produced as a result of nonpoint source activities."

For those situations with temperature where the numeric criteria cannot be met due to natural conditions, IDAPA 58.01.02.200.09 states that "when natural background conditions, exceed any applicable water quality criteria set forth in Sections 21, 250, 251 or 253, the applicable water quality criteria shall not apply; instead pollutant levels shall not exceed the natural background conditions."

DEQ's procedure to determine whether a water body fully supports designated and existing beneficial uses is outlined in IDAPA 58.01.02.053. The procedure relies heavily upon biological parameters and is presented in detail in the Water Body Assessment Guidance (Grafe et al. 2002). This guidance requires the use of the most complete data available to make beneficial use support status determinations.

Table 11 includes the most common numeric criteria used in TMDLs to determine pollutants that might be impairing beneficial uses.

Figure 16 provides an outline of the stream assessment process for determining support status of the beneficial uses of cold water aquatic life, salmonid spawning, and contact recreation.

Table 11. Selected numeric criteria supportive of designated beneficial uses in Idaho water quality standards.

Designated and Existing Beneficial Uses				
Water Quality Parameter	**Primary Contact Recreation**	**Secondary Contact Recreation**	**Cold Water Aquatic Life**	**Salmonid Spawning (During Spawning and Incubation Periods for Inhabiting Species)**
Water Quality Standards: IDAPA 58.01.02.250				
Bacteria, pH, and Dissolved Oxygen	Less than 126 *E. coli*/100 ml[a] as a geometric mean of five samples over 30 days; no sample greater than 406 *E. coli* organisms/100 ml	Less than 126 *E. coli*/100 ml as a geometric mean of five samples over 30 days; no sample greater than 576 *E. coli*/100 ml	pH between 6.5 and 9.0 DO[b] exceeds 6.0 mg/L[c]	pH between 6.5 and 9.5 Water Column DO: DO exceeds 6.0 mg/L in water column or 90% saturation, whichever is greater Intergravel DO: DO exceeds 5.0 mg/L for a one day minimum and exceeds 6.0 mg/L for a seven day average
Temperature[d]			22 °C or less daily maximum; 19 °C or less daily average	13 °C or less daily maximum; 9 °C or less daily average Bull trout: not to exceed 13 °C maximum weekly maximum temperature over warmest 7-day period, June – August; not to exceed 9 °C daily average in September and October at elevations greater than 4592 feet
Turbidity			Turbidity shall not exceed background by more than 50 NTU[e] instantaneously or more than 25 NTU for more than 10 consecutive days.	
EPA Bull Trout Temperature Criteria: Water Quality Standards for Idaho, 40 CFR Part 131				
Temperature				7 day moving average of 10 °C or less maximum daily temperature for June - September

[a] *Escherichia coli* per 100 milliliters
[b] dissolved oxygen
[c] milligrams per liter
[d] Temperature Exemption - Exceeding the temperature criteria will not be considered a water quality standard violation when the air temperature exceeds the ninetieth percentile of the seven-day average daily maximum air temperature calculated in yearly series over the historic record measured at the nearest weather reporting station.
[e] Nephelometric turbidity units

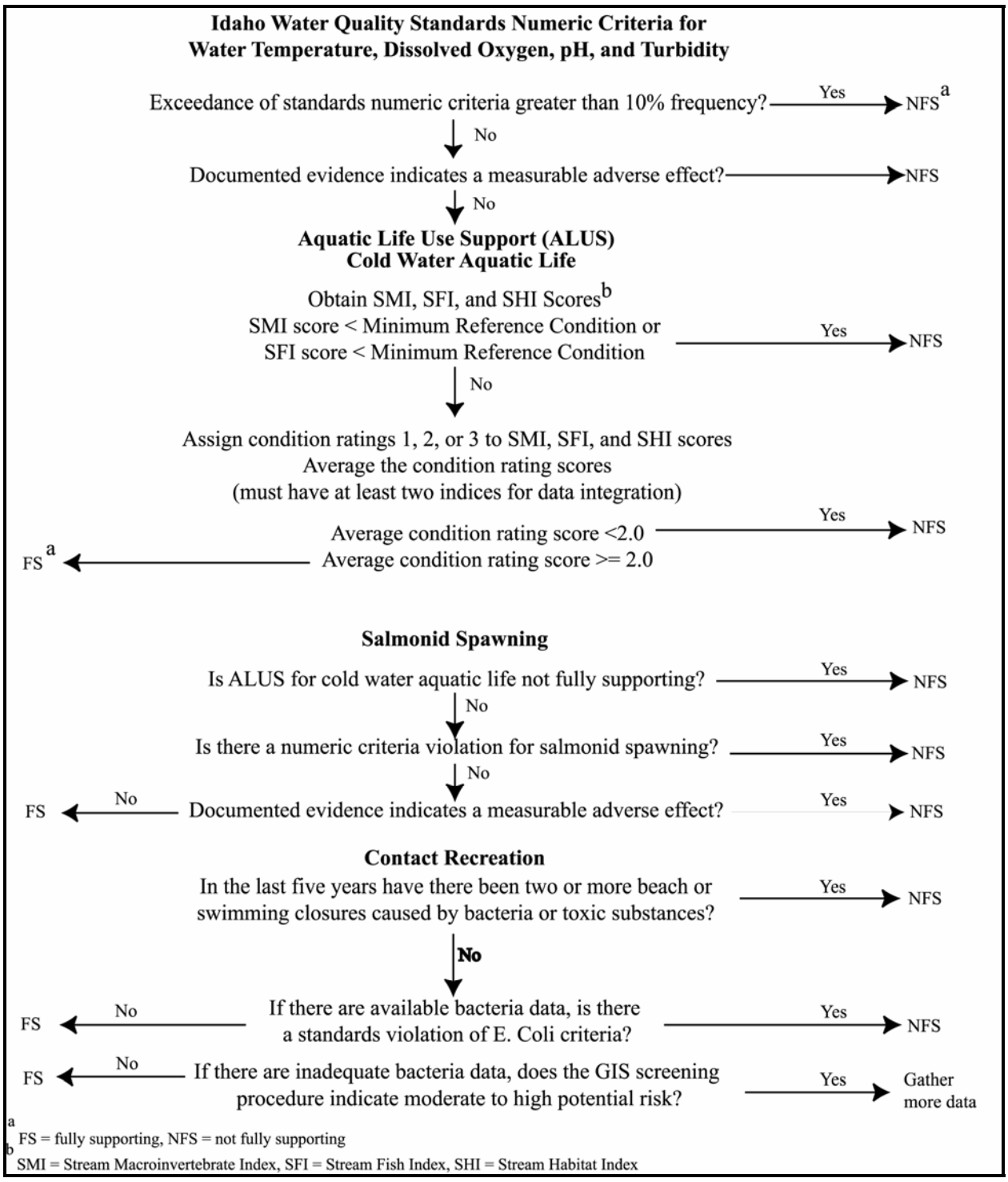


Figure 16. Process for determining support status of beneficial uses in wadeable streams: *Water Body Assessment Guidance*, Second Addition (Grafe *et al*. 2002).

2.3 Pollutant/Beneficial Use Support Status Relationships

Most of the pollutants that impair beneficial uses in streams are naturally occurring stream characteristics that have been altered by humans. That is, streams naturally have sediment, nutrients, and the like, but when anthropogenic sources cause these to reach unnatural levels, they are considered "pollutants" and can impair the beneficial uses of a stream. The following sections discuss pollutants that may be impairing beneficial uses in the Little Salmon River basin in more detail.

Temperature

Temperature is a water quality factor integral to the life cycle of fish and other aquatic species. Different temperature regimes also result in different aquatic community compositions. Water temperature dictates whether a warm, cool, or coldwater aquatic community is present. Many factors, natural and anthropogenic, affect stream temperatures. Natural factors include altitude, aspect, climate, weather, riparian vegetation (shade), and channel morphology (width and depth). Human influenced factors include heated discharges (such as those from point sources), riparian alteration, channel alteration, and flow alteration.

Elevated stream temperatures can be harmful to fish at all life stages, especially if they occur in combination with other habitat limitations such as low dissolved oxygen or poor food supply. Acceptable temperature ranges vary for different species of fish, with cold water species being the least tolerant of high water temperatures. Temperature as a chronic stressor to adult fish can result in reduced body weight, reduced oxygen exchange, increased susceptibility to disease, and reduced reproductive capacity. Acutely high temperatures can result in death if they persist for an extended length of time. Juvenile fish are even more sensitive to temperature variations than adult fish, and can experience negative impacts at a lower threshold value than the adults, retarding growth rates. High temperatures also affect embryonic development of fish before they even emerge from the substrate. Similar kinds of affects may occur to aquatic invertebrates, amphibians and mollusks, although less is known about them.

Dissolved Oxygen

Oxygen is necessary for the survival of most aquatic organisms and essential to stream purification. Dissolved oxygen (DO) is the concentration of free (not chemically combined) molecular oxygen (a gas) dissolved in water, usually expressed in milligrams per liter (mg/L), parts per million, or percent of saturation. While air contains approximately 20.9% oxygen gas by volume, the proportion of oxygen dissolved in water is about 35%, because nitrogen (the remainder) is less soluble in water. Oxygen is considered to be moderately soluble in water. A complex set of physical conditions that include atmospheric and hydrostatic pressure, turbulence, temperature, and salinity affect the solubility.

Dissolved oxygen levels of 6 mg/L and above are considered optimal for aquatic life. When DO levels fall below 6 mg/L, organisms are stressed, and if levels fall below 3 mg/L for a prolonged period, these organisms may die; oxygen levels that remain below 1-2 mg/L for a few hours can result in large fish kills. Dissolved oxygen levels below 1 mg/L are often referred to as hypoxic; anoxic conditions refer to those situations where there is no measurable DO.

Juvenile aquatic organisms are particularly susceptible to the effects of low DO due to their high metabolism and low mobility (they are unable to seek more oxygenated water). In addition, oxygen is necessary to help decompose organic matter in the water and bottom sediments. Dissolved oxygen reflects the health or the balance of the aquatic ecosystem.

Oxygen is produced during photosynthesis and consumed during plant and animal respiration and decomposition. Oxygen enters water from photosynthesis and from the atmosphere. Where water is more turbulent (e.g., riffles, cascades), the oxygen exchange is greater due to the greater surface area of water coming into contact with air. The process of oxygen entering the water is called aeration.

Water bodies with significant aquatic plant communities can have significant DO fluctuations throughout the day. An oxygen sag will typically occur once photosynthesis stops at night and respiration/decomposition processes deplete DO concentrations in the water. Oxygen will start to increase again as photosynthesis resumes with the advent of daylight.

Temperature, flow, nutrient loading, and channel alteration all impact the amount of DO in the water. Colder waters hold more DO than warmer waters. As flows decrease, the amount of aeration typically decreases and the in-stream temperature increases, resulting in decreased DO. Channels that have been altered to increase the effectiveness of conveying water often have fewer riffles and less aeration. Thus, these systems may show depressed levels of DO in comparison to levels before the alteration. Nutrient enriched waters have a higher biochemical oxygen demand due to the amount of oxygen required for organic matter decomposition and other chemical reactions. This oxygen demand results in lower in-stream DO levels.

Sediment

Both suspended (floating in the water column) and bedload (moves along the stream bottom) sediment can have negative effects on aquatic life communities. Many fish species can tolerate elevated suspended sediment levels for short periods of time, such as during natural spring runoff, but longer durations of exposure are detrimental. Elevated suspended sediment levels can interfere with feeding behavior (difficulty finding food due to visual impairment), damage gills, reduce growth rates, and in extreme cases eventually lead to death.

Newcombe and Jensen (1996) reported the effects of suspended sediment on fish, summarizing 80 published reports on streams and estuaries. Increased levels of sediment yield can adversely affect fish habitat by changes to fish embryo survival, summer rearing capacity, and winter carrying capacity. An inverse relationship exists between the amount of deposited fine sediments in spawning or rearing areas and fish survival and abundance. For rainbow trout, physiological stress, which includes reduced feeding rate, is evident at suspended sediment concentrations of 50 to 100 mg/L when those concentrations are maintained for 14 to 60 days.

Similar effects are observed for other species, although the data sets are less reliable. Adverse effects on habitat, especially spawning and rearing habitat presumably from sediment deposition, were noted at similar concentrations of suspended sediment.

Organic suspended materials can also settle to the bottom and, due to their high carbon content, lead to low intergravel DO through decomposition.

In addition to these direct effects on the habitat and spawning success of fish, detrimental changes to food sources may also occur. Aquatic insects, which serve as a primary food source for fish, are affected by excess sedimentation. Increased sedimentation leads to a macroinvertebrate community that is adapted to burrowing, thereby making the macroinvertebrates less available to fish. Community structure, specifically diversity, of the aquatic macroinvertebrate community is diminished due to the reduction of coarse substrate habitat.

Settleable solids are defined as the volume (milliliters [ml]) or weight (mg) of material that settles out of a liter of water in one hour. Settleable solids may consist of large silt, sand, and organic matter. Total suspended solids (TSS) are defined as the material collected by filtration through a 0.45 µm (micrometer) filter (Standard Methods 1975, 1995). Settleable solids and TSS both contain nutrients that are essential for aquatic plant growth. Settleable solids are not as nutrient rich as the smaller TSS, but they do affect river depth and substrate nutrient availability for macrophytes. In low flow situations, settleable solids can accumulate on a stream bottom, thus decreasing water depth. This increases the area of substrate that is exposed to light, facilitating additional macrophyte growth.

Bacteria

Escherichia coli or E. coli, a species of fecal coliform bacteria, is used by the state of Idaho as the indicator for the presence of pathogenic microorganisms. Pathogens are a small subset of microorganisms (e.g., certain bacteria, viruses, and protozoa), which, if taken into the body through contaminated water or food, can cause sickness or even death. Some pathogens are also able to cause illness by entering the body through the skin or mucous membranes. Direct measurement of pathogen levels in surface water is difficult because pathogens usually occur in very low numbers and analysis methods are unreliable and expensive. Consequently, indicator bacteria which are often associated with pathogens, but which generally occur in higher concentrations and are thus more easily measured, are assessed.

Coliform bacteria are unicellular organisms found in feces of warm-blooded animals such as humans, domestic pets, livestock, and wildlife. Bacteria is found in both point source discharge (a discrete source like a pipe or an identifiable point of discharge into a water body) and nonpoint source runoff (a dispersed source of pollutants from a geographical area from activities like agriculture, forestry, or stormwater runoff from cities and subdivisions). Coliform bacteria are commonly monitored as part of point source discharge permits (National Pollution Discharge Elimination System [NPDES] permits), but may also be monitored in nonpoint source arenas. The human health effects from pathogenic coliform bacteria range from nausea, vomiting, and diarrhea to acute respiratory illness, meningitis, ulceration of the intestines, and even death. Coliform bacteria do not have a known effect on aquatic life. The bacteria have a lifespan of 24-30 hours outside the intestinal tracks of warm-blooded animals, meaning that bacteria do not persist in streams beyond 24-30 hours after entering the water.

Coliform bacteria from both point and nonpoint sources impact water bodies, although point sources are typically permitted and offer some level of bacteria-reducing treatment prior to discharge. Nonpoint sources of bacteria are diffuse and difficult to characterize. Unfortunately, nonpoint sources often have the greatest impact on bacteria concentrations in

water bodies. This is particularly the case in urban storm water and agricultural areas. *E. coli* is often measured in colony forming units (cfu) per 100 ml.

Recent studies have shown, that grass fed cattle as opposed to grain fed cattle, have a much lower incidence of the E. coli strain 0157:H7 which has been linked to outbreaks of infections in humans. Additionally, grass fed cattle produce less acid resistant bacteria which makes it less likely that the bacteria will survive in the human digestive tract than acid resistant bacteria (Cornell News, 1998).

Cornell University researchers have discovered that grassfed cows have a less acidic digestive tract than grainfed cows, so their E. coli does not have a chance to become acclimated to an acid environment. This translates into the probability that more than 99% of the bacteria found associated with grassfed cows would be destroyed by human digestive juices if ingested (Cornell News 1998).

Nutrients

While nutrients are a natural component of the aquatic ecosystem, natural cycles can be disrupted by increased nutrient inputs from anthropogenic activities. The excess nutrients result in accelerated plant growth and can result in a eutrophic or enriched system.

The first step in identifying a water body's response to nutrient flux is to define which of the critical nutrients is limiting. A limiting nutrient is one that normally is in short supply relative to biological needs. The relative quantity affects the rate of production of aquatic biomass. Either phosphorus or nitrogen may be the limiting factor for algal growth, although phosphorous is most commonly the limiting nutrient in Idaho waters. Ecologically speaking, a resource is considered limiting if the addition of that resource increases growth.

Total phosphorus (TP) is the measurement of all forms of phosphorus in a water sample, including all inorganic and organic particulate and soluble forms. In freshwater systems, typically greater than 90% of the TP present occurs in organic forms as cellular constituents in the biota or adsorbed to particulate materials (Wetzel 1983). The remainder of phosphorus is mainly soluble orthophosphate, a more biologically available form of phosphorus than TP that consequently leads to a more rapid growth of algae. In impaired systems, a larger percentage of the TP fraction is comprised of orthophosphate. The relative amount of each form measured can provide information on the potential for algal growth within the system.

Nitrogen may be a limiting factor at certain times if there is substantial depletion of nitrogen in sediments due to uptake by rooted macrophyte beds. In systems dominated by blue-green algae, nitrogen is not a limiting nutrient due to the algal ability to fix nitrogen at the water/air interface.

Total nitrogen to TP ratios greater than seven are indicative of a phosphorus-limited system while those ratios less than seven are indicative of a nitrogen-limited system. Only biologically available forms of the nutrients are used in the ratios because these are the forms that are used by the immediate aquatic community.

Nutrients primarily cycle between the water column and sediment through nutrient spiraling. Aquatic plants rapidly assimilate dissolved nutrients, particularly orthophosphate. If sufficient nutrients are available in either the sediments or the water column, aquatic plants will store an abundance of such nutrients in excess of the plants' actual needs, a chemical phenomenon known as luxury consumption. When a plant dies, the tissue decays in the water column and the nutrients stored within the plant biomass are either restored to the water column or the detritus becomes incorporated into the river sediment. As a result of this process, nutrients (including orthophosphate) that are initially released into the water column in a dissolved form will eventually become incorporated into the river bottom sediment. Once these nutrients are incorporated into the river sediment, they are available once again for uptake by yet another life cycle of rooted aquatic macrophytes and other aquatic plants. This cycle is known as nutrient spiraling. Nutrient spiraling results in the availability of nutrients for later plant growth in higher concentrations downstream.

Sediment – Nutrient Relationship

The linkage between sediment and sediment-bound nutrients is important when dealing with nutrient enrichment problems in aquatic systems. Phosphorus is typically bound to particulate matter in aquatic systems and, thus, sediment can be a major source of phosphorus to rooted macrophytes and the water column. While most aquatic plants are able to absorb nutrients over the entire plant surface due to a thin cuticle, bottom sediments serve as the primary nutrient source for most sub-stratum attached macrophytes. Sediment acts as a nutrient sink under aerobic conditions. However, when conditions become anoxic, sediments release phosphorus into the water column. The United States Department of Agriculture determined that other than harvesting and chemical treatment, the best and most efficient method of controlling growth is by reducing surface erosion and sedimentation.

Sediments can play an integral role in reducing the frequency and duration of phytoplankton blooms in standing waters and large rivers. In many cases there is an immediate response in phytoplankton biomass when external sources are reduced. In other cases, the response time is slower, often taking years. Nonetheless, the relationship is important and must be addressed in waters where phytoplankton is in excess.

Floating, Suspended, or Submerged Matter (Nuisance Algae)

Algae are an important part of the aquatic food chain. However, when elevated levels of algae impact beneficial uses, the algae are considered a nuisance aquatic growth. The excess growth of phytoplankton, periphyton, and/or macrophytes (rooted aquatic plants) can adversely affect both aquatic life and recreational water uses. Algal blooms occur where adequate nutrients (nitrogen and/or phosphorus) are available to support growth. In addition to nutrient availability, flow rates, velocities, water temperatures, and penetration of sunlight in the water column all affect algae (and macrophyte) growth. Low velocity conditions allow algal concentrations to increase because physical removal by scouring and abrasion does not readily occur. Increases in temperature and sunlight penetration also result in increased algal growth. When the aforementioned conditions are appropriate and nutrient concentrations exceed the quantities needed to support normal algal growth, excessive blooms may develop.

When algae die in low flow velocity areas, they sink slowly through the water column, eventually collecting on the bottom sediments. The biochemical processes that occur as the

algae decompose remove oxygen from the surrounding water. Because most of the decomposition occurs within the lower levels of the water column, a large algal bloom can substantially deplete DO concentrations near the bottom. Low DO in these areas can lead to decreased fish habitat as fish will not frequent areas with low DO. Both living and dead (decomposing) algae can also affect the pH of the water due to the release of various acid and base compounds during respiration and photosynthesis. Additionally, low DO levels caused by decomposing organic matter can lead to changes in water chemistry and a release of phosphorus to the water column at the water/sediment interface.

Excess nutrient loading can be a water quality problem due to the direct relationship of high TP concentrations on excess algal growth within the water column, combined with the direct effect of the algal life cycle on DO and pH within aquatic systems. Therefore, the reduction of TP inputs to the system can act as a mechanism for water quality improvements Phosphorus management within these systems can potentially result in improvement in nutrients (phosphorus), nuisance algae, DO, and pH.

2.4 Summary and Analysis of Existing Water Quality Data

This section presents the most recent data for both 303(d) listed streams/assessment units and non 303(d) listed streams/assessment units in the watershed. All 303(d) listed streams/assessment units are included in this section and the information presented is used to determine whether beneficial uses (i.e. fisheries, recreation) are impaired. A TMDL is necessary to restore beneficial uses if the data shows that beneficial uses are impaired.

Data Assessment Methods

Several primary methods were used to evaluate the data for this subbasin assessment. A brief description of each method is located below. Where there were numeric criteria for pollutants like temperature and bacteria, the data were initially assessed by comparing results to the numeric standard. More information about targets used for narrative criteria such as sediment and nutrients is found in section 5 in the Water Quality Targets section for water bodies that have TMDLs.

DEQ-Water Body Assessment Guidance – Second Edition (Grafe et al. 2002)

The Water Body Assessment Guidance (WBAG) describes DEQ's methods used to consistently evaluate data and determine the beneficial use support status of Idaho water bodies. The WBAG utilizes a multi-index approach to determine overall stream support status. The methodology addresses many reporting requirements of state and federal rules, regulations, and policies. For the most part, DEQ Beneficial Use Reconnaissance Program (BURP) data are used in the assessment. However, where available, other data are integrated into the assessment process.

An assessment entails analyzing and integrating multiple types of water body data such as biological, physical/chemical, and landscape data to address multiple objectives. The objectives are as follows:

1. Determine beneficial use support status of the water body (i.e., fully supporting versus not fully supporting).

2. Determine biological integrity using biological information or other measures.
3. Compile descriptive information about the water body and data used in the assessment.

The multi-metric index approach measures biological, physiochemical, and physical habitat conditions within a stream. The indexes include several characteristics to gauge overall stream health. Three primary indexes are used, which include the Stream Macroinvertebrate Index (SMI), the Stream Fish Index (SFI) and the Stream Habitat Index (SHI). The SMI is a direct measure of cold water aquatic life health. The SFI is also a direct measure of cold water aquatic life health, but it is also specific to fish populations. The SHI is used to measure in-stream habitat suitability, although some of the measurements used to generate the SHI are linked to the riparian area.

A few of the habitat parameters that are discussed individually in this report in reference to DEQ, USFS, and BLM data are described below:

Width Depth Ratio

Width-to-depth ratio (W:D) provides a dimensionless index of channel morphology, and can be an indicator of change in the relative balance between sediment load and sediment transport capacity (MacDonald and others 1991). Large W:D ratios are often a result of lateral bank excursion due to increased peak flows, sedimentation, and eroding banks (Overton et al. 1995). Aberrant W:D ratios can cause reduced pool numbers (Beschta and Platts 1986), increased stream temperature, increased bank erosion and thus direct sediment delivery, decreased riparian vegetation and associated diminished ability of riparian area to capture nutrients and sediment (MacDonald et al. 1991). In the Idaho Batholith, W:D ratios of <10 (INFISH RMO) are not common in even wilderness streams (Overton et al. 1995).

Pools and Large Woody Debris

A pool is a portion of the stream with reduced water velocity and water deeper than the surrounding area. The bottom of a pool is often concave. There are four basic types of pools: large-shallow, large-deep, small-shallow, and small-deep. In general, the greater the pool type diversity, the better the habitat.

Pools provide important resting and feeding habitat for fish. Overton et al. (1993) found pools in less impacted watersheds were more frequent, had higher volumes, and were of greater depth than those in more impacted watersheds.

Trees provide shade and stream bank stability because of their large size and massive root systems. As trees mature and fall into or across streams, they not only create high-quality pools and riffles, but their large mass also helps to control the slope and stability of the channel (Platts 1983). Large woody debris (LWD) influences sediment transport in streams by forming depositional sites (MacDonald et al. 1991). Wood was responsible for storing half the sediment in several small streams in Idaho (Megahan and Nowlin 1976). In many aquatic habitats, if it were not for the constant entry of large organic debris (trees) into the streams, the channel would degrade and soon flow on bedrock, leaving insufficient spawning gravels and few high-quality

rearing pools for fish (Platts et al. 1987). LWD is one of the most important sources of habitat and cover for fish populations in streams (MacDonald et al. 1991).

Width-to-Maximum-Depth Ratio

Width-to-maximum-depth ratio is calculated for scour pools based on mean scour pool width and maximum depth. Width max depth is a useful indicator of scour pool condition. Elevated in-stream sediment, as indicated by percent fines data, would be expected to settle and reduce depth in lower gradient habitats (i.e. pools).

Bank Stability

Bank stability is rated by observing existing or potential detachment of soil from upper and lower stream banks and its potential movement into the stream. Measurements of bank angle and bank height may also be taken. Generally, steeper banks are more subject to erosion and correspondingly streams with largely unstable banks will often have poor in-stream habitat. Eroding banks can result in sedimentation, excessively wide streams, decreased depth and lack of vegetative cover. Banks that are protected by plant root systems or boulder/rock material are less susceptible to erosion.

Surface Fines

The particle size of the substrate directly affects the flow resistance of the channel, stability of the streambed, and the amount of aquatic habitat. If the substrate is predominantly composed of fines, then the spaces between the particles are too small to provide refuge for most organisms. The greatest number of species, and thus the greatest diversity, is found with a complex substrate of boulders, stone, gravels, and sand. Coarse materials such as gravels provide a variety of small niches for juvenile fish and benthic invertebrates. Because salmonids have adapted to the natural size distributions of substrate materials, no single sized particle class will provide the optimum conditions for all life stages of salmonids. A mix of gravel with a small amount of fine sediment and small rubble creates optimal conditions for fish spawning. When small fines (<6.35 mm) exceed 20-25% of the total substrate, embryo survival and emergence of swim-up fry is reduced by 50% (Bjornn and Reiser 1991).

Reference Conditions

In order to determine whether measurements of the above habitat parameters are indicative of impairment, they were compared to reference condition measurements made in pristine streams of similar stream channel and geologic parent types. Reference condition refers to a condition that fully supports applicable beneficial uses with little affect from human activity and represents the highest level of support attainable. It is a benchmark for populations of aquatic ecosystems used to describe desired conditions in a biological assessment and acceptable or unacceptable departures from them. The reference condition can be determined through examining regional reference sites, historical conditions, quantitative models, and expert judgment

Cumulative Watershed Effects (CWE) Assessment Methodology

Idaho Code Section 38-1303 (17) defines cumulative watershed effects as "*...the impact on water quality and/or beneficial uses which result from the incremental impact of two (2) or more forest practices. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time*." The CWE methodology is designed, first, to examine conditions in the forest watershed surrounding a stream, and then in the stream itself. It then attempts to identify the causes of any adverse conditions. Finally, it helps to identify actions that will correct any identified adverse conditions. The CWE process is utilized for identifying general watershed problems and not as readily for estimating existing loads (quantities) of pollutants.

The CWE process consists of seven specific assessments:

1) Erosion and Mass Failure Hazards
2) Canopy Closure/Stream Temperature
3) Channel Stability
4) Hydrologic Risks
5) Sediment Delivery
6) Nutrients, and
7) Beneficial Uses/Fine Sediment

StreamStat

StreamStats is a method of determining stream flow in basins where stream gage information is lacking. StreamStats, a cooperative effort of the USGS and ESRI, Inc., is an integrated GIS application that uses ArcIMS , ArcSDE , ArcGIS , and the ArcHydro Tools. It incorporates a map-based user interface for site selection; a Microsoft Access database that contains information for data-collection stations; a GIS program that delineates drainage-basin boundaries and measures physical and climatic characteristics of the drainage basins; and a GIS database that contains land elevation models, historic weather data, and other data needed for measuring drainage-basin characteristics and for locating sites of interest in the user interface.

After StreamStats measures the drainage-basin characteristics, the values are input to a separate program named the USGS National Flood Frequency Program (NFF) , which is a Microsoft Windows program that contains all of the USGS-developed equations for estimating flood-frequency statistics in the Nation. NFF has been modified for StreamStats so that it can also contain equations for estimating other types of stream flow statistics. Estimates provided by StreamStats assume natural flow conditions at the site.

Equations for estimating monthly exceedance (80-, 50-, and 20-percent) and mean annual discharge values at ungaged sites were developed using a multiple-regression analysis. The analysis related stream flow to eight basin characteristics. These eight standard characteristics were: drainage area (A), mean basin elevation (E), basin relief (BR), slopes greater than 30 percent (S30), mean annual precipitation (P), forested area (F), basin slope (BS), and main channel slope (MCS).

StreamStats estimates stream flow and there is a range of error associated with these estimates that varies from drainage to drainage. Thus, while StreamStats can give an estimate of the flow, it may be higher or lower than estimated, particularly if there are management activities in the area that affect flow.

Little Salmon River

Subwatershed characteristics for the Little Salmon River, including fisheries, are covered in Section 2. The Little Salmon River is comprised of two assessment units, which include many of its tributaries. The upper Little Salmon River meanders through wide low-gradient meadows while the lower 24 miles flows through a more confined canyon, with a steeper gradient. The upper meadows are C channel types, while the lower canyon reaches are B channel types. The upper meadows area stretch of the river is able to access its floodplain and frequently overflows its banks during high flow periods.

The lower reaches of the Little Salmon River have high flushing flows during peak run-off. Flooding events in 1974, 1976 and 1997 contributed large amounts of mud and debris to the Little Salmon River. The majority of suspended sediment appears to be from natural causes (USFS 1995). The mainstem Little Salmon River has had severe flood damage scouring and riparian/flood plain degradation in the lower canyon reaches downriver from river mile 24 (BLM BA). The lower canyon river reaches are in a state of disequilibrium that the river adjusts to by reworking alluvial deposition and building new stream banks. The stream banks in the lower reaches have unstable sections which are primarily attributed to flood events.

The Little Salmon River is split into three assessment units on the 2002 303(d) list. These sections will be called the lower and upper (17060210SL007_04 and 17060210SL007_5) reaches for the purposes of this TMDL. The lower reach begins at Riggins where the Little Salmon enters into the Salmon River and extends up to the confluence with Round Valley Creek. The lower reach is approximately 24 miles long. Assessment unit 17060210SL007_05 of the Little Salmon extends from Round Valley Creek to approximately East Branch Goose Creek. Assessment units 17060210SL007_04, _03, and _02 comprise the assessment units of the Little Salmon River from East Branch Goose Creek to Mill Creek, Mill Creek to Vicks Creek, and Vicks Creek to the headwaters, respectively. Assessment units _03 and _02 are not on the 303(d) list.

The 1997 floods resulted in down cutting and lateral movement in the lower elevations of the river and loss of riparian vegetation. Portions of Highway 95 were completely washed out and many residences were partially or totally destroyed. Debris avalanches and slumps are evident throughout this section. As shown in Figure 17, the erosion hazard is high along the Little Salmon River from Round Valley Creek to Rattlesnake Creek.

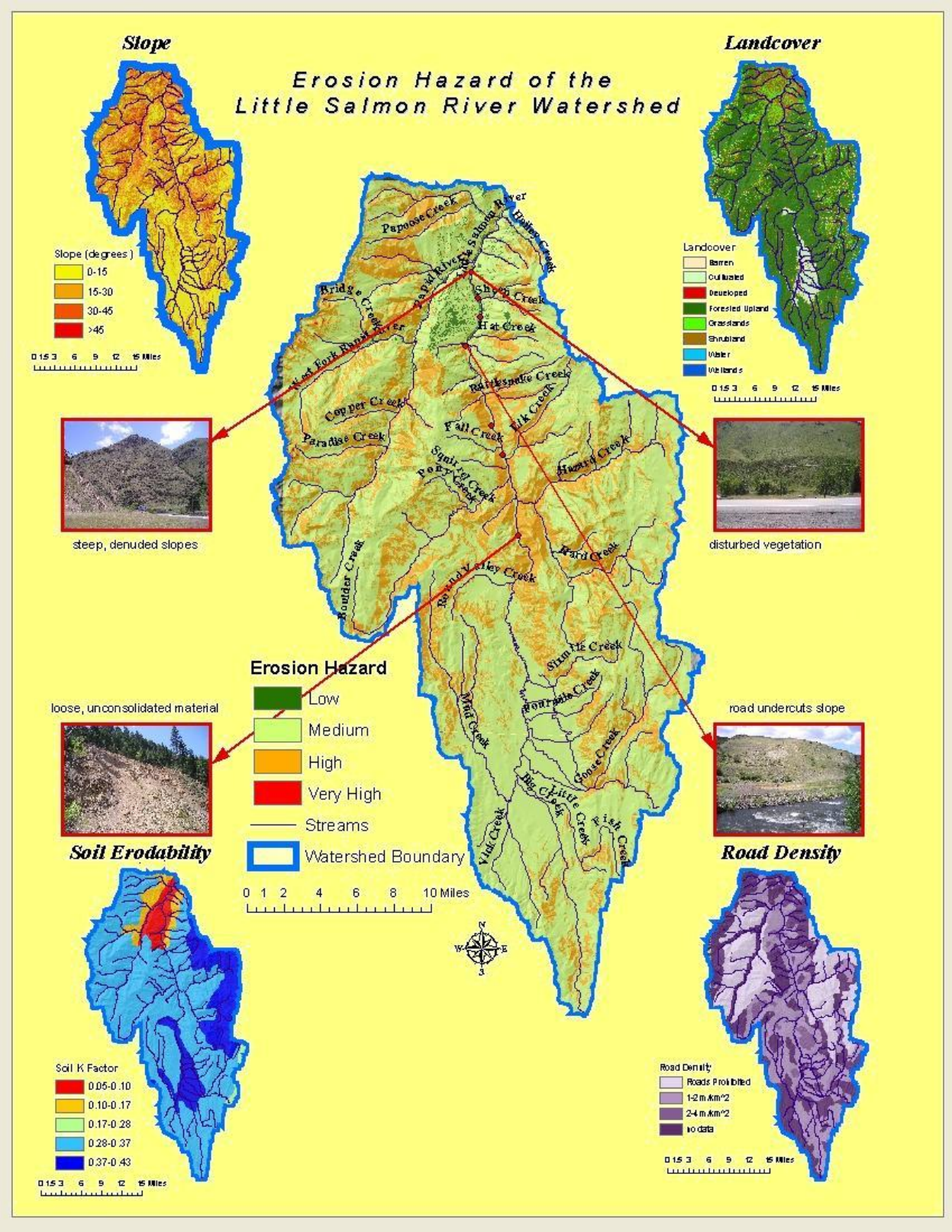


Figure 17. Mass Wasting Potential: Little Salmon River (DEQ 2005).

Temperature

During the summer, the upper reach has high water temperatures, which is suboptimal for salmonids. However, as the Little Salmon River flows towards the confluence with the Salmon River, the larger tributary streams contribute significant discharges of cooler water. These larger tributary streams include Hazard/Hard Creek, Boulder Creek, and Rapid River. Consequently, the mainstem Little Salmon River has cooler average water temperatures as it flows downstream towards the mouth. There are significantly more juvenile rainbow/steelhead below Hazard Creek than above it. Tributaries with cooler water, particularly larger ones create a localized cool water plume and mixing zone at the mouth of the creek. Cool water plumes or mixing zones at the mouth of tributary streams create important holding and rearing habitat in the Little Salmon River (BLM 2000).

As shown in Figure 18, temperatures in the Little Salmon River at the 45th parallel violate the state maximum daily average standard of 19 degrees Celsius. Temperatures in the Little Salmon River at Six Mile Creek (Figure 19)also had exceedances of the maximum daily average temperature standard, but the water was cooler than at the 45th parallel (June 21-September 22). This cooling effect in the Little Salmon River in the Meadows Valley is partly due to the influence of groundwater in the lower Meadows Valley. By the time the Little Salmon River reaches Riggins, temperatures are significantly cooler due to the input of cold water from Hazard Creek, Boulder Creek and Rapid River (Figure 20). Bull trout temperature criteria are not applicable in this reach due to the elevation (below the elevation that bull trout temperature criteria apply). Some results from 2005 are shown in Appendix C. These results, which are from the Little Salmon River near the 45th parallel, show violations of the state maximum daily average standard of 19 degrees Celsius.

A thermal infrared flyover was done in August 2004 during the low flow period to investigate temperature increases due to natural hot springs along the river corridor. The section of the Little Salmon River from Hazard Creek upstream to the headwaters was flown and photographed. The results did not show any hot springs influence in Meadows Valley. Zims Hot Springs probably does not have a thermal influence because the water is discharged from the swimming pool (where it is mixed with cold well water) into cooling ponds and then a 20 acre pasture separates the cooling pond from the Little Salmon River. There is no discrete channel leading from the cooling pond to the Little Salmon River, meaning that water reaches the river through subsurface flow which would result in further cooling. Other geothermal sources may have too small a discharge to affect the overall temperature of the Little Salmon River.

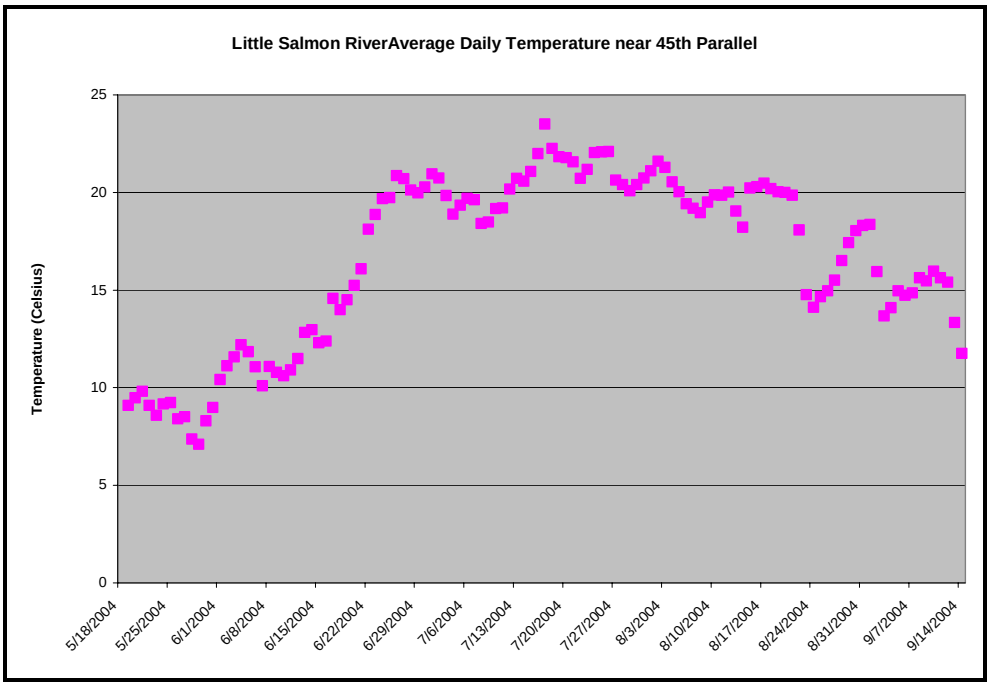


Figure 18. Little Salmon River Near 45th Parallel: Average Daily Temperature.

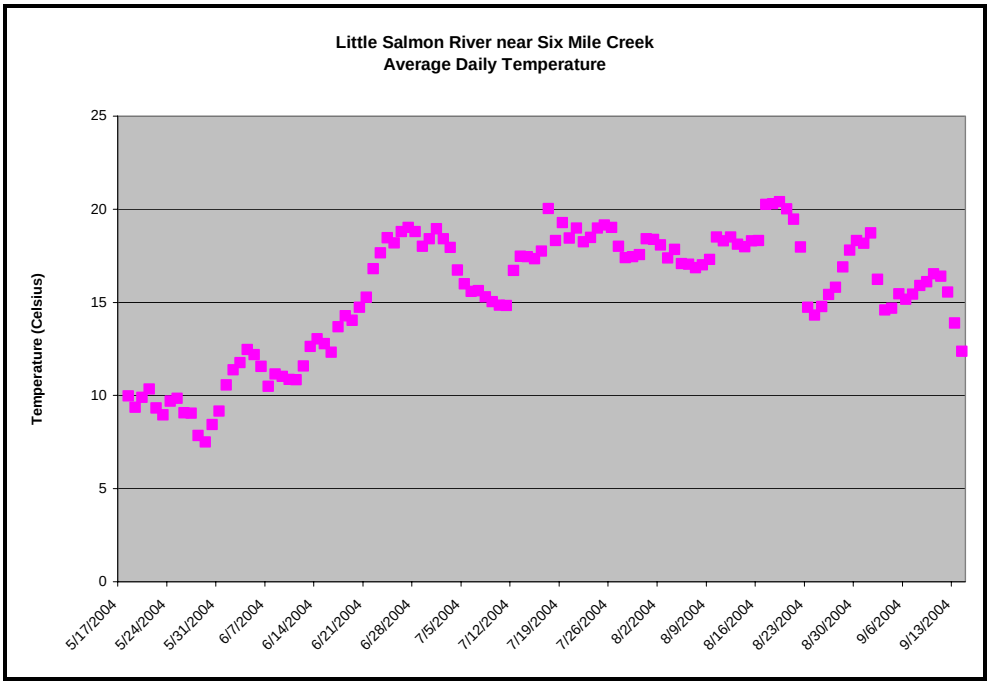


Figure 19. Little Salmon River Near Six Mile Creek: 2004 Average Daily Temperature.

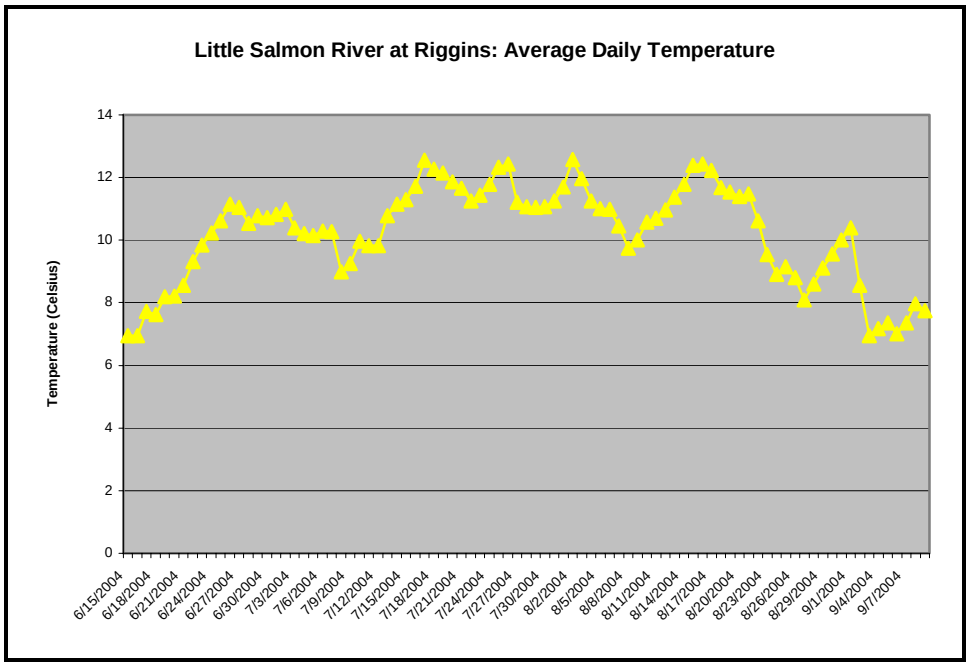


Figure 20. Little Salmon River at Riggins: Average Daily Temperature.

Fisheries

The Little Salmon River in the Meadows Valley reach has been stocked with rainbow trout by IDFG in the past. An IDFG fish survey in year 2000 found both rainbow and brook trout. The report notes that numerous nongame fish including Paiute sculpin, speckled dace and longnose sucker, were also caught. An IDFG fish survey in year 2005 found rainbow trout ranging from 170-400 mm in size, cutthroat (1 individual), brook trout, and whitefish.

The Little Salmon River downstream of the fish barriers has a limited occurrence of spring/summer Chinook salmon spawning and rearing as well as steelhead spawning and rearing. Mainly, the Little Salmon River is used as a migratory corridor. Populations of both these species are depressed throughout the Northwest region.

Other fish utilizing the mainstem Little Salmon River include rainbow trout, bull trout, whitefish, dace, sculpin, suckers, redside shiners, and pikeminnow.

The mainstem Little Salmon River downstream from river mile 24 has limited amounts of good Chinook salmon spawning habitat, due to the predominantly large sized substrate. The steeper stream gradient and high flushing flows do reduce sediment deposition, however, high discharge also "flushes" smaller sized suitable salmonid spawning gravels. Limited suitable gravels that do occur are primarily in deposition areas along the river margins or behind boulders.

Hydrology

A gaging station has been maintained at the mouth of the Little Salmon River since 1951. Mean annual streamflow recorded at the gaging station is 794 cubic feet per second (cfs). The mean monthly high flow (2,380 cfs) occurs in June while the mean monthly low flow

(225 cfs) occurs in September (USGS 1951-1998). On January 1, 1997, an extreme flood event (50 year flood) occurred in the Little Salmon River. The average flow for that day was estimated at 8,000 cfs with the flow peaking at 10,500 cfs. This was the second highest flow event monitored during the period of record. The extreme discharge event for the period of record occurred on June 17, 1974 (a 100-year flood). The average flow for that day was 9,650 cfs with the flow peaking at 12,500 cfs. The lowest daily flow was recorded on December 21, 1990 at 60 cfs. Figure 21 shows the average monthly flows at the mouth of the Little Salmon River.

Flood stage is considered to be 10 feet on the gage, and the Little Salmon River has been at flood stage nine times since 1948.

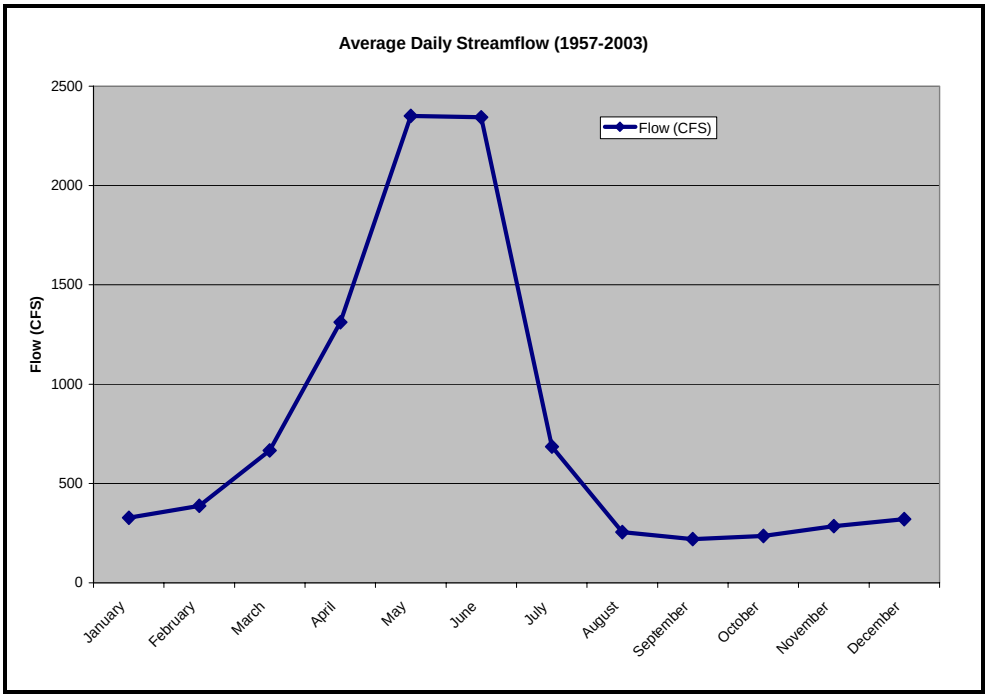


Figure 21. Little Salmon River Average Monthly Flow at Mouth (USGS).

Water Column Data

The Idaho Department of Agriculture monitored the Little Salmon River from April through October of 2004 and resumed monitoring in April of 2005. DEQ monitored periphyton in 2005. Results from 2005 were not available at the time this TMDL was written. In 2004, five sites were selected based on accessibility and locations that would best characterize sections of the river. Site LSR 1 is located at the mouth, site LSR 2 is located at White Bird Ridge Road Bridge at Indian Creek (downstream of Hazard and Boulder Creeks), site LSR 3 is located at the Circle C bridge upstream of Round Valley Creek and at the downstream end of Meadows Valley, site LSR 4 is located at the Old Highway Bridge in New Meadows and site LSR 5 is located at Carr Road at the upstream end of Meadows Valley (Figure 22). In 2005, monitoring focused on Meadows Valley and sites LSR 3 and LSR 4 were monitored as well as the Little Salmon River at Meadow Creek which is below the branches of Goose Creek. An agricultural drain near Four Mile Creek, Four Mile Creek, Little Creek, Mud Creek and

Big Creek were also monitored to determine what nutrient inputs are from tributary sources. Big Creek was also monitored in 2004.

Bacteria monitoring (Table 12) showed that the Little Salmon River at Circle C Bridge (LSR-3), the Little Salmon River at New Meadows (LSR-4) violated the state of Idaho bacteria standard. LSR-4 had particularly high levels of bacteria. This violation means that primary and secondary contact recreation uses are not supported. In other words, there is an increased chance of illness as a result of dermal contact or accidental ingestion of the water in these locations. The bacteria standard is < 126 *E. coli* organisms/100 mL as a 30 day geometric mean with a minimum of five samples and no sample > 406 *E. coli* organisms/100 mL. Recreational uses such as fishing and swimming take place in the Little Salmon River during the summer months when bacteria levels are high.

Table 12. Little Salmon River 2004 bacteria monitoring results.

Date	LSR-1 (E. coli organisms/100mL)	LSR-2 (E. coli organisms/ 100 mL)	LSR-3 (E. coli organisms/100 mL)	LSR-4 (E. coli organisms/100 mL)
6/29/2004	19	41	650	2400
7/8/2004	4	110	200	2400
7/13/2004	71	40	240	1400
7/19/2004	48	8	130	1600
7/22/2004	50	26	260	730
Geomean	26	33	254	1566

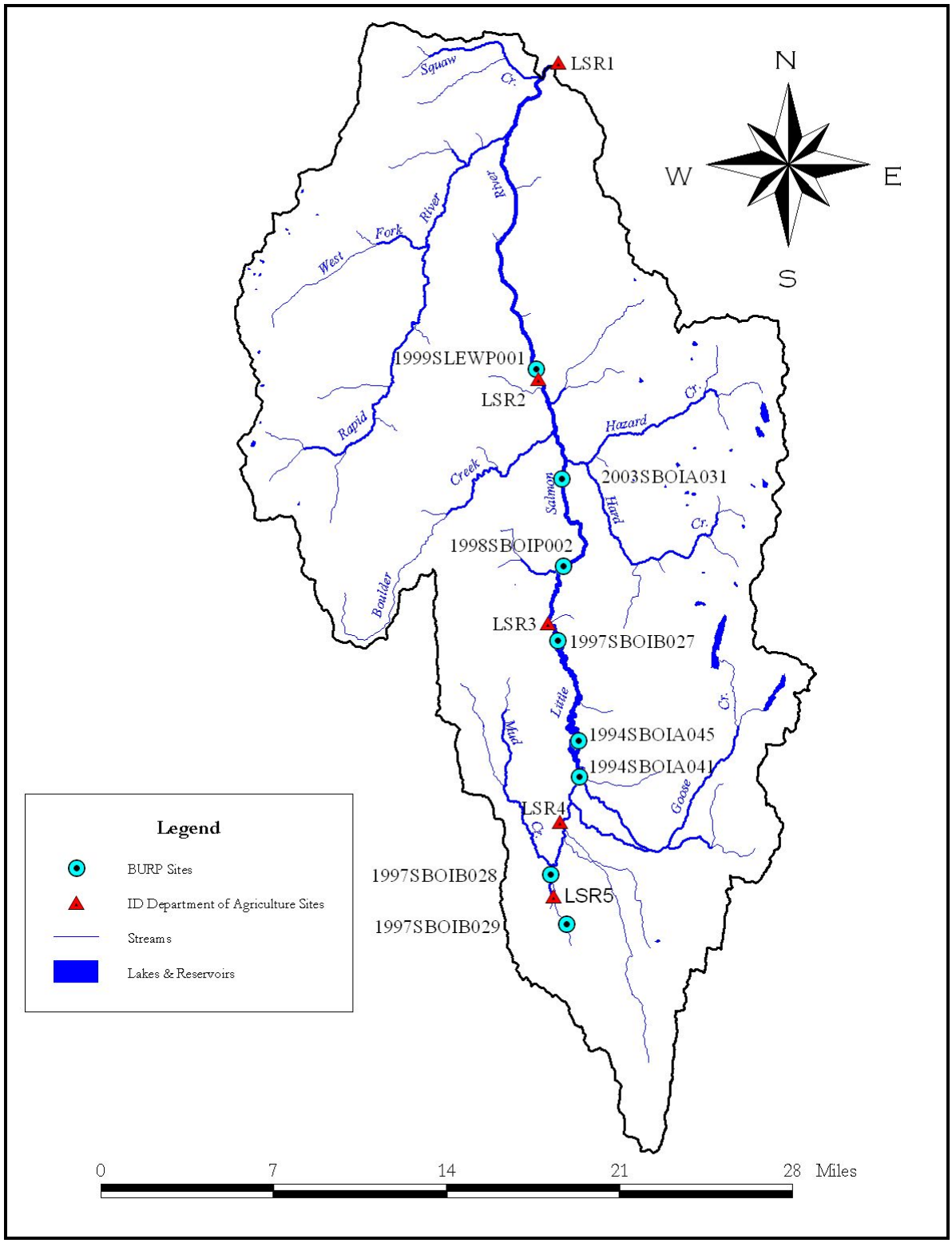


Figure 22. Little Salmon River Monitoring Sites.



Figure 23. Periphyton Present at Little Salmon River at New Meadows.

Nutrient monitoring showed that nutrient concentrations were low in the lower reach of the Little Salmon River (LSR 1 and LSR2) (see Appendix C for results). Elevated nutrient concentrations were seen at LSR 3 (LSR at Circle C Ranch) and LSR 4 (LSR at New Meadows), particularly from late July through August when flows decreased. This time period also coincided with the appearance of nuisance periphyton growth. Phosphorus concentrations were consistently lower at the downstream LSR3 site (Figure 24). The Idaho Department of Agriculture surmised that high levels of organic phosphorus found in the water quality analysis are from algal die off or periphyton sloughing off. Decreased concentrations downstream may be due to the use of phosphorus by periphyton or other algal species.

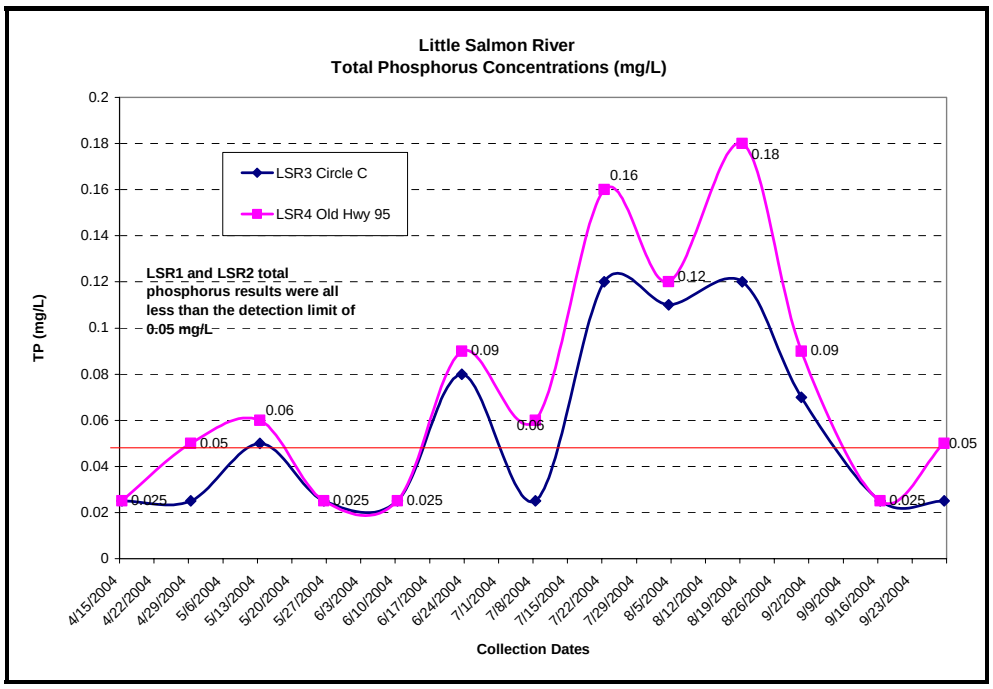


Figure 24. Little Salmon River: 2004 Total Phosphorus Concentrations.

Potential conditions for depressed dissolved oxygen were seen in August 2004 and periphyton growth was also seen at this time (Figure 23). These are indicators of nutrient impairment. In late July through mid August 2005, depressed dissolved oxygen concentrations (< 6 mg/L which is in violation of the state standard) were observed in the early morning hours, indicative of a diurnal sag. This means that during the day dissolved oxygen levels rise due to algal productivity but during the night dissolved oxygen is used up due to algal die-off and since photosynthesis is not taking place, this dissolved oxygen is not replaced. Low dissolved oxygen puts significant stress on fish and other aquatic organisms. Stream waters are especially vulnerable to depressed dissolved oxygen during times of warmer temperatures and high nutrient levels.

The results from the biweekly monitoring showed that the Little Salmon River was far below the 50 mg/L suspended sediment concentration target that has been used in many Idaho TMDLs as a target that will support cold water aquatic life including salmonid spawning (Figure 25). Several sampling dates took place either after or during rain events. Bedload sediment was not measured due to both lack of equipment and appropriate monitoring locations. In the Meadows Valley reach, it was surmised that since the predominant fraction of bank material is fine material, this would have been picked up in the samples during high flow events. Given that levels remained low even after rain events and high flows, in-stream channel erosion does not appear to be a contributor to excess sediment load during normal water years.

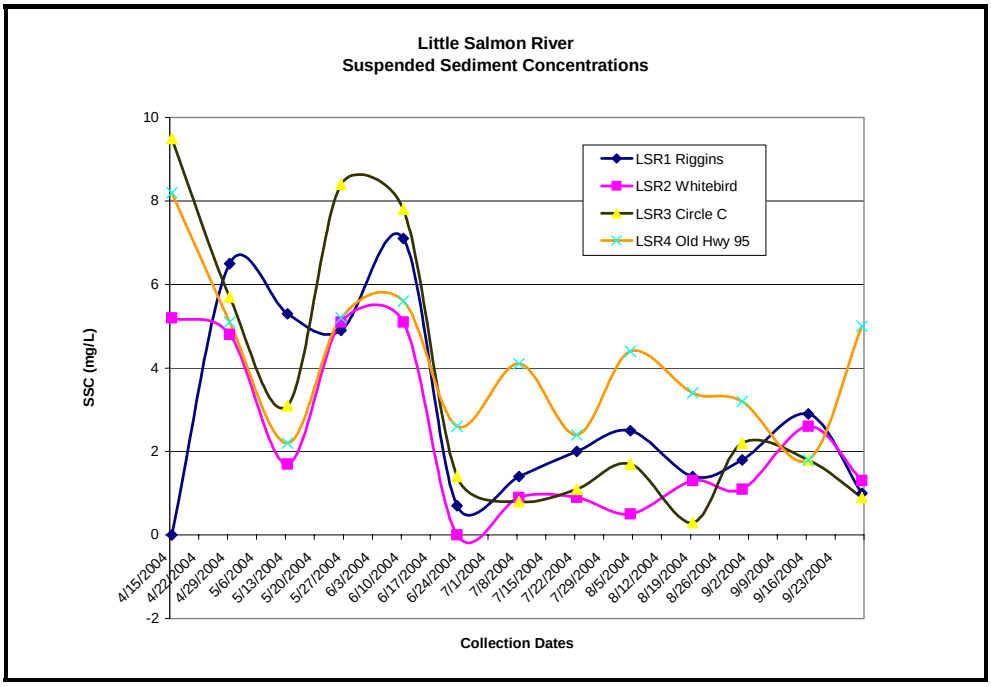


Figure 25. Little Salmon River: 2004 Suspended Sediment Concentrations.

Habitat Data

DEQ water body assessment data shows that beneficial uses are impaired in the section between Mill Creek and Round Valley Creek (Tables 13 and 14). The Stream Habitat Index (SHI) is calculated from a range of habitat inventory parameters including bank stability, riparian cover, percent surface fines, pool quality, large organic debris etc.) Scores range from 1-3, with 3 being the highest score. The Stream Macroinvertebrate Index (SMI) is calculated from nine macroinvertebrate metrics having to do with pollutant tolerance, species diversity, number of individuals, species distribution, etc. Scores range from the lowest which is below < minimum threshold, through the highest score of 3. The < minimum threshold score indicates an impaired aquatic environment and lack of beneficial use support. The Stream Fish Index (SFI) is also calculated from a range of fish metrics and the scores also range from < minimum through a high score of 3. 'NA' means that that the stream was not electrofished (NA= not assessed). Not all streams are electrofished, depending upon the safety conditions for electrofishing and whether or not a DEQ staffperson with an electrofishing permit is available to electrofish the stream with the stream inventory crew.

The SMI score at the Round Valley Site showed a Hilsenhoff Biotic Index (an index that relates to nutrient enrichment) score of 6.3. The index ranges from 1-10, with 1 being indicative of an environment with little to no nutrient enrichment and 10 being a heavily nutrient enriched environment. 6 is in the moderate nutrient enrichment range.

Water body assessment scores for the section below Round Valley Creek showed full support of beneficial uses.

Table 13. Little Salmon River: DEQ water body assessment scores.

DEQ Stream Site ID	SHI	SMI	SFI	Assessment Score	Beneficial Use Support Status
	(maximum score= 3)				
2003SBOIA031 (downstream of Round Valley Creek, 1 mile upstream of Hazard Creek)	1	2	3	2	Full Support
1997SBOIB028 (upper reach just below Mill Creek)	1	3	NA	2	Full Support
1997SBOIB027 (just upstream of Round Valley Creek)	1	1	NA	1	Not Full Support

Table 14. Little Salmon River: DEQ large river water body assessment scores.

DEQ Stream Site ID	RMI	RDI	RFI	Assessment Score	Beneficial Use Support Status
	(maximum score= 3)				
1998RLEWP001 (LSR below Fall Creek)	3	1	NA	2	Full Support
1998RBOIP002 (LSR at Round Valley Creek)	2	1	NA	1.5	Not Full Support

Conclusions

DEQ water body assessment data showed that beneficial uses were impaired in the Little Salmon River below Mill Creek and above Round Valley Creek during the summer months. The Idaho Department of Agriculture conducted water quality monitoring to identify potential pollutants impairing beneficial uses. Elevated total phosphorus levels during low flow periods and violations of the state bacteria standard were shown in the results. The Little Salmon River does not meet Idaho water quality criteria for temperature or bacteria. Nutrient concentrations were also elevated during the summer months. More information on temperature and nutrient targets can be found in Section 5. TMDLs for temperature, bacteria, and nutrients were developed.

While habitat scores showed that the Little Salmon River below Round Valley Creek supported beneficial uses, this section is an important anadromous fishery. This section is listed for sediment and coarse sediment (bedload) is likely reducing spawning habitat in the river. Coarse sediment was transported during the 1997 flood and remains in the channel and side channels.

While DEQ was able to identify areas that were subject to mass wasting (Figure 19), separating out human caused factors from natural factors was not possible. At this time, DEQ plans to work with other agencies to not only identify areas of potential concern for erosion, but also those sections of channel that are currently aggraded and vulnerable to further loading

DEQ proposes to list the Little Salmon River below Round Valley Creek for habitat alteration. Historic highway construction is the main factor in the habitat alteration. It is imperative that any new construction or any other management activity not encroach upon the natural meander of the Little Salmon River. The state of Idaho's antidegradation policy states that the existing in stream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.

Mud Creek

Mud Creek, a second order stream, originates at 5,700 feet on Brush Mountain, flows in a southerly direction and enters the Little Salmon River approximately three miles southwest of New Meadows. Mud Creek drains approximately 20,608 acres. Little Mud and Middle Mud Creeks are tributaries to Mud Creek (Figure 26). The Mud Creek watershed comprises assessment units17060210SL008_02 and _03.

Geology

Mud Creek originates in Imnaha basalt and Grande Ronde basalt of the Weiser Embayment. Little Mud Creek originates in basalt but also runs through Idaho Batholith material. The lower elevations of Mud Creek flow through Quaternary alluvial deposits before entering the Little Salmon River.

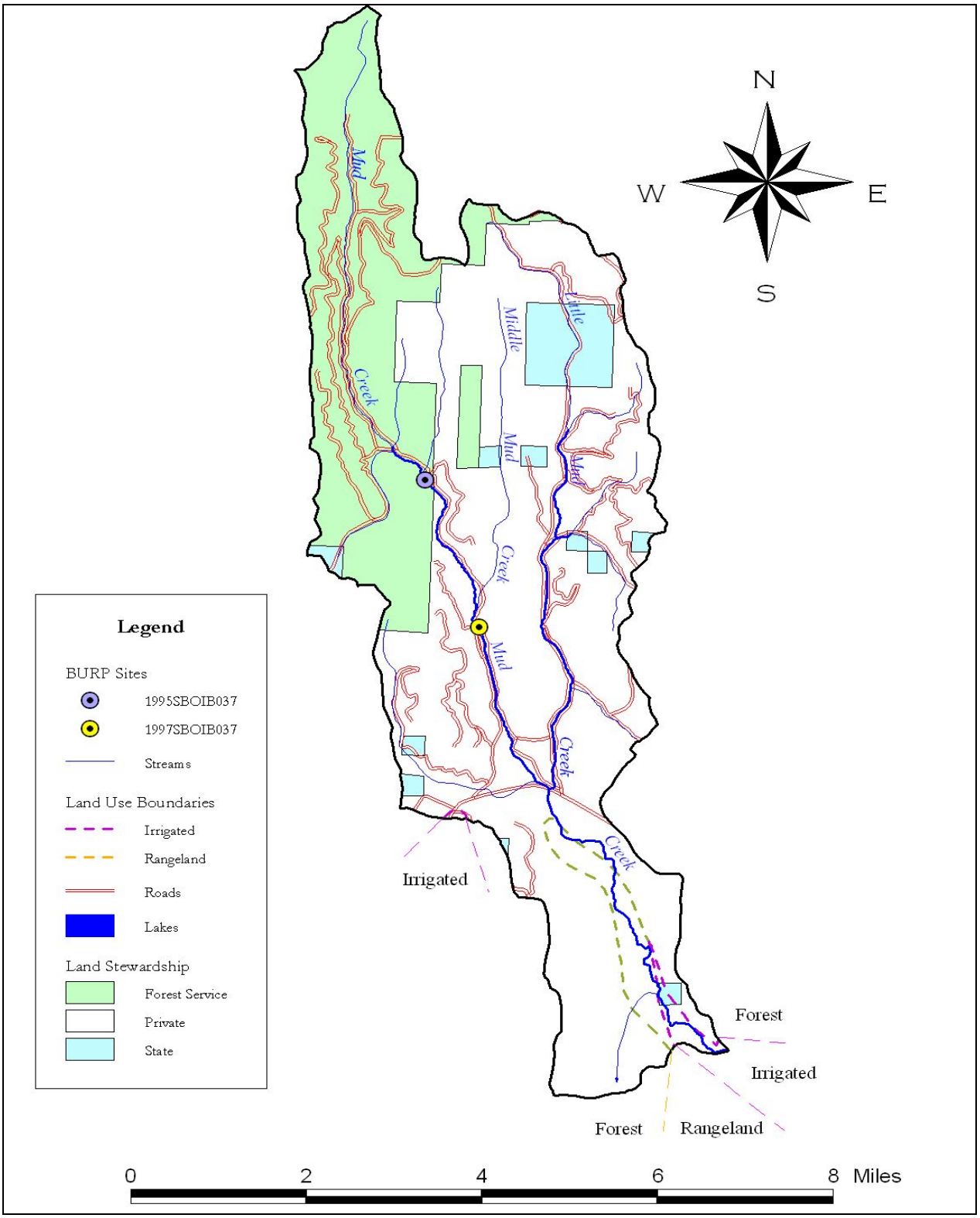


Figure 26. Mud Creek Subwatershed.

Vegetation

The watershed is primarily forested, but the lower reaches of Mud Creek and Little Mud Creek flow in a southerly direction through both range and pastureland.

Douglas fir, Englemann spruce, Grand fir, and lodgepole are the dominant species in the forested areas. The higher elevations have subalpine fir, larch, lodgepole pine and Douglas fir. Midstory vegetation consists of alder, willow, dogwood, and serviceberry with various forbs and grasses interspersed between the shrubs.

The lowest elevations are grasses and forbs. Willow and alder species are present within the riparian zone. The vegetative communities are affected by grazing pressure in these areas. Within the riparian zones of heavily grazed areas, sedges are dominant (USFS 1992a).

Land Use

Mud Creek is used for grazing, agriculture and is being developed residentially in its lower reaches. The upper reaches have been managed for grazing and timber harvest. Mud Creek is within the USFS Price Valley S&G grazing allotment. In 2004, the grazing permit was approved for two bands of 950 ewe/lamb pair to graze between June 6 and July 10.

Road densities within Mud Creek are 6.24 mile road/mile^2 in the upper area and 5.46 mile road/mile^2 in the lower areas. Thirty-three percent of the upper Mud Creek roads are within riparian conservation areas(RCAs), and 39% of the lower Mud Creek roads are within RCAs.

Hydrology

A moderately sinuous stream, Mud Creek is a Rosgen Stream Type (RST) C at the lower open meadow elevations (Figure 27). Within the middle elevations, Mud Creek has RST B characteristics. It is moderately sinuous, moderately confined, and has an average gradient of 5%. Above 4,760 feet in elevation, the RST is mostly RST A. The substrate changes to boulder with some granite outcroppings.

Gauging records for Mud Creek exist from 1946-1959. The stream follows a typical hydrologic regime for central Idaho. The peak flow occurs during mid-April to late-May and reaches base flow by late July (Figure 28).



Figure 27. Mud Creek (March 2005).

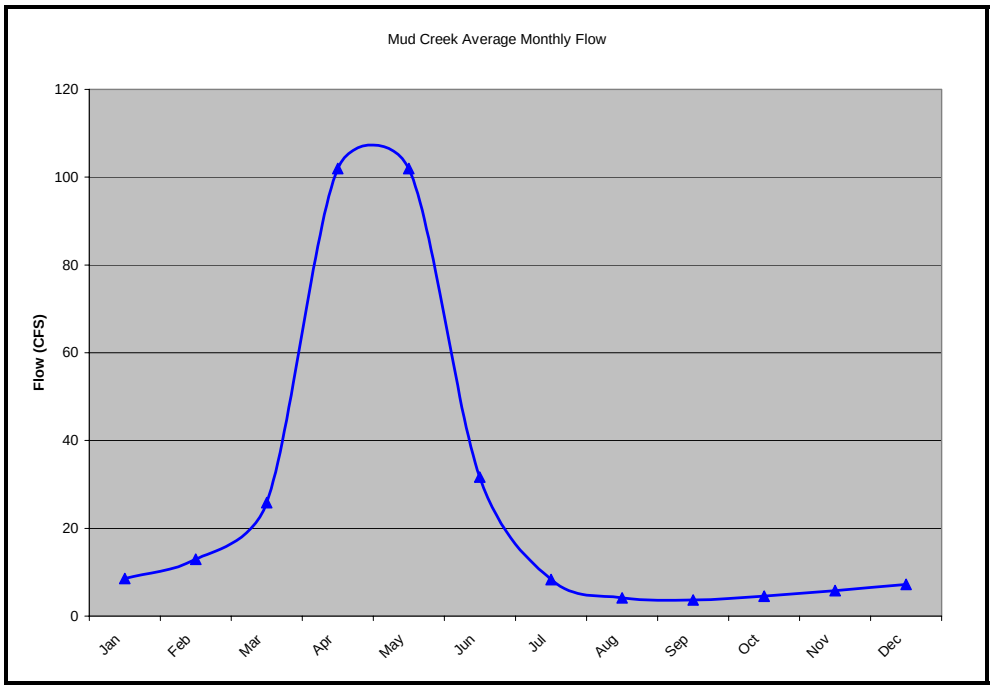


Figure 28. Mud Creek Average Monthly Flow at Mouth (Estimated Using StreamStat).

Temperature

The Idaho Department of Fish and Game has monitored temperature in Mud Creek for several years below a riparian improvement project located at the Highway 95 crossing. The most recent data is presented below (Figure 29). Exceedances of the temperature standard

comprised less than 10% of the summertime temperatures in 2005. 2004 results had exceedances comprising 11% of the summertime daily temperatures. In 2003, 29% of the summertime daily temperatures exceeded the average maximum daily standard and in 2002, 12% of the summertime daily temperatures exceeded the average maximum daily standard.

The USFS has measured in-stream temperatures higher up in the watershed near the 1995 BURP site (Figure 22), no exceedances of the 19 degrees Celsius average daily maximum temperature were seen at this site in 2004 or 2003.

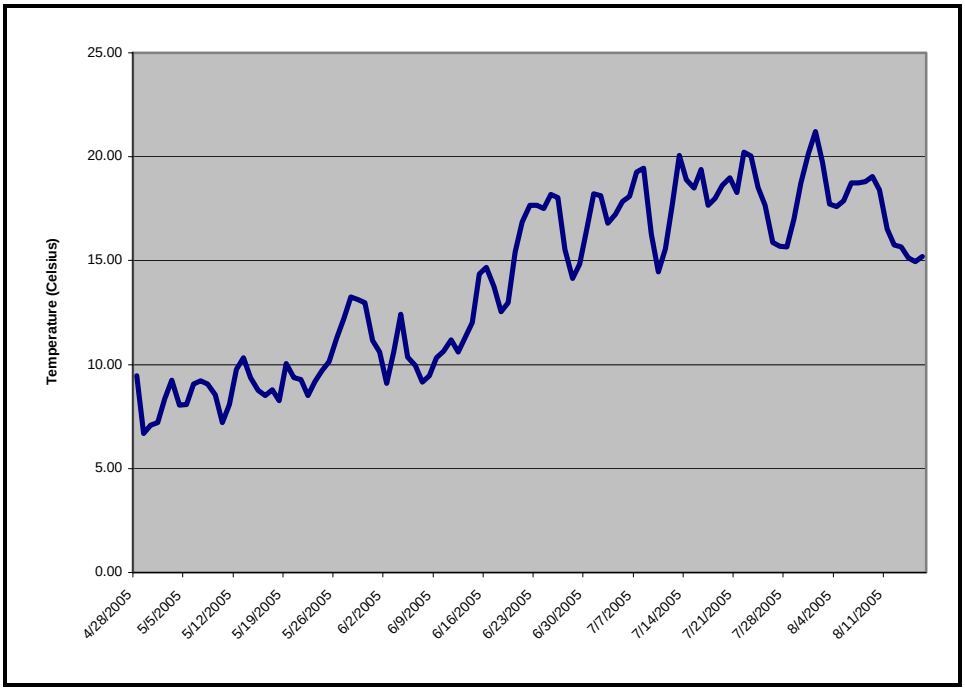


Figure 29. Mud Creek at Highway 95 Bridge: 2005 Average Daily Temperature.

Fisheries

Within Mud Creek, redband trout and brook trout are the only salmonid species that have been observed. The redband trout were small sized (110-120mm in length) while the brook trout ranged in size from under 50mm up to over 200mm in length. The proportion of fish species present was clearly dominated by brook trout with population numbers spanning various age classes.

Chinook salmon and steelhead are not observed within Mud Creek due to the falls on the Little Salmon River. Bull trout have not been observed within Mud Creek.

A 1997 BURP survey observed fresh water clams within the stream.

Habitat Data

1997 water body assessment scores (Table 15) indicate that beneficial uses are not impaired in Mud Creek near the confluence of Middle Mud Creek. This assessment encompasses the watershed above the confluence of Middle Mud Creek. The 1997 score supercedes the 1995 score which was taken upstream of that site.

Table 15. Mud Creek: DEQ water body assessment scores.

DEQ Stream Site ID	SHI	SMI	SFI	Assessment Score	Beneficial Use Support Status
	(maximum score= 3)				
1997SBOIB037	3	3	Not Measured	3	Full Support
1995SBOIB037	1	2	Not Measured	1.5	Not Full Support

Mud Creek originates in volcanic parent material. According to Overton (1995), volcanic RST C channels have mean percent surface fines of 37%. Substrate monitoring provided by the USFS, has shown Mud Creek mean percent surface fines ranging from 3.4 to 23.7% over the past ten years. These values are below the Overton values for volcanic RST C. However, an IDFG survey in 2000 recorded percent surface fines as 100% in one transect of a low gradient RST C depositional reach.

A 1994 R1R4 fisheries habitat inventory performed by the Forest Service found bank stability functioning at risk. (USFS, unpublished data 1994). A 1992 PfanKuch Channel Stability Evaluation found the mainstem on forest service lands to be in generally fair condition. An IDFG fish survey in 2000 also noted degraded banks in Little Mud Creek. Preliminary data from the Idaho Department of Agriculture from close to the mouth of Mud Creek (Mud Creek at Highway 95) has shown very low amounts of suspended sediment, showing that runoff events are not causing excessive in-stream channel erosion. Sampling occurred after several rain events.

Preliminary data from a 2005 survey of Little Mud Creek at the confluence with Mud Creek indicated low flow (0.4 cfs in mid-July), moderately stable banks (82% stable) and high percent fines (67%). Macroinvertebrate information is not available as of the time of this writing. An assessment of benefical use support will not be completed until after the macroinvertebrate data is obtained.

Conclusions

Beneficial uses appear to be supported in the upper reaches of Mud Creek. The most recent data suggests that the temperature standard is met through the mainstem of Mud Creek from the headwaters to the mouth. The DEQ Waterbody Assessment Guidance allows for 10% of the measured temperatures to exceed the standard and still be indicative of supporting beneficial uses in a stream that is not on the 303(d) list. The status of beneficial use support in Little Mud Creek and Middle Mud Creek are not known. A BURP inventory was conducted in 2005 for Little Mud Creek but the data were unavailable at the time this report was written in order to make a beneficial use assessment. Mud Creek should continue to be monitored for temperature to keep track of trends in the temperature regime.

Big Creek

Big Creek originates south of the Little Salmon River at 6,600 feet on the east side of Blue Bunch Ridge (Figure 30). It flows north through forested and meadow areas, and enters the Little Salmon River about a mile southwest of New Meadows (approximately 41 miles upstream of the mouth of the Little Salmon River). The watershed drains 18,592 acres. Assessment unit 17060210SL009_02 comprises of the Big Creek watershed.

Geology

Big Creek originates in Columbia River basalt and then flows through alluvial/glacial deposits in the low gradient meadow areas of the lower reaches. A biotite gneiss/schist outcropping is present on the western slope of Big Creek just before the alluvial plain.

Soil types in the middle to upper elevations of Big Creek are cobbly-loam and have a moderate to very slow infiltration rate. The lowest elevations within the valley are loam-clay soil types. Infiltration and drainage in these soil types are slow and poor.

Land Use

The majority of Big Creek is privately owned with its headwaters within Forest Service, BLM, and state managed land (Figure 31).

In the middle to lower parts of the watershed, livestock grazing, irrigated pastures, hayfields and agriculture are the predominant land uses (Figure 31). The BLM Big Creek allotment allows 81 animal unit months (AUMs) of sheep to graze on BLM lands from June through October. Rural residential development also occurs in the lower watershed.

The upper part of the watershed is entirely forested and is actively managed for timber harvest (approximately 13,000 acres).



Figure 30. Big Creek (BC2, June 2003).

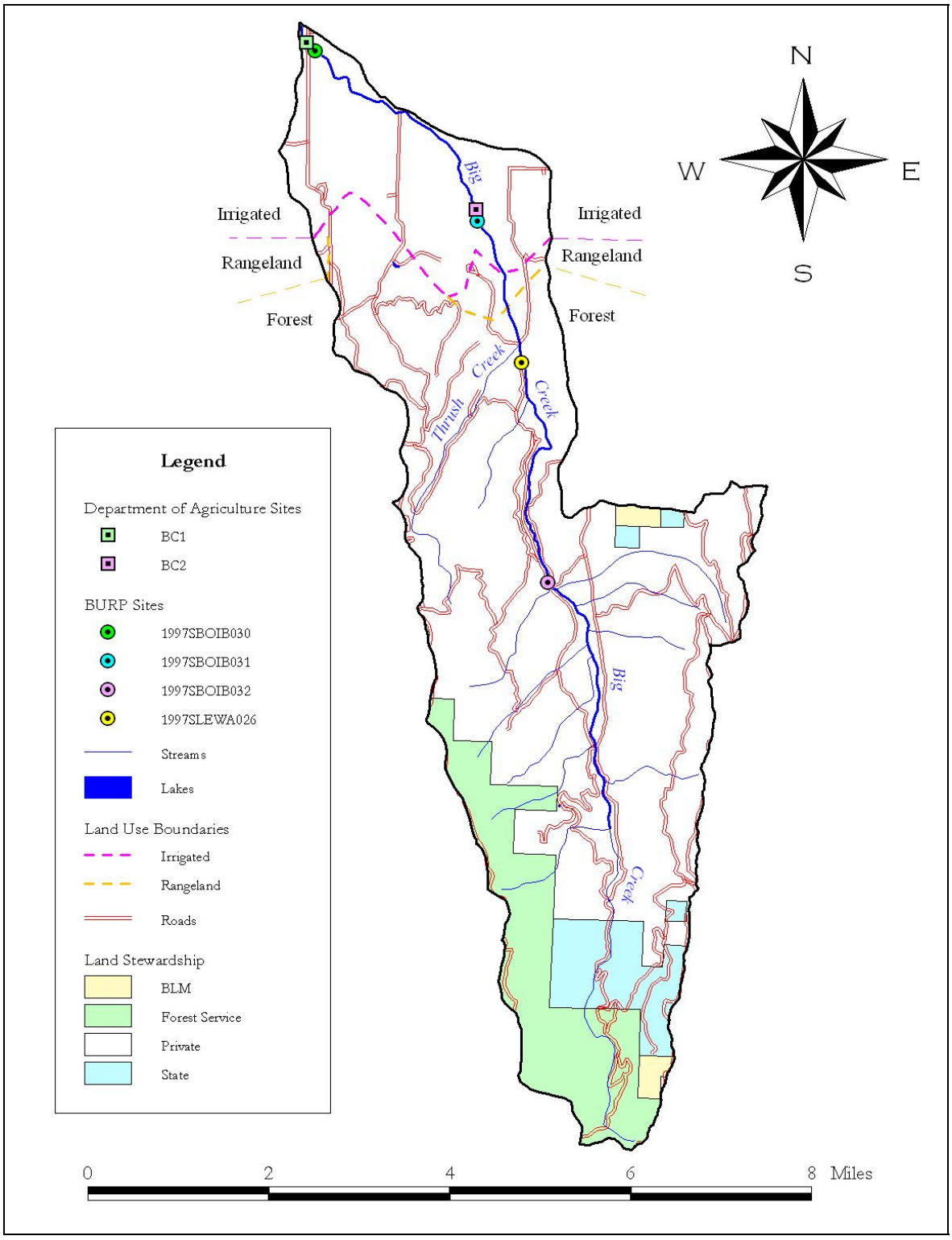


Figure 31. Big Creek Subwatershed.

Hydrology

The upper steeper, timbered reaches of Big Creek are Rosgen Stream Types (RST) A and B whereas the lower reaches in the meadow area is typically RST C with some RST B sections.

Big Creek hydrology follows typical central Idaho mountain flow regimes. The peak flow in this second order stream occurs from mid April to May, and low flows occur by late August and continue into the winter months (Figure 32). Stream order is a hierarchical ordering of streams based on the degree of branching. A first-order stream is an unforked or unbranched stream. Higher order streams result from the joining of two streams of the same order.

Water is removed from Big Creek for irrigation of pastureland, and fluctuations in flows between BC1 and BC2 are likely attributable to water management. Figure 30 shows the location of BC1 and BC2 monitoring sites. Figure 31 shows the change in water flow between the BC1 and BC2 sites.

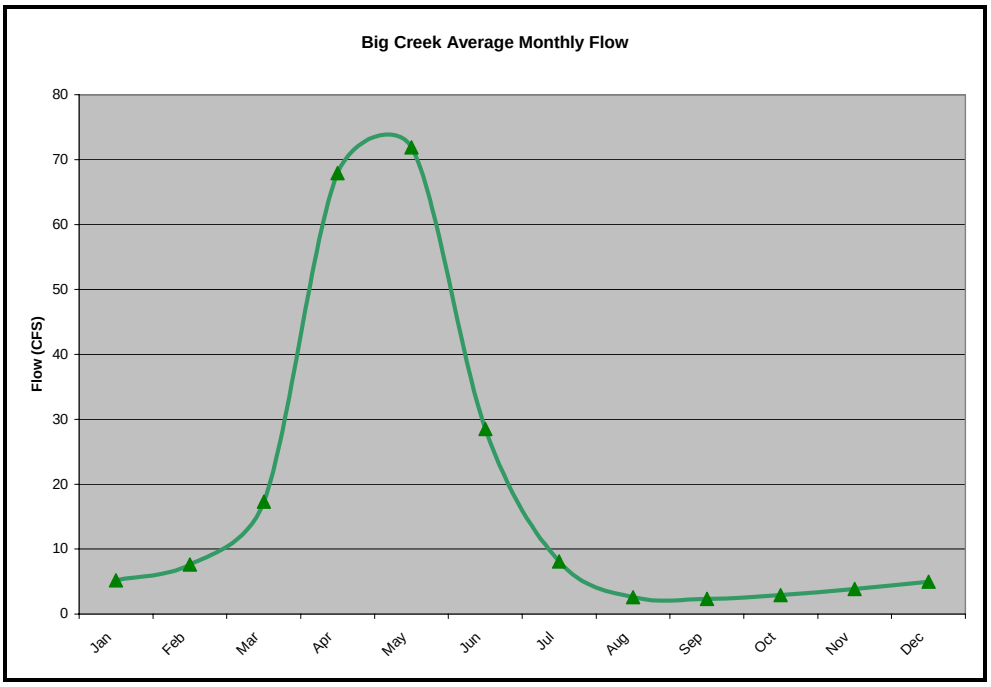


Figure 30. Big Creek Average Monthly Flows at Mouth (Estimated using StreamStat).

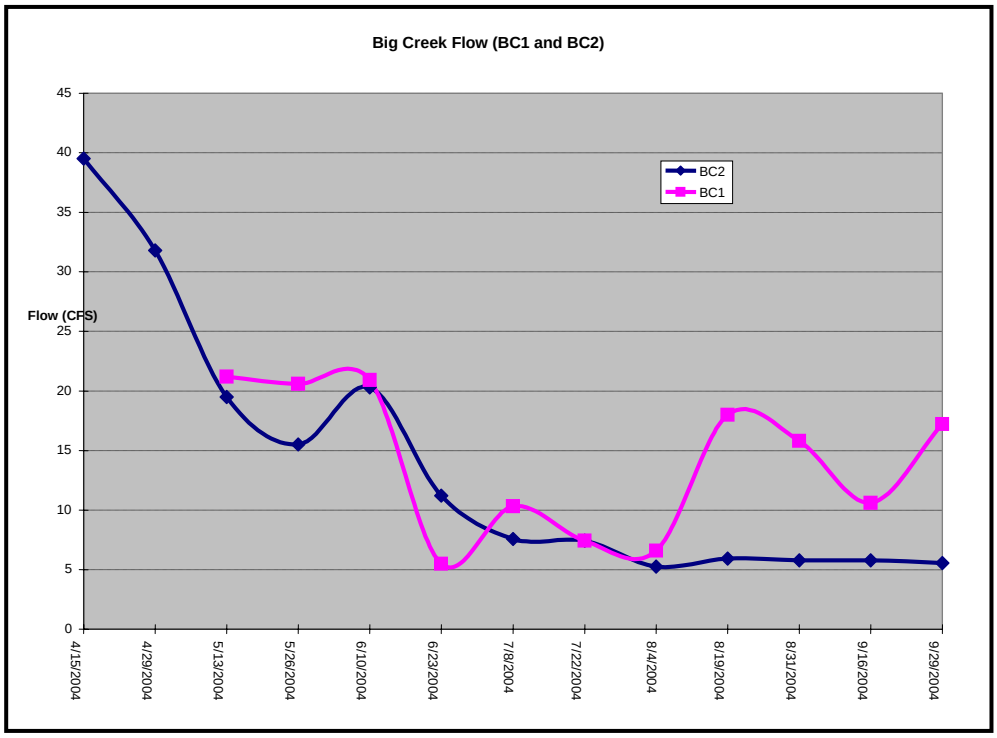


Figure 31. 2004 BC1 and BC2 Flows.

Fisheries

Cutthroat trout, brook trout and rainbow/redband trout have been documented within Big Creek. Chinook salmon and steelhead cannot access Big Creek due to the falls on the Little Salmon River. No bull trout have been documented within Big Creek.

A 1997 BURP survey observed longnose dace, speckled dace, and sculpin within Big Creek. A 2000 IDFG fish survey in the forested section of the watershed showed predominantly brook trout present in Big Creek.

Habitat Data

In the lower and middle watershed, impacts to the riparian area from grazing were assessed as moderate to severe (Ferguson 2001).

An Idaho Department of Lands Cumulative Watershed Effects study (IDL 2002) showed low surface erosion hazard and mass failure hazard ratings in the forested part of the watershed. Channel stability was evaluated as moderate. A road sediment delivery analysis indicated that sediment delivery from Forest Service roads was low. Road density for the Big Creek area is at 5.96 miles road/mile^2, 28% of which are within riparian conservation areas (RCAs). An RCA is a U.S. Forest Service description of land that lies within the following number of feet up-slope of each of the banks of a stream:

- 300 feet from perennial fish-bearing streams
- 150 feet from perennial non-fish-bearing streams
- 100 feet from intermittent streams, wetlands, and ponds in priority watersheds.

1997 DEQ water body assessment scores showed that beneficial uses were not impaired in the forested reaches of Big Creek, but were impacted in the lower agricultural/rangeland reaches (Table 16).

The Hilsenhoff Biologic Index for stream sites 1997SBOIB030 and 1997SBOIB031 were 6.61 and 6.23 respectively, indicating moderate nutrient enrichment. This is a measurement of the macroinvertebrate community that is tolerant of nutrient enrichment.

Table 16. Big Creek: DEQ water body assessment scores.

DEQ Stream Site ID	SHI	SMI	SFI	Assessment Score	Beneficial Use Support Status
	(maximum score= 3)				
1997SBOIB030	1	<min	1	<1	Not Full Support
1997SBOIB031	1	3	1	1.67	Not Full Support
1997SBOIB032	1	3	3	2.33	Full Support
1997SLEWA026	1	3	3	2.33	Full Support

Temperature

Both instantaneous and average daily temperature measurements show that Big Creek does not violate the water quality temperature criteria for cold water aquatic life (Figures 32 and 33). Figure 34 shows the temperature/time of measurement for most of the data points.

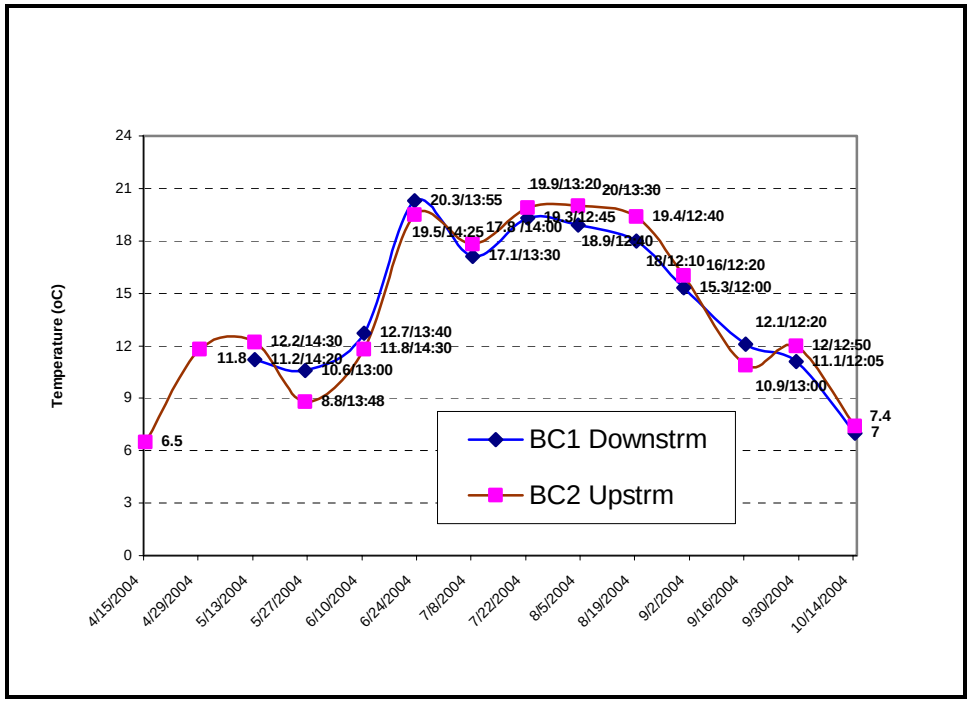


Figure 32. Big Creek: 2004 Instantaneous Temperatures.

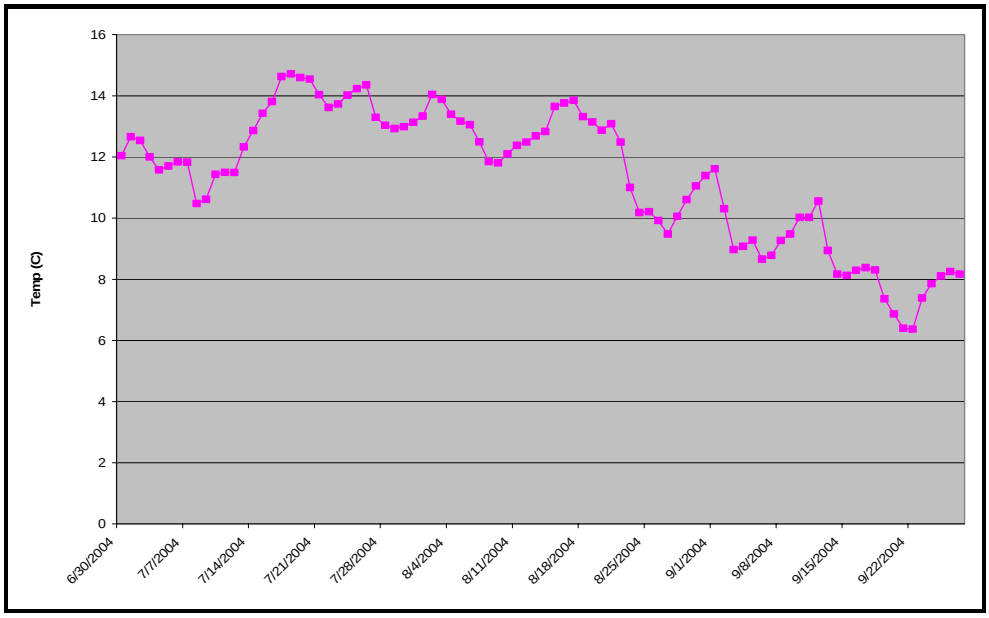


Figure 33. Big Creek In-stream Average Daily Temperatures (Upper Watershed).

Water Column Data

The Idaho Department of Agriculture monitored water quality in Big Creek in 2004. Total phosphorus concentrations were elevated, off and on, from the start of the monitoring season through August (Figure 34. Big Creek: 2004 Total Phosphorus Results.). Thereafter, a downward trend in in-stream nutrient concentrations was observed.

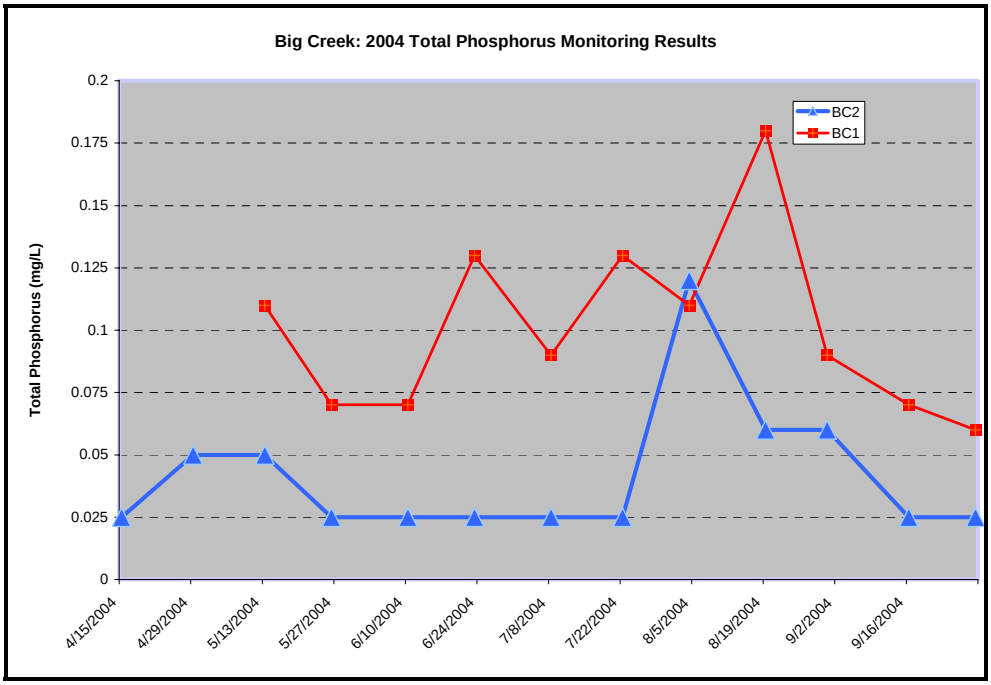


Figure 34. Big Creek: 2004 Total Phosphorus Results.

As shown in Table 17, the geometric mean for Big Creek and each individual concentration violate the state standard for bacteria. This violation means that primary and secondary contact recreation are not supported. In other words, there is an increased chance of illness as a result of contact of the skin with water or accidental ingestion of the water in these locations. The bacteria standard for primary contact recreation is < 126 *E. coli* organisms/100 mL as a 30 day geometric mean with a minimum of five samples and no sample > 406 *E. coli* organisms/100 ml. The bacteria standard for secondary contact recreation is less than 126 *E. coli*/100 ml as a geometric mean of five samples over 30 days and no sample greater than 576 *E. coli*/100 ml.

Table 17. Big Creek bacteria results

Date	BC-1 (E. coli organisms/100 mL)
6/29/2004	**2400**
7/8/2004	**1400**
7/13/2004	**2400**
7/19/2004	**2400**
7/22/2004	**2400**
Geomean	2155

Conclusions

The Big Creek watershed was listed for an unknown pollutant after DEQ water body assessment scores showed that beneficial uses were impaired. Elevated nutrient and bacteria levels indicate that these are the most likely pollutants impairing beneficial uses. Stream surveys in the forested parts of the watershed showed no impairment of beneficial uses and a cumulative watershed effects survey showed that sediment is not being exported out of the upper reach at levels above natural background. A TMDL has been completed for Big Creek for nutrients and bacteria.

Goose Creek

Goose Creek (Figure 35 and Figure 36) originates above Goose Lake at 6,360 feet. Granite Mountain (elevation 8,478 feet) and Slab Butte (elevation 8,225 feet) flank the west and east sides of Goose Lake. Goose Creek flows south and west where it splits into the East Branch and the West Branch of Goose Creek. These two branches appear to be of natural origin. Both branches enter the Little Salmon River north of New Meadows, the East Branch at river mile 37.9 and the West Branch at river mile 38.8.

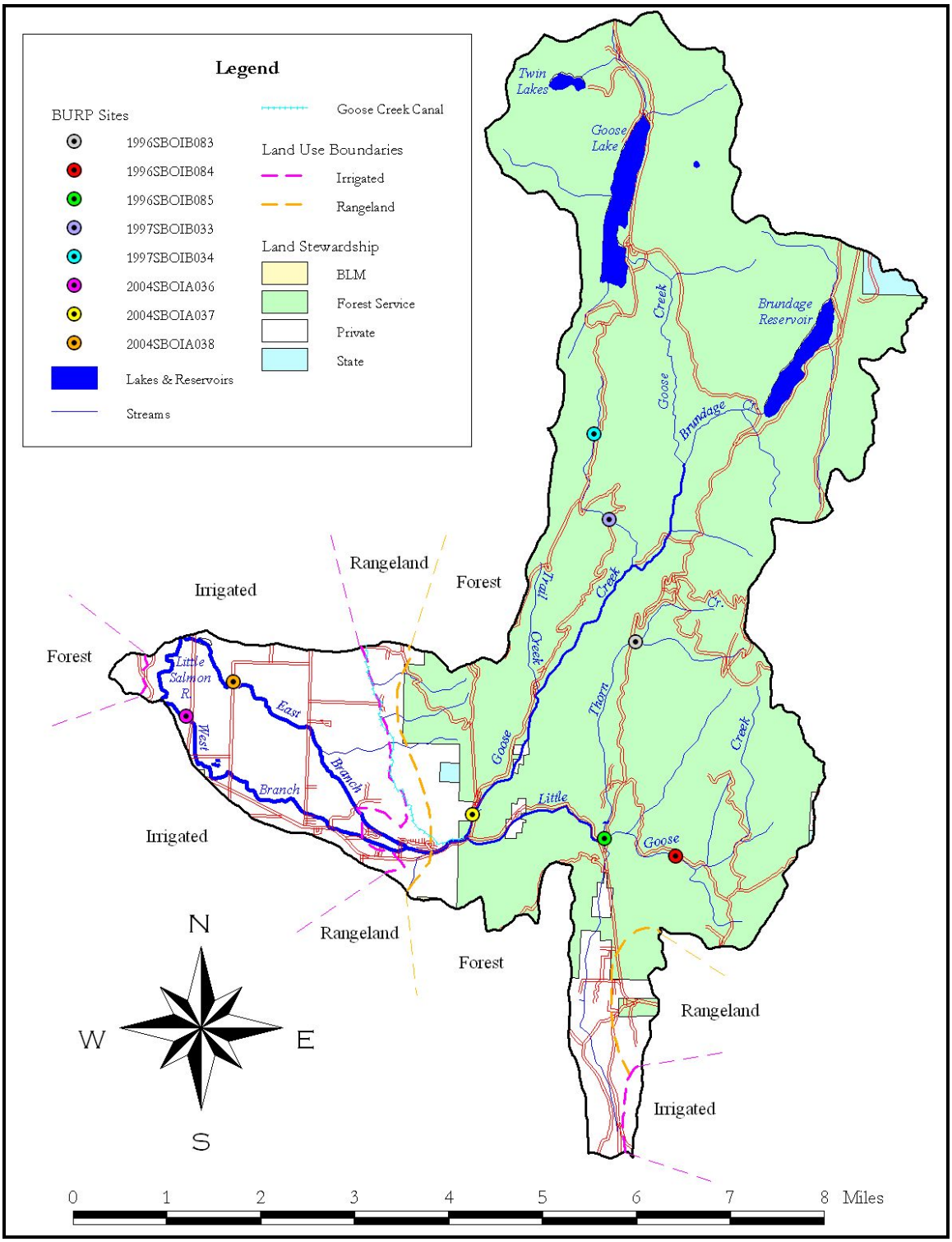


Figure 35. Goose Creek Subwatershed.



Figure 36. Goose Creek upstream of confluence with Little Goose Creek.

Geology

Starting in part of the Idaho Batholith, the stream flows through granitic parent material. Glaciers scoured the upper basin while various faults and large bedrock outcrops channelize the mid section of Goose Creek. Alluvial deposition shaped the lower elevations. The action of alluvial deposition may have formed the East and West Branches of Goose Creek. The sinuosity and apparent lack of channelization of each branch, along with substrate composition and riparian vegetation, make it appear that the branches are of natural origin (Olsen, personal comm. 2005).

Vegetation

Upland vegetation is predominately late seral stage with an overstory of coniferous species: Douglas fir, Englemann spruce, grand fir, and lodgepole. The higher elevations have subalpine fir, larch, lodgepole, whitebark pine and Douglas fir.

Mid-story vegetation consists of alder, willow, dogwood, and serviceberry with various forbs and grasses are interspersed between the shrubs. Mosses are present in the deep canyons (USFS 1996b).

The lower elevation valley consists of mature ponderosa pine forest with an understory of grasses and small shrubs. Further in the valley, riparian vegetation of willows and grasses are apparent on private agricultural lands.

Land Use

The headwaters are on Forest Service managed public lands while the lower sections are on private land, flowing through the town of Meadows and agricultural lands before entering the Little Salmon River.

Recreation is a primary use on public lands in the Goose Creek area. Last Chance campground and other dispersed campgrounds are present in the middle drainage. Around Goose Lake, campsites and off-road vehicle use is prevalent. Many roads crisscross the upper headwaters of the drainage.

Grazing occurs within the drainage on public and private land. Private land owners graze cattle, horses, and sheep on their land. The USFS Brundage S&G, Slab Butte S&G, and Meadows Valley C&H grazing allotments are within the Goose Creek watershed. The Brundage permit is split into a north unit and a south unit that joins with the Slab Butte permit. In 2004, the south Brundage and Slab Butte permit allowed 930 ewe/lamb pairs to graze between July 10 and September 21, while the north Brundage permit allowed 1700 dry ewes to graze between September 22 and October 15. The Meadows Valley permit allowed a total of 445 cow/calf pairs to graze between June 1 and September 30

Irrigation for agriculture also occurs and water for irrigation is stored in three reservoirs within the Goose Creek drainage. Twin Lakes and Goose Lake are directly on Goose Creek while Brundage Reservoir is on Brundage Creek, a tributary to Goose Creek. Much of the sediment produced in the higher elevations is trapped within these reservoirs (USFS 1996b).

Logging occurs extensively along the upper ridges of this area. Historic logging appeared to occur within riparian areas while more recent logging occurs high up the steep slopes. Many roads exist in the drainage from past logging. Some are still heavily used by ATVs, ORVs, and motorbikes (USFS 1996a).

Road densities are high within the watershed at 2.6 mi road/mile^2. Twenty-two percent of the roads are within riparian conservation areas (RCA) on USFS managed land. Little Goose Creek is a tributary to Goose Creek and has a road density of 6.83, and 18% of roads are within RCAs.

Hydrology

This fourth-order stream is steep with an average gradient of 4.5% until it enters Meadows Valley and becomes a very sinuous Rosgen Stream Type (RST) C. The upper reaches of Goose Creek fluctuate between high gradient RST A with an average gradient of 10-15% and lower gradient RST A-B with average gradients of 3-6%.

The peak high flow is not reached until late May, and the base low flow is reached in late August (Figure 37). The flow regime is regulated by three reservoirs resulting in unnaturally high flows later in the runoff season (USFS 1996b). Due to flow management, flows in East Branch and West Branch Goose Creek fluctuate, depending upon water needs. Little Goose Creek is a tributary to Goose Creek and runs alongside Highway 55. Bear Creek, an intermittent tributary to Little Goose Creek, drains the Rock Flat area.

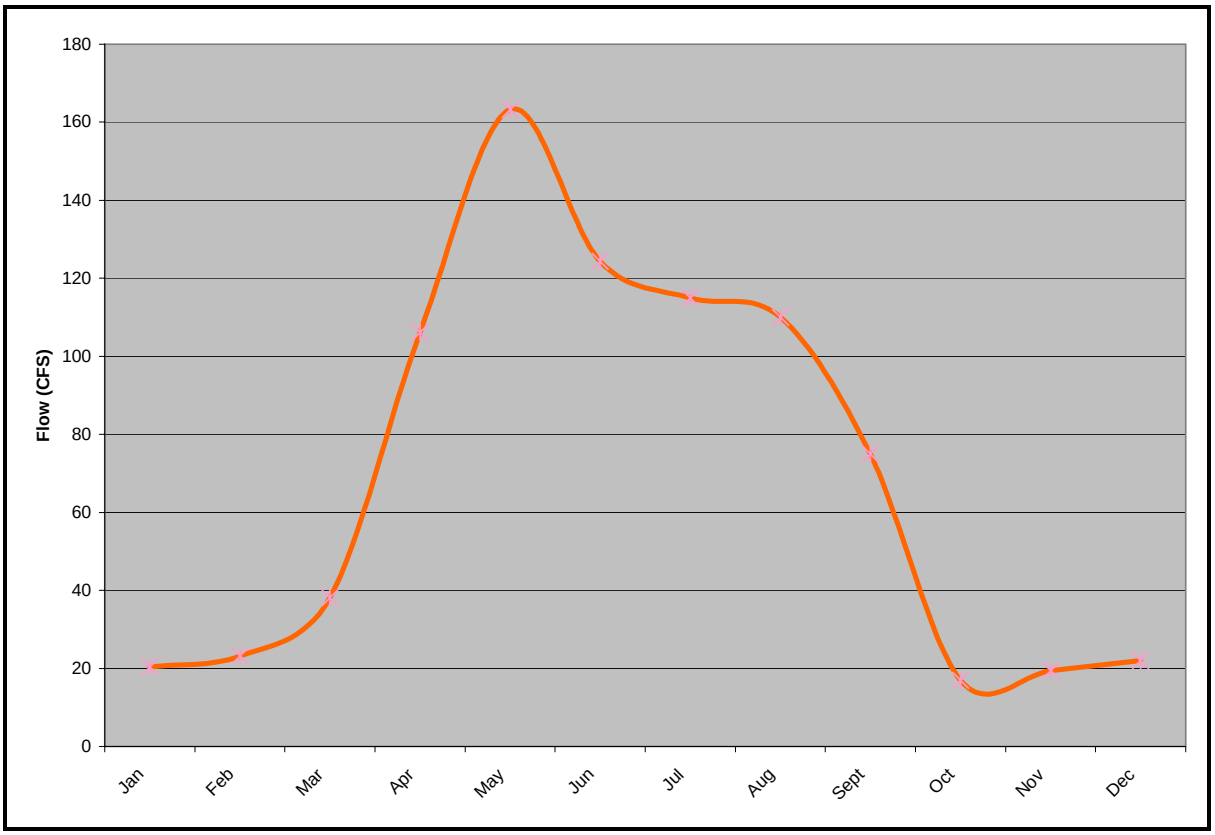


Figure 37. Goose Creek Average Monthly Flow at confluence of Little Goose Creek and Goose Creek (Estimated Using StreamStat).

Temperature

Goose Creek met the state water quality criteria for temperature during the summer months (Figure 38). The most recent temperature data is shown in this graph.

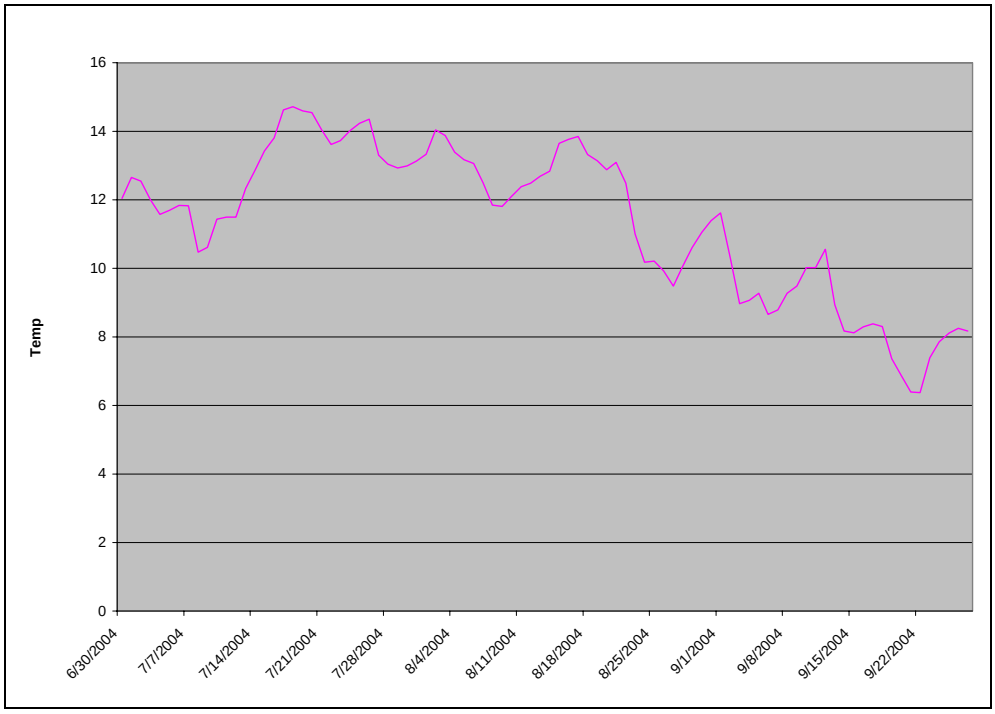


Figure 38. Summer Water Temperature in Goose Creek (USFS 2003).

Fisheries

Various fish species are present within Goose Creek. Redband, rainbow trout and brook trout have been observed. High gradients and large substrate in the upper elevations provide little fish habitat for juvenile fish. Goose Creek is upstream of the fish barrier falls on the Little Salmon River and, therefore, supports only resident populations of fish. Past stocking of trout in the lakes and reservoirs also may contribute to fish populations. Lower West and East Branch Goose Creek contain speckled dace and sculpin. Little Goose Creek contains brook trout and rainbow trout. An IDFG fish survey in 2000 found a variety of age classes of rainbow trout including young of the year in Little Goose Creek (IDFG 2001).

Chinook salmon and steelhead are not observed within Goose Creek due to the falls on the Little Salmon River, a fish passage barrier. However, Nez Perce elders have stated that anadromous fish were fished historically in Goose Creek. As part of the Nez Perce oral tradition, these reports may date back to the late 1800s. Bull trout have not been observed within Goose Creek.

Habitat Data

The beneficial uses in the forested sections of Goose Creek are considered not impaired according to 1997 BURP data (Table 18). 2004 BURP inventories conducted near the mouth

of the East Branch of Goose Creek showed that beneficial uses were not fully supported. The West Branch of Goose Creek was only at 0.4 cfs in early July and because the flow was less than 1 cfs could not be assessed. Beneficial use impairment in these branches may be partially attributable to very low flow conditions. Water management results in fluctuating flows in both channels.

Table 18. Goose Creek: DEQ water body assessment scores.

DEQ Stream Site ID	SHI	SMI	SFI	Assessment Score	Beneficial Use Support Status
	(maximum score= 3)				
2004SBOIA36 (West Branch Goose Creek)	NA	NA	NA	NA	Not Assessed Due to Low Flow
2004SBOIA38 (East Branch Goose Creek)	1	Data Not Yet Available	<minimum	<minimum	Not Full Support
1996SBOIB083 Thorn Creek	3	-	3	3	Full Support
1996SBOIB084 Little Goose Cr (upper)	3	1	3	2.33	Full Support
1996SBOIB085 Little Goose Cr (lower)	2	1	2	1.67	Not Full Support
1997SBOIB033 Seawell Creek (lower)	3	-	3	3	Full Support
1997SBOIB034 Seawell Creek (upper)	2	-	3	2.5	Full Support

The channel condition risk rating (<15% ECA to reduce the risk of peak flows and subsequent channel instabilities) is low in the upper Goose Creek drainage and moderate in the lower and Little Goose Creek drainages (USFS 2004b).

Goose Creek originates in plutonic parent material. According to Overton (1995), plutonic RST A, B, and C have mean percent surface fines of 26, 23, and 37% respectively. Substrate monitoring of Goose Creek within all three RSTs show mean percent, surface fines of 1.4 to 18.5%. These values are below the Overton guidelines for plutonic streams. The Little Goose Creek watershed had percent fines greater than 20% in several reaches but the overall average percent fines was equal to 20%. Due to the proximity of lower Little Goose Creek to

Highway 55 for part of its length, sections of Little Goose Creek may have excess sediment delivered due to road sanding activities. Thorn Creek, a tributary to Little Goose Creek, had surface fines over 20%.

Data show that almost all reaches had >90% stable stream banks on USFS managed land.

Width-to-maximum-depth ratio, bank stability, and large woody debris for Goose Creek were considered functioning appropriately according to a 1996 R1R4 Fisheries Habitat Survey.

Conclusions

The beneficial uses in the forested portions of Goose Creek are not impaired. The East branch of Goose Creek does not support beneficial uses. DEQ recommends listing the fourth -order section of Goose Creek for an unknown pollutant and characterizing the flows to determine if fluctuating flows are impacting beneficial uses.

Brundage Reservoir

Brundage Reservoir is a 270 acre reservoir used for irrigation located at 6,238 feet in the Goose Creek watershed. It receives water from Brundage Creek, a tributary to Goose Creek. The reservoir is bordered by Brundage Mountain (elevation 7,802 feet) on the south and an unnamed peak (elevation 7,677 feet) on the north.

The USFS holds a 500 acre-foot water right for fish and wildlife habitat with the designated beneficial use being for recreational storage. Originally built as a Works Project Administration project in 1936, the current dam (the original was replaced in 1987) is 92 feet long, 63 feet high and has a capacity of 7,330 acre-feet. The reservoir typically fills between late May and early July with water releases starting in late June and continuing through early September. At full pool, the maximum release is 291 cfs and this release comes out from the bottom of the dam.

Geology

Brundage Reservoir lies in the Idaho Batholith and the surrounding area consists of heavily glaciated lands.

Land Use

Brundage Reservoir is a popular recreation destination. A developed handicap accessible fishing dock is located near the outlet. Many dispersed campsites and hiking trails exist. Motorized boats and off road vehicle use is prevalent. The reservoir is managed as trophy trout fishery. In winter months, the area is a popular snowmobile and backcountry ski destination. A Brundage Mountain Ski Area snowcat skiing route is located within the southern end of the watershed.

The Brundage Reservoir watershed is within the USFS Brundage S&G grazing allotment. The Brundage permit is split into a north unit and a south unit that joins with the Slab Butte

permit. In 2004, the south Brundage and Slab Butte permit allowed 930 ewe/lamb pairs to graze between July 10 and September 21, while the north Brundage permit allowed 1700 dry ewes to graze between September 22 and October 15.

Much of the watershed was logged between 1940 and1960. The Brundage Water Users Association operates the dam for irrigation purposes.

Fisheries

Brundage Reservoir is managed as a trophy trout fishery and has been stocked with hatchery rainbow, cutthroat and kamloops trout.

Habitat Data

A 1996 Forest Service survey of the outlet creek from Brundage Reservoir found percent fines of 3.4% and bank stability at 99.3% stable (USFS 1996a).

Temperature

Temperature profiles taken in mid-July and mid-August during 2004 showed an average water column temperature of 14.5 degrees Celsius and 18.96 degrees Celsius, respectively. These profiles were taken near the dam and no single measurement exceeded the cold water temperature criteria. Temperature profile measurements taken weekly July through mid-August in 2005 (Appendix C) also showed no exceedances of the coldwater temperature criteria. Measurements were generally taken between 2 and 7 pm in order to measure temperature during the times when the water would be at the warmest for the day.

Conclusions

In 2004 and 2005, Brundage Reservoir did not violate cold water temperature criteria. Brundage Reservoir is proposed for delisting for temperature.

Six Mile Creek/ Four Mile Creek/ Three Mile Creek

Six Mile, Four Mile and Three Mile Creeks enter the Little Salmon River approximately 32-35 miles above the mouth of the Little Salmon River. Six Mile Creek, a second order stream, originates at an elevation of 7,300 feet. The Six Mile Creek drainage comprises assessment unit 17060210SL013_02. Four Mile Creek, a first order stream, originates at an elevation of 7,260 feet and is in assessment unit 17060210SL007_02, which also includes Three Mile and Martin Creeks. Three Mile Creek, a second order stream, originates at an elevation of 6,900 feet. These creeks originate in V-shaped valleys and flow west, entering a U-shaped valley in the middle reaches and eventually flows into the Meadow Valley floor.

Geology

These creeks originate in Imnaha basalt of the Weiser Embayment but also flow through Idaho Batholith and some volcanics. The lowest elevations flow through alluvial deposits within Meadows Valley.

Land Use

Six Mile Creek, Four Mile Creek, and Three Mile Creek, are separate tributaries to the Little Salmon River. The headwaters of these creeks are within Forest Service lands, and the lower reaches are in private ownership. Timber harvest exists on both public and private lands.

Cattle grazing occurs on both private and public lands. The USFS Meadows Valley C&H grazing allotment extends from Six Mile Creek down to Goose Creek. In 2004, 445 cow/calf pairs were permitted to graze public land between June 6 and September 30. The USFS Brown Creek grazing allotment is within the Six Mile watershed and allowed 235 cow/calf pairs to graze between August 7 and September 30.

Roads within these subwatersheds are at a density of 3.58 mi road/mile^2, and 20% of these roads are within RCAs. Within the Three Mile Creek watershed, old log skid roads are parallel to and within the stream bed. Road/stream crossings within the steep gradient sections have created possible fish passage barriers. The culvert at the crossing of Forest Service Road 303 is a significant fish barrier at low flows.

Recreation mainly consists of hunting in the late fall and ATV use on the roads. A gravel pit exists within the upper area of the Three Mile Creek drainage but does not appear to have been used recently. Old diversions and ditches exist within the middle and lower watershed of Three Mile Creek.

Vegetation

Riparian vegetation consists of ferns, mosses, currant, cottonwood, hawthorn, huckleberry, alder, dogwood, and Rocky Mountain maple. Spruce, Douglas and grand fir are also present and large in size. Upland slopes have a ponderosa pine overstory with arrowleaf balsam root and grasses for a sparse understory. Upland ridgelines have larch and subalpine fir present. The lower elevations areas are predominately pastureland (USFS 2004a).

Hydrology

All these creeks exhibit confined channels in the upper sections and flow westerly onto the meadow floor where Rosgen Stream Type (RST) B/C channels exist. Deep V-shaped channels are tucked between gentle sloping uplands. These streams are predominately RST B channels with sections of steep RST A/A+ within the upper elevations. Casual observations show Three Mile and Four Mile Creeks to be intermittent below the diversions. Six Mile Creek also exhibits low flows near the mouth. StreamStat analysis shows that without flow alteration, Three Mile Creek at the mouth would naturally have flows below 1 cfs during the period from July-February and that base flow would be 0.18 cfs. Four Mile and Martin Creek would likely be similar to Three Mile Creek. Idaho Department of Agriculture flow data for Four Mile Creek showed flows of 0.41 cfs on July 12, 2005 and 1.15 cfs on July 26, 2005.

Flows in these creeks fluctuate due to agricultural diversion activity. If Six Mile Creek did not have flow alteration, it would have flows at the mouth below 1 cfs during August and September with base flow at 0.79 cfs.

Temperature

Temperature in the forested reaches of Six Mile Creek met the state water quality criteria (Figure 39).

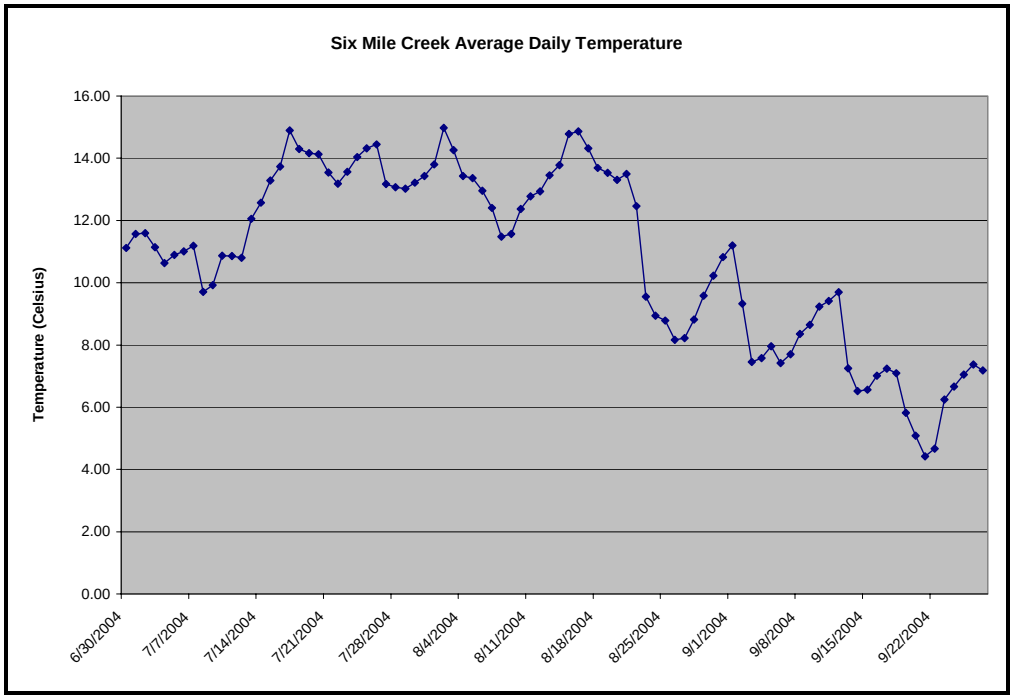


Figure 39. Six Mile Creek Temperature Data (USFS 2004).



Figure 40. Six Mile Creek (July 2004-Lower Reach).

Habitat Data

Six Mile Creek

Six Mile Creek originates in volcanic and plutonic parent material. The substrate was boulder/bedrock within the Rosgen Stream Type (RST) A and boulder/cobble/gravel within the RST B. According to Overton (1995), plutonic RST A and B have mean percent surface fines of 26 and 23% respectively, while volcanic RST A and B have mean percent surface fines of 25 and 27% respectively. A 2003 Forest Service survey of Six Mile Creek showed percent fines of 2.5 to 21% within RST A and B. A 2004 DEQ stream inventory in the lower reaches of Six Mile Creek showed an average mean percent fines value of 11%. These values are below the Overton values for both plutonic and volcanic RST A and B.

Large woody debris was abundant within the RST B and appeared to trap sediment upstream.

Large pools as well as overall pool frequency met the USFS environmental baseline desired condition (USFS 2004). The 2004 DEQ inventory showed >98% stable banks throughout the sampled reach. Bank stability ranged from 80 to 99% over six reaches surveyed by USFS personnel in 2002. A 1996 PfanKuch Channel Stability Evaluation found most of the mainstem of Six mile Creek on forest service lands to be in good condition. One small section was documented to be in fair condition due to flood damage.

While the final water body assessment score is not yet available for Six Mile Creek, the preliminary habitat and fish data indicate that beneficial uses are supported (Table 19). This monitoring site was in the lower reaches of Six Mile Creek (**Figure** 41).

Table 19. Six Mile Creek: DEQ water body assessment score.

DEQ Stream Site ID	SHI	SMI	SFI	Assessment Score	Beneficial Use Support Status
	(maximum score= 3)				
2004SBOIA35	3	NA	2	NA	NA

Four Mile Creek

In 2002 the Forest Service surveyed two miles of Four Mile Creek within Forest Service lands (Figure 41). The substrate in Four Mile Creek varied between the reaches. Gravels, fines and cobbles were present in the lower gradient reaches changing to large boulder and bedrock present in higher gradient reaches. Surface fines were determined to be at USFS target levels on USFS managed lands (USFS 2004). Large woody debris and pool frequency was also determined to be at USFS target levels. A 2004 PfanKuch Channel Stability Evaluation found the mainstem of Four Mile Creek on forest service lands to be in good condition. An IDFG fish survey of Four Mile Creek noted low bank stability (IDFG 2004). Overall stream banks appear to be stable with some isolated unstable locations.

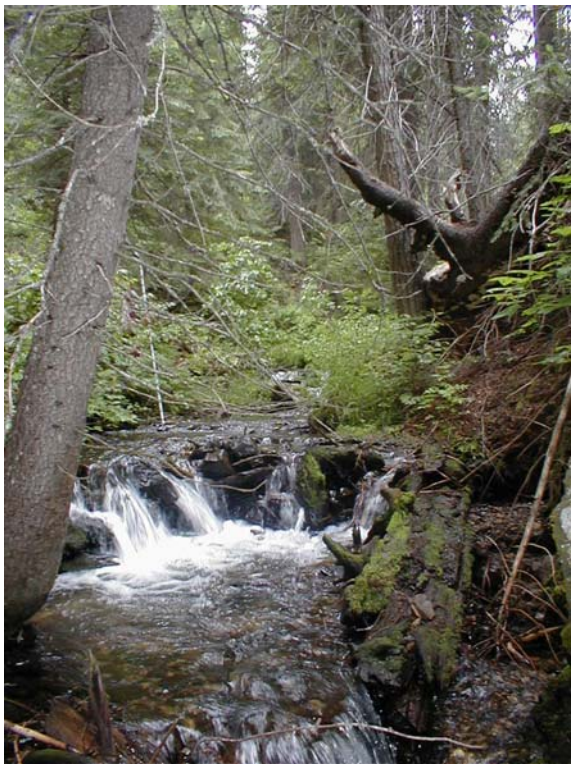


Figure 41. Four Mile Creek (2003 on USFS Land).

Three Mile Creek

Three Mile Creek was surveyed by the USFS in 2002 (Figure 42). The section of stream surveyed began at the forest service boundary and ended approximately 1.5 miles upstream at the road 303 crossing. The streambed is moderately confined and meanders slightly in the lower reach. The middle reach streambed has extensive braiding and many side channels throughout. The upper reach is very confined with few side channels. The reaches surveyed

were RST B while above the survey area RST A existed. Long runs of fast water and small pools are characteristic of Three Mile Creek. Some small seeps and springs contribute to stream flow.

The substrate of Three Mile Creek increases in size as elevation increases. Within the lower reach, the substrate is predominately gravel to fines typical of grazed meadow streams. The middle reach is mostly small cobble and gravels with lots of fines within the pools, while the upper reach has large cobble and small boulder with fines in the pools.

The large woody debris exists mostly across the streambed but not necessarily within the stream channel. Most of the woody debris was aggregates of branches, live alder, and dogwood, and a few large logs that appeared to be placed as bank stabilizers decades ago. Bank stability varied from very low (< 65%) with active erosion prevalent to stable or solid rock bank. A 2003 PfanKuch Channel Stability Evaluation found the mainstem of Threemile mile Creek on forest service lands to be in fair condition.

An irrigation ditch which originates within the Forest Service boundary was leaking and creating a gully down the slope, causing erosion problems. In 2003, this ditch was fixed and the erosive action was stopped.



Figure 42. Three Mile Creek (Summer 2002).

Fisheries

Six Mile, Four Mile and Three Mile Creeks are upstream of the barrier falls on the Little Salmon River. Bull trout have not been observed within these creeks.

A 2000 IDFG fish survey in Four Mile Creek found that fish present were primarily redband trout and brook trout, all under 200mm in length (IDFG 2001). USFS fish surveys have also found redband trout. Fish barriers were found at two USFS road crossings. A DEQ BURP survey in 2004 found the RST C channel of Six Mile Creek, below the Goose Creek Canal had sculpin, rainbow trout and brook trout.

Martin Creek has multiple road crossings, and the results of a culvert inventory showed that most of the culverts are fish barriers. The USFS road crossings on Three Mile Creek have also been shown to be potential fish barriers due to the culvert placement.

Conclusions

Overall, beneficial uses appear to be unimpaired throughout the forested sections of Six Mile, Four Mile and Three Mile Creek watershed. A beneficial use support status call cannot be made on the lower sections of these creeks due to lack of information. Although a BURP inventory was conducted on a lower reach of Six Mile Creek, this information may not be applicable to Four Mile and Three Mile creeks due to differences in the flow regimes and habitat. Additional data were not collected for this TMDL report because these creeks were not on the 303(d) list.

Round Valley Creek

Round Valley Creek (**Figure** 43) is upriver of the Little Salmon River barriers and flows into the Little Salmon River at river mile 25.3. It is a third order stream which originates on the eastern slopes of Brush Mountain, elevation 6,247 feet. The lower reach meanders through meadows in wide valley bottoms.



Figure 43. Round Valley Creek.

Land Use

Primary land uses in the lower reaches of these creeks are irrigated pastures, hay fields, livestock grazing, and residences. Increased home development and subdivisions have also occurred in this drainage and as a result grazing has decreased somewhat. In the uplands impacts are mainly due to logging and roads.

The USFS Round Valley C&H grazing allotment is located on public lands within Round Valley and Trail Creek watersheds. In 2004, the Round Valley grazing allotment allowed 110 cow/calf pairs to graze public land between June 15 and August 1.

Hydrology

This low gradient stream has primarily RST C and B flowing through meadows in the lower reaches while the upper reaches are more timbered and steeper gradient. Figure 44 shows the estimated average monthly flow at the mouth of Round Valley Creek.

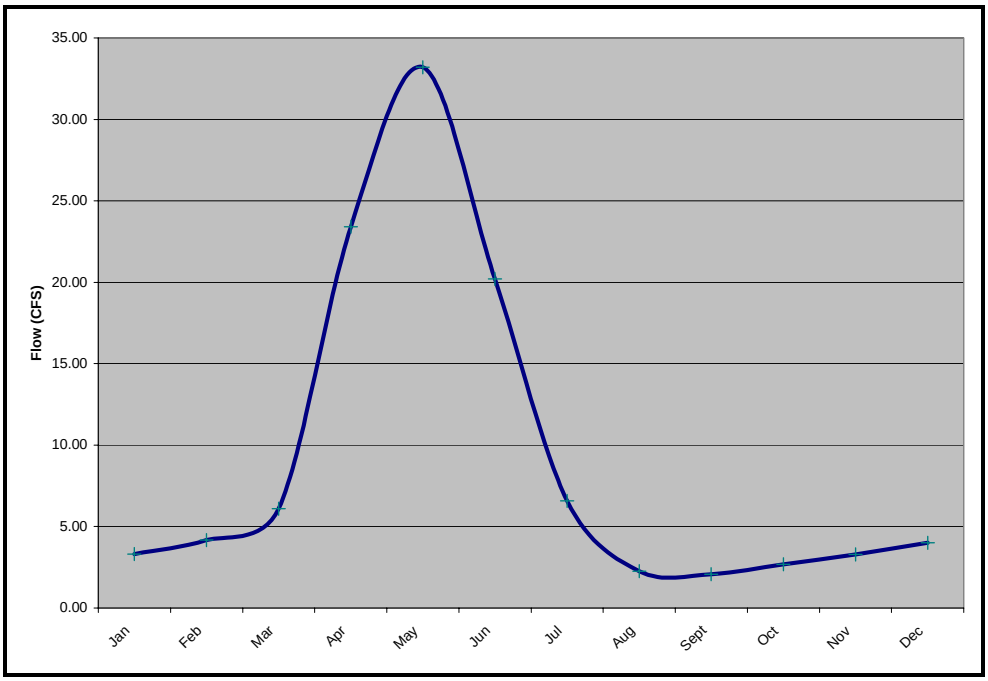


Figure 44. Round Valley Creek Average Monthly Flow at Mouth (Estimated Using StreamStat).

Fisheries

Rainbow trout, cutthroat trout, and brook trout are found in Round Valley Creek. Chinook salmon and steelhead are not observed within Round Valley Creek due to the falls on the Little Salmon River, a natural fish passage barrier. Bull trout have not been observed within Round Valley Creek.

Habitat

A 2000 PfanKuch Channel Stability Evaluation found the mainstem on forest service lands to be in good condition in the upper section and fair condition closer to the forest boundary. DEQ water body assessment scores have shown that beneficial uses are not impacted (Table 20).

Table 20. Round Valley Creek: DEQ water body assessment scores.

DEQ Stream Site ID	SHI	SMI	SFI	Assessment Score	Beneficial Use Support Status
	(maximum score= 3)				
1994SBOIA017	3	3	Not Measured	3	Full Support
1994SBOIA018 (North Branch)	2	3	Not Measured	2.5	Full Support

Conclusions

Beneficial uses are not impaired and a TMDL is not necessary for Round Valley Creek.

Hazard Creek

Hazard Creek (Figure 45 and Figure 46) originates at 8,767 feet, flows west and enters the Little Salmon River about 19.1 miles above the mouth of the river. Hazard Creek is a fifth order stream that drains an 86 mile2 area and provides important salmonid habitat.

The *headwaters* of Hazard Creek are bordered by Bruin Mountain (elevation 8,766 feet) on the east, Hard Butte (elevation 8,658 feet) on the north, and the Grass Mountains on the south, which separate the Hazard Creek drainage from the Hard Creek drainage. Hazard Creek is in assessment units 17060210SL014_02 and 17060210SL014_03, and its tributary, Hard Creek is in assessment units 17060210SL015_02 and 17060210SL015_03.

Hard Creek (**Figure** 47) is a fourth order stream and enters Hazard Creek at stream mile 0.9. The drainage area of Hard Creek (24,053 acres) is slightly smaller than Hazard Creek (27,865 acres). The Hard Creek drainage is bordered by the Grass Mountains on the north, Granite Mountain (elevation 8,478 feet) on the south, Bally Mountain (elevation 6,818 feet) on the west, and an unnamed mountain (elevation 8,255 feet) on the east. Hard Creek flows west and north until it enters Hazard Creek.

The headwaters area of the Hazard Creek watershed burned in 1989, 1992, and 1994. Salvage logging took place in 1996, 1997, and 1998.



Figure 45. Hazard Creek (August 2003).

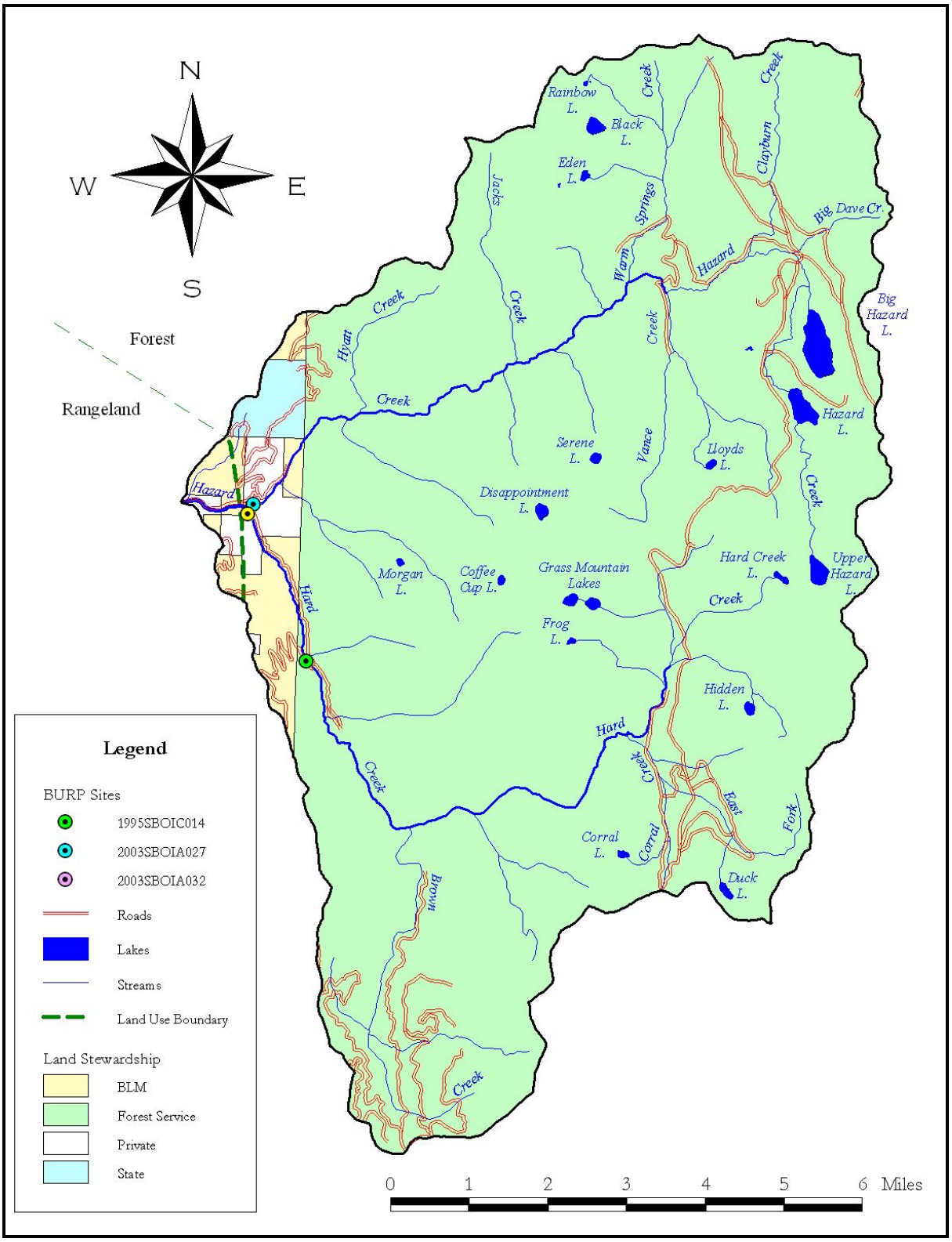


Figure 46. Hazard Creek and Hard Creek Watershed.



Figure 47. Hard Creek, a Tributary of Hazard Creek (August 2003).

Geology

The dominant geologic type is the border/transition type of the Idaho Batholith. This geologic type consists of granitic rocks, granitic gneisses, schist, quartzites, and other metamorphic rocks. Glacial activity has shaped the Hazard Creek basin.

An erosion inventory of the Forest Service managed lands showed that 35.6% of that area was erosion sensitive. This percentage is partly attributable to the granitic soils of the Idaho Batholith in which the watershed lies. These decomposed granitics are more susceptible to disturbance (i.e. fires, road construction, timber harvest, grazing) than watersheds within the subbasin that are in predominantly metamorphic or volcanic rock.

Vegetation

Common riparian species include subalpine fir, Engelmann spruce, grand fir, cottonwood, and birch; a midstory of alder, prickly currant, dogwood, serviceberry, and willow; and an understory of sweet-scented bedstraw, bead lily, starry solomon-plume, twisted stalk, lady fern, arrowleaf groundsel, monkshood, meadow rue, and miner's lettuce depending on elevation, aspect, and canopy cover. Due to flood stage discharges, there is little streamside soil or vegetation below the high water mark. Riparian vegetation is brush mixed with occasional conifers (Horton 1983). High coverage of mosses and liverworts occur on rocks and stream banks.

Upland vegetation types are diverse and represent a range of seral stages, which are primarily influenced by past timber harvest, fires, and livestock grazing. Lower elevations are dominated by a mixed conifer overstory, which includes Douglas fir, grand fir, larch, and ponderosa pine. Upper elevations are dominated by grand fir, Douglas fir, larch, Engelmann spruce, lodgepole pine, and subalpine fir. The timber is interspersed with patches of perennial grassland, brush, and riparian vegetation (USFS 1994a).

Land Use

The Hazard Creek watershed covers 43 square miles. About 96% of the basin is public land. Federal agencies manage about 26,515 acres. State and local governments manage 471 acres. Private ownership, 459 acres, is clustered primarily along the downstream end of the basin. The Hard Creek watershed covers 38 square miles. The majority of the basin is public land with some private land in the lowest reaches.

Hazard Creek headwaters are primarily undeveloped except for a road and recreational use associated with it. One developed and one dispersed campground, and several trails exist in the watershed. The watershed receives moderate recreational use from hiking, horseback riding, and off-road vehicles. Hunting activity is heavy in the late fall.

The headwaters are managed for sheep grazing. The lower reaches are irrigated agricultural land and grazing. Two grazing allotments are permitted on BLM lands within the Hazard-Hard Creeks drainage. The Hard Creek allotment permits 218 AUMs of sheep and the Little Elk Creek allotment permits 103 AUMs of cattle. Various USFS grazing allotments occur within the Hazard/Hard Creek watershed. Grassy Mountain S&G, Vance Creek S&G, Jacks Creek C&H, and Hersey Lava S&G are within the Hazard Creek watershed. Meadows Valley C&H, Brown Creek C&H, and Grassy Mountain S&G are within the Hard Creek watershed. In 2004, the Grassy Mountain permit allowed 930 ewe/lamb pairs to graze between July10 and September 21. The Vance Creek permit allowed 1700 dry ewe to graze between September 22 and October 15. The Jacks Creek permit allowed 420 cow/calf pairs to graze between July 11 and October 10. The Hersey Lava permit allowed 930 ewe/lamb pairs to graze between July 10 and September 21. The Meadows Valley permit allowed 445 cow/calf pairs to graze between June 1 and September 30. The Brown Creek permit allowed 235 cow/calf pair to graze between August 7 and September 30.

Recent timber activity consists of the Forest Service Hazard Lake Salvage Sale. Logging has taken place on both federal and non-federal lands. A mine claim was previously in use within the middle section of Hazard Creek but closed in 1984.

Road densities within the drainage are separated into lower and upper sections for both Hazard Creek and Hard Creek. Upper Hazard Creek has a road density of 0.90 mi road/sq. mile, 24% within Riparian conservation areas (*RCA*). Lower Hazard Creek has a road density of 0.81 mi road/mile^2, 21% within RCA. The Forest Service characterized the road density in this drainage as moderate at 0.71 mi road/ square mile. Upper Hard Creek has a road density of 1.03 mi road/mile^2, 38% within RCA. Lower Hard Creek has a road density of 1.8 mi road/mile^2, 19% within RCA.

Hydrology

Hazard Creek is predominately a Rosgen Stream Type (RST) A2/B3. Riffles, pools, and braids with stable boulder/rubble substrate flow through deeply entrenched channels. The lower and upper elevations are RST A2a, flowing through pools and falls with deeply entrenched large boulder channels (USFS 1994a). The Delbaere-Campbell ditch diverts water from Browns Creek (a Hard Creek tributary) to Six Mile Creek.

A 1983 in-stream flow investigation by the BLM developed the following recommendations for Hazard Creek from Hard Creek to Jacks Creek: 18 cfs from August 1 to March 15 for trout passage, 32 cfs from March 16 to March 31 for trout passage, 38 cfs from April 1 to June 30 for steelhead trout spawning, and 32 cfs during July for Chinook salmon passage (Howard 1983).

The hydrograph of Hazard Creek exhibits typical flow regimes for west-central lower elevation Idaho mountain streams (Figure 48). The peak flow is observed May to June, and base flow is observed by August.

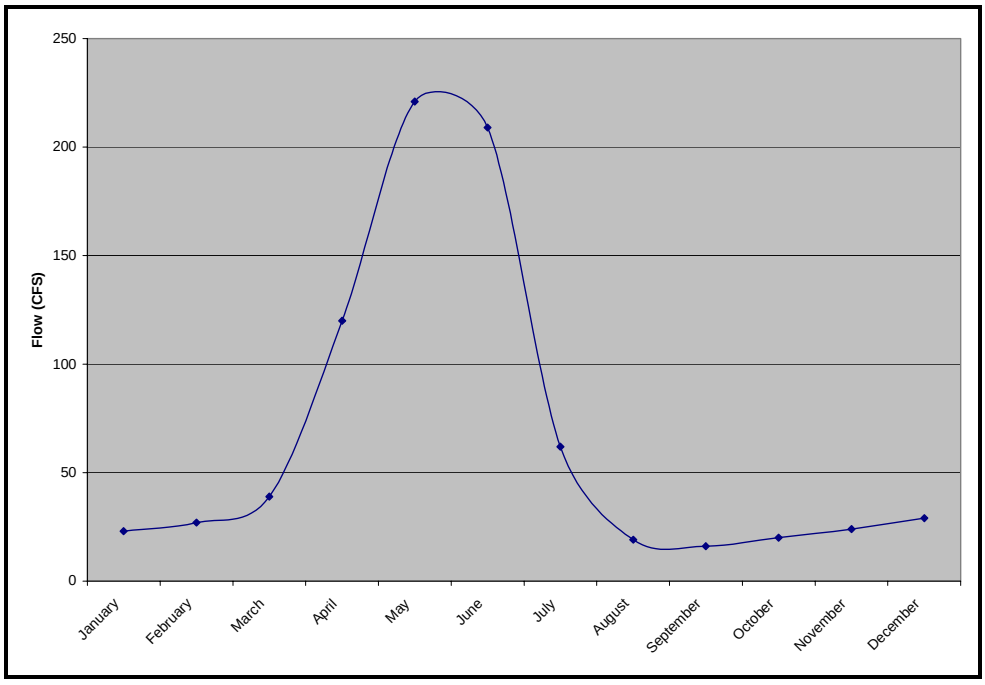


Figure 48. Hazard Creek: Average Monthly Flow at Mouth (Estimated Using StreamStat).

Fisheries

Chinook salmon, steelhead, fluvial bull trout, and cutthroat trout are able to access the cold water habitat. A full passage barrier (falls) for spring/summer Chinook salmon, steelhead trout, and bull trout occurs at stream mile 3.7 on Hazard Creek. A partial/full barrier (whether it is a partial or full barrier is dependent upon flow) restricts Chinook salmon and bull trout fish passage at stream mile 0.6 on Hard Creek (steelhead trout are still able to get by). A full passage barrier for steelhead trout occurs at stream mile 4.7 on Hard Creek.

Hazard Creek, from mouth to falls, supports primarily steelhead, secondarily Westslope cutthroat trout and bull trout spawning and rearing. Limited spawning and rearing habitat for Chinook salmon, steelhead trout, and rainbow trout exists mostly near the mouth. Upstream, from the falls to the headwaters, is dominated by brook trout with some redband/rainbow trout (IDWR 2005). Hard Creek provides habitat for Westslope cutthroat trout, steelhead, Chinook salmon, bull trout, rainbow trout, and brook trout.

The Hard/Hazard Creek complex is considered of medium importance for bull trout. The lower reaches of Hazard and Hard Creeks are used by *fluvial* bull trout for subadult and adult rearing. Upstream of the barriers on Hard Creek, additional suitable habitat exists for bull trout. The entire Hazard Creek watershed is considered a key bull trout watershed because of important production of forage fish (Batt 1996). BLM and IDFG monitoring efforts have documented the presence of bull trout in the lower reaches of the watersheds but numbers are low.

Downstream of the barriers, in both Hazard and Hard Creeks, sculpin and suckers have been observed.

Habitat

The substrate of Hazard Creek is characterized by large boulders and cobbles. Gravel substrate, suitable for trout and salmon spawning, is present in pocket pools behind large boulders. The tributaries to Hazard Creek are high gradient channels with boulder and cobble substrate. Some headwater tributaries contain sand/silt within the streambed.

Hazard Creek and Hard Creek both originate within plutonic parent material. According to Overton (1995), plutonic Rosgen Stream Type (RST) A and B *reference condition* streams have mean percent surface fines of 26 and 23% respectively. DEQ compared USFS percent fines scores with Overton mean scores to determine if habitat impairment was evident. A 1993 Forest Service survey of Hazard Creek recorded percent surface fines between 4.7 and 67%. Two reaches within the headwaters of Hazard Creek were well above the Overton mean for RST A and B. Within a RST A section, 48% surface fines were observed, and a RST B section had 67% surface fines. One section of RST C had 27.5% surface fines, which is below the Overton mean of 37% for RST C plutonic streams. Substrate monitoring of Hazard Creek is performed annually further downstream within RST B. Results show mean percent surface fines between 0.6 and 4.3%.

In 2005, DEQ personnel investigated bank stability in the headwaters area and performed general reconnaissance to see what factors may have contributed to elevated fines. The riparian area throughout the headwaters area appeared healthy although in the meadows areas, large shrubs were not present in great numbers. Salvage logging had occurred throughout the drainage but the slopes had revegetated and the riparian areas were intact. All streambanks surveyed, which included Rosgen A, B and C channels, showed greater than 90% stability. The elevated percent fines observations, which occurred just after the 1992 fire, may be attributable to sediment delivery after the fire.

A 1993 Forest Service study of Hard Creek recorded percent surface fines of 0.3 to 11.5% Substrate monitoring of Hard Creek within RST B show mean percent fines of 2.1 to 8.3% over the past 10 years. These numbers are well below the Overton mean percent surface fines for plutonic streams.

PfanKuch Channel Stability Evaluations done in 1993 and 2004 found sections along the mainstem of Hazard Creek on forest service lands to be in good condition.

The watershed had an ECA (equivalent clearcut area) rating of 21% which is below the 30% threshold of hydrologic impact risk. ECA is an indicator of basin condition that is calculated from the total amount of crown removal that has occurred from harvesting, road building, wildfire, and other activities, based on the current state of vegetative recovery**.**

Table 21 shows that beneficial uses are not impaired in the Hazard and Hard Creek watersheds. (Figure 46 shows the DEQ monitoring locations, which are in the lower reaches of the watershed.)

Table 21. Hazard Creek and Hard Creek: DEQ water body assessment scores.

DEQ Stream Site ID	SHI	SMI	SFI	Assessment Score	Beneficial Use Support Status
	(maximum score= 3)				
2003SBOIA027 (Hazard Creek)	3	3	3	3	Full Support
2003SBOIA032 (Hard Creek)	3	2	1	2	Full Support

Temperature

Hazard Creek is an important tributary to the Little Salmon River with regard to water quality. It contributes cold water to temperature-limited salmonids in the Little Salmon River during the summer (IWRB 2001). The Hazard-Hard Creek complex provides a sustained contribution of cold water that supports downstream salmonid habitat (IWRB 2001). These creeks meet the state water quality criteria for temperature (Figure 49 and Figure 50).

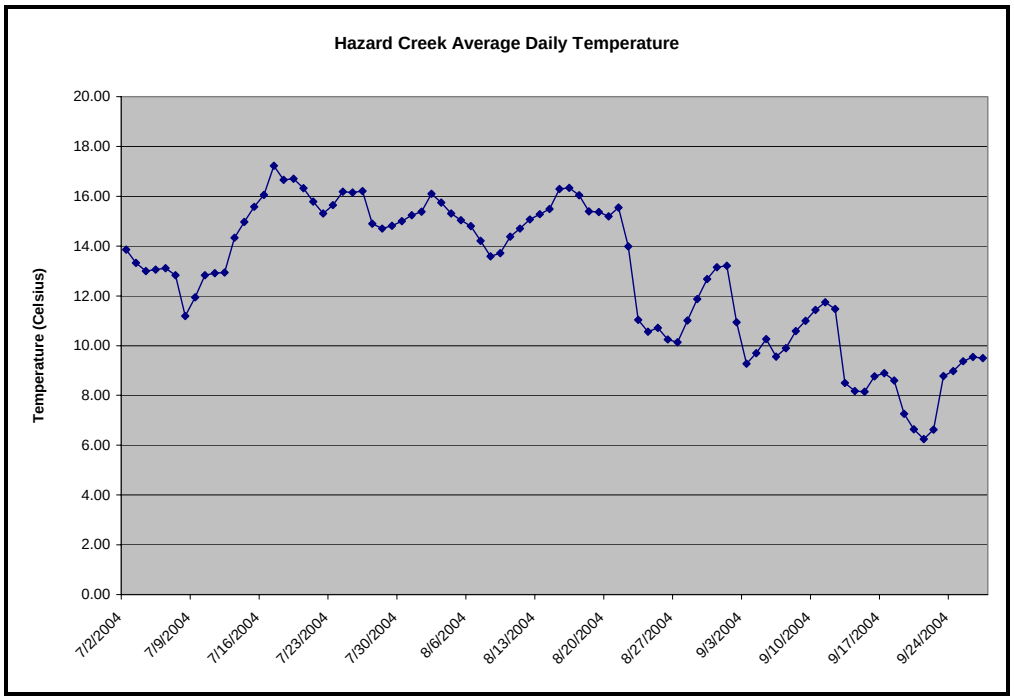


Figure 49. Hazard Creek Summer Average Daily In-stream Temperatures (USFS 2004).

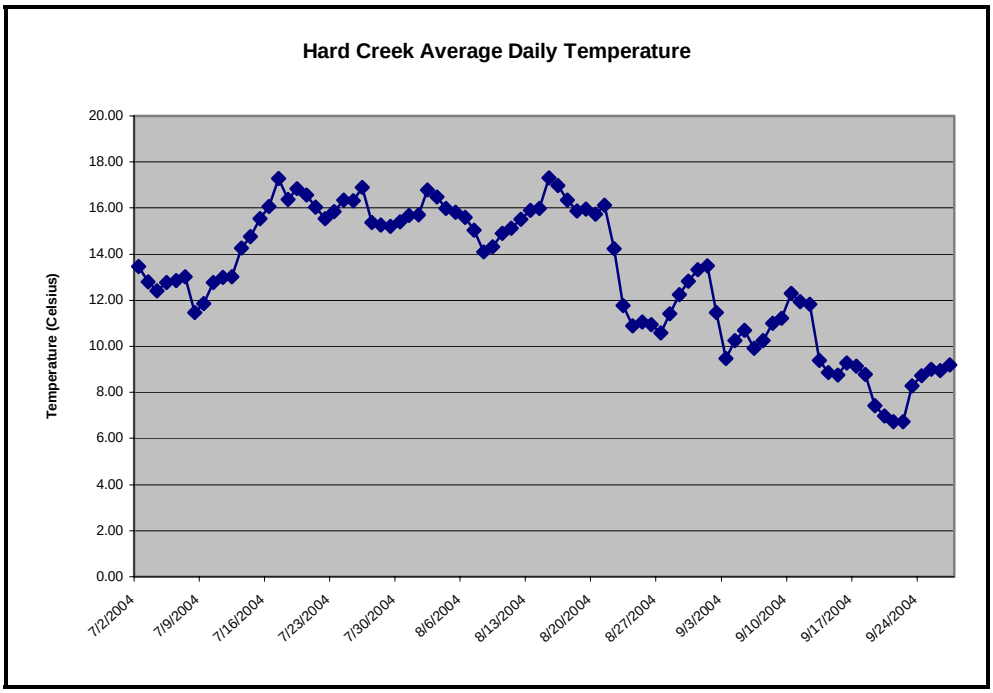


Figure 50. Hard Creek Summer Average Daily In-stream Temperatures (USFS 2004).

Conclusion

Hazard Creek is an important cold water contributor to the Little Salmon River and provides cold water fisheries habitat. The beneficial uses in the Hazard Creek watershed are not impaired. A TMDL is not necessary.

Boulder Creek

Boulder Creek (Figure 51) is a fourth order drainage, which flows into the Little Salmon River at river mile 17.7. The Boulder Creek watershed (Figure 52) has a total of 25,175 acres (41 square miles). It originates at an elevation of 6,900 feet and flows north-easterly into the Little Salmon River at an elevation of 3,040 feet. The highest point in the drainage is Pollock Mountain at 8,048 feet. The north and west side of the drainage is bordered by Pollock Mountain, North Star Butte (7,451 feet), and Ant Butte (7,047 feet). The southern and eastern side is bordered by Brush Mountain (6,247 feet). Boulder Creek is in assessment units 17060210SL005_02 and _03.

A natural falls in Boulder Creek (stream mile 4.4) was modified in 1985 to allow fish passage into the upper watershed. An investigation of the falls was made in 1983, and at this time several large bull trout were observed immediately below the falls in a large deep pool. The bull trout were observed trying to jump over the falls and were jumping four feet in height but could not negotiate the falls. The barrier at this time consisted of a bedrock "beaver-slide" falls that was 7 feet high and 10 feet in length. The pool below the falls was estimated at 6 feet deep. In 1985, the Idaho Department of Fish and Game modified the falls through the bedrock excavation of immediate jumping pools (DEQ 1998). Now all fluvial bull trout and Chinook salmon, have access to the upper watershed.



Figure 51. Boulder Creek Falls (August 2002).

Geology

Surface geology of the watershed is a mix of granitics, transitional zones of metamorphosed granitic rocks, volcanics, and basalts. A fault line is present along middle Boulder Creek, and the upper reaches are highly faulted.

The lower reach is in an active landslide zone, which has caused accelerated sediment loading. Past and recent landslides contributed significant amounts of sediment to Boulder Creek and the Little Salmon River. In March 1989, a debris torrent occurred in Hillman Creek, a tributary of Boulder Creek at stream mile 1.7, resulting in significant amounts of sediment reaching Boulder Creek. The Hillman Creek drainage and other tributary drainages in Boulder Creek also experienced significant debris torrents during the January 1, 1997 storm event (IDEQ 1998).

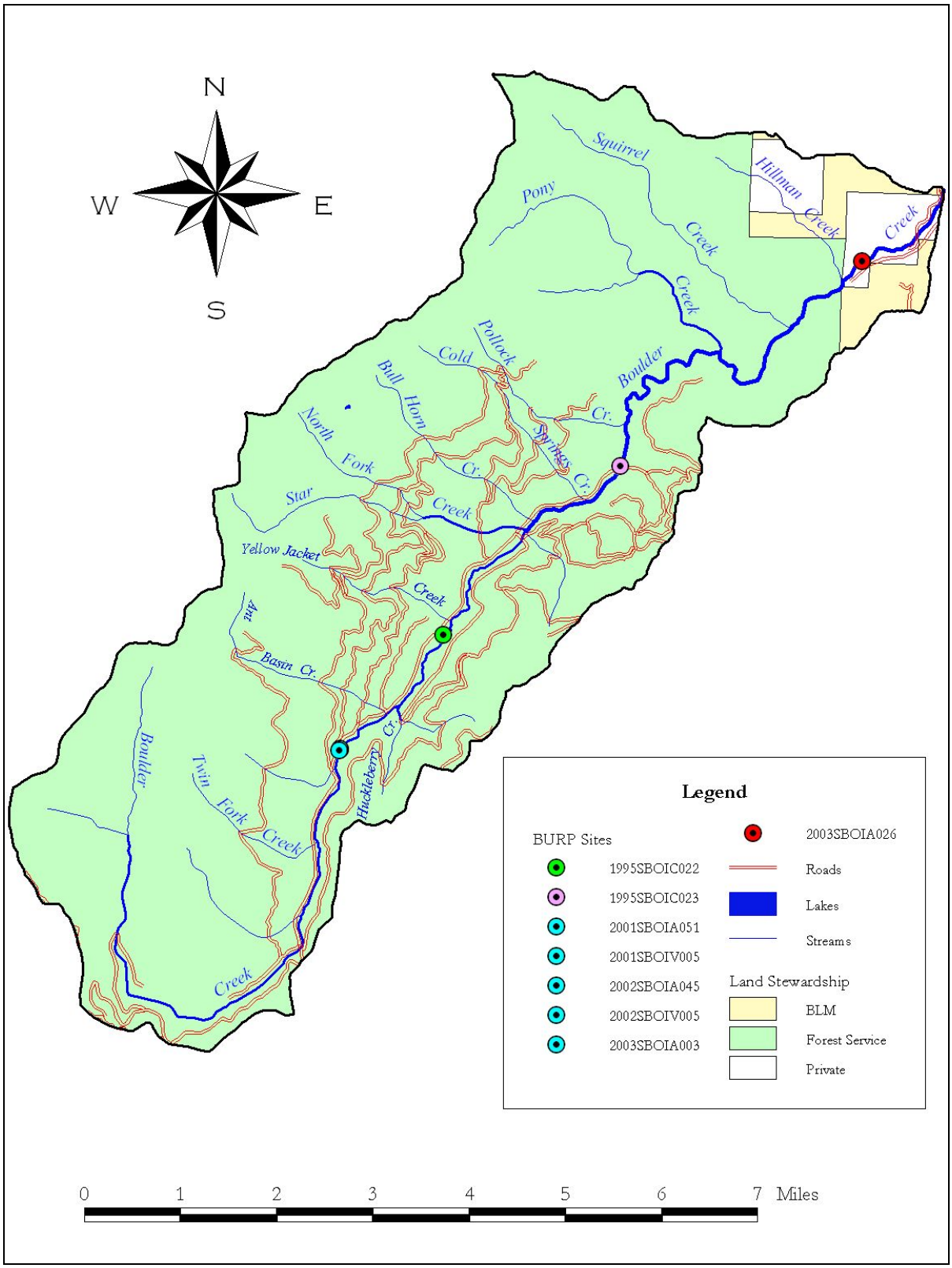


Figure 52. Boulder Creek Watershed.

Vegetation

Common riparian species include subalpine fir, Engelmann spruce, grand fir, alder, currant, red-osier dogwood, syringa, willow, gooseberry, sweet-scented bedstraw, bead lily, starry solomon-plume, twisted stalk, lady fern, monkshood, meadow rue, miner's lettuce, sedges and forbs depending on elevation, aspect, and canopy cover. High coverage of mosses and liverworts occur on rocks and stream banks.

Upland vegetation types are diverse and represent a range of seral stages, which are primarily influenced by past timber harvest, fires, and livestock grazing. Lower elevations are dominated by a mixed conifer overstory, which includes Douglas fir, grand fir, larch, and ponderosa pine. Upper elevations are dominated by grand fir, Douglas fir, larch, Engelmann spruce, lodgepole pine, and subalpine fir. The timber is interspersed with patches of perennial grassland, brush, and riparian vegetation.

Land Use

The lowermost portion of the watershed is primarily private land (3% of the total watershed) and BLM managed public land (3% of the total watershed), and the upper portion of the watershed is Forest Service managed public land (94% of the total watershed) (Figure 53).

Boulder Creek headwaters are undeveloped and in National Forest Service land. The rest of the creek has been impacted by stream alterations including removal of large wood from the floodplain and hardening of the stream banks. These alterations are believed to have contributed to decreased production of Chinook salmon, steelhead, bull trout and Westslope cutthroat trout (IDWR 2001).

Logging has occurred on the southern slopes of the Boulder Creek drainage, particularly within the middle area of the watershed.



Figure 53. Middle of Boulder Creek Watershed (August 2004).

An extensive road network is found throughout the upper and lower watershed. This road network has reduced habitat connectivity at some locations by eliminating fish passage (USFS 2003). Lower Boulder Creek has a road density of 2.75 mi road/square mile, 30% of which are in Riparian conservation areas (RCA). The lower end of Boulder Creek has been subdivided. Upper Boulder Creek has a road density of 4.15 mi road/square mile with 29% within RCA.

Grazing is currently permitted on four Forest Service allotments and two BLM allotments in the watershed. The Forest Service allotments include: Boulder Creek S&G; Round Valley C&H; Fall Creek/Whitebird C&H; and Price Valley S&G. In 2004, the Boulder Creek permit allowed two bands of 950 ewe/lamb pairs to graze between July 11 and August 21. The Round Valley permit allowed 110 cow/calf pairs to graze between June 15 and August 1. The Fall Creek/Whitebird permit allowed 240 cow/calf pairs to graze between June 10 and October 31. The Price Valley permit allowed two bands of 950 ewe/lamb pairs to graze between June 16 and July 10. The BLM Hard Creek allotment and the Trail Creek allotment permits 218 AUMs of sheep and 85 AUMs of cattle, respectively, to graze on BLM lands within the Boulder Creek area.

Numerous trails occur in the watershed for recreational use as well as livestock movement between pastures and allotments. Camping, hunting, fishing, hiking, and ATV are the major recreational uses within the drainage.

Hydrology

Boulder Creek consists of a number of second-third order tributaries. The stream is comprised primarily of Rosgen Stream Type (RST) B channels (79.8%). The lower stream section from the confluence with the Little Salmon River upstream for about two miles is predominately RST A channel (12.4%). A short section of RST C channel is found near Yellow Jacket Creek (7.8%).

The Boulder Creek hydrologic regime is typical of central Idaho mid-elevation streams. The peak run-off occurs in April/ May and base flows are reached by late July (Figure 54). Table 22 shows the estimated irrigation use. There are water rights both on the public and private lands.

Table 22. Boulder Creek estimated irrigation use.

	Estimated Existing Use (155 acres irrigation) (cfs)
January	1.9
February	1.9
March	1.9
April	5.6
May	9.2
June	9.2
July	9.2
August	8.6
September	5.7
October	2.0
November	1.9
December	1.9

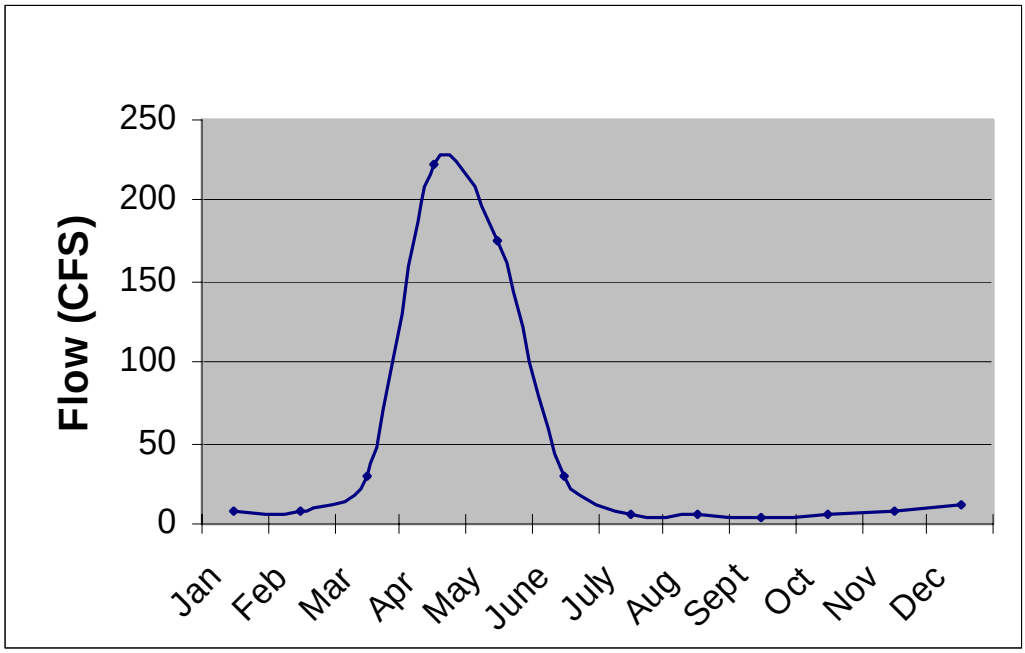


Figure 54. Boulder Creek Average Monthly Flow at Mouth (Estimated Using StreamStat).

Fisheries

Game fish species found in Boulder Creek include rainbow trout, steelhead trout, and Chinook salmon. Brook trout, bull trout, Northern pike minnow, and sculpin have also been observed within Boulder Creek (BLM 2000).

Boulder Creek is second to the Rapid River in providing good salmonid habitat in the Little Salmon River drainage (U.S. Department of Interior 1993, 1994). It is important habitat for Chinook, steelhead, bull trout, and cutthroat trout. Boulder Creek is considered of high importance for bull trout spawning and early rearing (IDEQ 1998). Road crossings (culverts) have reduced connectivity between Boulder Creek and tributary subpopulations (USFS 2003).

Lower Boulder Creek provides spawning and rearing habitat for spring/summer Chinook salmon and steelhead trout. Spawning and rearing habitats for spring/summer Chinook salmon are found on the lower four miles (Mallet 1974). Periodicity information is shown in Table 4 in Section 1.2. In late spring, 1997, the middle RST C-channel section of Boulder Creek above the falls was surveyed for spawning steelhead but no fish were observed. In 1997, a large number of adult Chinook returned to the Rapid River Fish hatchery. Excess adult fish were transported upstream near Boulder Creek. Later that year in August, spawning ground surveys found these hatchery salmon distributed upstream along Boulder Creek to the above-mentioned falls. No adults were found upstream of the falls. During snorkel surveys, IDFG & USFS personnel have found juvenile Chinook above the falls (Olson, personal communication). Annual spawning surveys conducted by the USFS since 2002 have found adult Chinook salmon within Boulder Creek downstream of the falls.

During a 1991 Forest Service Intermountain Station fish inventory, all reaches of Boulder Creek were extensively snorkeled. This inventory found 69% of all bull trout in the middle of the stream near Yellow Jacket Creek (approximate stream mile 10). The largest number of brook trout (65%) were also found in the same section. Larger sized fish (greater than 300 mm) were conspicuously absent from Boulder Creek. Yellowjacket Creek was surveyed by the USFS in 2002. The surveyors reported a narrow channel, the presence of brook trout, and dense riparian canopy. Field notes suggest that the reach was difficult to snorkel survey and more fish may have been present.

A 2002 IDFG report stated that redband and brook trout were abundant in the upper reaches of Boulder Creek (IDFG 2004).

Habitat Data

Boulders and cobble size rocks are the primary substrate within the lower reaches. Deep pools and fast moving sections are both present. Gravel is found in pockets behind boulders but adequate sized spawning gravel for trout is limited. However, salmon are apparently able to spawn successfully in the larger substrate (Horton 1983). The upper reaches of Boulder Creek consist of cobble and gravel substrate with some sections of large cobble or boulder.



Figure 55. Lower Boulder Creek.

Boulder Creek originates within volcanic and plutonic parent material types. According to Overton (1995), plutonic RST A, B, and C have mean percent surface fines of 26, 23%, and 37% respectively, while volcanic RST A, B, and C have mean percent surface fines of 25, 27%, and 17% respectively. Substrate monitoring on Boulder Creek within a RST B show mean percent surface fines of 1.9 to 14.3% over the past 10 years. These values are below the Overton values for volcanic and plutonic RST B, meaning that the conditions in Boulder Creek are similar to those found in pristine streams.

Large woody debris and width-depth ratios were determined to be at levels that were functioning appropriately (USFS 2003). Large pools are present in lower Boulder Creek but overall, pool frequency appears to be low. Pools provide feeding and resting habitat for fish.

A 1992 PfanKuch Channel Stability Evaluation found sections of fair and good conditions on the mainstem streambanks on forest service lands.

DEQ data for Boulder Creek shows that beneficial uses are not impaired (Table 23). Monitoring locations are shown in Figure 52. Monitoring sites occurred both in the upper and lower reaches on public and private land.

Table 23. Boulder Creek: DEQ water body assessment scores.

DEQ Stream Site ID	SHI	SMI	SFI	Assessment Score	Beneficial Use Support Status
	(maximum score= 3)				
2003SBOIA003	3	3	Not Measured	3	Full Support
2002SBOIA045	3	3	2	2.67	Full Support
2002SBOIV005	3	3	2	2.67	Full Support
2001SBOIA051	3	3	3	3	Full Support
2001SBOIV005	3	3	Not Measured	3	Full Support
1995SBOIC022	3	3	Not Measured	3	Full Support

Conclusions

Boulder Creek is an important fishery. While human caused impacts occur within the watershed, overall, the beneficial uses in the Boulder Creek watershed are not impaired as shown by recent and past DEQ data in both the upper and lower reaches of Boulder Creek. A TMDL is not necessary.

Elk Creek

Located near the town of Pinehurst, Elk Creek (Figure 56) is a third order stream that enters the Little Salmon River at approximately river mile 16.6. The Elk Creek watershed covers 14.8 miles^2 (9,489 acres) and is oriented in a southwesterly direction with side tributaries entering mostly from the east. Elevation in the watershed ranges from 2,940 feet where Elk Creek empties into the Little Salmon River to 7,994 feet in the headwaters (IDL 2002b). Hard Butte (elevation 8,658 feet) is located on the south eastern edge of the watershed. Elk Creek flows through a moderate to steep sloped canyon, passing through both forested and open grassland areas.

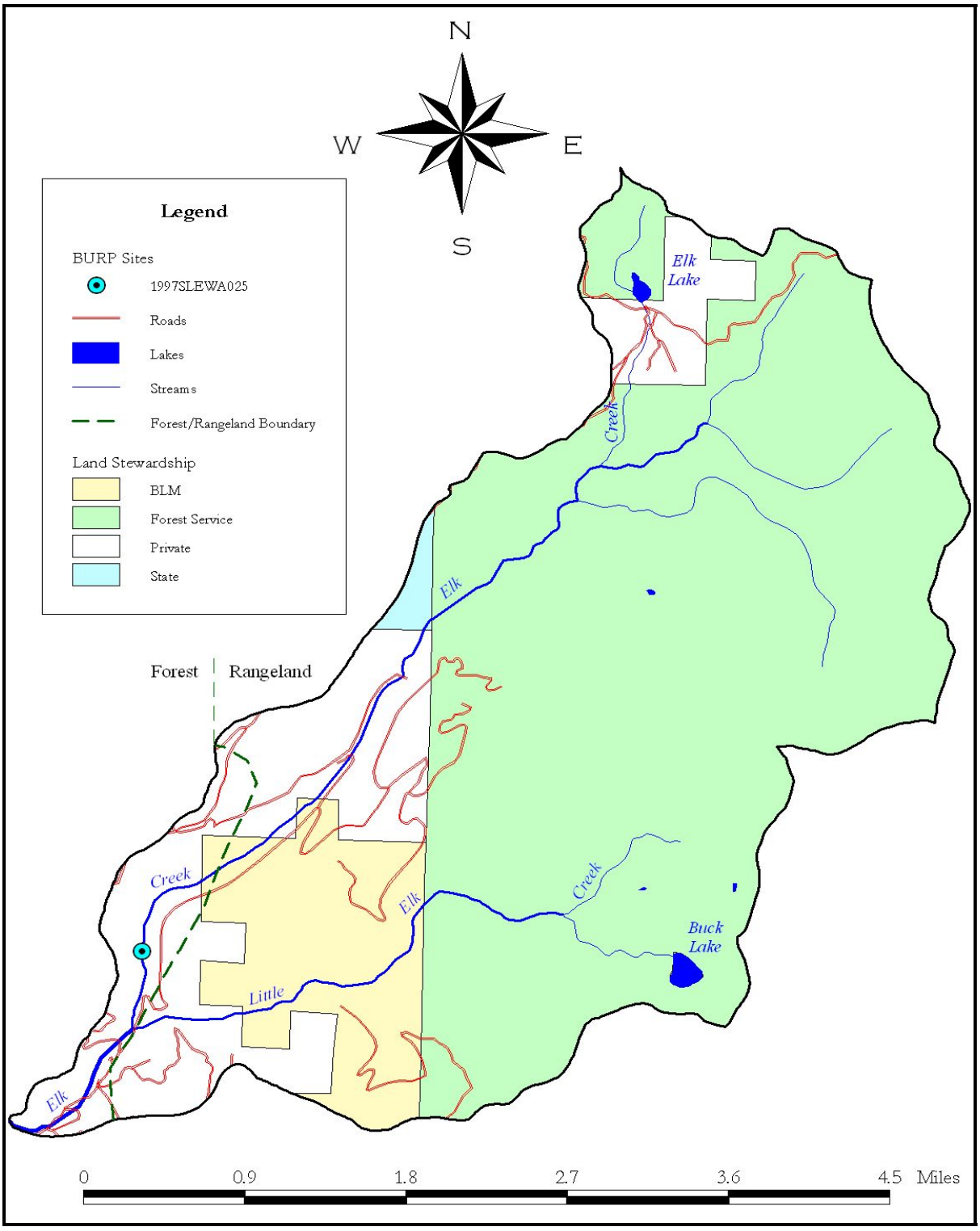


Figure 56. Elk Creek Subwatershed.

A small hydroelectric project occurs within the drainage. The diversion dam occurs at stream mile 3.7, which diverts water through a buried penstock to a power house located approximately 150 feet from the mouth of the stream. A fish ladder has not been constructed for this project.

Comparison between 1994 and 2003 aerial photographs shows an increase in structures between the mouth of Elk Creek up to Little Elk Creek. No new roads appear to be developed and old timber roads have either been obliterated or revegetated. No new timber harvest is apparent. Within the upper area of Elk Creek, near Elk Lake, some new trails appear to have been made by ATVs, but these trails are concentrated away from the creek and do not appear to be a major source of sediment.

Geology

The Elk Creek drainage is predominately underlain by highly and weakly weathered granitics of the Idaho Batholith and is bisected by large basalt flows. These granite rocks are typically divided with the highly weathered material occurring along the lower elevations and dominating the main stem flood plain and lower tributary flood plains. The upper Elk Creek basin has been scoured by glaciers and much of the lower drainage is underlain by the glacial drift/till. The weakly weathered granitics and basalt ridges and escarpments are common in the uplands and ridgelines

Vegetation

Vegetation varies with elevation and aspect. Strong south to east facing slopes at lower elevations support ponderosa pine, with spruce present in the riparian zone. A midstory of alder and an understory of forbs and grasses exist in the lower elevations. On northwest facing slopes and with increasing elevation, forest stands become denser with Douglas fir, grand fir, western larch, spruce, lodgepole pine, and ponderosa pine overstory. Alder, willow, spirea and currants grow densely within the midstory of the riparian areas. Ferns, grasses and forbs cover the understory. The headwaters are characterized by forbs and carex species with sparse subalpine fir and lodgepole groves (USFS 1993a).

Land Use

About 80% of the basin is public land. Federal agencies manage 7,522 acres. State and local governments manage 68 acres. Private ownership, 1,884 acres, is clustered primarily along the downstream end of the basin. Elk Creek headwaters are undeveloped and lie in the Payette National Forest. The upper reaches are managed for timber production and grazing. The lower reaches are irrigated agricultural land, grazing and subdivisions. Access to lower Elk Creek is difficult due to the amount of private land along it.

Logging has occurred within the Elk Creek drainage on both private and public lands. Most of the logging on the public land has occurred between the Elk and Little Elk Creek watersheds. Apparently, no logging has occurred near the riparian zone. However, in the upland portions of a tributary to Elk Creek, significant logging had occurred. Clearcuts on extremely steep land have been observed, often without protective buffer strips along the streams. The impact of this logging on sediment input to the stream is difficult to ascertain (USFS 1994b).

Very light livestock use occurs on the BLM managed land in the upper watershed. The Little Elk Creek allotment on BLM lands allow 103 AUMs of cattle to graze within Elk Creek and Little Elk Creek drainages. Grazing within the riparian area is very light. Primary grazing use is associated with timber harvest units and roads. Grazing along intermittent or perennial

streams is generally light and no measurable adverse sediment or temperature impacts are predicted to occur to downstream listed species habitat (i.e., Little Salmon River, mouth area of Elk Creek, and Hazard Creek) (BLM 2000). The USFS Elk Lake S&G grazing allotment has been rested for the past few years. Use has been limited to driving stock through the allotment to reach the USFS Jacks Creek allotment. The Jacks Creek Allotment permits 420 head of cattle to graze from mid-July to mid-October. Grazing impacts to the stream are limited to areas where the cattle congregate and drink water. This activity affects the riparian community and causes increased sedimentation to the stream (USFS 1994b).

Limited road access is accessible by ATV or four-wheel drive only. Most of these trails are on private land and outside of the streams riparian zone. The potential impacts from these roads are assumed to be negligible (USFS 1994b). Road density within the Elk Creek drainage is at 1.87 road miles/mile^2; 18% of these roads are within RCAs.

IDWR (2004) estimated 320 acres in the drainage were irrigated.

Hydrology

Elk Creek is a 3rd order tributary, with a dendritic stream feeder pattern, to the Little Salmon River. The Elk Creek stream channel alternates between Rosgen Stream Type (RST) A, B and C, although it is primarily a RST A (A3 and A3+). The upper reaches on Forest Service land are primarily RST B with some RST A and C.

The area has an average annual precipitation ranging from 15 inches at the lower elevations to 40 inches at the higher elevations. The majority of precipitation occurs as winter snowfall and spring rain. High-volume runoff occurs during spring snowmelt and major rain-on-snow events (IDL 2002b). Flow data for Elk Creek was estimated by the Idaho Department of Water Resources (Figure 57). Table 24 shows the estimated irrigation use in the watershed.

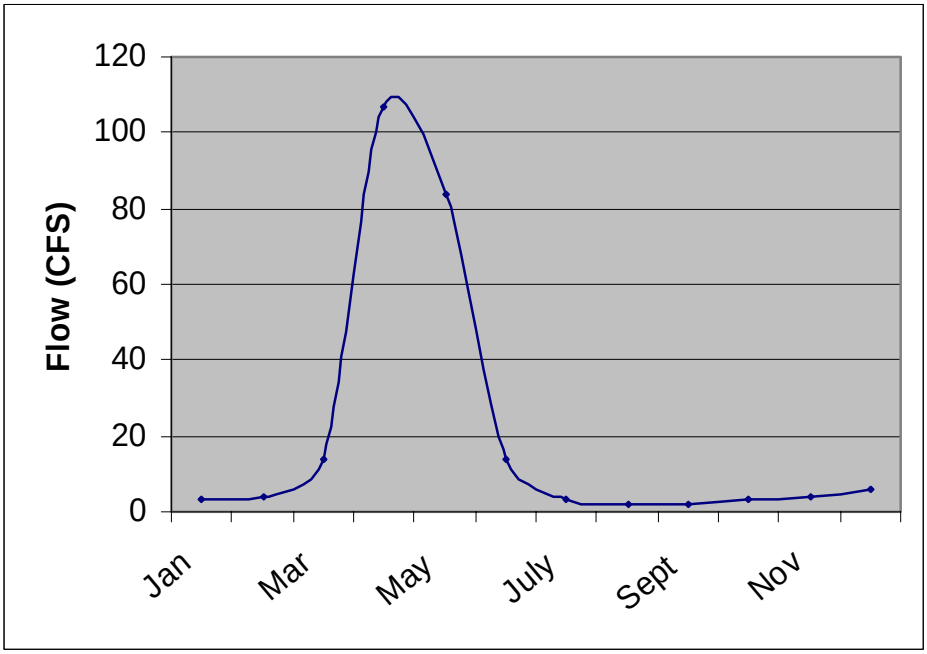


Figure 57. Elk Creek Average Monthly Flow at Mouth (Estimated Using StreamStat).

Table 24. Elk Creek estimated irrigation use.

	Estimated Existing Use (321 acres irrigation) (cfs)
January	0
February	0
March	1
April	12
May	12
June	13
July	6
August	3
September	0
October	0
November	0
December	0

Temperature

Stream temperatures within Elk Creek and Little Elk Creek are within the range of temperatures considered optimal for all life stages of resident trout (USFS 1994b). The primary limiting factors for fish production in Elk Creek include steep gradient and lack of good quality pools (BLM 2000).

Fisheries

A 12 foot bedrock falls creates a fish barrier 0.1 miles from the mouth of the stream. Adult steelhead are documented in Elk Creek from the mouth to the barrier falls at river mile 0.1.

Upstream of the falls, brook trout and rainbow trout have been observed (BLM 2000). This mouth area of the stream provides very limited Chinook salmon rearing habitat (IWRB 2001). Rainbow trout have been documented in Little Elk Creek but the high gradient of the stream may limit fish populations (USFS 1994b). No bull trout use has been documented for this stream.

Habitat Data

A CWE analysis of Elk Creek (IDL 2002) showed low sediment delivery to the stream from roads. The USFS reported that sediment input from roads in the upper watershed is low (USFS 1994b). Although surface erosion hazard was estimated to be high, the actual amount of sediment being transported into the stream appears to be minimal. These ratings refer to potential for sedimentation and on the ground measurements show that excess stream sedimentation is not occurring. Surface erosion hazard ratings are based on surface soil where the above ground vegetation and duff have been removed but the soil itself has not been substantially disturbed. Mass Failure hazard rated as moderate. Channel stability was rated as moderate. Overall sediment delivery rating which combines road, skid trail and mass failure estimates was low (IDL 2002). A 1994 USFS watershed analysis identified a 1992 fire as the major source of sediment to the stream at that time.

Stream substrate correlated to channel type. RST A and B typically were characterized by cobble, boulder and bedrock where as RST C were dominated by fines, gravels and small cobbles. Percent surface fines in the RST C averaged 31% which is below the 37% reference condition found in RST C pristine streams originating in plutonic parent material. The stream banks within Elk Creek are highly stable (99% of total length). A 1993 Pfankuch Channel Stability Evaluation found fair and good conditions on the mainstem on forest service lands. Erosion of the stream banks does not appear to contribute significantly to the sediment load of the stream (USFS 1994b).

On March 11, 2005, DEQ employees surveyed Elk Creek. The location of the survey was below the confluence of Elk Creek and Little Elk Creek. Three transects were measured and the averages were compared to the Overton (1995) descriptions of fish habitat within natural conditions of the Salmon River Basin. The width to depth ratio of a metamorphic stream type should be 26 (Overton, 1995). The survey recorded width to depth ratio for Elk Creek as 32. Percent surface fines of a metamorphic stream should be 14% (Overton 1995). The 2005 survey recorded percent fines at 4.3% within the wetted width and 10.8% within the bankfull width of Elk Creek. Bank stability within the survey area was 100%. The substrate along the banks was predominately boulders with pebble and cobble filling in the gaps and areas of slower water. Atop the solid banks was thick vegetation of grasses and shrubs such as hawthorn and dogwood. Large mature cottonwoods and ponderosa pines existed within the flood plain. Overall, impacts due to excess sediment either traveling through this section or depositing within it were not seen. The stream channel and substrate were in good to excellent condition.

As shown in Table 25, Elk Creek above Little Elk Creek fully supported beneficial uses. Field notes indicated a good riparian area.

Table 25. Elk Creek: DEQ water body assessment score.

DEQ Stream Site ID	SMI	SHI	SFI	Water Body Assessment Score	Beneficial Use Support Status
	(maximum score = 3)				
1997SLEWA025	3	2	3	2.67	Full Support

Conclusions

Elk Creek does not have impaired beneficial uses nor does aerial photograph analysis show any potential inputs of sediment due to management actions. A TMDL is not necessary and Elk Creek will be proposed for delisting from the 303(d) list for sediment.

Indian Creek

Originating at approximately 4,800 feet, Indian Creek (Figure 58) is a Rosgen Stream Type (RST) A and B first order, low volume stream (the branches of the stream shown on the map are either ephemeral or intermittent) located mainly in Idaho County (the headwaters are located in Adams County) between the small communities of Pollock and Pinehurst. Flowing from west to east, Indian Creek enters the Little Salmon River at approximately 2,500 feet and drains approximately 1,735 acres (Figure 59). The creek flows through a narrow, forested, V-shaped canyon area. Indian Creek is in assessment unit 17060210SL001_03.

Comparisons of aerial photographs, taken between 1994 and 2003, show that logging roads within the middle and upper section of the watershed have partially revegetated. Approximately 9 acres are developed south of the mouth of Indian Creek.

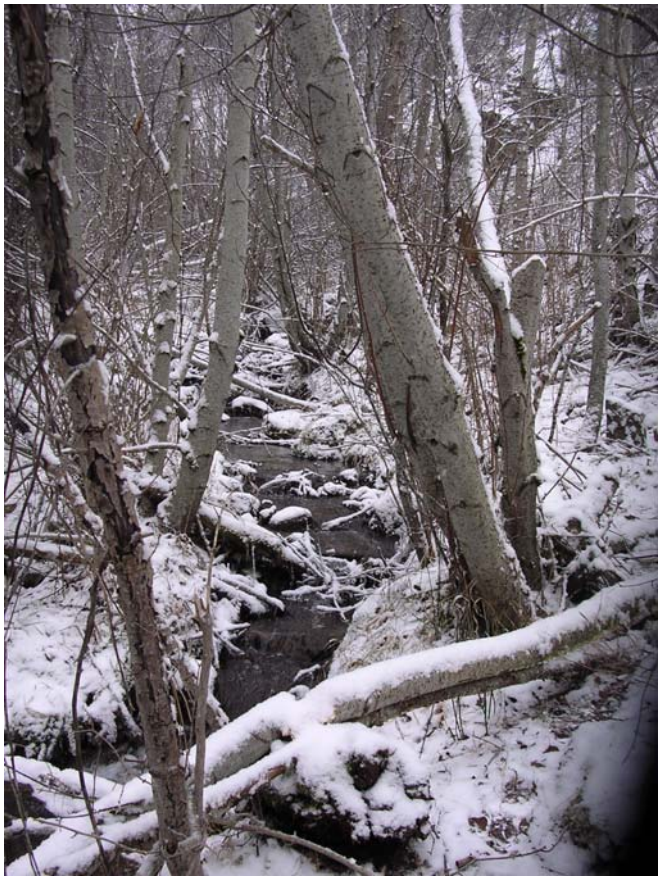


Figure 58. Indian Creek Near Mouth (November 2004).

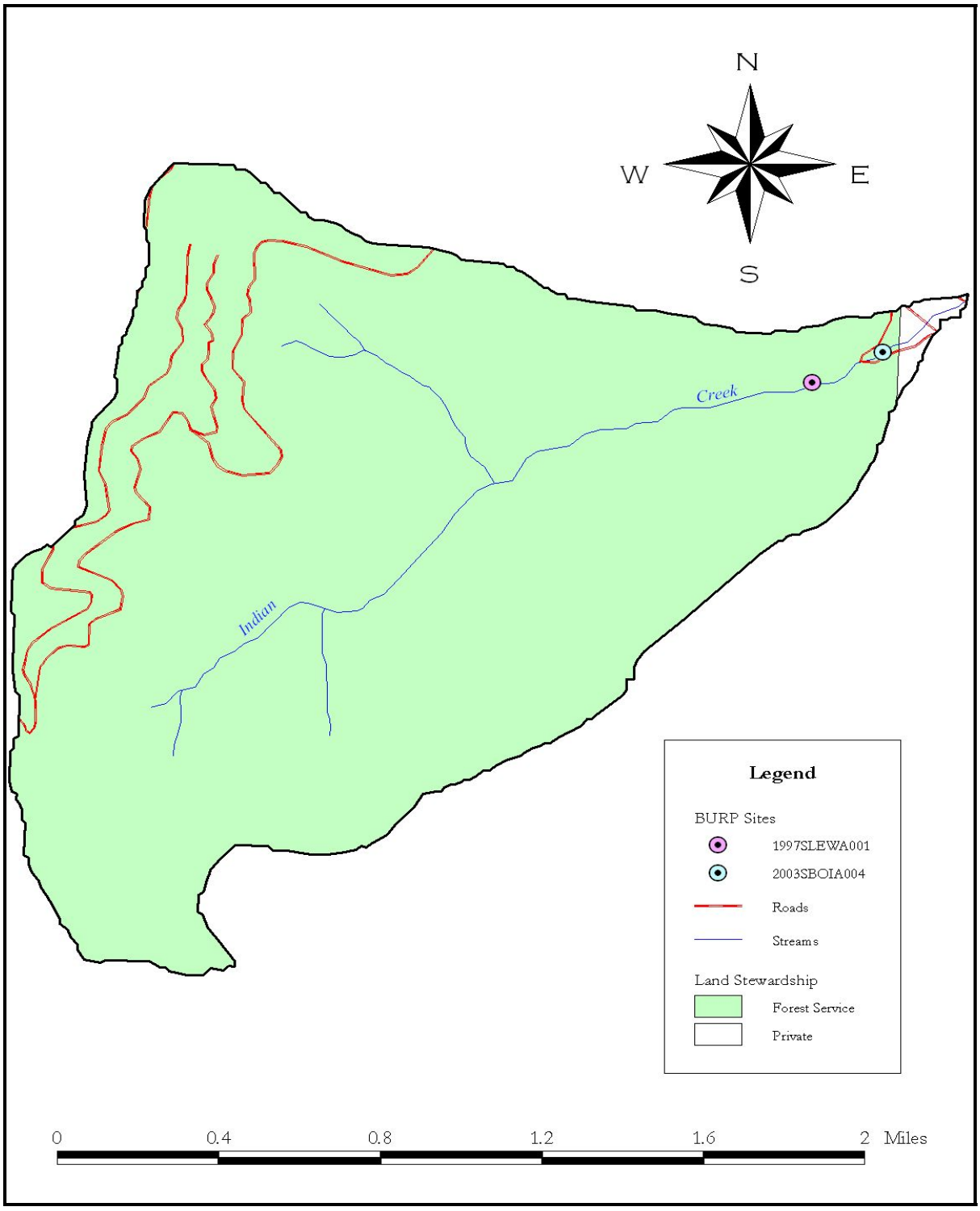


Figure 59. Indian Creek Subwatershed.

Geology

The parent materials in the watershed are schist and gneiss from the Baker terrane, an Idaho Batholith formation, while the rest of the watershed shows border/volcanic properties.

Vegetation

The primary vegetation within Indian Creek riparian zone is Grand fir, Douglas-fir, Engelmann spruce, alder and various forbs. The upland slopes are predominately Ponderosa pine and hawthorne overstory with an understory of grasses, forbs and shrubbery. The higher elevations are Douglas fir and lodgepole pine forested areas.

Land Use

Timber harvest has occurred in the watershed. There are no roads directly adjacent to the stream.

A natural landslide occurred in 1974 which affected fisheries in the stream in the short term. A trail that was located adjacent to the creek was also washed out at this time, and there are no plans to rebuild it. The trail is now overgrown and does not appear to be used.

Hydrology

Little flow information exists for Indian Creek. The creek is perennial, but base flows are below 1 cfs and flows likely remain below 5 cfs for much of the year (Figure 60).

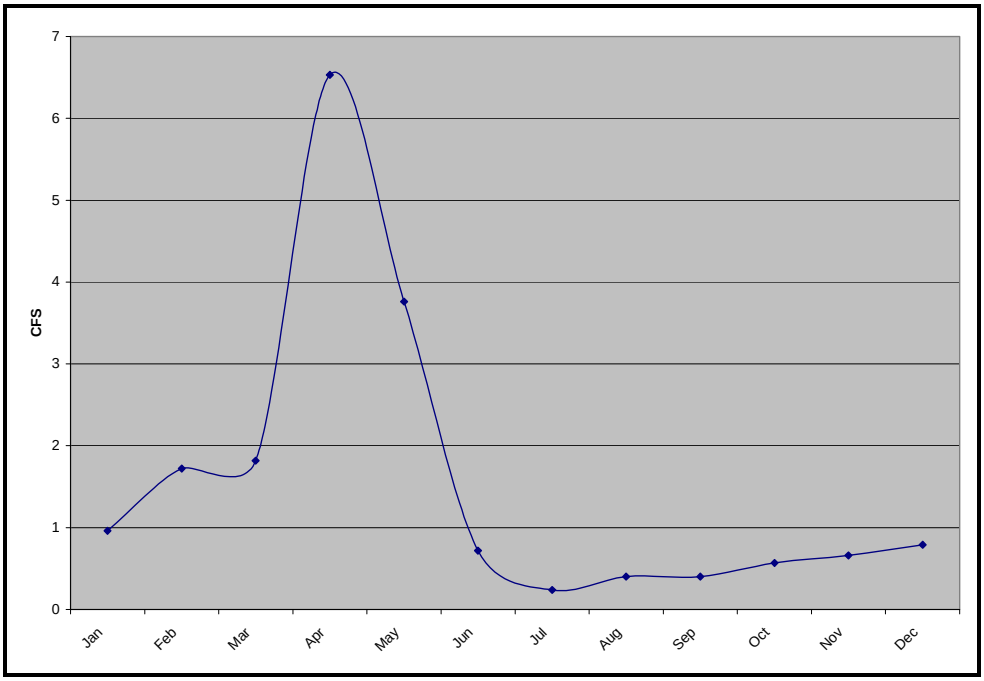


Figure 60. Indian Creek Average Monthly Flow at Mouth (Estimated Using StreamStat).

Fisheries

The fish that likely inhabit Indian Creek are brook and rainbow trout. The low hydrologic flows may not support fish populations within the upper reach of Indian Creek. In July 2005 a DEQ stream inventory crew tried to electrofish the creek but low flow prevented them from doing so.

Habitat Data

1997 DEQ stream inventory data indicated that the stream did not support beneficial uses and Indian Creek was put on the draft 2003 303(d) list for sediment. As shown in Table 26, the most recent 2003 DEQ data (taken in the same area as the 1997 inventory) shows that beneficial uses are not impaired.

The stream survey results indicated 26% surface fines, >80% stable banks, and 12.77 width/depth ratio. These results were compared to results for the same parameters seen in geologically similar pristine streams using reference condition work done by Overton (1995) to see if impairment from sediment was evident.

The 12.77 width/depth ratio is below the 16 width/depth ratio seen in pristine Rosgen Stream Type A streams of volcanic origin. The mean percent surface fines for Rosgen Type A channel streams (Overton 1995) is 25%. A surface fines score of 26% indicates that surface fines levels are close to that seen in pristine streams. Bank stability was also similar to that of pristine streams.

2004 data width/depth data taken near the mouth of Indian Creek indicated a width/depth ratio of 17 in a Rosgen Type B channel which is below the mean width/depth ratio of 27 seen in pristine streams, indicating that the channel is not excessively wide. Banks appeared stable throughout the ½ mile section walked by DEQ personnel.

Table 26. Indian Creek: DEQ water body assessment scores.

DEQ Stream Site ID	SMI	SHI	SFI	Assessment Score	Beneficial Use Support Status
	(maximum score = 3)				
2003SBOIA004	2	3	No data	2.5	Full Support
1997SLEWA001	1	1	No data	1	Not Full Support

Conclusions

The beneficial uses in Indian Creek are not impaired, and Indian Creek is recommended for delisting from the 303(d) list. No human caused sources of sediment appear to either threaten or currently impair beneficial uses in Indian Creek. Habitat measurements related to sediment were similar to conditions seen in pristine streams. No TMDL is necessary for Indian Creek.

First and Second Order Tributaries to the Little Salmon River below Round Valley Creek

The following sections on Sheep, Rattlesnake, Lockwood, Denny, Hat and Fall Creeks all discuss similar first and second order streams that lie in the Little Salmon River assessment unit (17060210SL001_02) (Figure 61).

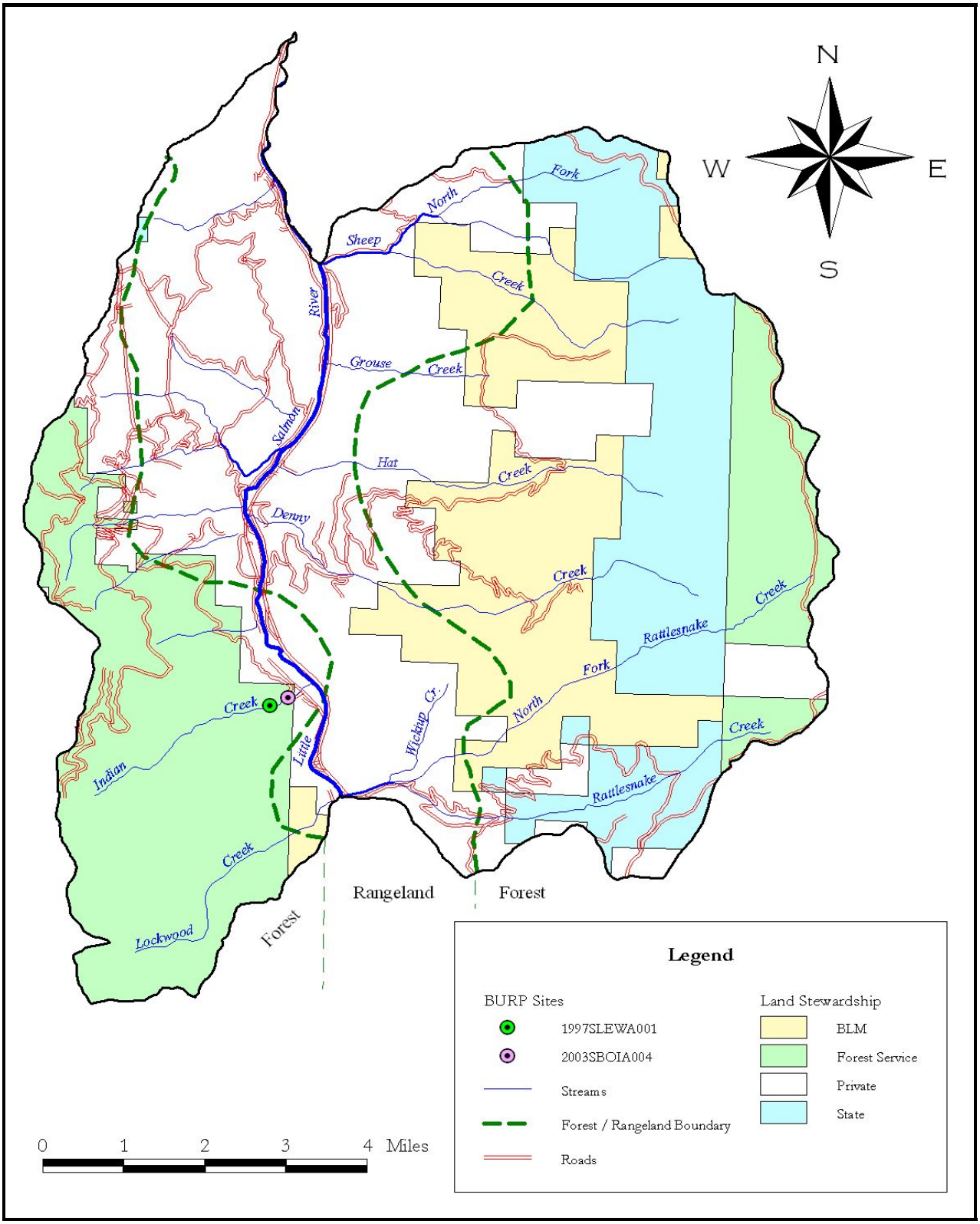


Figure 61. Lockwood, Indian, Rattlesnake, Denny, Hat, and Sheep Creeks.

Sheep Creek

Sheep Creek (Figure 62) is a second order stream that flows into the Little Salmon River at river mile 6.9. The watershed is 4,291 acres in size. The elevation at the mouth is 1,900 feet and the highest elevation in the drainage is 7,718 feet. Sheep Mountain (elevation 7,415 feet) borders the east side of the watershed and Indian Mountain (elevation 7,113 feet) borders the north side.

Sheep Creek flows through a steep sloped V-shaped canyon. The upper watershed is timbered while the lower portion of the watershed is a mixture of grasslands and timbered sites. A residence is located along Sheep Creek near the mouth.

Land Use

State lands comprise approximately 38% of the ownership, 34% are BLM lands, private lands 23%, and Forest Service total 5%. No public access exists in the lower drainage, however, public access is provided to the upper watershed.

Land uses which have impacted the drainage include logging, roads, and livestock grazing. Livestock grazing on private lands in the lower watershed has resulted in localized areas of stream bank degradation. Very light use to no use from livestock occurs on BLM and USFS lands along the creek in the upper watershed.

Hydrology

The stream is primarily a Rosgen Stream Type (RST) A channel with a steep gradient ranging from 10 - 25%. The dominant RST is A3+. Figure 65 shows estimated monthly flows for Sheep Creek.

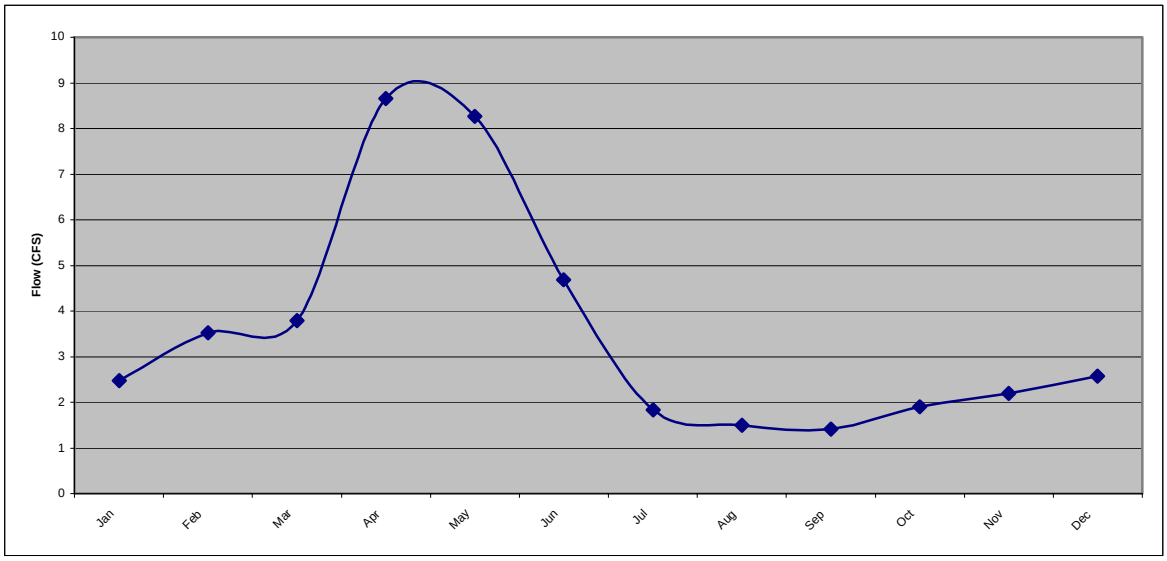


Figure 62. Sheep Creek Average Monthly Flow at Mouth (Estimated Using StreamStat).

Fisheries

Sheep Creek provides spawning and rearing habitat for rainbow/steelhead trout. A 15 foot falls at stream mile 0.7 is a complete fish passage barrier therefore documented steelhead spawning is limited to the lower reach. The mouth area or lower reach segment provides limited value for spring/summer Chinook rearing. No bull trout use has been documented for this stream. Ringe et al. (1978) sampled two sections of Sheep Creek in 1977. Ringe et al. (1978) found rainbow/steelhead near the mouth and found no fish approximately one mile (upstream from falls) from the mouth. A local resident has reported that rainbow trout do occur upstream from the barrier (BLM 2000).

The BLM monitored fish populations in 1982 at stream mile 0.4 and only found rainbow/steelhead trout. Densities of over-yearling rainbow/steelhead trout were estimated at 0.10 fish per square meter and young of the year fish densities were 0.21 fish per square meter (BLM 2000).

Habitat Data

The BLM has a permanent greenline monitoring station established on Sheep Creek (stream mile 3.1). Monitoring in 1993 and 1995 documented no unstable stream banks, and no recent signs of livestock use. The primary limiting factors for fish production in Sheep Creek include steep gradient, lack of good quality pools, and deposited sediment. The steep gradient has prevented the formation of good quality pools and sediment is deposited in the existing pools due to the step/cascade morphology of the stream. These limiting factors are natural not anthropogenic in nature.

Conclusions

Limited information is available for Sheep Creek, but the information available for this creek and similar streams (Rattlesnake, Hat, Lockwood and Denny Creeks) suggests that beneficial uses are not impaired. A TMDL is not necessary.

Hat Creek

Hat Creek (**Figure** 63), a first order stream, flows into the Little Salmon River at river mile 9.3. The watershed is 3,389 acres in size. The elevation at the mouth is 2,315 feet and the highest elevation in the drainage is 7,975. Hat Creek flows through a steep sloped V-shaped canyon. The upper watershed is timbered while the lower portion of the watershed is a mixture of grasslands and timbered sites.

Land Use

State lands comprise approximately 21% of the ownership; BLM lands 35%, private lands 31%, and Forest Service total 20%.

Land uses which have impacted the drainage include logging, roads, livestock grazing, and recreation. Very light to no use from livestock occurs on BLM and USFS lands along the creek in the upper watershed. A BLM public access road provides access to BLM managed lands: however, the lower portion of the drainage is primarily private lands.

Hydrology

This stream is primarily a Rosgen Stream Type (RST) A channel with steep gradients (10 - 20%), the dominant RSTs are A3+, A3, and A2. Hat Creek is a low volume stream, and flows are generally below 15 cfs (Figure 66).

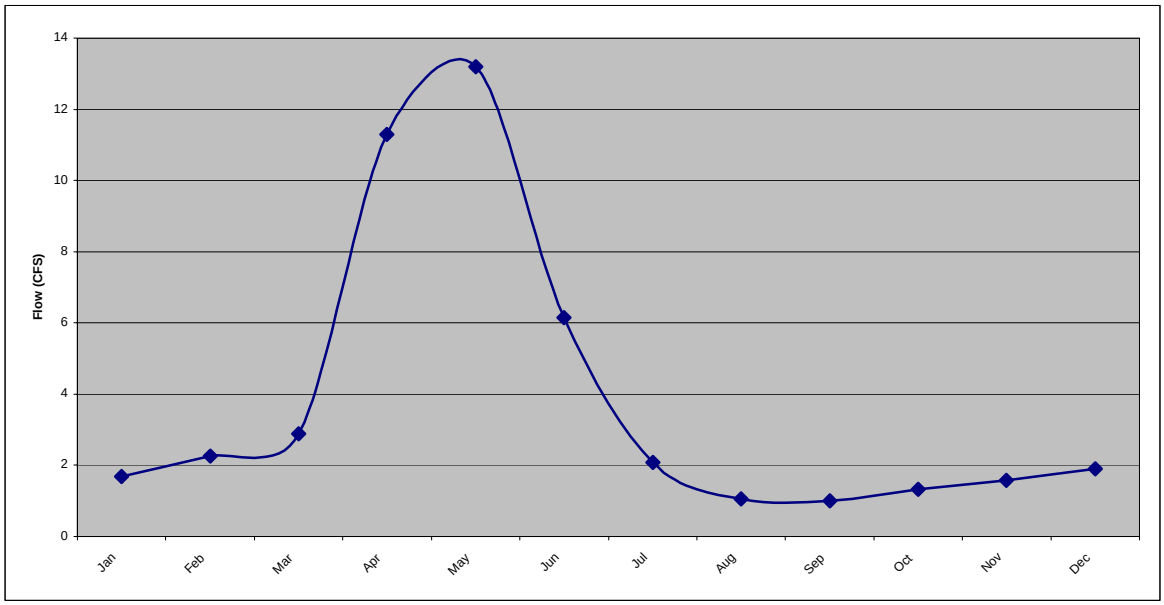


Figure 63. Hat Creek Average Monthly Flow at Mouth (Estimated Using StreamStat).

Fisheries

Hat Creek provides spawning and rearing habitat for rainbow/steelhead trout. A steep gradient cascade/falls is located at stream mile 0.05 and is a complete fish passage barrier. Hat Creek has documented adult steelhead use below the barriers. The mouth area or lower reach segment provides marginal habitat for spring/summer Chinook rearing. No bull trout use has been documented for this stream. In 1982, the BLM documented the presence of rainbow trout at stream mile 3.0.

Habitat Data

The BLM has a permanent greenline monitoring station established on Hat Creek (stream mile 3.1). Monitoring in 1995 documented no unstable stream banks and light livestock use.

Conclusions

Information available for Hat Creek and similar streams (Rattlesnake, Sheep, Lockwood, and Denny Creeks) indicate that beneficial uses are not impaired. A TMDL is not necessary for Hat Creek.

Denny Creek

Denny Creek, a first order stream, flows into the Little Salmon River at river mile 9.7. The watershed is 2,624 acres in size. The elevation at the mouth is 2,380 feet and the highest elevation in the drainage is 7,385 feet. Denny Creek flows through a steep sloped V-shaped canyon. The upper watershed is timbered while the lower portion of the watershed is a mixture of grasslands and timbered sites.

Land Use

State lands comprise approximately 13% of the ownership, private lands 41%, BLM lands 33%, and Forest Service 1%.

Land uses which occur in the drainage include logging, roads, livestock grazing, and recreation. Very light to no use from livestock occurs on BLM and USFS lands along the creek in the upper watershed. A BLM public access road provides access to BLM managed land. However, the lower portion of the drainage is primarily private lands.

Hydrology

This low volume stream is primarily a RST A channel with steep gradients (15 - 30%) and the dominant RSTs are A3 and A3+.

Fisheries

Denny Creek provides spawning and rearing habitat for rainbow/steelhead trout. At stream mile 0.05, there is a steep gradient cascade/falls which is a complete fish passage barrier. Denny Creek has documented adult steelhead use below the barriers. The mouth area or lower reach segment provides marginal habitat for spring/summer Chinook rearing. No bull trout use has been documented for this stream. The only occupied fish habitat occurs in the lower 0.05 mile of stream below the barrier (BLM 2000).

Habitat Data

No habitat data is available.

Temperature

Temperature data is limited; the highest recorded summer temperature was 14^{o} C in 1983. The primary limiting factors for fish production in Denny Creek include steep gradient, barriers, low flows, lack of good quality pools, and deposited sediment.

Conclusions

Information available for Denny Creek and similar streams (Rattlesnake, Sheep, Lockwood, Fall, and Hat Creeks) indicate that beneficial uses are not impaired. A TMDL is not necessary for Denny Creek.

Lockwood Creek

Lockwood Creek (Figure 64), a first order stream, flows into the Little Salmon River at river mile 12.8. The watershed is 1,803 acres in size. The highest point in the drainage is Lockwood Point, elevation 6,969 feet. Lockwood Creek flows through a steep sloped V-shaped canyon. The watershed is primarily timbered with brush patches.

Land Use

The majority of Lockwood Creek is within USFS managed public land, 8 % (140 acres) is BLM lands, and the land right at the mouth is under private ownership.

Land uses which have impacted the drainage include logging, roads, and livestock grazing. A residence occurs near the mouth of this creek and a water diversion is used for irrigation of private lands.

Lockwood Creek is within the USFS Fall Creek/Whitebird Ridge C&H grazing allotment. In 2004, the permit allowed 240 cow/calf pairs to graze USFS land between June 10 and October 31. Very light use to no livestock use occurs on BLM lands.

This stream has experienced periodic severe flood scouring damage. The most recent flood event occurred January, 1997.

Hydrology

This low volume stream is primarily a RST A channel with steep gradients (6 - 15%) and the dominant RSTs are A3+ and A3.

Fisheries

Lockwood Creek provides spawning and rearing habitat for rainbow/steelhead and has documented adult steelhead use. The mouth area or lower reach segment provides marginal habitat for spring/summer Chinook salmon juvenile rearing, however, no Chinook use has been documented. No bull trout use has been documented in this stream. Ringe et al. (1978) sampled Lockwood Creek in 1977 and found rainbow/steelhead trout in the lower 0.7 mile of stream (upper BLM boundary), and found no fish above the BLM boundary in 104 seconds of electrofishing. The BLM monitored fish populations in 1986 at stream mile 0.4 and only found rainbow/steelhead trout. Densities of overyearling rainbow/steelhead trout were estimated at 0.33 fish per square meter, and young of the year fish densities were 0.16 fish per square meter (BLM 2000).

Habitat Data

The BLM has a permanent greenline monitoring station established on Lockwood Creek (stream mile 0.4). Monitoring in 1994 documented 1% unstable stream banks, and no livestock use. It should be noted that the 1997 flood event resulted in severe channel and bank scouring. A 2004 PfanKuch Channel Stability Evaluation found fair and good conditions on the mainstem on forest service lands.

Conclusions

Information available for Lockwood Creek and similar streams (Rattlesnake, Sheep, Denny, Fall, and Hat Creeks) indicates that beneficial uses are not impaired. A TMDL is not necessary for Lockwood Creek.

Rattlesnake Creek

Rattlesnake Creek, a second order stream, flows into the Little Salmon River at river mile 12.9. The watershed is 4,954 acres in size. The highest point is an unnamed peak above Elk Lake, with an elevation over 8,000 feet. Rattlesnake Creek flows through a steep sloped V-shaped canyon. The watershed is grassland and timbered in the lower drainage, while the upper drainage is mostly timbered.

Land Use

Majority of Rattlesnake Creek drainage is private and state ownership; 28% are BLM lands, and a small portion of the headwaters is within Forest Service lands.

Land uses occurring in the drainage include logging, roads, and livestock grazing. Very light use to no livestock use occurs on stream segments crossing BLM or UFSF lands.

Hydrology

This stream has experienced periodic severe flood scouring damage. The most recent flood event occurred in January, 1997. In 1974, the lower reach of Rattlesnake Creek was severely damaged by a flood, which severely degraded fish habitat (BLM 2000). The stream is primarily a RST A channel with steep gradients (10 - 20%). The dominant RSTs are A3+ and A3. Flows in Rattlesnake Creek are estimated to remain below 20 cfs throughout the year (Figure 64).

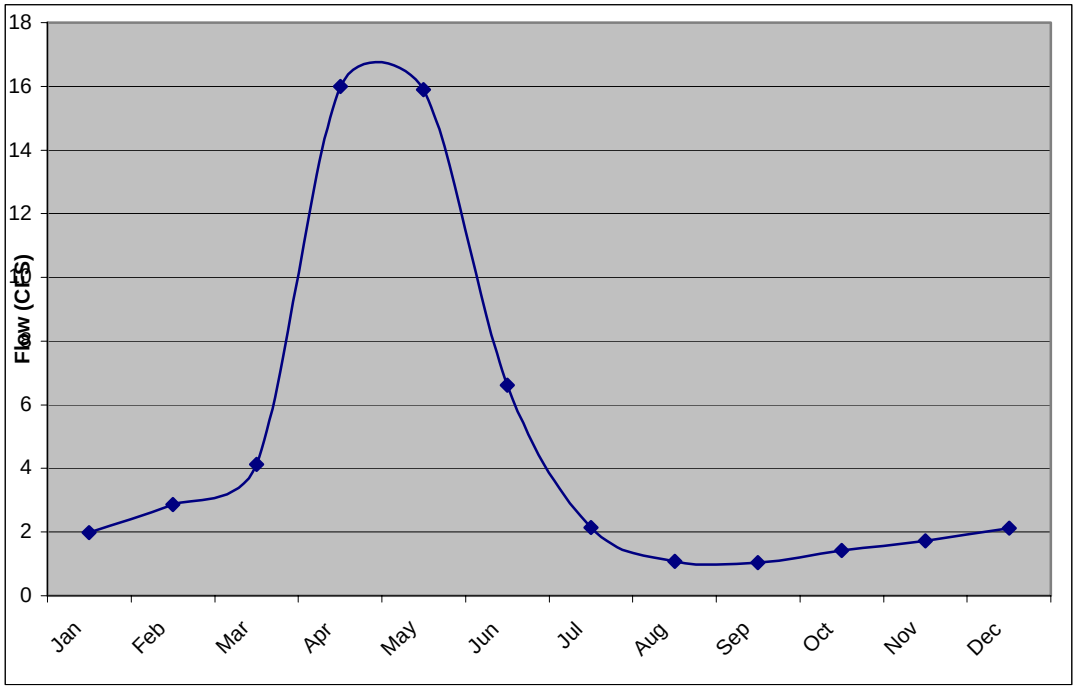


Figure 64. Rattlesnake Creek Average Monthly Flow at Mouth (Estimated Using StreamStat).

Fisheries

Rattlesnake Creek provides spawning and rearing habitat for rainbow/steelhead in the mouth area and lowest reach segment (150 feet). Rattlesnake Creek has documented adult steelhead use. A cascade/fall restricts fish passage at stream mile 0.05. During the early 1960s when the existing Highway 95 bridge was constructed, the highway and bridge resulted in the creation of the fish passage barrier approximately 150 feet from the mouth of Rattlesnake Creek (BLM 2000). The mouth area or lower reach segment provides marginal habitat for spring/summer Chinook rearing. No Chinook salmon use or bull trout use has been documented for this creek. Rattlesnake Creek was sampled in 1977 and rainbow trout were found.

The primary limiting factors for fish production in Rattlesnake Creek include steep gradient, lack of good quality pools, channel and stream bank scouring, barriers, lack of in-stream cover, and sediment. The North Fork of Rattlesnake Creek flows into Rattlesnake Creek at stream mile 0.5. The BLM monitored fish populations in 1986 in the North Fork of Rattlesnake Creek at stream mile 0.4 and only found rainbow/redband trout. Densities of over-yearling rainbow trout were estimated at 0.2 fish per square meter, and young of the year fish densities were 0.1 fish per square meter (BLM 2000).

Habitat Data

No habitat information was available for Rattlesnake Creek.

Temperature

Temperature data is limited; the highest recorded summer temperature was 17^{o} C in 1979.

Conclusions

Information available for Rattlesnake Creek and similar streams (Lockwood, Sheep, Denny, Fall, and Hat Creeks) indicates that beneficial uses are not impaired. A TMDL is not necessary for Rattlesnake Creek.

Fall Creek

Fall Creek, a first order stream, flows east into the Little Salmon River at river mile 16.2. The watershed is 1,782 acres in size. The highest point is an unnamed peak above 7,000 feet in elevation, and the second highest is Lockwood Point at 6,969 feet. The watershed is primarily timbered with shrubs and some grassland openings.

Land Use

Fall Creek flows through Forest Service, BLM, and private lands. Ownership is approximately 33% for each.

Land uses occurring within the drainage include logging, roads, and livestock grazing.

Fall Creek is within the USFS Fall Creek/Whitebird Ridge C&H grazing allotment. In 2004, the permit allowed 240 cow/calf pairs to graze USFS lands between June 10 and October 31. Very light to no livestock use occurs on BLM lands adjacent to Fall Creek.

Hydrology

This low volume stream is primarily a RST A channel with steep gradients (7 - 25%). The dominant RSTs are A3+ and A3.

Fisheries

A 25 foot falls occurs within 100 feet of the Little Salmon River. No documented adult steelhead use is known to occur in Fall Creek; however, steelhead may potentially use the mouth area or lower 25 feet for juvenile rearing. The mouth area or lower 25 feet provides limited value for spring/summer Chinook rearing. No bull trout use has been documented for this stream. Ringe et al. (1978) sampled two sections of Fall Creek in 1977, electrofishing two sections of this stream. The survey found rainbow trout at stream mile 0.75 but no fish at stream mile 1.5. The BLM monitored fish populations in 1986 at stream mile 0.9 and found only rainbow trout (Johnson 1986C). Densities of over-yearling redband/rainbow trout were estimated at 0.06 fish per square meter (Johnson 1986C). A stream survey of Fall Creek was conducted during 1982. A ten foot fall occurs at stream mile 1.1, and it is believed that this may be the upper limit of fish presence in Fall Creek (BLM 2000). Fish were observed in the creek below the falls, but no visual observation was made of fish upstream from the falls (stream mile 1.1).

Habitat Data

No habitat data is available for this stream.

Conclusions

Information available for Fall Creek and similar streams (Lockwood, Sheep, Denny, Rattlesnake, and Hat Creeks) indicates that beneficial uses are not impaired. A TMDL is not necessary for Fall Creek.

Rapid River

Rapid River is a fifth order tributary to the Little Salmon River, located about four miles south of Riggins (Figure 65 and Figure 66). The entire watershed is 80,017 acres in size, 21,991 acres of which are in West Fork and 7,919 acres in Shingle Creek. Aside from the West Fork, major tributaries include Paradise Creek, Lake Fork and Granite Fork. The upper watershed features bare rock and alpine lakes, such as Black Lake, Crystal Lake and Satan Lake.

The watershed is bounded on the east by White Bird Ridge and Pollock Mountain (elevation 8,048 feet). The spine of the Seven Devils Mountain range forms its western boundary and includes named peaks such as The Ogre, The Goblin, Heavens Gate (elevation 8,428 feet), She Devil, Tower of Babel, Mount Belial and The Devils Farm. The southern boundary of the watershed is formed by Pyramid Peak (elevation 8,360 feet), Echols Mountain (elevation 8,327 feet) and North Star Butte (elevation 7,451 feet). The highest points in the watershed are He Devil and Devils Throne mountains, both 9,280 feet. The Rapid River watershed encompasses assessment units 17060210SL002_02, 03 and_04.

Entering six miles from Rapid River's confluence with the Little Salmon River, West Fork Rapid River is a fourth order stream with an average gradient of 14%. Its headwaters lie on Middle Mountain, Black Imp, Horse Heaven, and Carbonate Hill. Its major tributaries are Dog Creek, Hanson Creek and Bridge Creek. The upper watershed is dotted with many alpine lakes, including Slide Rock Lake, Cannon Lakes, Mirror Lake and Dog Lake. The headwaters of West Fork Rapid River have a steep gradient, and flow through a narrow enclosed canyon for the first five miles, after which the gradient decreases.

Upon passage of Public Law 94-199 on the last day of 1975, Rapid River was added to the national list of Wild and Scenic Rivers. The main stem was protected from the headwaters to the National Forest boundary, and the West Fork was protected from the wilderness boundary to its mouth. Both were designated as 'Wild' rivers, the most pristine designation established in the act. In the words of the Wild and Scenic Rivers act, "…these (rivers) represent vestiges of primitive America".

Geology

The dominant geologic type is border/volcanics. This geologic type occurs on the borders of the Idaho Batholith granitics with scattered outcrops of Columbia River Basalts throughout the region. It consists of granitic rocks, granitic gneisses, schist, quartzites, and other

metamorphic rocks. This geologic type does not weather as quickly as central core rocks. Soil textures are medium to coarse and are generally highly erodible. The volcanics consist of various basalt formations that occur throughout the area. Basalts produce a medium to fine textured soil with low to medium erodibility (BLM 2000).



Figure 65. Rapid River Upstream of Fish Hatchery (March 2005).

Vegetation

Lower elevation riparian species include white alder, cottonwood, Rocky mountain maple, black hawthorn, willow, Douglas fir, dogwood, syringa, and birch. Mid to upper elevation riparian species include sub alpine fir, Engelmann spruce, Douglas fir, grand fir, alder, prickly currant, huckleberry, dogwood, syringa, willow, sweet-scented bedstraw, bead lily, starry solomon-plume, twisted stalk, lady fern, monkshood, meadow rue, and miner's lettuce, depending on elevation, aspect, and canopy cover.

Upland Vegetation types are diverse and represent a range of seral stages, which are primarily influenced by past timber harvest, fires, and livestock grazing. Lower elevations are dominated by canyon grasslands and a mixed conifer over story, which includes Douglas-fir, grand-fir, larch, and ponderosa pine. Upper elevations are dominated by grand-fir, Douglas-fir, larch, Engelmann spruce, lodgepole pine, and sub alpine fir. The timber is interspersed with patches of perennial grassland, brush, and riparian vegetation (USFS 1993b).

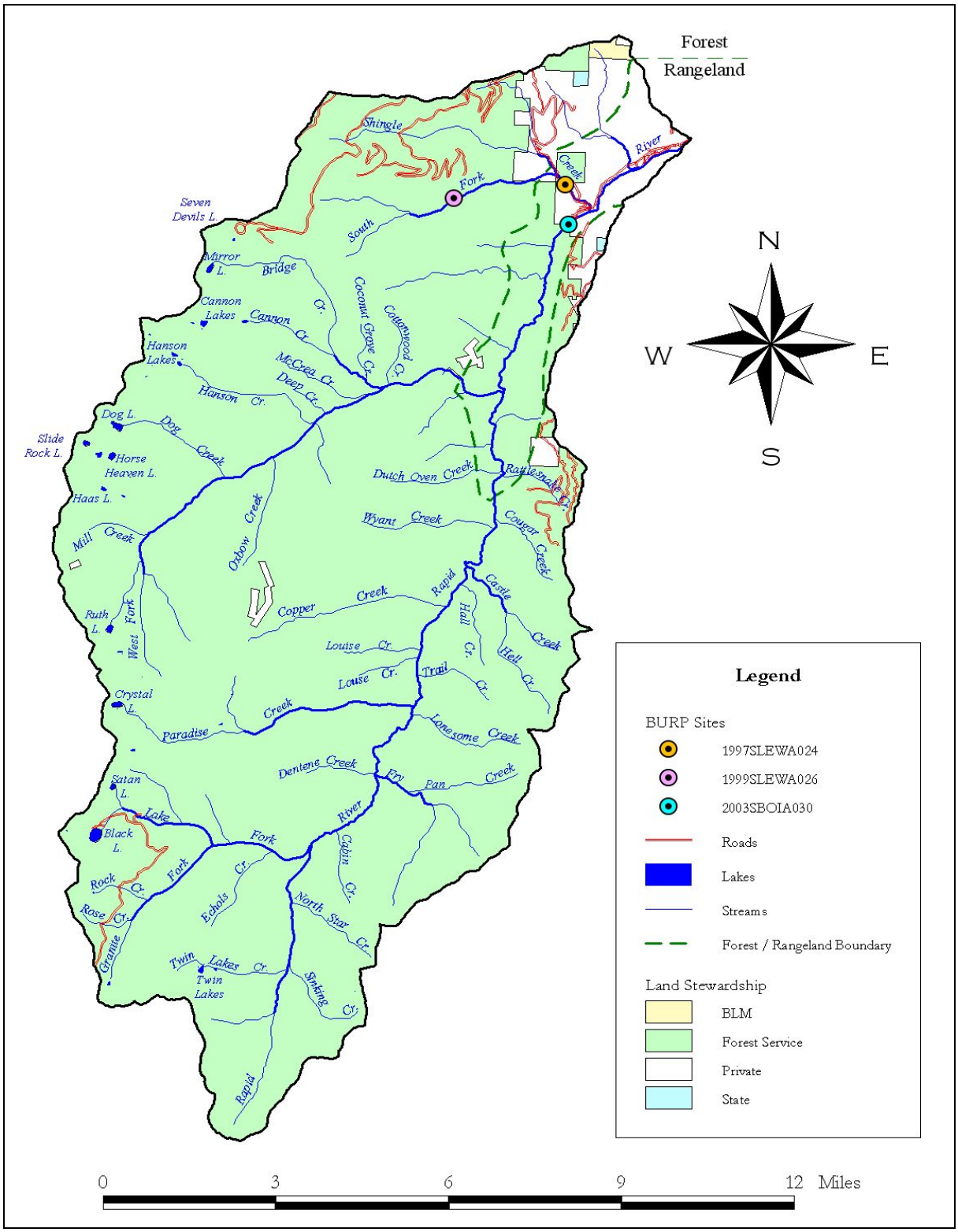


Figure 66. Rapid River Subwatershed.

Land Use

Public land makes up the majority of the watershed. Private lands are found only in the very lower portions of the watershed. The Nez Perce National Forest manages 33,719 acres (42%); Payette National Forest manages 42,430 acres (53%); private lands total 4,003 acres (5%); BLM lands total 152 acres (< .2%); and State lands total 43 acres (<0.1%).

The only major development occurs in the lower portion of the watershed and includes roads, residences, and the Rapid River Fish Hatchery. Primary land uses include cattle grazing, gardening, and minor amounts of timber harvest. High-use pasture areas and feedlots exist along 1.5 miles of lower Rapid River. Overall, there are no major land disturbing activities within Rapid River above the Payette/Nez Perce National Forest boundary. The watershed is used for recreation and has an extensive trail system.

Livestock grazing is permitted in part of the watershed. The Papoose Creek allotment permitted by BLM allows 27 animal unit months (AUMs) of cattle to graze. The USFS-Payette National Forest has three grazing allotments within the Rapid River watershed. The Fall Creek/Whitebird Ridge C&H allotment permits 240 cow/calf pairs to graze between June 6 and October 31. The Curren Hill S&G allotment permits 1650 dry ewe to graze between August 22 and September 30. The Echols Butte S&G allotment permits 950 ewe/lamb pairs to graze between July 19 and August 3.

There are 27 recorded water rights directly on the streams within the Rapid River watershed; in addition, numerous water rights are recorded for springs, smaller feeder streams, and ground water. Water rights are owned by federal, state, and private land owners. Of the water rights, two are for domestic use, nine are for irrigation purposes, four are for irrigation/stockwater use, two are for irrigation/domestic use, four are for fish propagation, and six are for power generation.

Road densities within this large watershed are low to non-existent. The lowest portion of Rapid River is within private lands and has a road density of 0.35 mi road/square mile, 59% within RCA. West Fork Rapid River has a low road density of 0.05 mi road/sq mile, none of which is within RCA. Lake Fork Creek, a headwater tributary to Rapid River has a high road density of 0.66 mi road/sq mile, but it is a small watershed with one main road that provides recreational access to the southern end of the Seven Devils Wilderness and the upper reaches of the Rapid River Wild and Scenic trail system. The Copper and Castle Creek drainages of Rapid River have a road density of 0.37 mi rd/sq mi, with only 0.68mi within RCA.

Hydrology

Stream gradient in Rapid River is moderate for the first three miles, becoming steeper as the river passes through a narrow, steep walled canyon. The river is 21 miles from its mouth to its headwaters. The lower sections are Rosgen Stream Type (RST) B3, B4, C2, C3, and C4. In the upper sections, the main stem and tributaries are typically RST A2, A3, B2, and B3 channels.

A gauging station on Rapid River, one quarter mile upstream of the fish hatchery, indicates that mean monthly high flows occur in May and June and mean monthly low flows occur in January and February (Figure 67). The highest daily average flow was 1275 cfs in 1986, and the lowest was 24.7 cfs in 1991. Many tributaries enter Rapid River and contribute substantial volumes of water.

The river has a high sediment transport capacity due to its steep gradient. Flash floods may occur, and are typically triggered by high-intensity summer thunderstorm, such as happened in 1975. Average precipitation in the watershed is thirty inches. High flows occur during rain-on-snow events or summer storms.

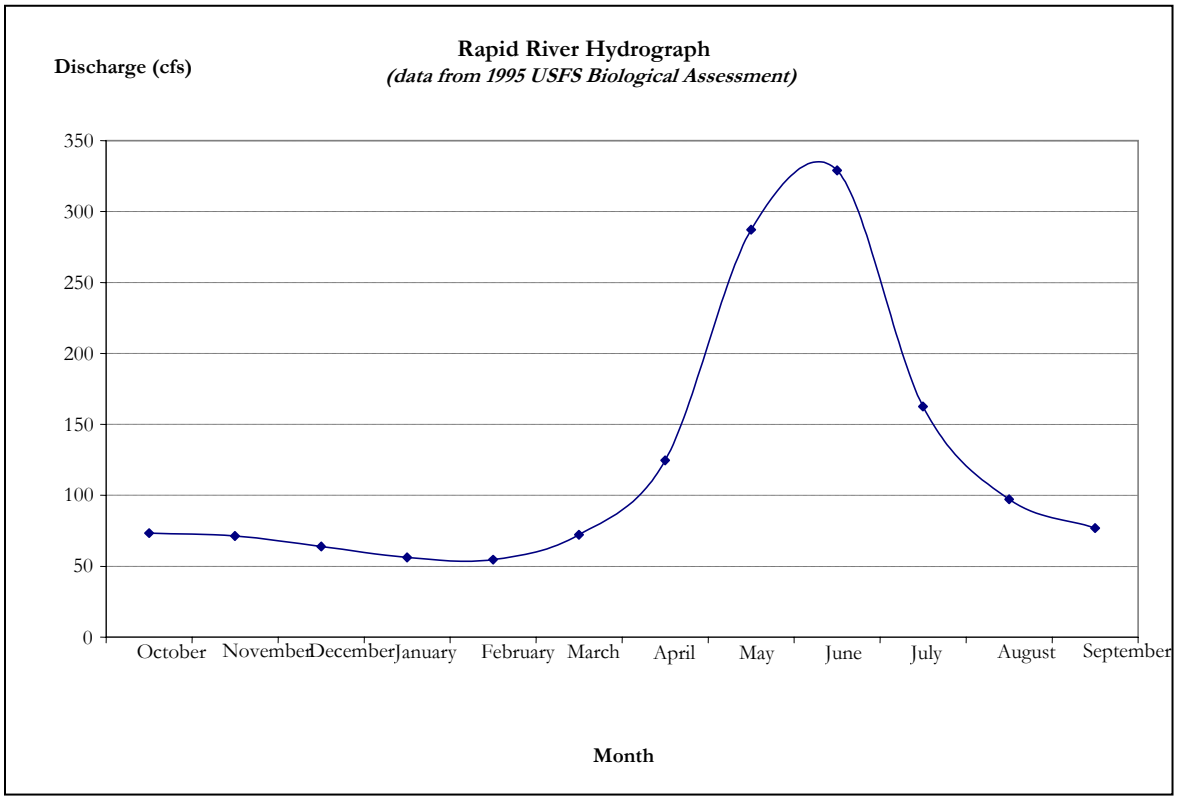


Figure 67. Rapid River Average Monthly Flow at Mouth (USFS).

Fisheries

Rapid River is used by bull trout for spawning and early rearing. Rapid River also is an important stream for spring/summer Chinook salmon and steelhead trout and provides good quality spawning and rearing habitat. Chinook salmon are found predominately in the lower third of the drainage based on snorkel observations. Brook trout are present in upper reaches of Lake Fork, a headwater tributary, and possibly in others as a result of past high mountain lake plants. Rainbow trout have also been observed in the upper reaches. Westslope cutthroat are present through out the drainage.

An Idaho Power Company fish hatchery for Chinook salmon is located on Rapid River, and is managed by Idaho Fish and Game. This hatchery was constructed in 1964 by Idaho Power

Company to serve as mitigation for sport fishing in the Hells Canyon Complex. The purpose of the hatchery is to replenish spring Chinook salmon supplies to the Hells Canyon Complex. A weir and trap about a mile downstream of the hatchery collects the migrating Chinook salmon and bull trout. The wild and natural Chinook are released upstream of the trap while the returning hatchery Chinook salmon are kept for spawning. The weir was reconstructed in late 2003 to early 2004 to minimize fish passage disruption.

The USFS Intermountain Research Station has monitored the bull trout throughout the Rapid River watershed. Adult bull trout have been observed migrating to the upper most reaches of Rapid River, West Fork Rapid River and Lake Fork, a tributary to West Fork Rapid River. These upper reaches appear to provide good spawning and rearing habitat for bull trout.

Habitat

Rapid River has a narrow stream channel with a mean width of 8 meters comprised largely of high gradient riffles, cascades and other fast water types (Figure 68).

The substrate is primarily cobble-rubble with some boulder within the lower to middle reaches. The swift RST B has some short RST A cascades within the confined canyon. As the stream approaches its headwaters, the substrate is more cobble to gravel sized with pocket pools behind boulders.



Figure 68. Rapid River (September 2003).

Rapid River originates within volcanic and plutonic parent material types. According to Overton, plutonic RST A, B, and C have reference condition mean percent fines of 26, 23%, and 37% respectively, while volcanic RST A, B, and C have reference condition mean percent fines of 25, 27%, and 17% respectively. Substrate monitoring within a RST B section of Rapid River show reference condition mean percent fines of 2.7 to 13.7% over the past 8 years. These values are below the Overton reference condition values for volcanic and plutonic RST B.

As shown in Table 27, Rapid River fully supports beneficial uses.

Table 27. Rapid River: DEQ water body assessment scores.

DEQ Stream Site ID	SHI	SMI	SFI	Assessment Score	Beneficial Use Support Status
	(maximum score= 3)				
2003SBOIA030	3	3	3	3	Full Support

Temperature

Temperatures within Rapid River fall within required parameters for functioning at full support. Rapid River is a source of cold water for the Little Salmon River. Its steep canyon walls shield the water from solar warming. Natural cold springs flow into the subwatershed. Rapid River meets state water quality criteria for temperature (Figure 69). It is assumed that the temperature criteria for bull trout are met since those criteria apply at elevations over 4,592 feet and the temperatures shown here were measured at a much lower elevation.

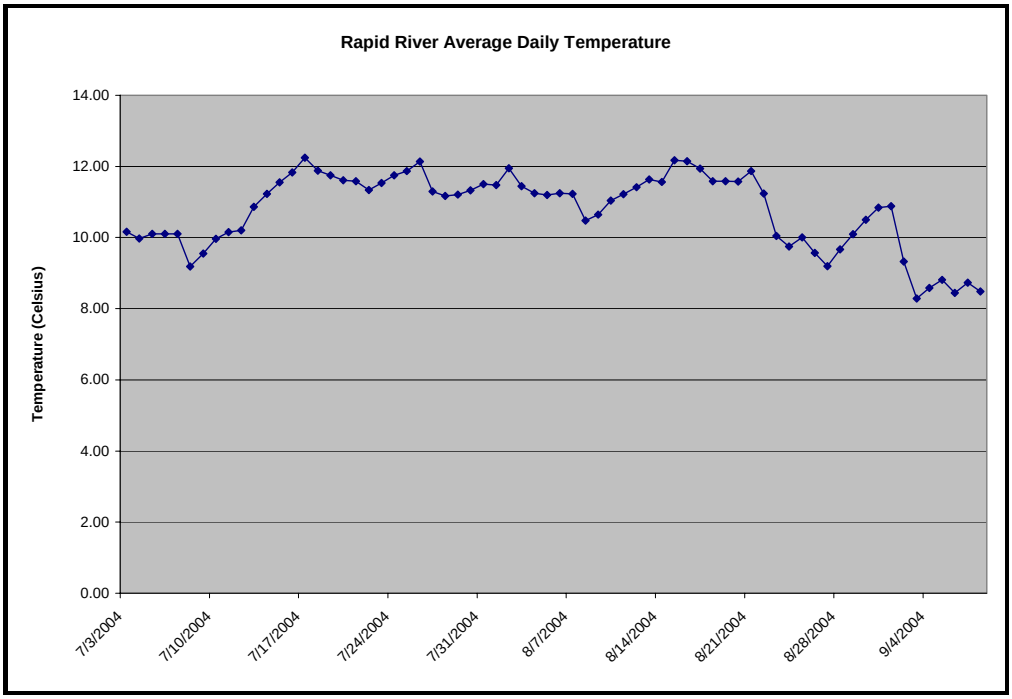


Figure 69. Rapid River Temperatures (USFS 2004).

Conclusions

Rapid River is protected by its Wild and Scenic River status, which minimizes the potential for human caused impairment of beneficial uses. The beneficial uses in the Rapid River watershed are not impaired, and a TMDL is not necessary.

Shingle Creek

Shingle Creek, a third order stream, is located about six miles southwest of Riggins. The watershed is approximately 7,750 acres, drains the north east flank of the Seven Devils Mountains and is primarily forested with a small wedge of rangeland at its mouth.

Originating from the eastern slopes of Heavens Gate at 8,429 feet and bounded on the north by McClinery Ridge, it flows in an easterly direction to its confluence with Rapid River at 2,180 feet elevation (Figure 70). Morrison Ridge divides Shingle Creek and its major tributary, South Fork Shingle Creek, which drains the north face of Cannonball Mountain (elevation 7,198 feet). A small tributary joins Shingle Creek from the north, and is identified on a 1929 water right claim as McGlimmer Creek. Shingle Creek lies in the Rapid River assessment unit with the exception of the first and second order sections of Shingle Creek, which forms its own assessment unit, 17060210SL002_02a. The reason for this delineation is that this represents the section of Shingle Creek that was listed on the 1998 303(d) list for sediment.

Geology

The geology of the lower half of Shingle Creek is dominated by mass wasted slopes derived from moderately weathered Columbia River basalt, Seven Devils volcanics, and associated limestone and slate. The erosion hazard is comparatively low for these materials, generating mostly silts, clays, gravels and cobbles. Waterfalls or alluvial fans may block fish passage. First and second order streams are prone to channel scour and debris torrents.

The upper reaches of Shingle Creek are dominated by steep glacial cirques and weakly developed glacial troughs with inclusions of convex ridges, colluvial slopes and moraines. The parent materials are poorly weathered sheared limestone and Seven Devils volcanics, generating mostly silt to cobble size material. This landform poses a moderate sediment delivery hazard. Channel morphology is defined by catastrophic events as well as bankfull flows. Debris torrent and debris avalanches can occur, most typically when intense fires are followed by intense storms. Subsurface flow can occur through limestone bedrock.

Vegetation

Throughout the watershed, slopes range from 40-80% and are dominated by ponderosa pine, Douglas fir, grand fir, western larch, lodgepole pine, subalpine fir and Engelmann spruce. Stand-replacing fires historically occurred on a 100-150 year cycle, with cooler surface fires occurring in the lower reaches at a 10-30 year interval. The riparian area changed from shrub-dominated (60%) in the lower reaches to conifer-dominated (45%) in the upper reaches. Forbs consistently made up about 10% of the riparian vegetation, with meadow plants noted in the upper reach.

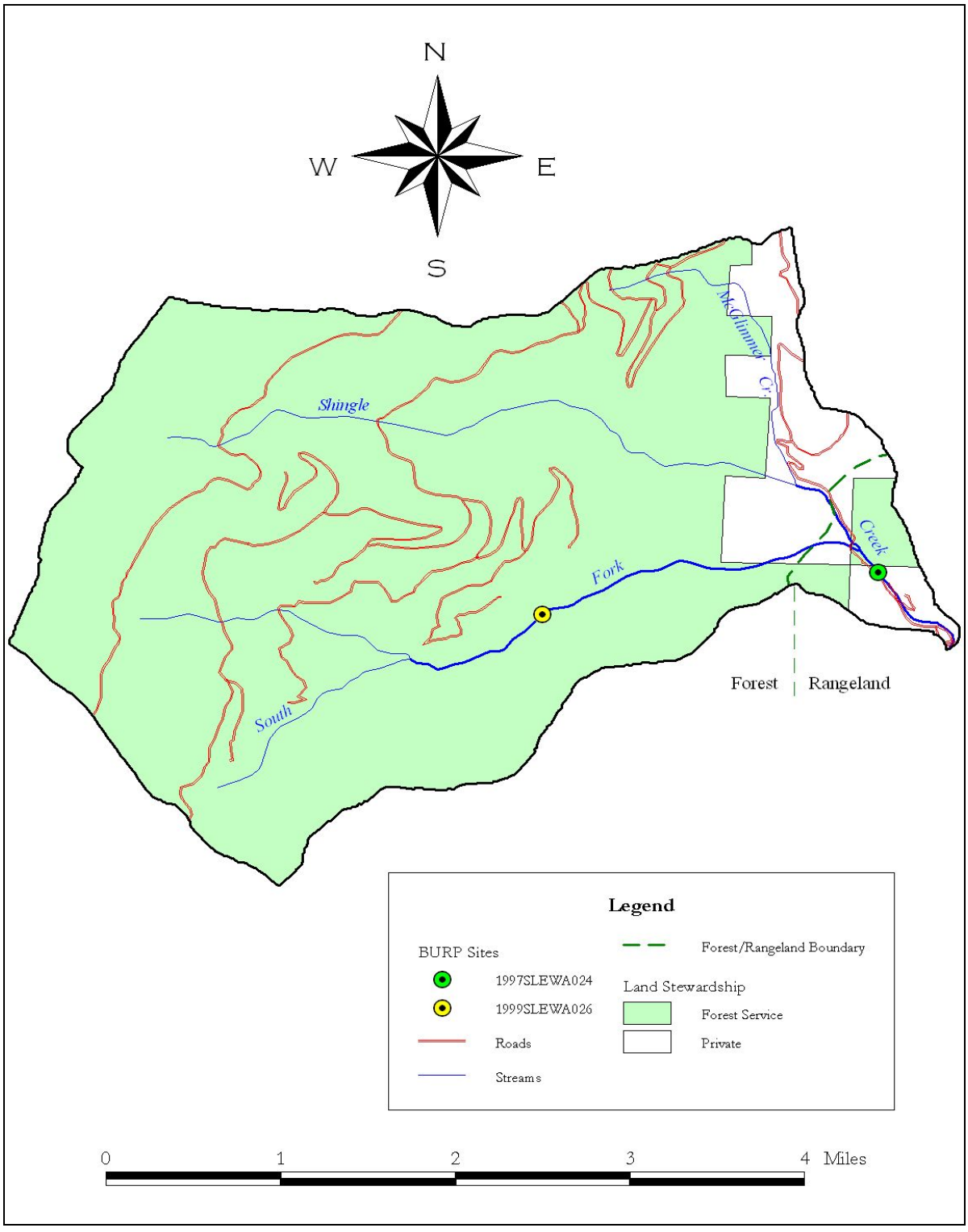


Figure 70. Shingle Creek Subwatershed.

Land Use

Most of the Shingle Creek watershed is managed by the Nez Perce National Forest (91%). Private land comprises the lower, more accessible 9%.

The Shingle Creek drainage is the only portion of the Rapid River basin that has been subject to recent timber harvest (1995 Biological Assessment). The Shingle Forks Timber Sale in the early 1990s harvested nearly nine million board-feet on 447 acres. Of that, 177 acres were clearcut and 166 acres were shelterwood cut. Roads were stabilized and maintained afterwards, and 278 acres were replanted. In some areas, some riparian areas were cut, but the 1997 stream surveys reported a ¼ mile riparian buffer left on main stem Shingle Creek.

Nearly the entire watershed is contained within the boundaries of two grazing allotments. The Cannonball Allotment (250 cow/calf pairs) encompasses the entire South Fork Shingle Creek drainage and the southern slopes of Shingle Creek. The Papoose Allotment (183 cow/calf pairs) includes the northern slopes of Shingle Creek. The 1995 Biological Assessment reported extensive grazing on the private lands in the lower watershed, with severe riparian impacts.

The Shingle Forks timber sale involved construction and reconstruction of several miles of roads. A few smaller roads appear to have been obliterated after the sale. ATV trails access the diversions at the bottom of the reach. The well used Seven Devils Road crosses Shingle Creek at the top of the watershed. Analysis of aerial photography did not find evidence of road failures.

A total of 28.61 miles of roads were identified in the watershed, and a road density of 2.31 miles/mile^2 calculated. Of these roads, 3.93 miles (14%) are within RCAs.

There are no known mines in the watershed. Recreational activities include hiking, horseback riding, hunting, gathering and mountain biking. The 1995 Biological Assessment noted that a youth mission camp development along Shingle Creek had caused severe impact to the riparian area.

Hydrology

Shingle Creek is a Rosgen Stream Type (RST) A3a+ channel. The stream drops nearly five thousand feet in less than six miles, entailing a very steep gradient, averaging 17%. The creek is composed of 30% pool, 60% riffle and 10% run.

Peak flows occur in June and fall to a minimum in January (Figure 71). Annual precipitation is approximately forty inches per year, falling mostly as snowfall.

There are fifteen water rights claims in Shingle Creek. Most of these are for less than 1cfs. A small, privately-owned hydroelectric power facility is located at the mouth of South Fork Shingle Creek, and has water rights to 9.94 cfs. The largest irrigation claim is for 2.64 cfs, and takes water from both Papoose and Shingle Creeks. There are no impoundments in the upper watershed.

The stream is often dewatered in the lower segment, and the upper reaches are perennial with marshy areas at the top. The middle section is intermittent, with the water sinking and reemerging from underground limestone caves. Springs on the northern side of the drainage are hydrologically linked to the adjacent Papoose Creek watershed through a system of caverns and faults.

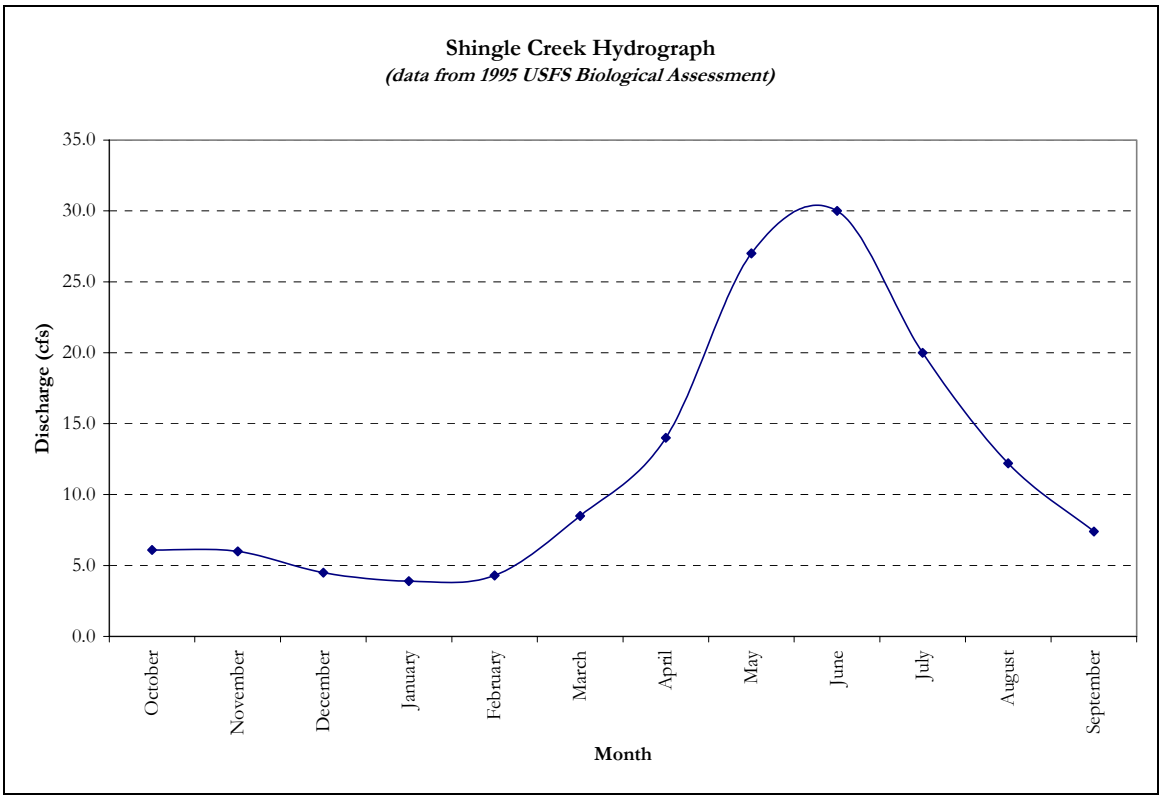


Figure 71. Shingle Creek Average Monthly Flow at Mouth (USFS).

Fisheries

The Idaho Department of Fish and Game has not stocked Shingle Creek or its tributaries since at least 1967. Electrofishing information collected by BURP survey crews revealed a rainbow trout and cutthroat trout fishery. The BURP data showed greater than three age classes of fish, including young of the year, which is indicative of a healthy fishery. Designated critical habitat for spring/summer Chinook salmon extends upstream about 1.3 miles from the mouth on the main stem and about 200 feet upstream on the South Fork. Most of this critical habitat is located on private lands. Shingle Creek supports steelhead spawning and rearing in the lower miles.

Between the years 1985-1993, four fish surveys were conducted due to the proposed installation of a hydro power project. Bull trout, rainbow trout, cutthroat trout and sculpin were reported at that time; however successive surveys have not shown the presence of bull trout. It is possible the stream is used for bull trout juvenile rearing.

The presence of Chinook salmon and steelhead was documented by the Rapid River Fish Hatchery manager in 1992. Chinook rearing habitat is marginal, most likely due to stream gradient. A 1997 stream survey noted a low to medium abundance of adequate spawning characteristics for anadromous fish. Several fish migration barriers were identified: two culverts with no jumping-off pools, waterfalls and cascades, and a dry (in September) segment where the water flowed underground through a cave system.

Biological and Habitat Data

Data collected in the Shingle Creek watershed includes two BURP sites, 1997SLEWA024 and 1999SLEWA026 (Figure 70). The former is located about half a mile upstream of the mouth of Shingle Creek and represents the third order section of the watershed. The latter, a second order site, is located about two miles upstream of the mouth of South Fork Shingle Creek and represents the entire South Fork watershed. Both indicated full support of beneficial uses (Table 28). There are no BURP sites in the first and second order sections of main stem Shingle Creek.

Table 28. Shingle Creek: DEQ water body assessment scores.

BURP Site ID	SHI	SMI	SFI	Assessment Score	Beneficial Use Support Status
	(maximum score= 3)				
1997SLEWA024	3	2	3	2.67	Full Support
1999SLEWA026	3	3	3	3	Full Support

The Nez Perce National Forest conducted stream surveys of the main stem of Shingle Creek in 1997. The banks were 90% stable, with 25-50% undercut. The creek was moderately embedded with cobble particles 27-50% surrounded by fine sediment. RST A3 channels are typically dominated by cobbles but also contain some small boulders, gravel and sand. They are a high energy stream with a high sediment supply, and have a correspondingly high rate of bedload sediment transport. RST A3 bedrock channels occur as a step/pool cascades that often store large amounts of sediment in the pools associated with debris dams (Rosgen 1996).

Shingle Creek originates within volcanic parent material. According to Overton (1995), volcanic RST A and B have mean percent surface fines of 25 and 27% respectively. A Nez Perce Forest Service survey in 1997 showed the substrate varied between 5% and 31% fines and averaged to 14% fines, which is within the range of reference conditions.

Medium-high levels of large woody debris were identified throughout the survey reaches. In-stream cover was moderately high, and primarily consisted of organic debris and aquatic vegetation (USFS 1999).

2005 Wolman pebble counts in the mainstem of Shingle Creek in the Nez Perce Forest showed percent fines of <20%. Bank stability was rated at 100%. 2005 Wolman pebble

counts near the mouth of Shingle Creek averaged 26%, bank stability was rated at 82% and the width:depth ratios averaged 34 which are all within the range of the mean of reference scores for RST B volcanic stream types. 27% is the mean for surface fines, 82% the mean for bank stability and 27 the mean for width:depth ratios for RST B volcanic streams.

Conclusion

The beneficial uses in Shingle Creek are not impaired. The high gradient of the upper Shingle Creek drainage limits habitat for fish. Within the lower section of the drainage where potential salmonid habitat exists, the combination of natural sinking of the water flow, culverts and irrigation diversions dewaters the lower sections late in the summer season. 2005 DEQ sediment information as well as DEQ water body assessment scores from South Fork Shingle Creek and upper Shingle Creek can be extrapolated to all the assessment units within the watershed, and these scores show that beneficial uses are not impaired. A TMDL is not necessary.

Squaw Creek

Squaw Creek originates at 7,200 feet and enters the Little Salmon River about river mile 1.1. It has a watershed of 11,829 acres.

Located in the far northwest of the Little Salmon River watershed, Squaw Creek is a third order stream that drains the northern tip of the Seven Devils Mountains (Figure 72). It flows eastward from its headwaters on Bald Mountain, Blue Mountain (elevation 6,302 feet) and a glacial cirque called The Narrows (elevation 7,356 feet) to its mouth about a mile southwest of the town of Riggins. Five miles upstream from its mouth, Squaw Creek splits into its North and South Forks, both second order, high-gradient streams. Squaw Creek lies in assessment unit 17060210SL001_03.

The major tributary to Squaw Creek is Papoose Creek, a second order stream that enters Squaw Creek from the south about 1.8 miles upstream from its mouth and originates from Papoose Lake, elevation 7,520 feet. Papoose Creek has a watershed of 4,196 acres. Papoose Creek is divided from the adjacent Shingle Creek watershed to the south by McClinery Ridge, and the two systems are hydrologically linked by springs and caverns.

The watershed has several caves. Many small tributaries, often flowing out of the ground, feed the headwaters. The high point of the watershed is an unnamed peak above Papoose Lake, at 8,210 feet. The lowest point is the mouth of Squaw Creek at 1,800 feet.

Squaw Creek is listed on the 1998 303(d) list for an unknown pollutant. The third order segment was delisted based on an assessment of a 1997 BURP site.

Comparison of aerial photographs taken in 1994 and 2003 show increased development within the lower reaches of Papoose Creek down to the mouth of Squaw Creek. Two new roads have been built to provide access for the new structures. No change is apparent within the upper sections of Papoose Creek, North Fork Squaw Creek, South Fork Squaw Creek or Rough Creek.

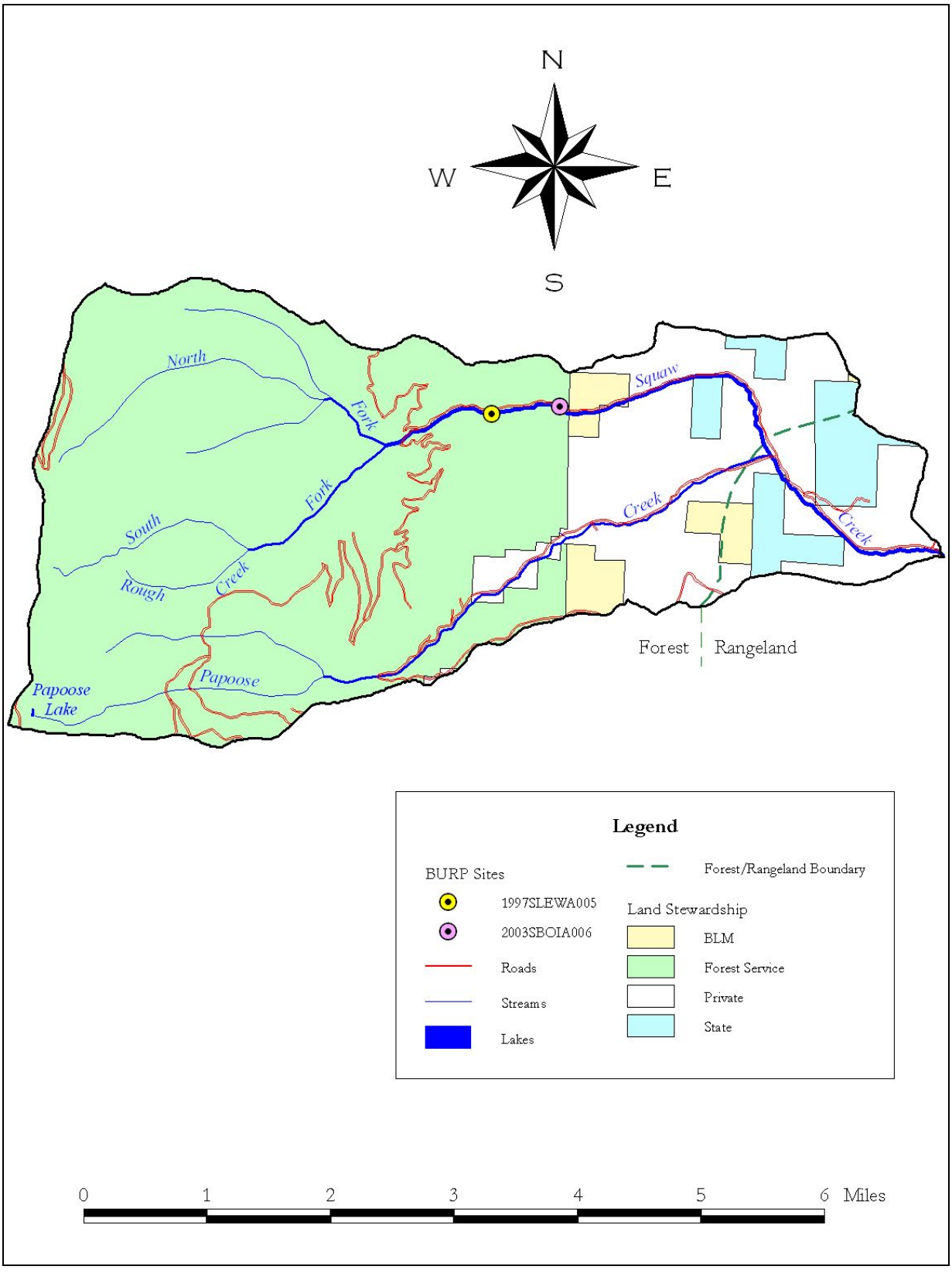


Figure 72. Squaw Creek Subwatershed.

Geology

The geology of Squaw Creek has been divided into three distinct areas (USFS 1995):

Headwaters:(25%)
The headwaters of Squaw Creek are dominated by steep glacial cirques and weakly developed glacial troughs with inclusions of convex ridges, colluvial slopes, and moraines. The parent materials are poorly weathered sheared limestone and Seven Devils volcanics, generating mostly silt to cobble size material. This landform poses a moderate sediment delivery hazard. Channel morphology is defined by catastrophic events as well as bankfull flows. Debris torrent and debris avalanches can occur, most typically when intense fires are followed by intense storms. Subsurface flow can occur through limestone bedrock.

Middle reaches:(72%)
The geology of the middle reaches of Squaw Creek is dominated by mass wasted slopes derived from moderately weathered Columbia River basalt, Seven Devils volcanics, and associated limestone and slate. The erosion hazard is comparatively low for these materials, generating mostly silts, clays, gravels, and cobbles. Waterfalls or alluvial fans may block fish passage. First and second order streams are prone to channel scour and debris torrents.

Lowest reaches (3%):
The lowest reaches of Squaw Creek are characterized by stream breaklands and mountain slopes derived from moderately well-weathered schist. The erosion hazard is high for this material, generating mostly fine sand to cobble materials. Sediment delivery efficiency is high and channel stability may depend on large organic debris and boulders. Waterfalls or alluvial fans may block fish passage.

Vegetation

Aside from the first hundred yards or so, all streams in the watershed are enclosed in fairly narrow, steep walled canyons. Only ten percent of the watershed had been burned in recent history by wildfire.

A 1995 USFS Biological Assessment (USFS 1995) identified the riparian areas in the upper reaches as about 55% conifers, 25% shrubs, and 20% forbs. Lower reaches featured 40% conifers, 5% meadows, 35% shrubs, and 20% forbs. Riparian zones help provide high degree of resistance to soil movement and quick regrowth.

Lower elevation riparian species include white alder, cottonwood, Rocky mountain maple, black hawthorn, willow, Douglas fir, dogwood, syringa, and birch. Mid to upper elevation riparian species include sub alpine fir, Engelmann spruce, Douglas fir, grand fir, alder, prickly currant, dogwood, syringa, willow, sweet-scented bedstraw, bead lily, starry solomon-plume, twisted stalk, lady fern, monkshood, meadow rue, and miner’s lettuce depending on elevation, aspect, and canopy cover.

Upland Vegetation types outside of the riparian area are diverse and represent a range of seral stages which are primarily influenced by past timber harvest, fires, and domestic animal

grazing. Lower elevations are dominated by canyon grasslands and a mixed conifer over story which includes Douglas-fir, grand-fir, larch, and ponderosa pine. Upper elevations are dominated by grand-fir, Douglas-fir, larch, Engelmann spruce, lodgepole pine, and sub alpine fir. The timber is interspersed with patches of perennial grassland, brush, and riparian vegetation.

Hydrology

Average annual mean flow is 9 cfs, with a mean monthly high of 31 cfs in June and a mean monthly low of 3.4 cfs in January. The flows in Papoose Creek, a major tributary to Squaw Creek, are approximately eighty percent of those in Squaw Creek, and follow a similar hydrograph. The stream drops nearly six and a half thousand feet in about eight miles, entailing a steep gradient, averaging fourteen percent.

Annual precipitation is approximately thirty inches per year, falling mostly as snowfall. Runoff is dominated by spring snowmelt. Rain-on-snow events and summer thunderstorms may cause flash flooding in the watershed.

There are twenty seven water rights claims on Squaw Creek. Most of these are for less than 1 cfs. Two are for hydroelectric power projects, neither of which has been implemented. The City of Riggins has a water right to 12 cfs for irrigation supply to approximately 130 users. The water is conveyed to the city by a ditch built by the Works Progress Administration in 1938. A claim for 2.12 cfs is used to irrigate several small fields along Squaw Creek.

Land Use

All the Forest Service land in the watershed is contained within the Papoose grazing allotment, with a permitted maximum 787AUM (1 cow/calf pair = 1.32AUM). Year-round grazing occurred, until a rotational system was instituted in the 1970s. Within BLM lands, two grazing allotments within the Squaw Creek and Papoose Creek drainages exist. A total of 50 AUMs are permitted between these allotments.

According to the 1995 Biological Assessment (USFS 1995), grazing activity and development have occured on private lands in the lower reaches. Domestic animals have had access to the creek and timber harvest has included riparian areas.

Timber harvest occurred on 643 acres from 1971 through 1990, and was mostly the *seed tree* method, where up to 10% mature trees are retained. Mining was fairly minimal in the area, with small placer gold and lode copper operations running until the early 1900s. There is no active mining in the watershed.

All streams in the watershed have roads or trails paralleling their lengths. Squaw Creek Road follows mainstem Squaw Creek 100-200 meters away from the stream. Abandoned spur roads cross Squaw Creek, and only remnants of bridges remain. Most roads are used mainly for livestock, except for the well used Seven Devils Road, which follows Papoose Creek. Both the North and South Forks have old roads or trails paralleling the creeks. They are little used and overgrown. A trail crosses the South Fork six times within a mile.

In total, there are 28.01 miles of road in the drainage, which entails a road density of 1.51 miles/mile^2; 38% of the roads are within RCAs. The 1995 USFS biological assessment states that FS517 and FS487 (Squaw Creek Road and Seven Devils Road) cause severe riparian impacts.

Many of the roads have year-round or seasonal closures and are mostly stable. However, the 1997 BURP field crew noted that the Squaw Creek Road was closed four times in 1997 because of slides, at least one of which impacted the creek.

Recreation uses consist of camping, sightseeing, wildlife viewing, hiking, hunting, fishing, and gathering. The only developed campsite in the drainage is located on Papoose Creek, just inside the National Forest boundary. There are two recognized dispersed camping spots, and the limited number of accessible flat areas restricts use elsewhere in the watershed. The biological assessment noted that grazing activity and development has been extensive on private lands in the lower reaches, severely impacting riparian vegetation, and the channel has lost much shading. Livestock had free access to the creek, riparian irrigation was common, and timber harvest included riparian areas.

Fisheries

Electrofishing information collected by the 1997 stream survey crew indicated a rainbow trout/steelhead and westslope cutthroat trout fishery on the mainstem of Squaw Creek. The tributaries had cutthroat trout fisheries. No fish were found in the upper reaches of South Fork Squaw Creek. In the same surveys, the entire watershed was identified as possessing medium salmon spawning characteristics, with the exception of the upper reaches of South Fork, which had low spawning characteristics.

The majority of suitable habitat for steelhead trout occurs on private lands. Designated habitat for spring Chinook salmon extends upstream from the mouth for 120 yards. At approximately stream mile 0.1 (50 feet upstream from Highway 95) is a concrete and board diversion dam, which creates an eight to ten foot falls and cascade. The dam uses boards for the flood gate, which diverts water thru a weir into a ditch. This is a full fish passage barrier with dam boards in place at all flows, but may be a partial barrier during high flow periods when the boards are removed. Several diversion dams in the lower reach divert water into irrigation ditches. Some of these diversions may not be properly screened to prevent fish from moving into the ditches and possibly being stranded in fields (BLM 2000). However, this fish passage barrier is slated to be removed within the next five years. Another full passage barrier at most flows exists at the culvert below the Squaw Creek Road (USFS Rd. #517) which essentially limits access to spawning and early rearing habitat to the bottom 4-5 miles of Squaw Creek.

Private fish surveys, conducted for the hydropower applications, documented a rainbow trout/steelhead fishery in Squaw Creek. A 1989 Forest Service survey showed a healthy population of cutthroat trout at the forest boundary. No Chinook salmon or bull trout use has been documented in Squaw Creek. Westslope cutthroat trout use the stream for spawning and rearing. Steelhead trout may use Papoose Creek when flow conditions are suitable.

Limiting factors for fish production in Squaw Creek include deposited sediment, lack of good quality pools, man-caused barriers, and water diversions. Of these, man-caused barriers and water diversions are of the greatest concern.

Idaho Fish and Game has never stocked Papoose Creek, Rough Creek or North or South Forks of Squaw Creek. Squaw Creek itself has been stocked on two occasions. The first, in 1980, released two hundred catchable-size rainbow trout of an unspecified strain. In the second stocking, in 1989, twenty five thousand 'A-run' steelhead fry were released.

Biological and Habitat Data

Data collected in the Squaw Creek watershed include two BURP sites: 1997SLEWA005 and 2003SBOIA006. These are located three quarters of a mile upstream of and at the National Forest boundary respectively. Both represent the forested third order section of Squaw Creek, and both indicated full support of beneficial uses (Table 29). There are no BURP sites on Papoose, North Fork, South Fork, Rough Creeks, or on the lowermost reaches of Squaw Creek.

Table 29. Squaw Creek: DEQ water body assessment scores.

BURP Site ID	SHI	SMI	SFI	Assessment Score	Beneficial Use Support Status
	(maximum score 3)				
2003SBOIA006	3	3	3	3	Full Support
1997SLEWA005	3	2	1	2	Full Support

Mainstem Squaw Creek was identified as a Rosgen Stream Type (RST) A4. These channels are typically dominated by gravel, with small amounts of boulders, cobble, and sand. The RST A4 has both high energy and a high sediment supply, and a correspondingly high rate of bedload sediment transport. These channels are generally unstable, with very steep banks that contribute large quantities of sediment. Although, these channels are typically unstable, since Squaw Creeks supports beneficial uses, the creek appears to not have excess sediment in the system.

South Fork Squaw Creek was identified as a mix of RST A3a+ and A4a+, with a gradient increasing from thirteen to twenty-nine percent. RST A4a+ have similar characteristics to RST A4 types (see above), but with a gradient in excess of ten percent. They are often associated with debris avalanches and debris torrents. The gradient flattens off at the headwaters, where the creek has a run/glide habitat type. Again, although RST A streams are associated with large amounts of sediment, the current conditions in the creek show that sediment is not impairing beneficial uses.

North Fork Squaw Creek was identified as a RST A3a+, which is typically dominated by cobbles but also contains some small boulders, gravel, and sand. Gradient increased from twelve to twenty-three percent. RST A3a+ streams have both high energy and a high sediment supply, and a correspondingly high rate of bedload sediment transport. This channel type can occur as a step/pool cascade that often stores large amounts of sediment in the pools associated with debris dams (Rosgen 1996).

The Nez Perce National Forest conducted stream surveys of Squaw Creek, North Fork Squaw Creek, and South Fork Squaw Creek in 1997. Wolman pebble counts showed a high degree of variability, with fine particles ranging from nine to thirty-three percent. Relative amounts of silt generally tended to decrease further up the watershed (for example, North Fork had twenty-six percent fines at the mouth and nine percent at the top). This particle size distribution is likely due to the lower reaches having lower gradients, resulting in deposition of transported fine particles. South Fork Squaw Creek had the highest percentage of fine particles, averaging twenty-five percent. For these surveys, "fine particles" were considered those with intermediate axis less than 2mm. However, these results are within the range of reference conditions determined by Overton (1995) for pristine streams originating in volcanic parent material.

Overall, bank stability measurements were high throughout the watershed. Banks were generally more stable in the upper reaches (ninety-five percent) than in mainstem Squaw creek (eighty-five percent stable), where sloughing was noted. Undercut banks were more prevalent in the North and South Forks.

Throughout the watershed, riffle/pool dominated channels prevail, with cobble and gravel substrates.

Temperature

All instantaneous temperature data collected by various survey crews, including data from 2003, showed summer water temperatures from 8-10˚C.

Conclusions

Squaw Creek does not show impairment of beneficial uses and parameters related to sediment are all within in good quality ranges. A TMDL is not necessary for Squaw Creek.

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3. Subbasin Assessment–Pollutant Source Inventory

This chapter describes the point and nonpoint pollutant sources within the Little Salmon River watershed. The nonpoint source descriptions are not intended to be specific. Rather, it is a description of the general processes whereby pollutants are delivered to the water bodies of concern.

3.1 Sources of Pollutants of Concern

Point Sources

Table 30. City of New Meadows Wastewater Treatment Plant and Rapid River Fish Hatchery

NPDES ID	Treatment Type	Service area population	Design Flow	Permit Limits E. Coli	Permit Limits Total Suspended Solids (TSS)
ID-002315-9 New Meadows WWTP	Lagoons followed by chlorination	576	0.36 mg/d (0.1mgd average daily flow)	126CFU/100mL 30 day average 406 CFU/100mL instantaneous limit	45 mg/L 30 day average 65 mg/L 7 day average
ID-002237 Rapid River Fish Hatchery	Settling pond	NA	NA	NA	During non-harvest: 5 mg/L 30 day average During harvest: 67 mg/L 30 day average

The New Meadows Wastewater Treatment Plant only discharges occasionally and almost never during the summer months when river flows are low. As the municipality grows the New Meadows Wastewater Treatment plant will go through a series of upgrades to accommodate additional capacity and provide additional treatment of wastewater.

There are no superfund or RCRA sites in the watershed. There is little to no recreational dredge activity in the watershed.

Nonpoint Sources

This description is not intended to be specific. Rather, it is a description of the general processes whereby pollutants are delivered to the water bodies of concern. A detailed description of locations and potential sites for improvement will be located in the final implementation plan.

Phosphorus

Phosphorus is found naturally throughout the environment. It can be present as a constituent of certain rock types (silicous igneous rock) and in the mineral apatite. The environment itself can also be a factor in the phosphorus levels occurring within a region due to the climate, pH of natural waters, and the presence of other substances that may adsorb or release phosphorus. However, there are also anthropogenic nutrient sources that greatly increase phosphorus levels over those found naturally. Applied fertilizers in farming or landscaping, the duration and density of livestock grazing, the creation of artificial waterways and water levels through agricultural practices, and the presence of sewage and septic waste (treated and untreated) in the surface, subsurface, and ground water of a region can significantly elevate the phosphorus concentrations in an area.

Sediment

Sediment may originate from natural causes such as bank erosion, landslides, forest or brush fires, high flow events; or anthropogenic sources such as urban/suburban storm water runoff or erosion from roadways, agricultural lands, and construction sites. Sediment loads within the system are highest in the spring when high flow volumes and velocities result from snowmelt in the higher elevations.

Surface erosion in forested terrain is predominantly a function of slope steepness, soil texture/structure and the amount of root material in the top few inches of soil. Soil characteristics are generally related to the parent material (i.e. granitics).

Mass failures can be predicted by slope steepness and geologic material as well as factors such as whether the area has burned recently or been disturbed by land management activities such as timber harvest. In general, a few mass failures occur every year, but the major contributors of sediment are the major episodes of mass failure that occur during large rain-on-snow events or during other high precipitation events when the soil mantle becomes supersaturated.

The contribution of mass wasting to sediment loading in the Little Salmon River drainage has not been quantified but is potentially high in the canyon section of the river.

Roads, depending upon their condition and location, can deliver large sediment loads to streams. The coarse grained granite and gneiss of the basin physically break down between the mineral grains in the rock, producing sand sized particles rather than silt or clay. In areas where basalt is the parent material, it breaks down into silt and clay sized particles.

Road erosion is directly influenced by road use including season of use, type of use (the heavier a vehicle, the greater the breakdown of the road tread into particles), road drainage patterns and road surfacing. Controlling these variables will affect the amount of sediment delivered to streams.

Temperature

Increases and decreases in water temperature are due to changes in the amount of heat reaching the water. Several factors contribute to the amount of heat reaching the water in the Little Salmon River watershed. The anthropogenic factors include agricultural return water, agricultural withdrawals, dams, and loss of riparian vegetation (shading). Natural factors include seasonal air temperature changes, ice floes, natural dams, and naturally warm springs that feed water to the stream. In addition, at times riparian vegetation has been lost both to manmade (i.e. poor grazing practices, off-road vehicle use) and natural causes (i.e. rain on snow events). Only those anthropogenic sources that are directly controllable are addressed in this TMDL.

Bacteria

Bacteria enter water bodies in a number of ways. In rural and agricultural areas the most common sources are usually domestic animals and wildlife, although failing septic systems can also be a significant source if they are situated adjacent to a water body. Studies have shown that per pound, human waste has higher concentrations of phosphorus than domestic animal waste. Wastewater treatment plants are also sources of bacteria, but bacteria levels are regulated by NPDES permits.

Pollutant Transport

Nutrients

Consideration of flow is important in the evaluation of nutrient, phytoplankton, periphyton, and rooted macrophyte concentrations. In a riverine system, flow transports phytoplankton and nutrients from upstream to downstream in an advective or dispersive transport mode. In other words, riverine systems are dynamic systems in which nutrients are being continually cycled as the water moves downstream. The flow regimen is important in determining the result of this combination of component concentrations. High flows can flush dissolved nutrients downstream, replacing them with the lower concentrations in the high flows. Since nutrient concentrations are inversely related to flow, nutrient retentiveness is much lower in high flow years than in low flow years. High flows can also scour periphyton and rooted macrophytes, reducing their mass considerably. Finally, high flows can scour sediments causing movement of the sediment downstream and increasing nutrient concentrations at the same time by releasing nutrients tied up in the sediments prior to scouring (IDEQ 2004).

Sediment

While no quantitative information is available, it is recognized that a substantial amount of sediment can be generated and transported relatively long distances by extreme precipitation events such as the January 1997 rain on snow event. It has been estimated these events can account for the movement of a greater volume of sediment in a single event than would be expected to occur in an entire water year under average conditions (BCC 1996). Sediment transport, and the transport and delivery of sediment-bound pollutants, are directly associated with increased flow volumes and high velocities. During peak flows, streams with unstable banks may have high sediment loads due to bank erosion.

Bacteria

Bacteria are primarily transported from their point of origin during precipitation and irrigation activities. Bacteria can enter surface water via movement from manured fields, problem feedlots and overgrazed pastures. Insufficient sewage management systems (septic tanks) may also transport bacteria, especially in areas where the water table is shallow and readily mixes with surface water. Bacteria may also be transported in storm water in areas where storm water is discharged directly to the water body.

3.2 Data Gaps

DEQ uses the most current data available for each watershed and tries to collect additional data if possible. However, DEQ acknowledges that there are additional data that would be helpful to increase the accuracy of the analysis. The datagaps that have been identified are outlined below:

- Little Salmon River
    - Hydrology- information on the interaction between ground water and surface water, daily flow information for Meadows Valley
    - Temperature- ground truthed estimates of existing shade from tributaries above Four Mile Creek and mainstem river in upper watershed
    - Sediment- coarse sediment transport information in lower reach
    - Periphyton- additional benthic chlorophyll-a information
- Three Mile, Four Mile, Goose Creek, Mud Creek, Six Mile, Martin Creek
    - Hydrology-weekly or daily flow information\to determine flows at mouth of creeks
    - Temperature- ground truthed existing shade information
    - Additional habitat information for lowermost reaches near mouth

Where viable, steps should be taken to fill the data gaps. Planned efforts to do so will be further outlined in the TMDL implementation plan. The information developed through these efforts may be used to revise the appropriate portions of the TMDL and determined and/or adjust implementation methods and control measures. Changes to the TMDL will not result in the production of a new TMDL document. Minor changes will be in the form of addenda to the existing document(s). Major changes will be in the form of supplements to the TMDL. DEQ will revisit the TMDL implementation goals every five years in order to assess progress toward implementation.

4. Subbasin Assessment – Summary of Past and Present Pollution Control Efforts

4.1 Point Sources

One discrete point source exists within the basin, the New Meadows Wastewater Treatment Plant (NPDES permit #ID002315-9), that discharges directly into the Little Salmon River. As part of the discharge monitoring report portion of their NPDES permits, the WWTP is required to monitor their effluent to determine compliance with their permit effluent limits. For the New Meadows WWTP, effluent limits are set for TSS (45 mg/L 30 day average and 65 mg/L 7 day average) and bacteria (126 CFU/100 mL 30 day average and 406 CFU/100 mL instantaneous) to levels at which it has been certified that violations in the state water quality standards will not occur as a result of the effluent. If permit violations occur, the facility is required to notify the U.S. Environmental Protection Agency (EPA) and DEQ to find a solution. The monthly discharge monitoring reports are sent to EPA and DEQ and are kept on file at the facility.

The Rapid River fish hatchery has an NPDES permit but does not discharge directly into the Little Salmon River. It discharges into Rapid River which is not on the 303(d) list.

4.2 Nonpoint Sources

Numerous private landowners have implemented conservation projects that have resulted in water quality improvement. These projects include fencing, riparian improvements, grazing management plans and streambank stabilization. Private landowners, corporations and state agencies have also cooperated to implement projects that have resulted in water quality improvements. Projects specific to the LSR watershed are summarized in Table 31. This list is not exhaustive, and there are likely many projects occurring on private land without state/federal funding that have not been included.

Table 31. Pollution control projects.

Project Location	Implementing Principal Agency	Description
Squaw Creek	BLM	No new roads will be established on BLM lands. Monitoring, the collecting of water quality information and spawning surveys continue.
Rapid River (Aaron Wilson Ranch)	Gov. of Idaho, Aaron Wilson	Riparian fencing and offsite livestock water development for bull trout conservation.
Denny Creek, Hat Creek, LSR face drainages	BLM Cottonwood Field Office (CFO)	Rehabilitated actively eroding slopes, replaced undersize culverts, improved drainage and reduced road related erosion and sediment from 4 miles of road.
Denny Creek	USFS (PNF)	Protects the Denny Creek Road right of way (IDI 30857) consisting of 9.16 acres from use that causes rutting, excessive snow plowing, and commercial use
Fall Creek	BLM	Sheep bedding grounds on BLM lands cannot be used more than one day during the authorized season-of-use. Bedding must be located more than ¼ mile from Fall, Boulder, Hazard or Hard Creeks. Sheep will not be trailed to and from water.
Boulder Creek Watershed	USFS (PNF)	13.2 miles of road obliteration, 6.7 miles of road closure
Trail Creek Culvert Replacement Project	BLM	Replaced a 3'6" round culvert that was a fish passage barrier, with a partially buried 9'4" wide squash culvert.
Trail Creek Watershed	BLM (CFO), USFS (PNF), Western Pacific Timber (WPT)	Implemented a cooperative watershed plan with BLM, USFS and WPT for lands in the Trail Creek drainage. Reduced active erosion from existing roads and implemented road closure.
Hazard Creek, Hard Creek	USFS (PNF)	2.3 miles of road closure, 4.8 miles of road obliteration.
Hard Creek, Hazard Creek, LSR	USFS (PNF) (Allotment No. 36242)	Alternate grazing patterns and trailing to be used on the Forest Service allotment in the lower drainage. Areas within the allotment leased for grazing includes 3.0 miles of the LSR,, 1.6 miles of Hazard Creek and 1.6 miles of Hard Creek.
Hard Creek	BLM (CFO), USFS (PNF)	Rehabilitated and converted to a trail 5 miles of road located on landslide prone sites. Damage due to '97 flood.
Lower Hard Creek, Hazard Creek	BLM (CFO)	Rehabilitated road failures that occurred in the 1997 rain on snow event. Improved drainage and reduced sediment from 4 miles of road located in the lower portions of the drainage. Converted surface to ATV tread. Reduced potential for catastrophic road failure. Road washout upstream from Hazard Creek has been repaired.
Round Valley Creek, LSR in Meadows Valley	NRCS, USFWS, private land owners, NOAA, IDFG, SW Reserve Volunteers	Planting native species
Round Valley Creek (Circle C Ranch)	IDFG	Riparian planting.
Meadows Valley (Brown's	NRCS, USFWS,	NRCS has acquired a 30 year conservation easement for the area. Primary restoration actions include fencing to exclude

Project Location	Implementing Principal Agency	Description
Industries, Inc.)	IDFG, BLM	cattle from 274 acres, plug lateral diversion ditches, divert water from channelized side channel into main channel, plant shrubs and trees, and construct offsite watering.
Meadows Valley (Breeswood Ranch)	ISCC, IDFG	Riparian fencing and planting
Meadows Valley (Osborn Ranch)	USFWS, IDFG	Wildlife extension agreement, riparian exclosure and vegetative planting.
Goose Creek	NRCS	Conservation Reserve Project (CRP) fencing a 50' riparian buffer area along ½ mile of stream. 22 acre riparian pasture for inclusion project on ½ mile of riparian corridor
Mud Creek, Little Mud Creek, Western Pacific Timber Property	Western Pacific Timber IDFG, Trout Unlimited	Riparian fencing, planting, livestock rotational grazing. Photo Stream temperature monitoring.

The BLM is continuing with the following efforts in the Little Salmon River drainage:

1) Temperature monitoring stations on the LSR at river miles 0.53, 10.31, and 24.7.
2) Implementation of the Roads and Trails Maintenance Management Monitoring Plan (USDA-BLM 1996B).
3) Implementation of road improvements to reduce all adverse erosion and sedimentation.
4) Establishment of additional permanent riparian monitoring stations (greenlines) in key areas. They are currently at the following creeks: Lockwood Hat, Denny, Hard, Hazard, Sheep,Trail, Squaw, and Papoose
5) Establishment of appropriate areas as "fishbearing" or designated perennial streams.
6) Inspection of Denny Creek Road, as well as other BLM roads, annually after precipitation occurs.
7) Monitoring the LSR and its tributaries for temperature and substrate characteristics.
8) Conducting fish surveys above barriers.

In addition to the projects listed above that are specific to the LSR watershed, more inclusive projects have been undertaken (Table 32).

Table 32. Comprehensive Restoration Projects that include the LSR watershed.

Project Name/Location	Implementing Principal Agency	Description
All Anadromous HUCs - Upper Salmon Basin (Mitchell Act, BPA#1994-015-00)	IDFG (funded by BPA and NOAA Fisheries)	An ongoing fish restoration project was begun in 1994 to prevent fish entrainment into irrigation systems.
Columbia Basin Fish Screening	Pacific State Marine Fish Commission, Columbia Basin Fish and Wildlife Foundation.	Plan and oversee the environmental, design and construction of several thousand fish screens and adult fish passage facilities in the Columbia River Basin.

As public awareness increases, private landowners are initiating BMPs voluntarily. Those efforts are difficult to document, but have considerable merit.

4.3 Reasonable Assurance

The state has responsibility under Sections 401, 402, and 404 of the Clean Water Act to provide water quality certification. Under this authority, the state reviews dredge and fill, stream channel alteration, and NPDES permits to ensure that the proposed actions will meet Idaho's water quality standards.

Under Section 319 of the Clean Water Act, each state is required to develop and submit a Nonpoint Source Management Plan. Idaho's most recent Nonpoint Source Management Plan was finalized in December 1999. The plan was submitted to and approved by the EPA. Among other things, the plan identifies programs to achieve implementation of nonpoint source *Best Management Practices* (BMPs), includes a schedule of project milestones, outlines key agencies and agency roles, identifies available funding sources, and is certified by the state attorney general to ensure that adequate authorities exist to implement the plan.

Idaho's Nonpoint Source Management Plan describes many of the voluntary and regulatory approaches the state will take to abate nonpoint pollution sources. One of the prominent programs described in the plan is the provision for public involvement, such as the formation of *Basin Advisory Groups* (BAGs) and *Watershed Advisory Groups* (WAGs). The WAGs are to be established in watersheds to assist DEQ and other state agencies in formulating specific action needed to decrease pollutant loading from point and nonpoint sources that affect water quality limited water bodies. The Little Salmon River WAG was established in 2004 and is the designated advisory group for the part of the basin affected by the Little Salmon River TMDL. The WAG provides guidance to DEQ on TMDL development and implementation.

The Idaho water quality standards refer to existing authorities to control nonpoint pollution sources in Idaho. Some of these authorities and the responsible state agencies are listed in Table 33.

Table 33. State of Idaho's regulatory authority for nonpoint pollution sources.

Authority	IDAPA Citation	Responsible Agency
Rules Pertaining to the Idaho Forest Practices Act	58.01.02.350.03(a)	Idaho Department of Lands
Rules Governing Solid Waste Management	58.01.02.350.03(b)	Idaho Department of Environmental Quality
Rules Governing Subsurface and Individual Sewage Disposal Systems	58.01.02.350.03(c)	Idaho Department of Environmental Quality
Rules and Standards for Stream-channel Alteration	58.01.02.350.03(d)	Idaho Department of Water Resources
Rules Governing Exploration and Surface Mining Operations in Idaho	58.01.02.350.03(f)	Idaho Department of Lands
Rules Governing Placer and Dredge Mining in Idaho	58.01.02.350.03(g)	Idaho Department of Lands
Rules Governing Dairy Waste	58.01.02.350.03(h)	Idaho Department of Agriculture

The state of Idaho uses a voluntary approach to address agricultural nonpoint sources. IDAPA 58.01.02.054.07 refers to *the Idaho Agricultural Pollution Abatement Plan* (Ag Plan), which provides guidance to the agricultural community and includes a list of recommended BMPs (IDHW and SCC 1993).

A portion of the Agricultural Pollution Abatement Plan outlines responsible agencies or elected groups (*Soil Conservation Districts*-SCDs) that will take the lead if nonpoint source pollution problems need to be addressed. For agricultural activity, it assigns the local SCDs to assist the landowner/operator with developing and implementing BMPs to abate nonpoint pollution associated with the land use.

The *Idaho Water Quality Standards and Wastewater Treatment Requirements* specify that if water quality monitoring indicates that water quality standards are not being met, even with the use of BMPs or knowledgeable and reasonable practices, the state may request that the designated agency evaluate and/or modify the BMPs to protect beneficial uses (IDAPA 58.01.02.52.

The water quality standards list designated agencies responsible for reviewing and revising nonpoint source BMPs: the Soil Conservation Commission for grazing and agricultural activities, the Department of Transportation for public road construction, the Idaho Department of Agriculture for aquaculture, and DEQ for all other activities (IDAPA 58.01.02.003).

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5. Total Maximum Daily Loads

A TMDL prescribes an upper limit on discharge of a pollutant from all sources so as to assure water quality standards are met. It further allocates this load capacity (LC) among the various sources of the pollutant. Pollutant sources fall into two broad classes: point sources, each of which receives a wasteload allocation (WLA); and nonpoint sources, each of which receives a load allocation (LA). Natural background (NB), when present, is considered part of the LA, but is often broken out on its own because it represents a part of the load not subject to control. Because of uncertainties regarding quantification of loads and the relation of specific loads to attainment of water quality standards, the rules regarding TMDLs (Water quality planning and management, 40 CFR Part 130) require a margin of safety (MOS) be a part of the TMDL.

Practically, the margin of safety is a reduction in the load capacity that is available for allocation to pollutant sources. The natural background load is also effectively a reduction in the load capacity available for allocation to human-made pollutant sources. This can be summarized symbolically as the equation: LC = MOS + NB + LA + WLA = TMDL. The equation is written in this order because it represents the logical order in which a loading analysis is conducted. First the load capacity is determined. Then the load capacity is broken down into its components: the necessary margin of safety is determined and subtracted; then natural background, if relevant, is quantified and subtracted; and then the remainder is allocated among pollutant sources. When the breakdown and allocation are completed the result is a TMDL, which must equal the load capacity.

Another step in a loading analysis is the quantification of current pollutant loads by source. This allows the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary in order for pollutant trading to occur. The load capacity must be based on critical conditions – the conditions when water quality standards are most likely to be violated. If protective under critical conditions, a TMDL will be more than protective under other conditions. Because both load capacity and pollutant source loads vary, and not necessarily in concert, determination of critical conditions can be more complicated than it may appear on the surface.

A load is fundamentally a quantity of a pollutant discharged over some period of time, and is the product of concentration and flow. Due to the diverse nature of various pollutants, and the difficulty of strictly dealing with loads, the federal rules allow for “other appropriate measures” to be used when necessary. These “other measures” must still be quantifiable, and relate to water quality standards, but they allow flexibility to deal with pollutant loading in more practical and tangible ways. The rules also recognize the particular difficulty of quantifying nonpoint loads and allow “gross allotment” as a load allocation where available data or appropriate predictive techniques limit more accurate estimates. For certain pollutants whose effects are long term, such as sediment and nutrients, EPA allows for seasonal or annual loads.

5.1 In-stream Water Quality Targets

The goal of a TMDL is to restore "full support of designated beneficial uses" (Idaho Code 39.3611, 3615). In order to do so, appropriate water quality targets for pollutants must be used. These targets must be quantifiable in order to determine the loading capacity of a water body. For example, the narrative water quality standard for nutrients is translated into a measurable water quality target designed to support beneficial uses.

Temperature

The most common surrogate target for a temperature TMDL is percent effective shade. The height and density of the potential natural vegetation is compared against the width of the stream to gauge the percent effective shade achievable for that stream. Effective shade is defined as that amount able to counteract the heating effects of solar radiation on the surface water temperature.

For the Little Salmon River Meadows Valley temperature TMDL, a potential natural vegetation (PNV) approach is utilized. It is assumed that shade is maximized and solar loading is minimized to a stream under PNV. Thus, stream temperatures are at their lowest achievable levels under PNV. The PNV approach is described below. Additionally, the procedures and methodologies to develop PNV target shade levels and to estimate existing shade levels are described in this section.

Potential natural vegetation (shade) was used as a surrogate for temperature because this would achieve natural background conditions. The temperature targets are based on IDAPA 58.01.02.200.09 which states that "when natural background conditions, exceed any applicable water quality criteria set forth in Sections 21, 250, 251 or 253, the applicable water quality criteria shall not apply; instead pollutant levels shall not exceed the natural background conditions." In laymen's terms, the temperature targets are based on a natural riparian plant cover condition over the stream. In this TMDL, the potential natural vegetation cover represents the loading capacity of the streams in terms of minimum heat load. This analysis contains an implicit margin of safety as all streams are assumed to be at potential natural vegetation when in reality natural cover can be more variable due to natural forces. Existing vegetative cover represents the existing load of heat to the streams.

Potential Natural Vegetation for Temperature TMDLs

There are several important contributors of heat to a stream including ground water temperature, air temperature and direct solar radiation (Poole and Berman 2001). Of these, direct solar radiation is the source of heat that is most likely to be controlled or manipulated. The parameters that affect or control the amount of solar radiation hitting a stream throughout its length are shade and stream morphology. Shade is provided by the surrounding vegetation and other physical features such as hillsides, canyon walls, terraces, and high banks. Stream morphology affects how closely riparian vegetation grows together and water storage in the alluvial aquifer. The shade effectiveness of riparian vegetation is also affected by stream orientation which is accounted for in the solar pathfinder measurements. The amount of shade provided by objects other than vegetation is not easy to change or manipulate. Vegetation and morphology remain as the most likely sources of

change in solar loading and, hence, temperature in a stream. In hydrologically modified systems, flow alteration also influences stream temperature.

Depending on how much vertical elevation also surrounds the stream, vegetation further away from the riparian corridor can provide shade. However, riparian vegetation provides a substantial amount of shade on a stream by virtue of its proximity. Stream shade can be measured in a number of ways. Effective shade, that shade provided by all objects that intercept the sun as it makes its way across the sky, can be measured in a given spot with a solar pathfinder. Effective shade can also be modeled using detailed information about riparian plants and their communities, topography, and the stream's aspect.

Potential natural vegetation (PNV) along a stream is that intact riparian plant community that has grown to its fullest extent and has not been disturbed or reduced in anyway. The PNV can be removed by disturbance either naturally (wildfire, disease/old age, wind-blown, wildlife grazing) or anthropogenically (domestic livestock grazing, vegetation removal, erosion). The idea behind PNV as targets for temperature TMDLs is that PNV provides the most shade and minimizes solar loading to the stream. Anything less than PNV results in the stream heating up from additional solar inputs (excess heat load). PNV is estimated from models of plant community structure (shade curves for specific riparian plant communities), and existing vegetative cover or shade is measured in the field or estimated using aerial photo analysis. Comparing the two will tell us how much excess solar load the stream is receiving, and what can be done to decrease solar gain.

Using information from the infrared flyover, hydrology data and temperature logger information, DEQ determined that tributary influences were negligible from Four Mile Creek to Round Valley Creek due to the volume of the Little Salmon River at that point. In other words, stream temperature would not be changed because the volume of the incoming tributaries is too small to make a difference. Thus, tributary shading estimates are included from upstream of Four Mile Creek. Tributary shading was investigated for tributaries both in the 303(d) listed section of the watershed as well as upstream of the listed watershed in the fourth order and third order sections. These shading estimates for tributaries outside the listed reach are included because cooler water from these streams could potentially provide cooling to the Little Salmon River. The information for these streams is included in Appendix D.

Existing shade or cover was estimated for the Little Salmon River from just above Vick Creek to just below Round Valley Creek and for major tributaries to the river in this meadows area (Vick, Mill, Mud, Big, Little, Goose, and Threemile Creeks) from visual observations of aerial photos. Estimates were field verified in several forested sections as well as meadow sections by measuring shade with a solar pathfinder at systematically located points along the streams (see below for methodology). If further field verified shading information becomes available, it will be incorporated into the TMDL and the loading estimates will be revised to better reflect the actual conditions.

PNV targets were determined from an analysis of probable vegetation and comparing that to shade curves developed for similar vegetation communities in other TMDLs. A shade curve shows the relationship between effective shade and stream width. As a stream gets wider, the shade decreases as the vegetation has less ability to shade the center of wide streams. As the

vegetation gets taller, the more shade the plant community is able to provide at any given channel width. Existing and PNV shade was converted to solar load from data collected on flat plate collectors at the nearest National Energy Research Laboratory weather stations collecting these data. In this case, the nearest station at Boise, ID was used. The difference between existing and potential solar load, assuming existing load is higher, is the load reduction necessary to bring the stream back into compliance with water quality standards. PNV shade and loads are assumed to be the natural condition, thus stream temperatures under PNV conditions are considered to be the lowest achievable temperatures (so long as there are no point sources or any other anthropogenic sources of heat in the watershed).

Pathfinder Methodology

The solar pathfinder is a device that allows one to trace the outline of shade producing objects on monthly solar path charts. The percentage of the sun's path covered by these objects is the effective shade on the stream at the spot that the tracing is made. In order to adequately characterize the effective shade on a reach of stream, ten traces should be taken at systematic or random intervals along the length of the stream in question.

Aerial Photo Interpretation

Canopy coverage estimates or expectations of shade based on plant type and density are provided for 200-foot elevation intervals or natural breaks in vegetation density, marked out on a 1:100K hydrography. Each interval is assigned a single value representing the bottom of a 10% canopy coverage or shade class as described below (*adapted from the CWE process, IDL, 2000)*:

Cover class	Typical vegetation type
0 = 0 – 9% cover	agricultural land, denuded areas
10 = 10 –19%	ag land, meadows, open areas, clearcuts
20 = 20 – 29%	ag land, meadows, open areas, clearcuts
30 = 30 – 39%	ag land, meadows, open areas, clearcuts
40 = 40 – 49%	shrublands/meadows
50 = 50 – 59%	shrublands/meadows, open forests
60 = 60 – 69%	shrublands/meadows, open forests
70 = 70 – 79%	forested
80 = 80 – 89%	forested
90 = 90 –100%	forested

The visual estimates of shade in this TMDL were field verified with a solar pathfinder. The pathfinder measures effective shade and is taking into consideration other physical features that block the sun from hitting the stream surface (e.g. hillsides, canyon walls, terraces, man-made structures). The estimate of shade made visually from an aerial photo does not take into account topography or any shading that may occur from physical features other than vegetation. However, research has shown that shade and cover measurements are remarkably similar (OWEB, 2001), reinforcing the idea that riparian vegetation and objects proximal to the stream provide the most shade.

Stream Morphology

Measures of current bankfull width or near stream disturbance zone width may not reflect widths that were present under PNV. As impacts to streams and riparian areas occur, width-to-depth ratios tend to increase such that streams become wider and shallow. Wider streams mean less vegetative cover to provide shading.

Shade target selection, which involves evaluating the amount of shade provided at PNV conditions, necessitates recognition of potential natural stream widths as well. In this TMDL appropriate stream widths for shade target selection were determined from analysis of existing stream widths and the relationship between drainage area and width-to-depth ratios (Rosgen, 1996). The drainage area associated with the Little Salmon River meadows area varies from 16 square miles for the drainage upstream of Mud Creek (includes Vick and Mill Creeks) to 196 square miles for the drainage area downstream to and including Round Valley Creek. Based on the relationship between drainage area and bankfull widths (Figure 73), it was estimated that the Little Salmon River natural widths varied from seven meters (~23 feet) to 25 meters (~82 feet) in the meadows area.

Each tributary drainage was evaluated similarly from its headwaters, where natural widths are about one meter (3.28'), to its mouth. Tributary drainage areas ranged from seven square miles for Threemile Creek to 40 square miles for the Goose Creek drainage.

Corresponding natural stream widths at mouths varied from five meters to 12 meters (16.4 feet to 39.37 feet). The Goose Creek drainage is unusual in that flows out of Goose Lake, an irrigation supply reservoir, are a constant 100cfs during the irrigation season. As a result, stream widths are much larger below the reservoir and field measured widths (~15m or 49') were used for the upper Goose Creek section. However, widths decrease in the Meadows Valley area and, thus, natural drainage size was used to determine widths of East Branch and West Branch Goose Creek below irrigation diversions.

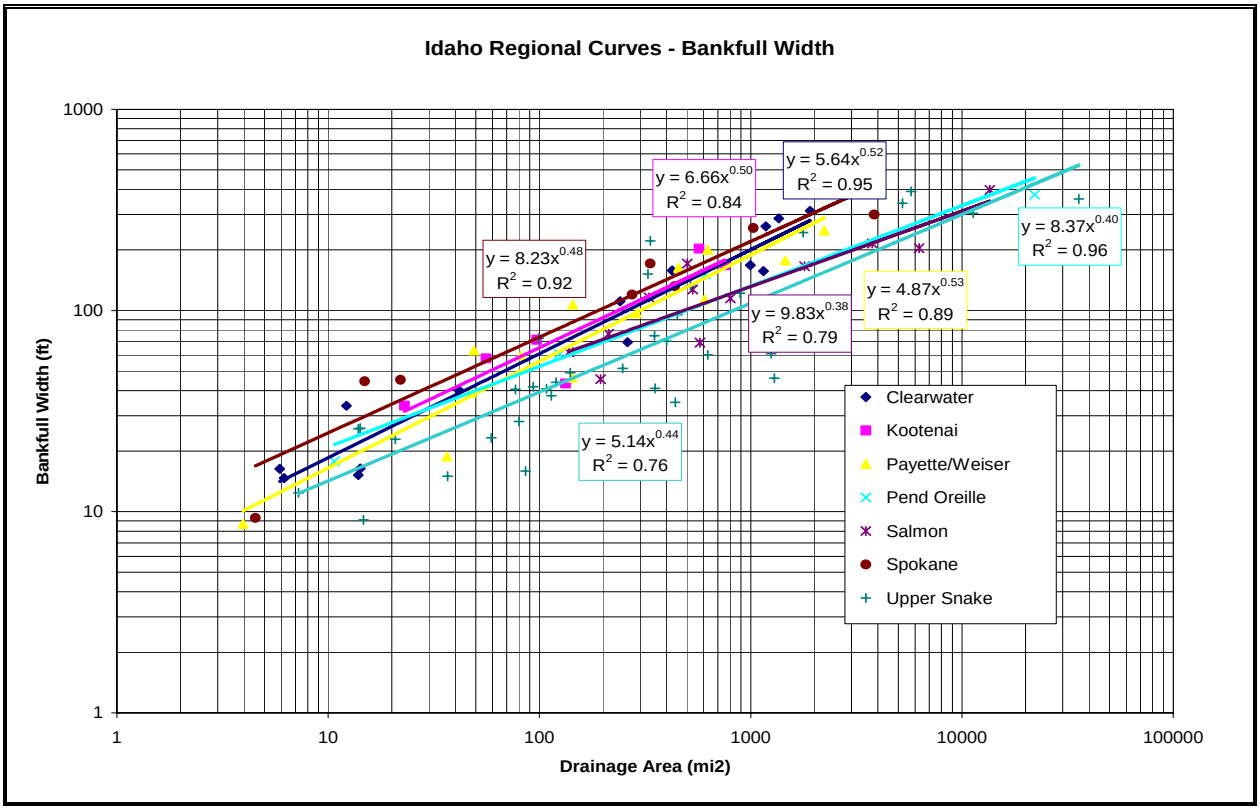


Figure 73. Bankfull Width as a Function of Width to Depth Ratio and Drainage Area.

Table 34. Drainage Area Size and Stream Width.

Drainage	Area (acres)	Area ($miles^2$)	Natural width (m)
Little Salmon River, above Mud Creek	10,308	16.1	7 (23')
Little Salmon River above Round Valley	125,491	196	25 (82')

Design Conditions

The critical period for temperature is during spring and summer. This is the period when aquatic organisms are most vulnerable to stress caused by elevated temperatures. Spring is included to account for spawning temperatures. Exceedance of the coldwater aquatic temperature standard is primarily seen during the summer months.

The Little Salmon River in the Meadows Valley area flows sinuously from the south to the north through a low gradient high mountain meadow. The dominant shade producing vegetation is willow (*Salix sp.*) most likely one of the mid-elevation species such as Scouler's willow (*S. scouleriana*), Bebb's willow (*S. bebbiana*), or Geyer's willow (*S. geyeriana*). These willows are generally up to six meters tall, and the density in and around

the Little Salmon River is estimated at 75% under potential natural vegetation conditions. The shade curves used had an average height of willows of 10 feet (the height of the willows ranged from 6 feet to 18 feet).

Target Selection

The potential natural vegetation along streams in the meadow area of the Little Salmon River is assumed to consist of four community types; forest, forest/shrub mix, willow-like shrub/grass meadow, and grass/willow meadow. To determine potential natural vegetation shade targets for the Little Salmon River and its meadow tributaries, effective shade curves from several existing temperature TMDLs were examined. These TMDLs had previously used vegetation community modeling to produce these shade curves. Curves for the most similar vegetation type were selected for shade target determinations. Because no two landscapes are exactly the same, shade targets were often derived by taking an average of the various shade curves available. Effective shade curves include percent shade on the vertical axis and stream width on the horizontal axis. As a stream becomes wider, a given vegetation type looses its ability to shade wider and wider streams.

For the forest community type the following shade curve was used:

- the Ponderosa pine/common chokecherry type from the Crooked Creek TMDL (IDEQ, 2002),

For the forest/shrub mix community type the following shade curves were used:

- the conifer/deciduous type from the Walla Walla River TMDL (ODEQ, 2004b),
- the Qg1 geomorphic surface type from the Willamette River TMDL (ODEQ, 2004a), and
- the black cottonwood-pacific willow type from the Alvord Lake TMDL (ODEQ, 2003).

For the willow-like shrub/grass community type the following shade curves were used:

- the coyote willow meadow type from the Crooked Creek TMDL (IDEQ, 2002),
- the Trout Creek Mtns. Willow community type from the Alvord Lake TMDL (ODEQ, 2003), and
- the Ow savanna-prairie type from the Willamette River TMDL (ODEQ, 2004a).

For the grass/willow mix type the following shade curves were used:

- the tufted hairgrass meadow type from the Crooked Creek TMDL (IDEQ, 2002),
- the Ow savanna-prairie type from the Willamette River TMDL (ODEQ, 2004a), and
- the co-dominant mesic graminoid-willow community type from the Alvord Lake TMDL (ODEQ, 2003).

The average shade targets derived from the above TMDLs at various stream widths needed for the Little Salmon River TMDL are presented in Table 35. Shade targets for the forest type vary little over the range of stream widths examined due to tree height. Targets vary

considerably more over the range of stream widths as plant height decreases in subsequent community types.

Table 35. Target Percent Shade (as a fraction) for Four Community Types at Varying Stream Widths.

Type	1-2m (3.3-6.6')	3m (9.8')	4m (13.1')	5m (16.4')	7m (23)	9m (29.5')	12m (39.4')	14m (45.9')	15-16m (49.1-52.5')	18-25 m (59-82')
Forest	0.8								0.5	
Forest/ Shrub	0.8	0.8	0.8	0.7	0.7		0.6		0.5	
Willow	0.7	0.5	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.1
Grass/ Willow		0.2	0.2	0.1	0.1	0.1	0.1			

Monitoring Points

Effective shade monitoring can take place on any reach throughout the Little Salmon River and meadows tributaries and compared to estimates of existing shade seen in Figure 77 and described in Tables 37 and Appendix D. Those areas with the lowest existing shade estimates in relation to their target shade should be monitored with solar pathfinders to verify the existing shade levels and to determine progress towards meeting shade targets.

Margin of Safety

The margin of safety in this TMDL is considered implicit in the design. Because the target is essentially background conditions, there are no loads allocated to sources or activities. Although the loading analysis used in this TMDL involves gross estimations that are likely to have large variances, there are no load allocations that may benefit or suffer from that variance. Using potential natural vegetation is inherently conservative given the generally variable distribution and age classes of riparian plants. Potential natural vegetation assumes that all plants are at potential when naturally there will be variation from these optimum shading numbers due to age of plants, soil types etc. Essentially, greater shading is assumed to occur than would be expected under natural conditions.

Seasonal Variation

This TMDL is based on average summer loads. All loads have been calculated to be inclusive of the six month period from April through September. This time period was chosen because it represents the time period when the combination of increasing air and water temperatures coincides with increasing solar inputs and increasing vegetative shade. Water temperature is not likely to be a problem for beneficial uses outside of this time period because of cooler weather and lower sun angle

5.2 Load Capacity

The loading capacity for a stream under PNV is essentially the solar loading allowed under the shade targets specified for the reaches within that stream. These loads are determined by multiplying the solar load to a flat plat collector (under full sun) for a given period of time by the fraction of the solar radiation that is not blocked by shade (i.e. the percent open or 1-percent shade). In other words, if a shade target is 60% (or 0.6), then the solar load hitting the stream under that target is 40% of the load hitting the flat plate collector under full sun.

Solar load data for flat plate collectors was obtained from the nearest National Renewable Energy Laboratory (NREL) weather stations in Boise, ID. The solar loads used in this TMDL are spring/summer averages, thus, an average load is calculated for the six month period from April through September. These months coincide with the time of year that stream temperatures are increasing and critical periods for salmonid spawning.

Table 36 shows the PNV shade targets (identified as Target or Potential Shade) and the corresponding potential summer load (in kWh/m^2/day and kWh/day) that serve as the loading capacity.

For the Little Salmon River meadows area, we have used the same willow community PNV with varying stream widths to produce shade targets from 40% (0.4) to 10% (0.1) for the reach from Vick Creek to Round Valley Creek (Tables 34 and 35).

5.3 Estimates of Existing Pollutant Loads

Regulations allow that loadings "...may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading," (Water quality planning and management, 40 CFR § 130.2(I)). An estimate must be made for each point source. Nonpoint sources are typically estimated based on the type of sources (land use) and area (such as a subwatershed), but may be aggregated by type of source or land area. To the extent possible, background loads should be distinguished from human-caused increases in nonpoint loads.

Existing loads in this temperature TMDL come from estimates of existing shade as determined from aerial photo interpretations. Like target shade, existing shade was converted to a solar load by multiplying the fraction of open stream by the solar radiation measured on a flat plate collector at the NREL weather stations. Existing shade data are presented in Figure 74.

Existing shade varied from 30% to 0% along the Little Salmon River in the meadows area (Figure 2 and Table 3). Solar pathfinder data (average shade 'April through September') taken at three sections of the river verified the accuracy of the aerial photo interpretation. Like loading capacities (potential loads), existing loads in Table 36 are presented on an area basis (kWh/m^2/day) and as a total load (kWh/day).

Table 36. Existing and Potential Solar Loads for Little Salmon River from Vick Creek to Round Valley Creek.

Segment Length (~miles)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	**Little Salmon (above Vick to below Round Valley)**
0.3	0.2	5.104	0.4	3.828	-1.28	Willow-23' wide
0.2	0.3	4.466	0.4	3.828	-0.64	Willow-23' wide
0.4	0.1	5.742	0.4	3.828	-1.91	Willow-23' wide
0.2	0.2	5.104	0.4	3.828	-1.28	Willow-23'wide
0.4	0.3	4.466	0.4	3.828	-0.64	Willow-23' wide
0.9	0.1	5.742	0.4	3.828	-1.91	Willow-23' wide
1.2	0.1	5.742	0.3	4.466	-1.28	29.5' wide
1.6	0.1[a]	5.742	0.2	5.104	-0.64	45.9' wide
4.8	0[b]	6.38	0.2	5.104	-1.28	52' wide
0.9	0.1	5.742	0.2	5.104	-0.64	59 ' wide
1.8	0	6.38	0.2	5.104	-1.28	65' wide
1	0.2[c]	5.104	0.2	5.104	0.00	72'wide
0.6	0	6.38	0.2	5.104	-1.28	72' wide
0.2	0.1	5.742	0.2	5.104	-0.64	82'wide
0.8	0	6.38	0.2	5.104	-1.28	82' wide
Segment Length (feet)	Segment Area (feet2)	Existing Summer Load (kWh/day)	Natural Stream Width (ft)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
1584.2	36368.8	17250	23	12937	-4312	
1056.2	24107.1	10062	23	8625	-1437	
2112.3	48484.6	25874	23	17250	-8625	
1056.2	24107.1	11500	23	8625	-2875	
2112.3	48484.6	20125	23	17250	-2875	
4749.4	109095.6	58217	23	38812	-19406	
6333.7	187019.6	99801	29.5	77623	-22178	
8446	387887.2	206995	45.9	183996	-22999	
2533.8	1329914.5	788553	52	630842	-157711	
4749.4	249363	149702	59	118283	0	
9502.2	498715.2	369634	65	236566	-36963	
5277.5	27552.5	180710	72	131425	22589	
3168.5	166242	135533	72	78855	-13553	
1056.2	55414	46204	82	26285	0	
4221.4	221656	205352	82	105140	-20535	**% Reduction**
Total	**3664178.1**	**2,325,512**		**2,034,631**	**-365,630**	**-13**

a = solar pathfinder measured 0% shade; b = solar pathfinder measured 0% shade; c = solar pathfinder measured 22.5% shade.

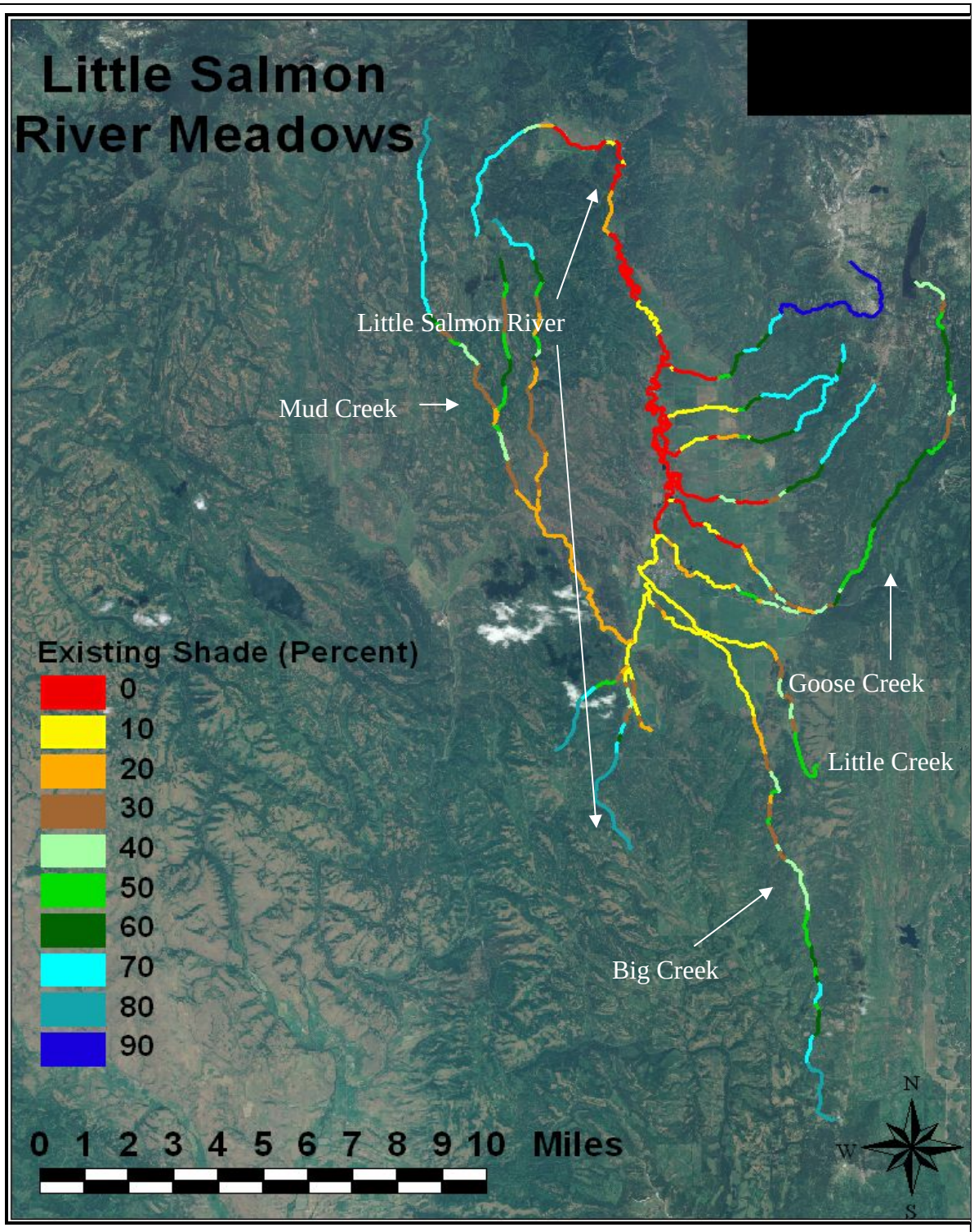


Figure 74. Existing Shade Estimated for Little Salmon River and its Meadow Tributaries by Aerial Photo Interpretation.

5.4 Load Allocation

Because this TMDL is based on potential natural vegetation, which is equivalent to background loading, the load allocation is essentially given to background. Load allocations are therefore stream reach specific and are dependent upon the target load for a given reach. Table 36 shows the target or potential shade, which is converted to a potential summer load by multiplying the inverse fraction (1-shade fraction) by the average loading to a flat plate collector for the months of April through September. That is the loading capacity of the stream and it is allocated completely to background. There is no opportunity to allocate shade removal to different human activities.

Generally, existing solar loads exceed potential solar because existing shade is less than potential shade. The Little Salmon River itself from Vick Creek to Round Valley Creek showed a moderate amount of excess load requiring a reduction to meet target loads. The river's existing solar load is 2,325,512 kWh/day and its target load should be 2,034,631 kW/day. The difference (-290,882 kWh/day) shows that loads on the Little Salmon River need to decrease by about 13% to achieve background conditions. This 13% is an overall average for the entire system not the implementation target for each individual reach. In actuality, shading varies between the individual reaches.

Practically speaking in implementation, a landowner could evaluate the current shade with a solar pathfinder and then compare that to the predicted potential shade using the tables/maps in this document to see what the difference, if any, between the two measurements is. Or landowners can confer with SCC or IASCD staff to determine if their riparian area is at system potential.

In addition, since tributaries have the potential to contribute excess thermal load, information on tributary loading is included in Appendix D. These streams are not receiving allocations due to uncertainties with actual thermal load delivered due to flow management considerations. The flow is managed during the summer months and several of these tributaries may not contribute enough flow to make a difference to Little Salmon River in-stream temperatures. Further, several of these tributaries may also meet the cold water aquatic life temperature standard. However, this information is necessary for use in developing the implementation plan.

Wasteload Allocation

A temperature wasteload allocation is shown in Table 37 for the New Meadows wastewater treatment plant based on base flow conditions and maximum design flow. Effluent temperature information was not available during the critical period. Temperature monitoring is required for effluent discharge to ensure compliance with the TMDL. This TMDL is based on the water quality standard for point sources which states that "no temperature increase will be allowed which raises the receiving water temperature greater than 0.3 degrees C". The temperature shown will not result in an increase in 0.3 degrees Celsius in the stream when cold water criteria are applicable assuming an ambient in-stream temperature of 19 degrees Celsius. The state water quality criteria for temperature, (19 degrees Celsius maximum average daily temperature), was used to calculate this load allocation.

Table 37. Wasteload allocation for New Meadows Wastewater Treatment Plant (WWTP)

Location	Allowable Effluent Temperature (C)	Base Flow (cfs)	Facility Design Flow (cfs)	Current Effluent Temperature
New Meadows WWTP	20.8	10	0.55	n/a

Reserve

An explicit reserve for future growth has not been set aside within the TMDL. Any increased discharge from future growth or development within the watershed should be consistent with these allocations.

Nutrients

Design Conditions

The critical period for nutrients is during summer from June 21st through September 22nd when aquatic organisms are most vulnerable to stress caused by excess nutrients. Nuisance algal growth and low dissolved oxygen are seen only in the summer months. Summer is also the period that was analyzed by Dodds et al. 1998 in his work on chlorophyll-a/TP targets for nuisance periphyton control. This period captures the low flow, higher temperature, and higher nutrient period when periphyton growth is most likely to occur.

Target Selection

This TMDL focuses in particular on periphyton, the algae that is found attached to rocks, wood and other materials in the stream, because the Idaho Department of Agriculture reported that they had seen nuisance levels of periphyton during their biweekly monitoring in late summer 2004. A number of factors besides nutrient levels influence algal densities in water bodies. These include, but are not limited to, the type of algae, stream flow patterns and scouring, water temperature and velocity, light intensity, and grazing by aquatic insects. From a management perspective, factors other than nutrients are difficult to control. Using a data base consisting of over 200 sample sites to relate algal densities to nutrient concentrations, Dodds et al 1998 were able to create a trophic state stream classification based on nutrients and benthic chlorophyll-a.

Using total phosphorus data and benthic chlorophyll-a data, a target was selected that would result in mean chlorophyll-a concentrations of less than 100 mg/m^2. Nuisance levels of periphyton have been determined to exist at mean levels exceeding 100 mg/m^2. Thus, benthic chlorophyll-a levels less than this are indicative of acceptable conditions with regard to benthic algal biomass (Dodds 1997).

0.075 mg/L of total phosphorus is the concentration of total phosphorus that was determined to represent the boundary between mesotrophic and eutrophic conditions. 0.075 mg/L is used as a preliminary target (benthic chlorophyll-a data from the watershed is not available yet) and is based on Dodds work in determining trophic boundary states in streams. This level of total phosphorus is correlated to a mean chlorophyll-a concentration of 70 mg/m^2. Thus, this target is conservative since mean chlorophyll-a

levels would remain below the nuisance level threshold and is assumed to result in dissolved oxygen concentrations that are above the 6 mg/L standard at all times.

Background

Natural background concentrations of total phosphorus were determined by sampling the headwaters of the Little Salmon River directly below where the river originates from springs. The background level of total phosphorus is 0.02 mg/L, which is similar to background total phosphorus concentrations found in the Idaho Batholith. The resultant background load is 3.28 kg/day for the Little Salmon River and 0.49 kg/day for Big Creek.

Existing Pollutant Loads

Total phosphorus was monitored in 2004 and 2005 in both Big Creek and the Little Salmon River. The existing pollutant load was calculated using 2004 data because the 2005 dataset was not complete at the time of this. The existing load is 10.16 kg/day for the Little Salmon River and 2.30 kg/day for Big Creek and was determined by a direct load calculation using average summer flow and average summer total phosphorus concentrations.

Monitoring Points

Monitoring sites for the Little Salmon River are shown in Figure 22 in Section 3. Total phosphorus was measured at stations LSR 3, 4 and 5 during the summer of 2004. In 2005, total phosphorus was measured at LSR 3, LSR4 and LSR at Meadow Creek. In addition, several tributaries were monitored for phosphorus. When this information becomes available, it will be used in creating the implementation plan. Since, more detailed information on phosphorus transport was not available, LSR 3, the most downstream monitoring station was selected as the compliance point for the TMDL and loads were determined for this station.

Big Creek monitoring sites (Idaho Department of Agriculture sites BC1 and BC2) are shown in Figure 30.

Margin of Safety

The total phosphorus target selected contains an implicit margin of safety because the corresponding mean chlorophyll-a concentration is below the 100 mg/m^2 level of chlorophyll-a that is shown to be associated with nuisance periphyton growth.

Seasonal Variation/Critical Condition

The TMDL addresses critical conditions by deriving allocations from the period of highest concentration and lowest flow. Excess algal growth and associated depressed dissolved oxygen are seen only during the summer time period determined by this TMDL as the critical period. Recreation and cold water aquatic life are impaired by excess algal growth and low dissolved oxygen in the summer period only.

Load Capacity/Load Allocation

Load capacity was determined for total phosphorus at LSR 3 using the target concentration (0.075 mg/L), natural background concentration (0.02 mg/L) and average summer flow (67 cfs) as shown in Table 38. The same methodology was applied at Big Creek except that an average summer flow of 10 cfs was used. This can be summarized symbolically as the equation: LC = MOS + NB + LA + WLA. The margin of safety is assumed to be implicit in the adoption of a conservative target for total phosphorus and is not included in the table. This load capacity was determined using 2004 information which was the only complete dataset available. Table 38 shows the load capacity for total phosphorus. The load capacity was determined using LSR 3 at the downstream end of the listed reach where the maximum load is expected due to the highest flows being seen at this point. The load capacity for Big Creek was determined using BC1 which was the most downstream sampling point. The reductions for Big Creek are significant and, thus, a phased approach will be taken in implementation. E.g. a higher target of 0.1 mg/L TP will be employed first, and the results of reducing total phosphorus levels to this amount will be evaluated (this would be an initial 21 percent reduction in pollutants).

Because source specific loading information was not available, the nonpoint allocations are gross allotments to all nonpoint sources within the reach upstream of LSR 3 and also for that upstream of BC1.

While these load values are helpful in giving a relative understanding of the reductions required, and will apply reasonably over most water years, it should be noted that the absolute level of reduction required will depend on flow and concentration values specific to a given water year. The target shown to result in attainment of water quality standards and support of designated uses in the reach is an in-stream concentration of less than or equal to 0.075 mg/L TP. The load capacity is calculated using the target of 0.075 mg/L TP. Transport and deposition of phosphorus, and the resulting algal growth within the reach, is seasonal in nature. Therefore, application of the target is also seasonal in nature, extending from the beginning of June 21st through September 22nd (summer). The length of this period was also determined by when BMPs would be most effective. Due to water column nutrients, particularly TP, being more abundant than plant uptake rates, responses by plant communities to management efforts will take time.

Table 38. Load Allocation for Nutrients (Total Phosphorus): Little Salmon River (Big Creek to Round Valley Creek) at LSR 3 and Big Creek (BC1)

Location	Load Capacity (kg/day)	Natural Background (kg/day)	Load Allocation (kg/day)	Wasteload Allocation kg/day	Existing Pollutant Load (excludes natural background) (kg/day)	% Reduction Necessary for Nonpoint Sources
Little Salmon River	12.3	3.28	8.91	.1	10.16	12
Big Creek	1.84	0.49	1.35	0	2.3	41

Wasteload Allocation

The wasteload allocation for the New Meadows Waste Water Treatment Plant is 3 kg/month although it is shown in kg/day in Table 38. The wasteload allocation is based on a maximum design capacity flow of 0.055 cfs and the 0.075 mg/L total phosphorus target. This allocation applies during summer only.

This load allocation was developed based on information given to DEQ in 2005 by the Wastewater Treatment plant operator. The operator indicated that at full capacity, the treatment plant would be unlikely to discharge during summer. The City of New Meadows has recently hired a new operator and if the city determines that the treatment plant may have to discharge more frequently in summer then a new wasteload allocation will be developed in consultation with the WAG. If the treatment plant is upgraded or expanded this may also trigger a new wasteload allocation. All wasteload allocations will be developed in consultation with the WAG and a new or modified NPDES permit would be developed and issued by EPA.

Reserve

An explicit reserve for future growth has not been set aside within the TMDL. The wasteload allocation was calculated at maximum design capacity resulting in an inherent reserve for growth since the plant is not at maximum capacity. As the city of New Meadows grows and reaches design capacity, different methods (pollutant trading, biological nutrient filtration, land application) should be investigated in order to ensure continued compliance with the TMDL.

Any increased discharge from future growth or development within the watershed should be consistent with these allocations.

Bacteria

Design Conditions

The critical period for bacteria is during summer from June 21st through September 22nd. This is the period when bacteria concentrations are elevated above the standard and also when people are most likely to be engaging in recreational activities that would result in the ingestion of water. This period correlates to the periods of lowest flow and highest temperatures.

Target Selection

The bacteria target is based on the numeric standard which has been used to establish the load capacity and subsequent pollutant allocations. Bacteria sources have not been delineated in this TMDL, because this information was not available. Thus, the load may include bacteria from wildlife.

The criteria for *E. coli* concentrations in Idaho WQS intended to protect the primary contact recreation beneficial use are:

- not to exceed 406 *E. coli* organisms (cfu)/100 ml at any time
- not to exceed a geometric mean of 126 *E. coli*(cfu)/100 ml[a] based on a minimum of 5 samples taken every 3 to 5 days over a 30 day period;

The criteria for *E. coli* concentrations in Idaho WQS intended to protect the secondary contact recreation beneficial use are:
• not to exceed 576 cfu per 100 ml at any time, and
• not to exceed a geometric mean of 126 cfu per 100 ml based on a minimum of 5 samples taken every 3 to 5 days over a 30-day period.

The primary recreation contact standard applies to the Little Salmon River and the secondary contract recreation standard applies to Big Creek. Low flows and lack of recreational access make primary contact recreation unlikely in Big Creek. Thus, since it is undesignated, secondary contact recreation is presumed to be the beneficial use. For compliance purposes during implementation, the secondary contact recreation standard of 576 cfu per 100 mL will be used for monitoring of Big Creek unless it is feasible to take 5 samples over 30 days.

Monitoring Points

Bacteria was monitored throughout the Little Salmon River watershed. Monitoring locations are discussed for the Little Salmon River in Section 2 for nutrients and bacteria and shown in Figure 22 (Idaho Department of Agriculture sites). Loads were calculated for LSR 3 and LSR 4, because these were the upstream and downstream points of where bacteria violations took place. Loads were also calculated for Big Creek at BC 1 and the Idaho Department of Agriculture monitoring location is shown in Figure 30.

Margin of Safety

The federal statute requires that a margin of safety be identified to account for uncertainty when establishing a TMDL. The margin of safety can be explicit in the form of an allocation, or implicit in the use of conservative assumptions in the analysis. One approach to setting a margin of safety is to set allocations based on conditions during the most critical period. In the above analysis of Little Salmon River bacteria data, the summer months are the critical period where E. coli standards are not being met and when primary and secondary contact recreation is most likely to take place. Setting the loading capacity based on the most critical month will be protective of the other months of the year when standards are currently met. Using the critical period will serve as the inherent margin of safety for this TMDL.

An implicit MOS has been incorporated into the TMDL by utilizing conservative assumptions. The period of lowest flows was used to estimate the LC. This method results in a LC far below that needed to achieve criteria during 9 months of the year. Further, the low flow period chosen was based on current data during a low water year, further increasing the inherent level of conservatism in the assumptions.

Seasonal Variation/Critical Condition

The TMDL addresses critical conditions by deriving allocations from the period of highest concentration and lowest flow. Summer is the period when bacteria is in violation of the state standard and also the period when recreation is most likely to take place in this section of the watershed.

Load Capacity/Load Allocation

The LC is the greatest amount of pollutant loading a water body can receive and still meet WQS. The LC will vary with flow, that is, at higher flows a water body can accept greater loading and still comply with criteria. The LCs were estimated for two sampling locations (LSR 3 and LSR 4) using the average flow recorded during July and August, the lowest flow months of the year, multiplied by the monthly mean *E. coli* criteria of 126 cfu/100 ml. While elevated concentrations of *E. coli* occur during periods of high runoff (e.g., in May), the LC was established utilizing the low flow period because a much lower bacteria loading is necessary in order to remain in compliance with established criteria. This establishes a margin of safety.

Table 39 lists LCs at the two sampling locations used to establish the monthly criteria. The loading is presented in terms of colony forming units per day. This is not a very practical measure as there is seldom information from which to estimate such daily loads. As a result, the allocations include the percent reduction in bacteria loading needed to achieve the LC in addition to the numeric criteria.

Nonpoint source allocations and WLAs are presented in Table 38 and 39. Because source specific loading information was not available, the nonpoint allocations are gross allotments to all nonpoint sources within the reach upstream of each point.

Allocations were established at the same loading and concentration as the LC without an explicit margin of safety. Due to the lack of sufficient information, it was not possible to differentiate background loading from anthropogenic loading, so background loading is included within the gross allocation to nonpoint sources. The percent reduction needed to achieve nonpoint source LAs is also shown, in order to provide some perspective on the magnitude of source control needed during the critical period.

Table 39. Bacteria Load Capacity and Allocation for Little Salmon River and Big Creek.

Location	Target (cfu/100 mL)	Critical Flow (CFS)	Load Capacity (cfu/day)	Geometric Mean (existing concentration) (cfu/100 mL)	Existing Load (cfu/day)	% Reduction
LSR 3	126	49.48	1.52 E 11	254	3.07 E 11	50
LSR 4	126	16.54	5.1 E 10	1566	6.34 E 11	92
BC1	126	11.62	3.58 E 10	2155	6.13 E 11	94

Wasteload Allocation

The WLA for the New Meadows WWTP is established at the level of the applicable water quality criteria for *E.* coli as shown in Table 40. The monthly geometric mean limit of 126 cfu/100 ml is the same as in NPDES permits for other wastewater facilities. These limits are expected to be incorporated into New Meadow's permit when it is reissued. Existing loads are not shown for the New Meadows WWTP because DEQ has no data available for discharge during the summer months.

Table 40. New Meadows WWTP Load Allocation.

Location	Load allocation (cfu/day)	NPDES[a] Permit Number
New Meadows WWTP	1.70 E 9	ID 002315-9

Reserve

An explicit reserve for future growth has not been set aside within the TMDL. Any increased discharge from future growth or development within the watershed should be consistent with these allocations.

Reasonable Assurance

There is reasonable assurance that implementation, as the next step of the water body management process, will occur. Idaho's water quality standards identify designated agencies that are responsible for evaluating and modifying best management practices to protect impaired water bodies. The state has committed itself to having implementation plans developed within 18 months of EPA approval of the TMDL document. DEQ, the Watershed Advisory Group (WAG), and the designated agencies will develop implementation plans, and DEQ will incorporate them into the state's water quality management plan. Also, in measuring the effectiveness of an implementation activity, DEQ will reassess the support status of the water body to determine if the water body has reached full support status. If full support status has not been obtained, then further implementation will be necessary and further reassessment performed until full support status is reached. Monitoring will be done at least every five years. If full support status is reached, then the requirements of the TMDL will be considered completed.

Construction Storm Water and TMDL Waste Load Allocations

Construction Storm Water

The Clean Water Act requires operators of construction sites to obtain permit coverage to discharge storm water to a water body or to a municipal storm sewer. In Idaho, EPA has issued a general permit for storm water discharges from construction sites. In the past storm water was treated as a non-point source of pollutants. However, because storm water can be managed on site through management practices or when discharged through a discrete conveyance such as a storm sewer, it now requires a National Pollution Discharge Elimination System (NPDES) Permit.

The Construction General Permit (CGP)

If a construction project disturbs more than one acre of land (or is part of larger common development) that will disturb more than one acre), the operator is required to apply for permit coverage from EPA after developing a site-specific Storm Water Pollution Prevention Plan.

Storm Water Pollution Prevention Plan (SWPPP)

In order to obtain the Construction General Permit operators must develop a site-specific Storm Water Pollution Prevention Plan. The operator must document the erosion, sediment, and pollution controls they intend to use, inspect the controls periodically and maintain the best management practices (BMPs) through the life of the project

Construction Storm Water Requirements

When a stream is on Idaho's § 303(d) list and has a TMDL developed, DEQ now incorporates a gross waste load allocation (WLA) for anticipated construction storm water activities, if possible. TMDLs developed in the past did not have a WLA for construction storm water activities. All TMDLs will also be considered in compliance with provisions of the TMDL if they obtain a CGP under the NPDES program and implement the appropriate Best Management Practices.

Typically there are specific requirements you must follow to be consistent with any local pollutant allocations. Many communities throughout Idaho are currently developing rules for

post-construction storm water management. Sediment is usually the main pollutant of concern in storm water from construction sites. The application of specific best management practices from *Idaho's Catalog of Storm Water Best Management Practices for Idaho Cities and Counties* is generally sufficient to meet the standards and requirements of the General Construction Permit, unless local ordinances have more stringent and site specific standards that are applicable. It is presumed that if the requirements of the general construction permit are met than the load allocations for this TMDL will be met as well.

WAG Consultation

DEQ has complied with the WAG consultation requirements set forth in Idaho Code § 39-3611. A WAG was officially formed in May 2004 for the Little Salmon River TMDL. DEQ provided the WAG with information concerning applicable water quality standards, water quality data, monitoring, assessments, reports, procedures, and schedules. The Little Salmon River WAG was officially recognized by DEQ in May of 2004. The group met regularly over the course of the development of the TMDL in New Meadows. In 2005, the WAG met January 31st, April 5th, June 14th, August 23rd, September 15th and December 8th. In 2004, the WAG met on May 17th , July 12th and September 15th.

DEQ utilized the knowledge, expertise, experience and information of the WAG in developing this TMDL. DEQ also provided the WAG with an adequate opportunity to participate in drafting the TMDL, reviewing draft versions of the TMDL and suggesting changes to the document.

Concern from some WAG members was expressed at the high reductions required for Big Creek for bacteria. In particular, those WAG members wondered if these reductions were possible. A WAG member pointed out that the E. coli present from the largely grass fed cows in the Meadows Valley area are far less virulent then the strains of E. coli that are excreted from grain fed cows.

At the end of the September 15, 2005 meeting of the Little Salmon River WAG, the WAG members present voted their approval to go out for public comment with the Little Salmon River TMDL. A public meeting was held on November 10th, 2005. The three WAG members present at a meeting on February 9, 2006 voted their approval to submit the final draft to EPA. Since a majority was not present, a majority vote was solicited by DEQ by mail and email. A majority vote was obtained on February 22nd .

One WAG voting member voted against submitting the TMDL to EPA because he felt that the sections on Mud Creek, Three Mile Creek, Four Mile Creek, Six Mile Creek and Martin Creek were impaired for beneficial uses and that additional data needed to be collected to ascertain whether on not this is the case. He stated that there had been significant discussion of these creeks and whether or not they were impaired but additional monitoring was not conducted during the course of TMDL development.

He stated that Kirk Campbell from the Idaho Department of Agriculture in his report "Little Salmon River Year Two Water Quality Report April 2005 through October 2005" that beneficial uses are impaired from data he collected on the Four Mile Creek site as well as other sites to be higher amounts than what meets the state tolerances. Mr. Campbell also stated at the December

2005 WAG meeting that Four Mile Creek was impaired rather than undetermined. The WAG member stated at that meeting that Leslie Freeman from DEQ would check into the alternatives of listing Three Mile, Four Mile and Martin Creek. That has not been done to this member's satisfaction.

The WAG member went on to state that these creeks are likely to be elevated nutrient/bacteria/temperature transporting streams that flow into the Little Salmon River as described by Kirk Campbell in his report on Four Mile Creek because of their similarity.

Also, DEQ did not include information in the TMDL on proposed monitoring in 2006 of Four Mile, Three Mile, Martin, Squaw and Six Mile Creeks (monitoring that was supported by a vote of the WAG). The member also stated that DEQ did not clearly delineate that lack of information prevented the agency from making a beneficial use support status call on the lower reaches of these creeks (see section 2 for more details on these specific streams). In addition, 2005 monitoring information was not presented in the TMDL.

The Idaho Department of Agriculture will monitor those streams if they can obtain access to them from the landowners in 2006. The WAG member emphasized that documentation of whether or not access was granted by landowners needed to occur in the TMDL in order to lend credibility to the document. Four Mile Creek was monitored sporadically in 2005 and not enough data was collected to make a determination of beneficial use impairment or unimpairment. This past and future monitoring will help delineate nutrient/bacteria loading to the system for the purposes of implementation planning for the mainstem Little Salmon River. If information regarding beneficial use impairment is gathered during this monitoring, it may be submitted to DEQ for 303(d) (integrated report) listing.

5.5 Implementation Strategies

DEQ recognizes that implementation strategies for TMDLs may need to be modified if monitoring shows that the TMDL goals are not being met or significant progress is not being made toward achieving the goals.

Time Frame

Implementation of the TMDL goals will likely rely partly on riparian management in the Little Salmon River watershed. Shrubs can take from 5 years to several decades to mature to their full size. Thus, the timeline for implementation will range from 5-25 years depending upon the BMP selected and the time necessary for the BMP to reach full efficiency.

Approach

The goal of the CWA and its associated administrative rules for Idaho is that water quality standards shall be met or that all feasible steps will be taken towards achieving the highest quality water attainable. This is a long-term goal in this watershed, particularly because nonpoint sources are the primary concern. To achieve this goal, implementation must commence as soon as possible. The approaches used will rely on the best practicable method for the Little Salmon River watershed taking into account cost, efficiency, practicality and applicability. Riparian management will likely be a large part of the temperature TMDL and will also play a

role in the nutrient and bacteria TMDLs. The approaches will be more explicitly outlined in the implementation plan.

The TMDL is a numerical loading that sets pollutant levels such that in-stream water quality standards are met and designated beneficial uses are supported. DEQ recognizes that the TMDL is calculated from mathematical models and other analytical techniques designed to simulate and/or predict very complex physical, chemical, and biological processes. Models and some other analytical techniques are simplifications of these complex processes and, while they are useful in interpreting data and in predicting trends in water quality, they are unlikely to produce an exact prediction of how streams and other water bodies will respond to the application of various management measures. It is for this reason that the TMDL has been established with a MOS.

Following this TMDL submission, in accordance with approved state schedules and protocols, a detailed implementation plan will be prepared for pollutant sources. Implementation strategies will be decided upon by designated agencies and individual landowners to best suit the particular watershed. Implementation typically includes activities like bank stabilization, riparian improvements, grazing management plans, conservation planning, fencing, off-site watering, and road improvements.

For nonpoint sources, DEQ also expects that implementation plans be implemented as soon as practicable. However, DEQ recognizes that it may take some time, from several years to several decades, to fully implement the appropriate management practices. DEQ also recognizes that it may take additional time after implementation has been accomplished before the management practices identified in the implementation plans become fully effective in reducing and controlling pollution.

In addition, DEQ recognizes that it is possible that after application of all reasonable best management practices, some TMDLs or their associated targets and surrogates cannot be achieved as originally established. DEQ will review monitoring data every five years after implementation commences and make determinations regarding whether the TMDL targets need to be modified. Nevertheless, it is DEQ's expectation that nonpoint sources make a good faith effort to achieving their respective load allocations in the shortest practicable time.
DEQ recognizes that expedited implementation of TMDLs will be socially and economically challenging.

Further, there is a desire to *minimize* economic impacts as much as possible when protecting water quality and beneficial uses. DEQ will rely on landowners and designated agencies to select best management practices that are effective and economically feasible for the watershed. DEQ further recognizes that, despite the best and most sincere efforts, natural events beyond the control of humans may interfere with or delay attainment of the TMDL and/or its associated targets and surrogates. Such events could be, but are not limited to floods, fire, insect infestations, and drought. Should such events occur that negate all BMP activities, the appropriateness of reimplementing BMPs will be addressed on a case by case basis. In any case, post event conditions should not be exacerbated by management activities that would hinder the natural recovery of the system.

For some pollutants, pollutant surrogates (i.e. shading for temperature) have been defined as targets for meeting the TMDLs. It is the expectation, however, that the specific implementation plan will address how human activities will be managed to achieve the water quality targets and surrogates. If a nonpoint source that is covered by the TMDL complies with its finalized implementation plan, it will be considered in compliance with the TMDL.

DEQ intends to regularly review progress of the implementation plan. If DEQ determines the implementation plan has been fully implemented, that all feasible management practices have reached maximum expected effectiveness, but a TMDL or its interim targets have not been achieved, DEQ may reopen the TMDL and adjust it or its interim targets.

The implementation of TMDLs and the associated plan is enforceable under the applicable provisions of the water quality standards for point and nonpoint sources by DEQ and other state agencies and local governments in Idaho under specific circumstances. However, it is envisioned that sufficient initiative exists on the part of local stakeholders to achieve water quality goals with minimal enforcement. Should the need for additional effort emerge, it is expected that the responsible agency will work with stakeholders to overcome impediments to progress through education, technical support, or enforcement.

In employing an adaptive management approach to the TMDL and the implementation plan, DEQ has the following expectations and intentions:
• Subject to available resources, DEQ intends to review the progress of the TMDLs and the implementation plans on a five-year basis.
• DEQ expects that designated agencies will also monitor and document their progress in implementing the provisions of the implementation plans for those pollutant sources for which they are responsible. This information will be provided to DEQ for use in reviewing the TMDL.
• DEQ expects that designated agencies will identify benchmarks for the attainment of TMDL targets and surrogates as part of the specific implementation plans being developed. These benchmarks will be used to measure progress toward the goals outlined in the TMDL.
• DEQ expects designated agencies to revise the components of their implementation plan to address deficiencies where implementation of the specific management techniques are found to be inadequate.

If DEQ, in consultation with the designated agencies, concludes that all feasible steps have been taken to meet the TMDL and its associated targets and surrogates, and that the TMDL, or the associated targets and surrogates are not practicable, the TMDL may be reopened and revised as appropriate. DEQ would also consider reopening the TMDL should new information become available indicating that the TMDL or its associated targets and/or surrogates should be modified. This decision will be made based on the availability of resources at DEQ.

Responsible Parties

Responsible parties include local landowners, planned unit developments, Adams and Idaho counties, the city of New Meadows, the USFS, the BLM, and the Idaho Department of Lands. Agencies involved in water quality improvement projects include the NRCS, Idaho Association of Soil Conservation Districts, Idaho Fish and Game, the Bureau of Reclamation, the Idaho Soil

Conservation Commission, the Idaho Department of Agriculture and DEQ. The Nez Perce Tribe is also actively involved in water quality improvement projects in the watershed.

Monitoring Strategy

The monitoring plan developed by the Idaho Department of Agriculture will also be suitable for post implementation monitoring of nutrients and bacteria. Monitoring for temperature can occur with aerial photo analysis or on the ground shading measurements using a solar pathfinder. The actual monitoring schedule and monitoring plan will be outlined in more detail in the implementation plan once BMPs are selected and a timeline for implementation is developed.

The objectives of a monitoring effort are to demonstrate long-term recovery, better understand natural variability, track implementation of projects and BMPs, and track effectiveness of TMDL implementation. This monitoring and feedback mechanism is a major component of the "reasonable assurance of implementation" for the TMDL implementation plan.

The implementation plan will be tracked by accounting for the numbers, types, and locations of projects, BMPs, educational activities, or other actions taken to improve or protect water quality. The mechanism for tracking specific implementation efforts will be annual reports to be submitted to DEQ.

The "monitoring and evaluation" component has two basic categories:
- Tracking the implementation progress of specific implementation plans; and
- Tracking the progress of improving water quality through monitoring physical, chemical, and biological parameters.

Monitoring plans will provide information on progress being made toward achieving TMDL allocations and achieving water quality standards, and will help in the interim evaluation of progress as described under the adaptive management approach.

Implementation plan monitoring has two major components:
- Watershed monitoring
- BMP monitoring.

The designated agencies have primary responsibility for BMP monitoring while DEQ has primary responsibility for watershed monitoring.

5.6 Conclusions

Water quality in the Little Salmon River can be improved and beneficial uses such as cold water aquatic life improved if a concerted effort is made to reduce both nonpoint and point source pollution. This document provides the information necessary to develop an implementation plan that will achieve restoration of beneficial uses.

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GIS Coverages

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Glossary

305(b)	Refers to section 305 subsection "b" of the Clean Water Act. The term "305(b)" generally describes a report of each state's water quality and is the principle means by which the U.S. Environmental Protection Agency, Congress, and the public evaluate whether U.S. waters meet water quality standards, the progress made in maintaining and restoring water quality, and the extent of the remaining problems.
§303(d)	Refers to section 303 subsection "d" of the Clean Water Act. 303(d) requires states to develop a list of water bodies that do not meet water quality standards. This section also requires total maximum daily loads (TMDLs) be prepared for listed waters. Both the list and the TMDLs are subject to U.S. Environmental Protection Agency approval.
Adsorption	The adhesion of one substance to the surface of another. Clays, for example, can adsorb phosphorus and organic molecules
Aeration	A process by which water becomes charged with air directly from the atmosphere. Dissolved gases, such as oxygen, are then available for reactions in water.
Aerobic	Describes life, processes, or conditions that require the presence of oxygen.
Alevin	A newly hatched, incompletely developed fish (usually a salmonid) still in nest or inactive on the bottom of a water body, living off stored yolk.
Algae	Non-vascular (without water-conducting tissue) aquatic plants that occur as single cells, colonies, or filaments.
Alluvium	Unconsolidated recent stream deposition.
Ambient	General conditions in the environment (Armantrout 1998). In the context of water quality, ambient waters are those representative of general conditions, not associated with episodic perturbations or specific disturbances such as a wastewater outfall (EPA 1996).

Anadromous	Fish, such as salmon and sea-run trout, that live part or the majority of their lives in the saltwater but return to fresh water to spawn.
Anaerobic	Describes the processes that occur in the absence of molecular oxygen and describes the condition of water that is devoid of molecular oxygen.
Anthropogenic	Relating to, or resulting from, the influence of human beings on nature.
Anti-Degradation	Refers to the U.S. Environmental Protection Agency's interpretation of the Clean Water Act goal that states and tribes maintain, as well as restore, water quality. This applies to waters that meet or are of higher water quality than required by state standards. State rules provide that the quality of those high quality waters may be lowered only to allow important social or economic development and only after adequate public participation (IDAPA 58.01.02.051). In all cases, the existing beneficial uses must be maintained. State rules further define lowered water quality to be 1) a measurable change, 2) a change adverse to a use, and 3) a change in a pollutant relevant to the water's uses (IDAPA 58.01.02.003.61).
Aquatic	Occurring, growing, or living in water.
Aquifer	An underground, water-bearing layer or stratum of permeable rock, sand, or gravel capable of yielding of water to wells or springs.
Assemblage (aquatic)	An association of interacting populations of organisms in a given water body; for example, a fish assemblage or a benthic macroinvertebrate assemblage (also see Community) (EPA 1996).
Assessment Unit (AU)	A segment of a water body that is treated as a homogenous unit, meaning that any designated uses, the rating of these uses, and any associated causes and sources must be applied to the entirety of the unit.
Batholith	A large body of intrusive igneous rock that has more than 40 square miles of surface exposure and no known floor. A Batholith usually consists of coarse-grained rocks such as granite.

Bedload	Material (generally sand-sized or larger sediment) that is carried along the streambed by rolling or bouncing.
Beneficial Use	Any of the various uses of water, including, but not limited to, aquatic life, recreation, water supply, wildlife habitat, and aesthetics, which are recognized in water quality standards.
Beneficial Use Reconnaissance Program (BURP)	A program for conducting systematic biological and physical habitat surveys of water bodies in Idaho. BURP protocols address lakes, reservoirs, and wadeable streams and rivers
Benthic	Pertaining to or living on or in the bottom sediments of a water body
Best Management Practices (BMPs)	Structural, nonstructural, and managerial techniques that are effective and practical means to control nonpoint source pollutants.
Biochemical Oxygen Demand (BOD)	The amount of dissolved oxygen used by organisms during the decomposition (respiration) of organic matter, expressed as mass of oxygen per volume of water, over some specified period of time.
Biological Integrity	1) The condition of an aquatic community inhabiting unimpaired water bodies of a specified habitat as measured by an evaluation of multiple attributes of the aquatic biota (EPA 1996). 2) The ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the natural habitats of a region (Karr 1991).
Biomass	The weight of biological matter. Standing crop is the amount of biomass (e.g., fish or algae) in a body of water at a given time. Often expressed as grams per square meter.
Biota	The animal and plant life of a given region.
Biotic	A term applied to the living components of an area.

Clean Water Act (CWA)	The Federal Water Pollution Control Act (commonly known as the Clean Water Act), as last reauthorized by the Water Quality Act of 1987, establishes a process for states to use to develop information on, and control the quality of, the nation's water resources.
Coliform Bacteria	A group of bacteria predominantly inhabiting the intestines of humans and animals but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms (also see Fecal Coliform Bacteria, *E. Coli*, and Pathogens).
Community	A group of interacting organisms living together in a given place.
Conductivity	The ability of an aqueous solution to carry electric current, expressed in micro (μ) mhos/centimeter at 25 °C. Conductivity is affected by dissolved solids and is used as an indirect measure of total dissolved solids in a water sample.
Cretaceous	The final period of the Mesozoic era (after the Jurassic and before the Tertiary period of the Cenozoic era), thought to have covered the span of time between 135 and 65 million years ago.
Criteria	In the context of water quality, numeric or descriptive factors taken into account in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels, and to limit the number of violations per year. The U.S. Environmental Protection Agency develops criteria guidance; states establish criteria.
Cubic Feet per Second	A unit of measure for the rate of flow or discharge of water. One cubic foot per second is the rate of flow of a stream with a cross-section of one square foot flowing at a mean velocity of one foot per second. At a steady rate, once cubic foot per second is equal to 448.8 gallons per minute and 10,984 acre-feet per day.
Debris Torrent	The sudden down slope movement of soil, rock, and vegetation on steep slopes, often caused by saturation from heavy rains.
Decomposition	The breakdown of organic molecules (e.g., sugar) to inorganic molecules (e.g., carbon dioxide and water) through biological and nonbiological processes.

Designated Uses	Those water uses identified in state water quality standards that must be achieved and maintained as required under the Clean Water Act.
Discharge	The amount of water flowing in the stream channel at the time of measurement. Usually expressed as cubic feet per second (cfs).
Dissolved Oxygen (DO)	The oxygen dissolved in water. Adequate DO is vital to fish and other aquatic life.
Disturbance	Any event or series of events that disrupts ecosystem, community, or population structure and alters the physical environment.
E. coli	Short for *Escherichia coli*, *E. coli* are a group of bacteria that are a subspecies of coliform bacteria. Most *E. coli* are essential to the healthy life of all warm-blooded animals, including humans, but their presence in water is often indicative of fecal contamination. *E. coli* are used by the state of Idaho as the indicator for the presence of pathogenic microorganisms.
Ecosystem	The interacting system of a biological community and its non-living (abiotic) environmental surroundings.
Effluent	A discharge of untreated, partially treated, or treated wastewater into a receiving water body.
Endangered Species	Animals, birds, fish, plants, or other living organisms threatened with imminent extinction. Requirements for declaring a species as endangered are contained in the Endangered Species Act.
Environment	The complete range of external conditions, physical and biological, that affect a particular organism or community.
Equivalent Clear Cut Area	An indicator of basin condition that is calculated from the total amount of crown removal that has occurred from harvesting, raod building, wildfire, and other activities, based on the current state of vegetative recovery.
Erosion	The wearing away of areas of the earth's surface by water, wind, ice, and other forces.

Exceedance	A violation (according to DEQ policy) of the pollutant levels permitted by water quality criteria.
Existing Beneficial Use or Existing Use	A beneficial use actually attained in waters on or after November 28, 1975, whether or not the use is designated for the waters in Idaho's *Water Quality Standards and Wastewater Treatment Requirements* (IDAPA 58.01.02).
Extrapolation	Estimation of unknown values by extending or projecting from known values.
Fecal Coliform Bacteria	Bacteria found in the intestinal tracts of all warm-blooded animals or mammals. Their presence in water is an indicator of pollution and possible contamination by pathogens (also see Coliform Bacteria, *E. coli*, and Pathogens).
Flow	See *Discharge*.
Fluvial	In fisheries, this describes fish whose life history takes place entirely in streams but migrate to smaller streams for spawning.
Focal	Critical areas supporting a mosaic of high quality habitats that sustain a diverse or unusually productive complement of native species.
Fully Supporting	In compliance with water quality standards and within the range of biological reference conditions for all designated and exiting beneficial uses as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).
Geographical Information Systems (GIS)	A georeferenced database.
Geometric Mean	A back-transformed mean of the logarithmically transformed numbers often used to describe highly variable, right-skewed data (a few large values), such as bacterial data.
Gradient	The slope of the land, water, or streambed surface.

Ground Water	Water found beneath the soil surface saturating the layer in which it is located. Most ground water originates as rainfall, is free to move under the influence of gravity, and usually emerges again as stream flow.
Growth Rate	A measure of how quickly something living will develop and grow, such as the amount of new plant or animal tissue produced per a given unit of time, or number of individuals added to a population.
Habitat	The living place of an organism or community.
Headwater	The origin or beginning of a stream.
Hydrologic Unit	One of a nested series of numbered and named watersheds arising from a national standardization of watershed delineation. The initial 1974 effort (USGS 1987) described four levels (region, subregion, accounting unit, cataloging unit) of watersheds throughout the United States. The fourth level is uniquely identified by an eight-digit code built of two-digit fields for each level in the classification. Originally termed a cataloging unit, fourth field hydrologic units have been more commonly called subbasins. Fifth and sixth field hydrologic units have since been delineated for much of the country and are known as watershed and subwatersheds, respectively.
Hydrologic Unit Code (HUC)	The number assigned to a hydrologic unit. Often used to refer to fourth field hydrologic units.
Hydrology	The science dealing with the properties, distribution, and circulation of water.
Inorganic	Materials not derived from biological sources.
Instantaneous	A condition or measurement at a moment (instant) in time.
Intergravel Dissolved Oxygen	The concentration of dissolved oxygen within spawning gravel. Consideration for determining spawning gravel includes species, water depth, velocity, and substrate.

Land Application	A process or activity involving application of wastewater, surface water, or semi-liquid material to the land surface for the purpose of treatment, pollutant removal, or ground water recharge.
Limiting Factor	A chemical or physical condition that determines the growth potential of an organism. This can result in a complete inhibition of growth, but typically results in less than maximum growth rates.
Load Allocation (LA)	A portion of a water body's load capacity for a given pollutant that is given to a particular nonpoint source (by class, type, or geographic area).
Load(ing)	The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. Loading is the product of flow (discharge) and concentration.
Load(ing) Capacity (LC)	A determination of how much pollutant a water body can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, and a margin of safety, it becomes a total maximum daily load.
Loam	Refers to a soil with a texture resulting from a relative balance of sand, silt, and clay. This balance imparts many desirable characteristics for agricultural use.
Luxury Consumption	A phenomenon in which sufficient nutrients are available in either the sediments or the water column of a water body, such that aquatic plants take up and store an abundance in excess of the plants' current needs.
Macroinvertebrate	An invertebrate animal (without a backbone) large enough to be seen without magnification and retained by a 500µm mesh (U.S. #30) screen.
Macrophytes	Rooted and floating vascular aquatic plants, commonly referred to as water weeds. These plants usually flower and bear seeds.

Margin of Safety (MOS)

An implicit or explicit portion of a water body's loading capacity set aside to allow the uncertainly about the relationship between the pollutant loads and the quality of the receiving water body. This is a required component of a total maximum daily load (TMDL) and is often incorporated into conservative assumptions used to develop the TMDL (generally within the calculations and/or models). The MOS is not allocated to any sources of pollution.

Mass Wasting

A general term for the down slope movement of soil and rock material under the direct influence of gravity.

Mean

Describes the central tendency of a set of numbers. The arithmetic mean (calculated by adding all items in a list, then dividing by the number of items) is the statistic most familiar to most people.

Median

The middle number in a sequence of numbers. If there are an even number of numbers, the median is the average of the two middle numbers. For example, 4 is the median of 1, 2, 4, 14, 16; 6 is the median of 1, 2, 5, 7, 9, 11.

Metric

1) A discrete measure of something, such as an ecological indicator (e.g., number of distinct taxon). 2) The metric system of measurement.

Milligrams per Liter (mg/L)

A unit of measure for concentration. In water, it is essentially equivalent to parts per million (ppm).

Million Gallons per Day (MGD)

A unit of measure for the rate of discharge of water, often used to measure flow at wastewater treatment plants. One MGD is equal to 1.547 cubic feet per second.

Monitoring

A periodic or continuous measurement of the properties or conditions of some medium of interest, such as monitoring a water body.

Mouth

The location where flowing water enters into a larger water body.

National Pollution Discharge Elimination System (NPDES)

A national program established by the Clean Water Act for permitting point sources of pollution. Discharge of pollution from point sources is not allowed without a permit.

Natural Condition	The condition that exists with little or no anthropogenic influence.
Nitrogen	An element essential to plant growth, and thus is considered a nutrient.
Nonpoint Source	A dispersed source of pollutants, generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernable point or origin. They include, but are not limited to, irrigated and non-irrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.
Not Assessed (NA)	A concept and an assessment category describing water bodies that have been studied, but are missing critical information needed to complete an assessment.
Not Fully Supporting	Not in compliance with water quality standards or not within the range of biological reference conditions for any beneficial use as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).
Nuisance	Anything that is injurious to the public health or an obstruction to the free use, in the customary manner, of any waters of the state.
Nutrient	Any substance required by living things to grow. An element or its chemical forms essential to life, such as carbon, oxygen, nitrogen, and phosphorus. Commonly refers to those elements in short supply, such as nitrogen and phosphorus, which usually limit growth.
Organic Matter	Compounds manufactured by plants and animals that contain principally carbon.
Orthophosphate	A form of soluble inorganic phosphorus most readily used for algal growth.
Parameter	A variable, measurable property whose value is a determinant of the characteristics of a system, such as temperature, dissolved oxygen, and fish populations are parameters of a stream or lake.

Pathogens	A small subset of microorganisms (e.g., certain bacteria, viruses, and protozoa) that can cause sickness or death. Direct measurement of pathogen levels in surface water is difficult. Consequently, indicator bacteria that are often associated with pathogens are assessed. *E. coli*, a type of fecal coliform bacteria, are used by the state of Idaho as the indicator for the presence of pathogenic microorganisms.
Perennial Stream	A stream that flows year-around in most years.
Periphyton	Attached microflora (algae and diatoms) growing on the bottom of a water body or on submerged substrates, including larger plants.
pH	The negative $\log_{10}$ of the concentration of hydrogen ions, a measure which in water ranges from very acid (pH=1) to very alkaline (pH=14). A pH of 7 is neutral. Surface waters usually measure between pH 6 and 9.
Phosphorus	An element essential to plant growth, often in limited supply, and thus considered a nutrient.
Physiochemical	In the context of bioassessment, the term is commonly used to mean the physical and chemical factors of the water column that relate to aquatic biota. Examples in bioassessment usage include saturation of dissolved gases, temperature, pH, conductivity, dissolved or suspended solids, forms of nitrogen, and phosphorus. This term is used interchangeable with the term "physical/chemical."
Plankton	Microscopic algae (phytoplankton) and animals (zooplankton) that float freely in open water of lakes and oceans.
Point Source	A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable "point" of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.
Pollutant	Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.

Pollution	A very broad concept that encompasses human-caused changes in the environment which alter the functioning of natural processes and produce undesirable environmental and health effects. This includes human-induced alteration of the physical, biological, chemical, and radiological integrity of water and other media.
Population	A group of interbreeding organisms occupying a particular space; the number of humans or other living creatures in a designated area.
Protocol	A series of formal steps for conducting a test or survey.
Quantitative	Descriptive of size, magnitude, or degree.
Reach	A stream section with fairly homogenous physical characteristics.
Reconnaissance	An exploratory or preliminary survey of an area.
Reference	A physical or chemical quantity whose value is known and thus is used to calibrate or standardize instruments.
Reference Condition	1) A condition that fully supports applicable beneficial uses with little effect from human activity and represents the highest level of support attainable. 2) A benchmark for populations of aquatic ecosystems used to describe desired conditions in a biological assessment and acceptable or unacceptable departures from them. The reference condition can be determined through examining regional reference sites, historical conditions, quantitative models, and expert judgment (Hughes 1995).
Reference Site	A specific locality on a water body that is minimally impaired and is representative of reference conditions for similar water bodies.
Resident	A term that describes fish that do not migrate.
Respiration	A process by which organic matter is oxidized by organisms, including plants, animals, and bacteria. The process converts organic matter to energy, carbon dioxide, water, and lesser constituents.

Riffle	A relatively shallow, gravelly area of a streambed with a locally fast current, recognized by surface choppiness. Also an area of higher streambed gradient and roughness.
Riparian	Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a water body.
River	A large, natural, or human-modified stream that flows in a defined course or channel or in a series of diverging and converging channels.
Runoff	The portion of rainfall, melted snow, or irrigation water that flows across the surface, through shallow underground zones (interflow), and through ground water to creates streams.
Sediments	Deposits of fragmented materials from weathered rocks and organic material that were suspended in, transported by, and eventually deposited by water or air.
Settleable Solids	The volume of material that settles out of one liter of water in one hour.
Species	1) A reproductively isolated aggregate of interbreeding organisms having common attributes and usually designated by a common name. 2) An organism belonging to such a category.
Spring	Ground water seeping out of the earth where the water table intersects the ground surface.
Stream	A natural water course containing flowing water, at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.
Stream Order	Hierarchical ordering of streams based on the degree of branching. A first-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher order streams result from the joining of two streams of the same order.

Storm Water Runoff	Rainfall that quickly runs off the land after a storm. In developed watersheds the water flows off roofs and pavement into storm drains that may feed quickly and directly into the stream. The water often carries pollutants picked up from these surfaces.
Subbasin	A large watershed of several hundred thousand acres. This is the name commonly given to 4th field hydrologic units (also see Hydrologic Unit).
Subbasin Assessment (SBA)	A watershed-based problem assessment that is the first step in developing a total maximum daily load in Idaho.
Subwatershed	A smaller watershed area delineated within a larger watershed, often for purposes of describing and managing localized conditions. Also proposed for adoption as the formal name for 6th field hydrologic units.
Surface Fines	Sediments of small size deposited on the surface of a streambed or lake bottom. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 605 millimeters depending on the observer and methodology used. Results are typically expressed as a percentage of observation points with fine sediment.
Surface Water	All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors that are directly influenced by surface water.
Suspended Sediments	Fine material (usually sand size or smaller) that remains suspended by turbulence in the water column until deposited in areas of weaker current. These sediments cause turbidity and, when deposited, reduce living space within streambed gravels and can cover fish eggs or alevins.

Total Maximum Daily Load (TMDL)

A TMDL is a water body's load capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual bases. A TMDL is equal to the load capacity, such that load capacity = margin of safety + natural background + load allocation + wasteload allocation = TMDL. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.

Total Suspended Solids (TSS)

The dry weight of material retained on a filter after filtration. Filter pore size and drying temperature can vary. American Public Health Association Standard Methods (Franson et al. 1998) call for using a filter of 2.0 microns or smaller; a 0.45 micron filter is also often used. This method calls for drying at a temperature of 103-105 °C.

Tributary

A stream feeding into a larger stream or lake.

Trophic State

The level of growth or productivity of a lake as measured by phosphorus content, chlorophyll *a* concentrations, amount (biomass) of aquatic vegetation, algal abundance, and water clarity.

Turbidity

A measure of the extent to which light passing through water is scattered by fine suspended materials. The effect of turbidity depends on the size of the particles (the finer the particles, the greater the effect per unit weight) and the color of the particles.

Wasteload Allocation (WLA)

The portion of receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. Wasteload allocations specify how much pollutant each point source may release to a water body.

Water Body

A stream, river, lake, estuary, coastline, or other water feature, or portion thereof.

Water Column

Water between the interface with the air at the surface and the interface with the sediment layer at the bottom. The idea derives from a vertical series of measurements (oxygen, temperature, phosphorus) used to characterize water.

Water Pollution	Any alteration of the physical, thermal, chemical, biological, or radioactive properties of any waters of the state, or the discharge of any pollutant into the waters of the state, which will or is likely to create a nuisance or to render such waters harmful, detrimental, or injurious to public health, safety, or welfare; to fish and wildlife; or to domestic, commercial, industrial, recreational, aesthetic, or other beneficial uses.
Water Quality	A term used to describe the biological, chemical, and physical characteristics of water with respect to its suitability for a beneficial use.
Water Quality Criteria	Levels of water quality expected to render a body of water suitable for its designated uses. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, or industrial processes.
Water Quality Limited	A label that describes water bodies for which one or more water quality criterion is not met or beneficial uses are not fully supported. Water quality limited segments may or may not be on a §303(d) list.
Water Quality Limited Segment (WQLS)	Any segment placed on a state's §303(d) list for failure to meet applicable water quality standards, and/or is not expected to meet applicable water quality standards in the period prior to the next list. These segments are also referred to as "§303(d) listed."
Water Quality Management Plan	A state or area-wide waste treatment management plan developed and updated in accordance with the provisions of the Clean Water Act.
Water Quality Standards	State-adopted and U.S. Environmental Protection Agency-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.
Water Table	The upper surface of ground water; below this point, the soil is saturated with water.

Watershed	1) All the land which contributes runoff to a common point in a drainage network, or to a lake outlet. Watersheds are infinitely nested, and any large watershed is composed of smaller "subwatersheds." 2) The whole geographic region which contributes water to a point of interest in a water body.
Water Body Identification Number (WBID)	A number that uniquely identifies a water body in Idaho and ties into the Idaho water quality standards and GIS information.
Wetland	An area that is at least some of the time saturated by surface or ground water so as to support vegetation adapted to saturated soil conditions. Examples include swamps, bogs, fens, and marshes.
Young of the Year	Young fish born the year captured, evidence of spawning activity.

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Appendix A. Unit Conversion Chart

Table A-1. Metric - English unit conversions.

	English Units	Metric Units	To Convert	Example
Distance	Miles (mi)	Kilometers (km)	1 mi = 1.61 km 1 km = 0.62 mi	3 mi = 4.83 km 3 km = 1.86 mi
Length	Inches (in) Feet (ft)	Centimeters (cm) Meters (m)	1 in = 2.54 cm 1 cm = 0.39 in 1 ft = 0.30 m 1 m = 3.28 ft	3 in = 7.62 cm 3 cm = 1.18 in 3 ft = 0.91 m 3 m = 9.84 ft
Area	Acres (ac) Square Feet (ft^2) Square Miles (mi^2)	Hectares (ha) Square Meters (m^2) Square Kilometers (km^2)	1 ac = 0.40 ha 1 ha = 2.47 ac 1 ft^2 = 0.09 m^2 1 m^2 = 10.76 ft^2 1 mi^2 = 2.59 km^2 1 km^2 = 0.39 mi^2	3 ac = 1.20 ha 3 ha = 7.41 ac 3 ft^2 = 0.28 m^2 3 m^2 = 32.29 ft^2 3 mi^2 = 7.77 km^2 3 km^2 = 1.16 mi^2
Volume	Gallons (gal) Cubic Feet (ft^3)	Liters (L) Cubic Meters (m^3)	1 gal = 3.78 L 1 L= 0.26 gal 1 ft^3 = 0.03 m^3 1 m^3 = 35.32 ft^3	3 gal = 11.35 L 3 L = 0.79 gal 3 ft^3 = 0.09 m^3 3 m^3 = 105.94 ft^3
Flow Rate	Cubic Feet per Second (cfs)[a]	Cubic Meters per Second (m^3/sec)	1 cfs = 0.03 m^3/sec 1 m^3/sec = 35.31cfs	3 ft^3/sec = 0.09 m^3/sec 3 m^3/sec = 105.94 ft^3/sec
Concentration	Parts per Million (ppm)	Milligrams per Liter (mg/L)	1 ppm = 1 mg/L[b]	3 ppm = 3 mg/L
Weight	Pounds (lbs)	Kilograms (kg)	1 lb = 0.45 kg 1 kg = 2.20 lbs	3 lb = 1.36 kg 3 kg = 6.61 lb
Temperature	Fahrenheit (°F)	Celsius (°C)	°C = 0.55 (F - 32) °F = (C x 1.8) + 32	3 °F = -15.95 °C 3 °C = 37.4 °F

[a] 1 cfs = 0.65 million gallons per day; 1 million gallons per day is equal to 1.55 cfs.

[b] The ratio of 1 ppm = 1 mg/L is approximate and is only accurate for water.

Appendix B. Distribution List

Little Salmon River Watershed Advisory Group

Victor Armacost, Chairman
Albert Becker
Jim Blair
Doug Boggan
Bill Brown
Steve Campbell
Darrell Campbell
Ferrel Crossley
Dean Dryden
Linnea Hall
John Lillehaug
Brian O'Morrow
Neal Osborn
Ed Raney
Sandy Schiffman
New Meadows Ranger District (position vacant)

Little Salmon River Technical Advisory Committee

Dale Allen, Idaho Fish and Game
Kim Apperson, Idaho Fish and Game
Kirk Campbell, Idaho Department of Agriculture
Kalissa Copeland, Idaho Association of Soil Conservation Districts
Craig Johnson, BLM
Russ Manwaring, West Central Highlands Resource Conservation District
Felix McGowan, Nez Perce Tribe
Jim Paradiso, USFS
Tom Yankey, NRCS

New Meadows Public Library

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Appendix C. Additional Data and Load Equations

Little Salmon River

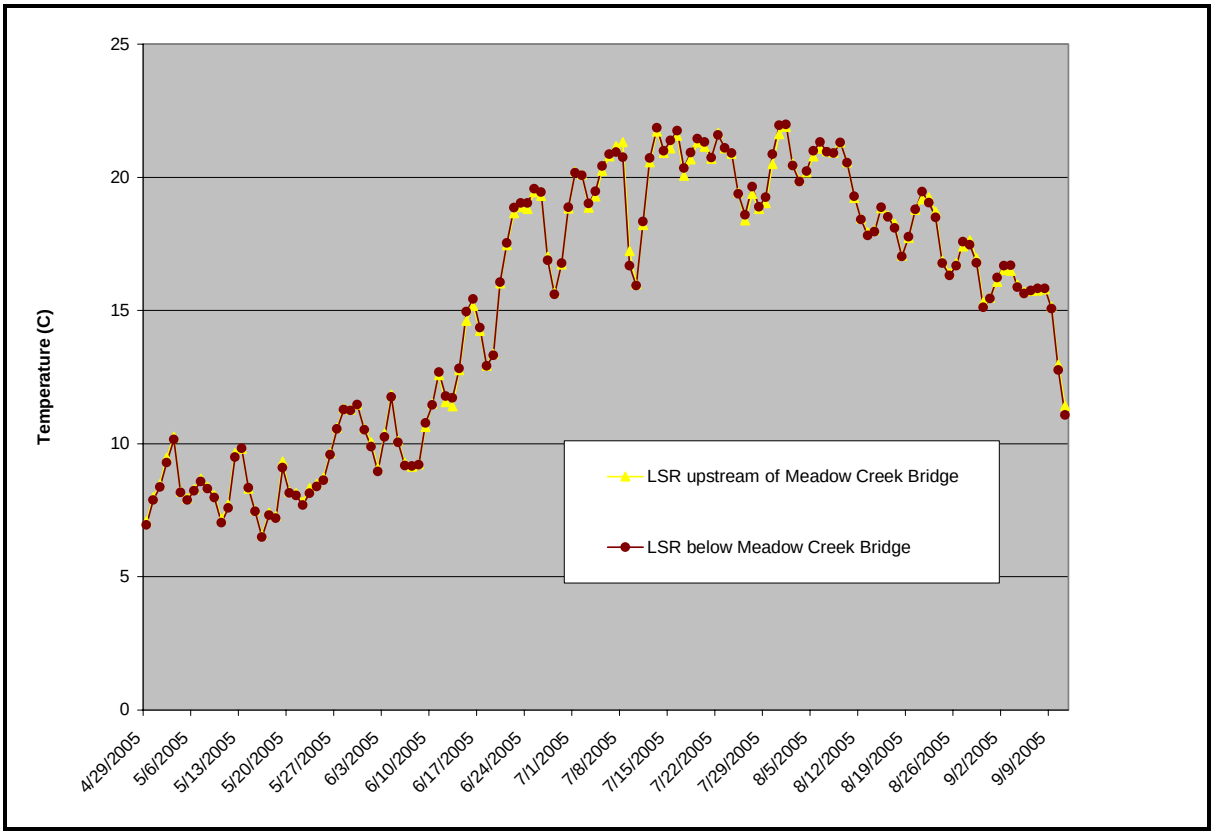


Figure C-1 Little Salmon River 2005 Average Daily Temperature Data near the 45th Parallel.

Table C-1. LSR 1 (Little Salmon River at Riggins) 2004 Results

LSR-1 (Riggins Bridge)								
Date	Cond.	TDS	pH	Discharge	SSC	TP	OP	NO3
4/15/2004					no sample			
4/29/2004	74	38	7.82	1150	6.5	<0.05	<0.05	
5/13/2004	69	37	7.71	1220	5.3	<0.05	<0.05	
5/26/2004	59	31	7.71	1670	4.9	<0.05	<0.05	
6/10/2004	53	26	7.82	2020	7.1	<0.05	<0.05	
6/23/2004	68	37	7.76	995	0.7	<0.05	<0.05	
7/8/2004	100	52	7.84	486	1.4	<0.05	<0.05	
7/22/2004	115	58	7.88	311	2	<0.05	<0.05	<0.2
8/4/2004	132	68	7.97	224	2.5	<0.05	<0.05	<0.2
8/19/2004	140	72	7.99	206	1.4	<0.05	<0.05	3.3
8/31/2004	123	62	7.8	243	1.8	<0.05	<0.05	<0.2
9/16/2004	108	58	7.78	347	2.9	<0.05	<0.05	<0.2
9/29/2004	122	61	7.73	249	1	<0.05	<0.05	<0.2

Table C-2. LSR 2 (Little Salmon River at White Bird Ridge Road) 2004 Results

LSR-2 (Whitebird)											
Date	DO	Temp	%Sat	Cond.	TDS	pH	Discharge	SSC	TP	OP	NO3
4/15/2004	12.53	5.3	97.7	64	31	7.96	NA	5.2	<0.05	<0.05	
4/29/2004	12.88	5.1	101.1	47	24	7.74	NA	4.8	<0.05	<0.05	
5/13/2004	12.64	5.3	99.9	45	23	7.63	854	1.7	<0.05	<0.05	
5/26/2004	11.48	8.2	96.8	48	25	7.66	1208	5.1	<0.05	<0.05	
6/10/2004	11.22	9.6	98.9	48	24	7.84	1688	5.1	<0.05	<0.05	
6/23/2004	10.73	12.3	100.7	41	21	7.71	691	<0.3	<0.05	<0.05	
7/8/2004	10.93	12.4	105	82	42	7.92	326	0.9	<0.05	<0.05	
7/22/2004	8.41	16.2	86.3	84	42	7.87	217	0.9	<0.05	<0.05	<0.2
8/4/2004	9.1	16.1	92.3	100	50	7.99	114	0.5	<0.05	<0.05	<0.2
8/19/2004	9.16	16.6	93.6	116	53	8.07	117	1.3	0.06	<0.05	0.5
8/31/2004	8.93	14.9	88.5	88	45	7.92	148.5	1.1	<0.05	<0.05	<0.2
9/16/2004	10.55	11.1	92.7	74	38	7.79	221.3	2.6	<0.05	<0.05	<0.2
9/29/2004	10.85	10.6	97.3	82	41	7.84	163	1.3	<0.05	<0.05	<0.2
10/14/2004	11.37	6.9	93.6	92	46	7.73					
			Discharge NA not enough weight for stable flow measurements								

Brundage Reservoir

Table C-3. July 12, 2005 Brundage Reservoir 2:00 pm

Depth (m)	Temperature (C)
1	16.8
2	16.43
3	16.21
4	16.15
5	14.42
6	12.39
7	11.69
8	11
9	10.79
10	10.49
11	10.21
12	9.66

Table C-4. July 19, 2005 Brundage Reservoir 6:00 pm

Depth (m)	Temperature (C)
1	11.55
2	11.94
3	12.32
4	12.73
5	14.14
6	18.23
7	18.54
8	18.61
9	18.64
10	18.66

Table C-5. July 26, 2005 Brundage Reservoir 5:45 pm

Depth (m)	Temperature
1	19.43
2	19.28
3	18.76
4	18.63
5	18.27
6	17.37
7	15.66
8	14.11
9	13.09
10	12.13

Table C-6 August 2, 2005 Brundage Reservoir 7:00 pm

Depth (m)	Temperature (C)
1	19.82
2	19.82
3	19.79
4	19.23
5	19.06
6	18.17
7	16.99
8	16.13
9	15.41
10	14.91

Table C-7. August 9, 2005, Brundage Reservoir 5:30 pm

Depth (m)	Temperature (C)
1	20.82
2	20.63
3	20.1
4	20
5	19.66
6	19.25
7	18.46
8	18.43

August 18, 2005 6:45

Reading at 1 meter below the surface: 19.11 degrees Celsius
Another reading at 2 meters below the surface: 18.77 degrees Celsius. Water obviously met standard so stopped measurements.

Load Equation:

For loads in kg/day: ((pollutant target concentration in ug/L*(flow in cfs*28.32 conversion factor of liters/cf)*60 seconds*60 minutes*24 hours)/1000000)/1000

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Appendix D. Tributary Temperature Analysis

Tributaries to the Little Salmon River in the meadows area generally flow from the east or west, from surrounding forested mountains to the Meadow Valley. The two largest drainages, Goose Creek and Mud Creek drain south through mountain valleys that parallel the river until they turn southeast (Mud Creek) or west (Goose Creek) to enter the Meadows Valley. Potential natural vegetation along these tributaries is assumed to vary from open coniferous forest in the headwaters, to a forest/shrub mix at the interface with forests, then onto a shrub/grass meadow community in the smaller meadows that line most of the tributaries at lower elevations. Actual shrub species may vary from alders and dogwoods to willows, but all are willow-like in stature and shade potential, and assumed to be more dominant along the stream than grass. A number of the tributaries pass through a grass meadow as they cross the Meadow Valley, where grass is assumed to be the more dominant component along streams with some willow-like shrubs as a minor component.

The thermal infrared flyover done in August 2004 combined with actual flow information and hydrological modeling, showed that the volume of the river became great enough just above Four Mile Creek that tributary contributions of water to the Little Salmon River had no effect on temperature. Thus, this TMDL examines tributaries from Vick Creek up to Four Mile Creek.

For each tributary, the plant community varies from coniferous forest in the headwaters, to a forest/shrub mix community at the interface, a willow-like shrub community in the smaller meadows, and a grass/willow community on most tributaries in the Meadow Valley area. Each stream and community type has varying widths depending on the size of the drainage area for the tributary. Loading capacities for tributaries (Tables D-4 through D-12) vary according to shade targets (Table D-2, Figure D-1) with forests having shade targets between 50% (0.5) and 80% (0.8) down to grass/willow areas with targets between 5% (0.05) and 20% (0.2).

For determining targets, channel width was determined as shown in Table D-1.

Existing shade on the tributaries varied from 50-80% in forested headwaters to 0% in grass/willow areas of Meadow Valley as shown in tables 2-13 below.

Although it may seem like the streams needing the largest reduction in solar load to meet their targets are the worst streams, in reality it is the larger drainages that can contribute the most excess load to the Little Salmon River. However, this is also dependent upon flow and some of the larger drainages like Goose Creek are managed for flow such that the return flow into the Little Salmon River does not reflect natural conditions. Determining the best places for load reductions will need to be worked out in the implementation plan, using local knowledge of natural conditions.

Table D-1. Drainage Area Size and Natural Stream Width.

Drainage	Area (acres)	Area ($miles^2$)	Natural width at Mouth (m)
Mud Creek	20,323	31.8	12 (39.37 ‘)
Big Creek	18,580	29	12 (39.37’)
Little Creek	11,786	18.4	9 (29.53’)
Goose Creek	25,700	40	12 (39.37’)
Threemile Creek	4,497	7	5 (16.4’)
Fourmile and Martin Creeks (+ west side drainages)	8,983	14	2-3 (6.56’-9.84’)

Table D-2. Excess Load (Existing Minus Potential) for Drainages in the Little Salmon River Meadows Area.

Water Body	Excess Load (kWh/day)
Little Salmon River	365,630
Upper Goose Creek	16,942
Mud Creek	95,694
Big Creek	93,846
West Branch Goose Creek	68,998
East Branch Goose Creek	76,391
Little Mud Creek	46,615
Little Creek	43,227
Threemile Creek	34,499
Middle Mud Creek	17,044
Vick Creek	9,245
Mill Creek	7,190

Table D-3. Existing and Potential Solar Loads for Little Creek.

Segment Length (~miles)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	**Little Creek**
1	0.5	3.19	0.8	1.276	-1.91	forest/shrub-13.1’
0.3	0.3	4.466	0.5	3.19	-1.28	willow-13.1’
0.4	0.4	3.828	0.5	3.19	-0.64	willow
0.3	0.3	4.466	0.5	3.19	-1.276	willow
0.4	0.4	3.828	0.8	1.276	-2.552	forest/shrub-13.1’
0.5	0.3	4.466	0.4	3.828	-0.638	willow-16.4’
0.4	0.2	5.104	0.4	3.828	-1.276	willow
2.5	0.1	5.742	0.1	5.742	0	grass/willow-23’
0.6	0.1	5.742	0.3	4.466	-1.276	willow-29.5’
Segment Length (feet)	Segment Area (feet2)	Existing Summer Load (kWh/day)	Natural Stream Width (feet)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
5277.5	69262.1	20535	13.1	8214	-12321	
1584.2	20777.6	8625	13.1	6161	-2464	
2112.3	27707	9857	13.1	8214	-1643	
1584.2	20777.6	8625	13.1	6161	-2464	
2112.3	27707	9857	13.1	3286	-6571	
2640.4	43287.5	17968	16.4	15401	-3850	
2112.3	34636.4	16428	16.4	12321	-5134	
13195.4	303044.6	161715	23	161715	0	
3168.5	93504.4	49901	29.5	38812	-13861	**% Reduction**
Total	**104801**	**303,511**		**260,824**	**-43,227**	**-14**

Table D-4. Existing and Potential Solar Loads for West Branch Goose Creek.

Segment Length (~miles)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	**West Branch**
0.5	0.4	3.828	0.6	2.552	-1.28	forest/shrub-39.5'
0.2	0.3	4.466	0.6	2.552	-1.91	
0.3	0.4	3.828	0.6	2.552	-1.28	
0.1	0.2	5.104	0.6	2.552	-2.552	
0.5	0.5	3.19	0.6	2.552	-0.638	
0.2	0.4	3.828	0.6	2.552	-1.276	
0.2	0.2	5.104	0.6	2.552	-2.552	
0.9	0.1	5.742	0.1	5.742	0	grass/willow-39.5'
0.5	0.2	5.104	0.3	4.466	-0.638	willow-39.5'
0.5	0.1	5.742	0.1	5.742	0	grass/willow-39.5'
0.2	0.2	5.104	0.3	4.466	-0.638	willow-39.5'
0.3	0.1	5.742	0.3	4.466	-1.276	
Segment Length (feet)	Segment Area (feet2)	Existing Summer Load (kWh/day)	Natural Stream Width (feet)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
2640.4	103319.2	36963	39.5	24642	-12321	
1056.2	41555.1	17250	39.5	9857	-7393	
1584.2	62343.4	22178	39.5	14785	-7393	
528.1	20777.6	9857	39.5	4928	-4928	
2640.4	103319.2	30803	39.5	24642	-6161	
1056.2	41555.1	14785	39.5	9857	-4928	
1056.2	41555.1	19714	39.5	9857	-9857	
4749.4	57027	99801	39.5	99801	0	
2640.4	103319.2	49285	39.5	43124	-6161	
2640.4	103319.2	55445	39.5	55445	0	
1056.2	41555.1	19714	39.5	17250	-2464	
1584.2	62343.4	33267	39.5	25874	-7393	**% Reduction**
Total	**914309.9**	**409,062**		**340,063**	**-68,998**	**-17**

Table D-5. Existing and Potential Solar Loads for East Branch Goose Creek.

Segment Length (~miles)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	**East Branch**
0.1	0.2	5.104	0.6	2.552	-2.55	forest/shrub-39.5'
0.3	0.3	4.466	0.6	2.552	-1.91	
0.3	0.4	3.828	0.6	2.552	-1.28	
0.1	0.3	4.466	0.6	2.552	-1.914	
0.1	0.2	5.104	0.3	4.466	-0.638	willow-39.5'
0.5	0.4	3.828	0.6	2.552	-1.276	forest/shrub-39.5'
0.3	0.2	5.104	0.3	4.466	-0.638	willow-39.5'
0.2	0.1	5.742	0.3	4.466	-1.276	
0.2	0.2	5.104	0.3	4.466	-0.638	
0.6	0	6.38	0.1	5.742	-0.638	grass/willow-39.5'
0.5	0.1	65.742	0.1	5.742	0	
0.9	0	6.38	0.1	5.742	-0.638	
0.1	0.1	5.742	0.3	4.466	-1.276	willow-39.5'
0.1	0	6.38	0.3	4.466	-1.914	
Segment Length (feet)	Segment Area (m2)	Existing Summer Load (kWh/day)	Natural Stream Width (feet)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
528.1	20777.6	9857	39.5	4928	-4928	
1584.2	62343.4	25874	39.5	14785	-11089	
1584.2	62343.4	22178	39.5	14785	-7393	
528.1	20777.6	8625	39.5	4928	-3696	
528.1	20777.6	9857	39.5	8625	-1232	
2640.4	103319.2	36963	39.5	24642	-12321	
1584.2	62343.4	29571	39.5	25874	-3696	
1056.2	41555.1	22178	39.5	17250	-4928	
1056.2	41555.1	19714	39.5	17250	-2464	
3168.5	124676.1	73927	39.5	66534	-7393	
2640.4	103319.2	55445	39.5	55445	0	
4749.4	187019.6	110890	39.5	99801	-11089	
528.1	20777.6	11089	39.5	8625	-2464	
528.1	20777.6	12321	39.5	8625	-3696	**% Reduction**
Total	**893531.9**	**448,489**		**372,098**	**-76,391**	**-17**

Table D-6. Existing and Potential Solar Loads for Upper Goose Creek.

Segment Length (~miles)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	**Upper Goose (from Goose Lake)**
0.8	0.4[a]	3.828	0.5	3.19	-1	forest-49.2'
0.3	0.3[b]	4.466	0.5	3.19	-1	
0.5	0.5	3.19	0.5	3.19	0	
1.2	0.6	2.552	0.5	3.19	-0.638	
0.4	0.5	3.19	0.5	3.19	0	
0.5	0.4	3.828	0.5	3.19	-0.638	
0.6	0.3	4.466	0.5	3.19	-1.276	
0.6	0.5	3.19	0.5	3.19	0	
2.1	0.6[c]	2.552	0.5	3.19	-0.638	
1.7	0.5	3.19	0.5	3.19	0	
0.1	0.4	3.828	0.5	3.19	-0.638	
0.1	0.3	4.466	0.5	3.19	-1.276	
0.2	0.6[d]	2.552	0.5	3.19	-0.638	
0.1	0.3[e]	4.466	0.5	3.19	-1.276	forest/shrub-49.2'
0.4	0.4	3.828	0.5	3.19	-0.638	
0.2	0.2	5.104	0.5	3.19	-1.914	
Segment Length (feet)	Segment Area (feet2)	Existing Summer Load (kWh/day)	Natural Stream Width (feet)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
4221.4	207797.1	73927	49.2	61606	-12321	
1584.2	77923.9	32343	49.2	23102	-9241	
2640.4	129873.2	38504	49.2	38504	0	
6333.7	311695.7	73927	49.2	92409	-18482	
2112.3	103319.2	30803	49.2	30803	0	
2640.4	129873.2	46204	49.2	38504	-7701	
3168.5	155847.8	64686	49.2	46204	-18482	
3168.5	155847.8	46204	49.2	46204	0	
11086.4	545467.4	129372	49.2	161715	-32343	
8974.1	441568.9	130912	49.2	130912	0	
528.1	2593.2	9241	49.2	7701	-1540	
528.1	2593.2	10781	49.2	7701	-3080	
1056.2	51949.3	12321	49.2	15401	-3080	
528.1	2593.2	10781	49.2	7701	-3080	
2112.3	103319.2	36963	49.2	30803	-6161	
1056.2	51949.3	24642	49.2	15401	-9241	**% Reduction**
Total	**2363703**	**771,611**		**754,670**	**-16,942**	**-2**

a = solar pathfinder measured 32% shade; b = solar pathfinder measured 28% shade; c = solar pathfinder measured 57%; d = solar pathfinder measured 63%; e = solar pathfinder measured 26%.

Table D-7. Existing and Potential Solar Loads for Threemile Creek.

Segment Length (~miles)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	**Threemile**
2.2	0.7	1.914	0.8	1.276	-.64	forest-6.6’
1.1	0.6	2.552	0.8	1.276	-1.28	
0.2	0.4	3.828	0.8	1.276	-2.55	forest/shrub-9.8’
0.3	0.3	4.466	0.8	1.276	-3.19	
0.8	0	6.38	0.2	5.104	-1.276	grass/willow-13.1’
0.3	0.4	3.828	0.5	3.19	-0.638	willow-13.1’
1.3	0	6.38	0.1	5.742	-0.638	grass/willow-16.4’
0.3	0	6.38	0.4	3.828	-2.552	willow-16.4’
Segment Length (feet)	Segment Area (feet2)	Existing Summer Load (kWh/day)	Natural Stream Width (feet)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
11614.5	38424	6777	3.3	4518	-2259	
5805.6	38424	9036	6.6	4518	-4518	
1056.2	10394.2	3696	9.8	1232	-2464	
1584.2	15580.5	6469	9.8	1848	-4620	
4221.4	55414	32856	13.1	26285	-6571	
1584.2	20777.6	7393	13.1	6161	-1232	
6861.8	111932.7	66739	16.4	60066	-6674	
1584.2	2593.2	15401	16.4	9241	-6161	**% Reduction**
Total	**316892.8**	**148,367**		**113868**	**-34,499**	**-23**

Table D-8. Existing and Potential Solar Loads for Vick Creek.

Segment Length (~miles)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	**Vick Creek**
2	0.8	1.276	0.8	1.276	0	forest-6.6'
0.3	0.7	1.914	0.8	1.276	-0.64	forest/shrub-9.8'
0.2	0.6	2.552	0.8	1.276	-1.28	
0.3	0.7	1.914	0.8	1.276	-0.638	
0.4	0.3	4.466	0.6	2.552	-1.914	willow-9.8'
0.4	0.4	3.828	0.6	2.552	-1.276	
Segment Length (feet)	Segment Area (feet^2)	Existing Summer Load (kWh/day)	Natural Stream Width (feet)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
10558.3	69272.9	8215	6.6	8215	0	
1584.2	15591.2	2773	9.8	1849	-924	
1056.2	10394.2	2465	9.8	1233	-1233	
1584.2	15591.2	2773	9.8	1849	-924	
2112.3	70778.3	8628	9.8	4930	-3698	
2112.3	70778.3	7396	9.8	4930	-2465	**% Reduction**
Total	**152426.2**	**32,251**		**23,006**	**-9,245**	**-29**

Table D-9. Existing and Potential Solar Loads for Mill Creek.

Segment Length (~miles)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	**Mill Creek**
1.3	0.8	1.276	0.8	1.276	0	forest-6.6'
0.5	0.7	1.914	0.8	1.276	-0.64	
0.3	0.5	3.19	0.8	1.276	-1.91	
0.2	0.5	3.19	0.8	1.276	-1.914	forest/shrub-6.6'
0.2	0.3	4.466	0.5	3.19	-1.276	willow-9,.8'
0.2	0.2	5.104	0.5	3.19	-1.914	
Segment Length (feet)	Segment Area (feet2)	Existing Summer Load (kWh/day)	Natural Stream Width (feet)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
6861.8	22509.9	2669	3.3	2669	0	
2640.4	17323.6	3082	6.6	2054	-1027	
1584.2	10394.2	3082	6.6	1233	-1849	
1056.2	6929.4	2054	6/6	822	-1233	
1056.2	10394.2	4314	9.8	3082	-1233	
1056.2	10394.2	4930	9.8	3082	-1849	**% Reduction**
Total	**77945.4**	**20,131**		**12,941**	**-7190**	**-36**

Table D-10. Existing and Potential Solar Loads for Mud Creek.

Segment Length (~miles)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	**Mud Creek**
0.6	0.8	1.276	0.8	1.276	0	forest-6.6'
3.5	0.7[a]	1.914	0.8	1.276	-0.64	forest
0.3	0.6	2.552	0.8	1.276	-1.28	forest
0.2	0.5	3.19	0.8	1.276	-1.914	forest/shrub-9.8'
0.5	0.3[b]	4.466	0.5	3.19	-1.276	willow-9.8'
0.2	0.5	3.19	0.5	3.19	0	willow
0.7	0.4	3.828	0.5	3.19	-0.638	willow
1.1	0.3	4.466	0.5	3.19	-1.276	willow
0.4	0.2	5.104	0.5	3.19	-1.914	willow
0.2	0.5	3.19	0.7	1.914	-1.276	forest/shrub-23.5'
0.7	0.4	3.828	0.4	3.828	0	willow-23.5'
0.7	0.3	4.466	0.4	3.828	-0.638	willow
0.7	0.2	5.104	0.4	3.828	-1.276	willow
3.5	0.2	5.104	0.3	4.466	-0.638	willow
0.7	0.2	5.104	0.3	4.466	-0.638	willow
Segment Length (feet)	Segment Area (feet2)	Existing Summer Load (kWh/day)	Natural Stream Width (feet)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
3168.5	20777.6	2464	6.6	2464	0	
18476.2	121211.4	21562	6.6	14375	-7187	
1584.2	10394.2	2464	6.6	1232	1232	
1056.2	10394.2	3080	9.8	1232	-1848	
2640.4	2593.2	10781	9.8	7701	-3080	
1056.2	10394.2	3080	9.8	3080	0	
3696.6	36368.8	12937	9.8	10781	-2156	
5805.6	57146.4	23718	9.8	16942	-6777	
2112.3	20777.6	9857	9.8	6161	-3696	
1056.2	24007.1	7187	23	4312	-2875	
3696.6	84853.4	30187	23	30187	0	
3696.6	84853.4	35218	23	30187	-5031	
3696.6	84853.4	40249	23	30187	-10062	
18476.2	118961.9	344992	39.5	301868	-43124	
3696.6	145453.7	68998	39.5	60374	-8625	**% Reduction**
Total	**388984.8**	**616,776**		**521,081**	**-95,694**	**-16**

a = solar pathfinder measured 71% shade; b = solar pathfinder measured 26% shade.

Table D-11. Existing and Potential Solar Loads for Little Mud Creek.

Segment Length (~miles)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target/ Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	**Little Mud**
0.2	0.8	1.276	0.8	1.276	0	forest-3.28 ‘
1	0.7	1.914	0.8	1.276	-0.64	forest
0.6	0.6	2.552	0.8	1.276	-1.28	forest
0.4	0.5	3.19	0.8	1.276	-1.914	forest/shrub-6.6 ‘
0.4	0.3	4.466	0.7	1.914	-2.552	willow-6.6’
0.5	0.2	5.104	0.7	1.914	-3.19	willow
0.3	0.5	3.19	0.8	1.276	-1.914	forest/shrub-9.8’
0.2	0.4	3.828	0.8	1.276	-2.552	forest/shrub
0.1	0.6	2.552	0.8	1.276	-1.276	forest/shrub
0.2	0.3	4.466	0.5	3.19	-1.276	willow-9.8’
0.5	0.2	5.104	0.5	3.19	-1.914	willow
1.6	0.3	4.466	0.5	3.19	-1.276	willow
0.3	0.2	5.104	0.5	3.19	-1.914	willow
0.1	0.2	5.104	0.5	3.19	-1.914	willow
0.2	0.2	5.104	0.4	3.828	-1.276	willow-6.6’
0.2	0.3	4.466	0.4	3.828	-0.638	willow
0.2	0.2	5.104	0.4	3.828	-1.276	willow
0.1	0.2	5.104	0.4	3.828	-1.276	willow
0.1	0.2	5.104	0.4	3.828	-1.276	willow
0.1	0.2	5.104	0.4	3.828	-1.276	willow
Segment Length (feet)	Segment Area (feet2)	Existing Summer Load (kWh/day)	Natural Stream Width (feet)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
1056.2	3464.7	411	3.3	411	0	
5277.5	17312.8	3080	3.3	2054	-1027	
3168.5	10394.2	2464	3.3	1232	-1232	
2112.3	12126.5	4107	6.6	1643	-2464	
2112.3	12126.5	5750	6/6	2464	-3286	
2640.4	17312.8	8214	6/6	3080	-5134	
1584.2	15580.5	4620	9/8	1848	-2772	
1056.2	10394.2	3696	9/8	1232	-2464	
528.1	5197.1	1232	9/8	616	-616	
1056.2	10394.2	4312	9/8	3080	-1232	
2640.4	2593.2	12321	9/8	7701	-4620	
8446	131325	34499	9/8	24642	-9857	
1584.2	15580.5	7393	9/8	4620	-2772	
528.1	5197.1	2464	9/8	1540	-924	
1056.2	17312.8	8214	16.4	6161	-2054	
1056.2	17312.8	7187	16.4	6161	-1027	
1056.2	17312.8	8214	16.4	6161	-2054	
528.1	8661.8	4107	16.4	3080	-1027	
528.1	8661.8	4107	16.4	3080	-1027	
528.1	8661.8	4107	16.4	3080	-1027	**% Reduction**
Total	**325554.6**	**130,501**		**83,886**	**-46,615**	**-36**

Table D-12. Existing and Potential Solar Loads for Middle Mud Creek.

Segment Length (~miles)	Existing Shade (fraction)	Existing Summer Load (kWh/m2/day)	Target or Potential Shade (fraction)	Potential Summer Load (kWh/m2/day)	Potential Load minus Existing load (kWh/m2/day)	**Middle Mud**
0.6	0.6	2.552	0.8	0.638	-1.276	forest-3.3’
0.4	0.5	3.19	0.8	0.957	-1.91	forest/shrub-3.3’
0.9	0.3	4.466	0.7	1.914	-2.55	willow meadow
0.7	0.5	3.19	0.8	0.957	-1.914	forest/shrub-6/6’
0.7	0.6	2.552	0.8	0.957	-1.276	forest/shrub
0.6	0.5	3.19	0.8	0.957	-1.914	forest/shrub
0.2	0.2	5.104	0.6	2.552	-2.552	willow-6.6’
Segment Length (feet)	Segment Area (feet2)	Existing Summer Load (kWh/day)	Natural Stream Width (feet)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
3168.5	10394.2	2464	3.3	1232	-1232	
2112.3	6929.4	2054	3.3	821	-1232	
4749.4	15580.5	6469	3.3	2772	-3696	
3696.6	24007.1	7187	6.6	2875	-4312	
3696,.6	24007.1	5750	6.6	2875	-2875	
3168.5	20777.6	6161	6.6	2464	-3696	
1056.2	6929.4	3286	6.6	1643	-1643	**% Reduction**
Total	**102166.2**	**30,084**		**13,040**	**-17,044**	**-57**

Table D-13 Existing and Potential Solar Loads for Big Creek

Segment Length (miles)	Existing Shade (%)	Existing Load (kWh/m^2/day)	Target Shade (%)	Potential Load (kWh/m2/day)	Potential minus Existing load (kWh/m2/day)	**Big Creek**
1	0.8	1.276	0.8	1.276	0	forest-3.3’
0.7	0.7	1.914	0.8	1.276	-1	forest-6.6’
0.7	0.6	2.552	0.8	1.276	-1	forest
0.2	0.5	3.19	0.8	1.276	-1.914	forest
0.5	0.7	1.914	0.8	1.276	-0.638	forest
0.2	0.6	2.552	0.8	1.276	-1.276	forest
0.2	0.5	3.19	0.8	1.276	-1.914	forest/shrub-9.8’
0.5	0.6	2.552	0.8	1.276	-1.276	forest/shrub
0.9	0.5	3.19	0.8	1.276	-1.914	forest/shrub
1.3	0.4	3.828	0.5	3.19	-0.638	willow-13.1’
0.2	0.3	4.466	0.5	3.19	-1.276	willow
0.2	0.4	3.828	0.5	3.19	-0.638	willow
0.5	0.3	4.466	0.5	3.19	-1.276	willow
0.2	0.5	3.19	0.7	1.914	-1.276	forest/shrub-16.4’
0.3	0.3	4.466	0.4	3.828	-0.638	willow-16.4’
0.2	0.2	5.104	0.4	3.828	-1.276	willow
0.2	0.5	3.19	0.7	1.914	-1.276	forest/shrub-23’
0.5	0.4	3.828	0.7	1.914	-1.914	forest/shrub
0.5	0.3	4.466	0.7	1.914	-2.552	forest/shrub
0.9	0.2	5.104	0.4	3.828	-1.276	willow-23’
3.1	0.08	5.8696	0.1	5.742	0	grass/willow-29.5’
0.2	0.2	5.104	0.3	4.466	-0.638	willow-29.5’
0.2	0.25	4.785	0.3	4.466	0	willow
0.4	0.1	5.742	0.3	4.466	-1.276	willow-39.5’
Segment Length (feet)	Segment Area (ft^2)	Existing Load (kWh/day)	Stream Width (feet)	Potential Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	
5277.5	17312.8	2054	3.3	2054	-1027	
3696.6	24007.1	4312	6.6	2875	-2875	
3696.6	24007.1	5750	6.6	2875	-4312	
1056.2	6929.4	2054	6.6	821	-1643	
2640.4	17312.8	3080	6.6	2054	-2054	
1056.2	6929.4	1643	6.6	821	-1232	
1056.2	10394.2	3080	9.8	1232	-2033	
2640.4	2593.2	6161	9.8	3080	-3542	
4749.4	46752.2	13861	9.8	5545	-9148	
6861.8	11932.7	40044	16.4	33370	-6674	
1056.2	17312.8	7187	16.4	5134	-2054	
1056.2	17312.8	6161	16.4	5134	-1027	
2640.4	43287.5	17968	16.4	12835	-5134	
1056.2	17312.8	5134	16.4	3080	-2875	
11584.2	2593.2	10781	16.4	9241	-2310	
1056.2	17312.8	8214	16.4	6161	-2567	
1056.2	24007.1	7187	23	4312	-3019	
2640.4	60611.1	21562	23	10781	-11140	
2640.4	60611.1	25156	23	10781	-14734	
4749.4	109995.6	51749	23	38812	-12937	
16363.9	48312.4	263549	29.5	257820	0	
1056.2	31171.7	14785	29.5	12937	-2772	
1056.2	31171.7	13861	29.5	12937	-1848	
2112.3	83121	44356	39.5	34499	-9857	**% Reduction**
Total	**129477j9.4**	**579,689**		**479.190**	**-93,846**	**-16**

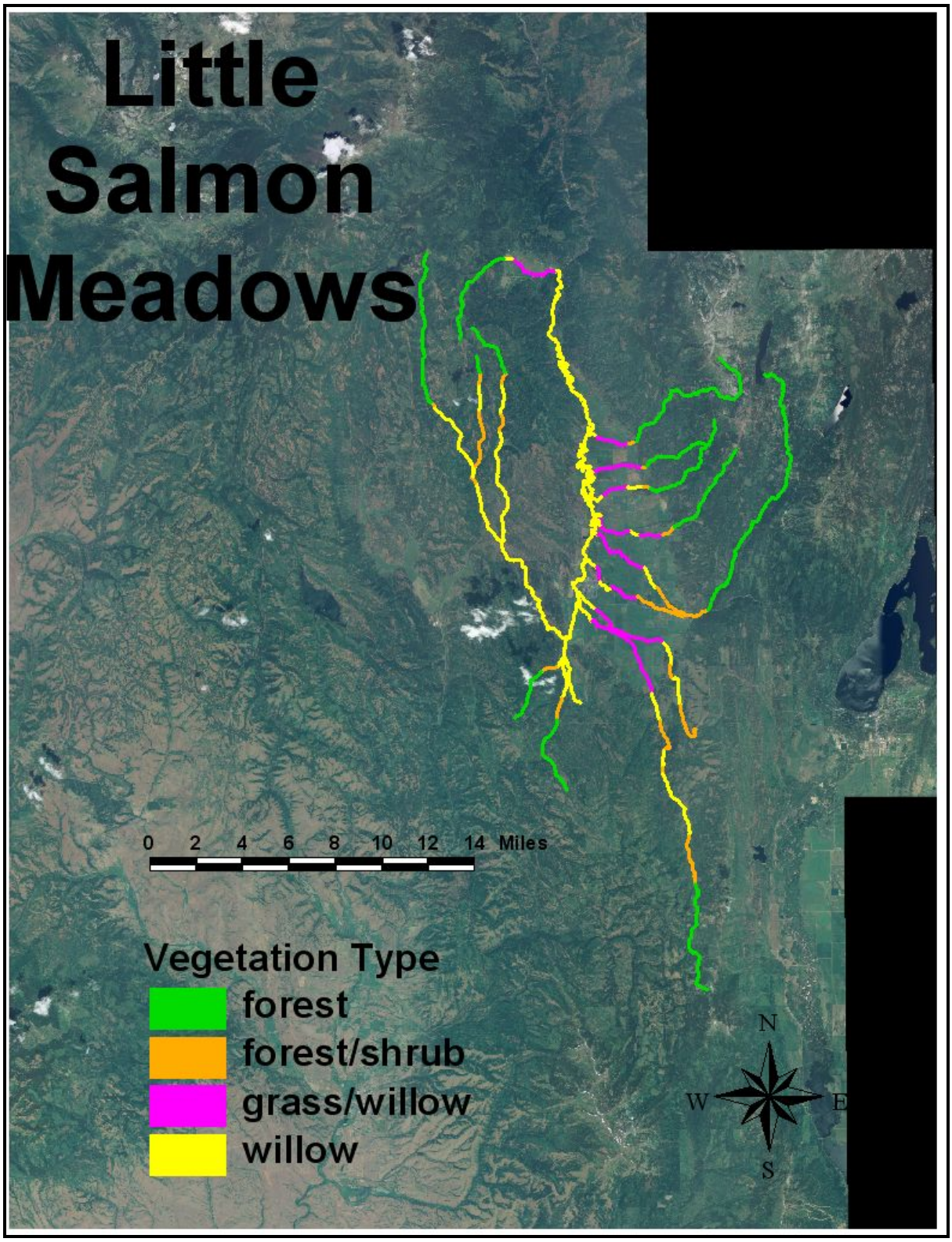


Figure D-1. Little Salmon River Vegetation Types.

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Appendix E. Public Participation and Public Comment

Comment	Response
Adams Soil and Water Conservation District	
1. Pg xxi: Under Little Salmon River from Round Valley to mouth: *several government agencies* **Comment:** What specific agencies have pointed out..?	Specified that in particular this was the US BOR and BLM.
2. Pg xxii: *Big Creek load capacities were based on the same targets…* **Comment**: State what the target is exactly.	Specified the targets
3. Pg 9: Table 2 is a description of soil attributes: *Fig 4 shows location of major soils in the basin* **Comment**: Add a period after basin.	Corrected error
4. Pg 12: Figure 5 map **Comment:** map needs a legend.	There is a legend on the side of the map.
5. Pg 49: Bacteria- paragraphs 2 and 3 **Comment:** Add a statement about what the differences are between point and non-point source pollution.	Defined point and non-point source pollution and added information to paragraph 2
6. Pg 50: *Recent studies have shown…* **Comment:** Is this cattle study from a good source? Are there any other studies you have found on this to add?	The study is from the USDA and Cornell University which DEQ deemed a good source.
7. Pg 53: Paragraph 3 **Comment:** Tree fall is important and often essential for maintaining stream stability is either in the wrong place or should be omitted. This statement sounds repetitious.	That sentence is repetitive and it has been removed.
8. Pg 60-62: Figures 18-21 **Comment:** Add days on y axis	Comment noted
9. Pg 63: Paragraph 1: *an agricultural drain….* **Comment:** Are you talking about a specific drain, or draining itself? Please specify.	A specific drain—this has been clarified.
10. Pg 66: Paragraph 1 >6 mg/l **Comment:** Should it be <6mg/l?	This has been corrected to < 6 mg/L
11. Pg 68: Conclusions...*The ISDA conducted…* **Comment:** State what were the findings and if there weren't any pollutants, state that.	A clarifying sentence was added.

Comment	Response
12. Pg 69: Paragraph 2 **Comment:** Who did the study?	USBR is proposing studies in this area but the sentence stating that the study is underway has been deleted because funding for this study has not been acquired.
13. Pg 149: Paragraph 6: comparison of aerial photos **Comment:** Do you have any on-the-ground data for those reaches? Do you think the aerial photography is sufficient enough to determine developmental impacts?	Yes, there is data for Shingle Creek. Any additional data would be welcomed. Aerial photography is sufficient to look at the effects of skid trails/road development in the forested part of the watershed.
14. Pg 166: Paragraph 2 on WAGs **Comment:** A better definition of what the WAG actually does would be helpful.	A sentence has been added.
15. Pg 167: Paragraphs 2 and 3 **Comment:** Do SCD(s) really take the lead if non-point source pollution needs to be addressed?	Clarified that SCC has the lead and that SCDs also have a pivotal role.
16. Pg 176: solar pathfinder data... **Comment:** We don't know if three sections of the river are sufficient to verify aerial photo interpretation.	We encourage the Soil Conservation District to submit additional data and DEQ will incorporate that into the verification process.
17. Pg 178: shade estimate map **Comment:** Could you please label the creeks and tributaries taken into account?	The creeks will be labeled in the final submittal of the TMDL to the EPA.
18. Pg 179: Paragraph 3 a landowner *could* evaluate… **Comment:** Change could to **should** evaluate the current shade with a solar pathfinder.	Will make change and also put in sentence stating that the SCDs now have solar pathfinders
19. Pg 226: Temperature Analysis **Comment**: A statement needs to be made on target selection as far as; a modified SVAP should be done on tributaries to get an accurate shade target for a section of the stream. It seems like the shade model puts a hammer down on landowners for percent shade that can logically be achieved in a reach. Who is held responsible if percent shade is in violation? One landowner? All landowners along the reach? On existing loads—the loads are pretty high in some areas. What is the basis of the potential load targets on the model? How were the calculations done for the reductions? The reductions seem unattainable on parts of Goose Creek and Mud	TMDLs are voluntary for nonpoint sources. The specifics of how the targets are going to be reached will be outlined in the implementation plan. In the implementation process, it is up to the WAG, SCD, and affected landowners to determine an implementation strategy for each particular waterbody. Implementation is typically based on practices that will be effective and economically feasible. Please read the section on Temperature in Section 5 for an explanation of target selection. The load reductions are based on the existing shade (or existing solar heat that gets to the stream) subtracted from what the

Comment	Response
Creek.	potential shade is. The loads are likely high in areas where it was determined that there would be a shrub community and right now there isn't one. When a stream is not that wide (Mud Creek) the difference between shade with partial shrub coverage vs.full density is large because the overhang from the shrubs results in high shading values. Thus, this reduction is likely achievable. There are parts of Goose Creek that are already at potential shade. A further explanation of why the 17% increase in shade is unachievable is needed in order to change the shade targets.
IDFG	
1. IDFG agrees with TMDL s for the upper mainstem Little Salmon River; agrees that aerial analysis of thermal infrared showed no thermal influence by adjacent hot spring discharge in August. A listing for habitat alteration in the lower Little Salmon River is reasonable. TMDLs for bacteria and nutrients in Big Creek are supported by findings as is recommendation to list East and West Branches of Goose Creek on the 303(d) list.	Comments noted
2. Stream temperatures monitored in Mud Creek, averaged over the past five years, indicate exceedances for cold water aquatic biota of 15%. In only one year of the past four did temperature exceed criteria by only the allowed 10%. This very marginal support coupled with the fact that the location of this monitoring station is at least two miles upstream from the confluence with the Little Salmon River and that shading is very limited throughout the lowermost reaches of Mud Creek leads to a recommendation for a temperature TMDL for Mud Creek.	Mud Creek will continue to be monitored and if the creek exceeds the temperature standard, then it will be proposed for 303(d) listing. At this time, the creek appears to support beneficial uses.
3. The recent BURP inventory for Little Mud Creek is not included in this assessment	The waterbody assessment scores are not available because the macroinvertebrate data has not been processed. However, information on habitat parameters will be included in the final report submitted to EPA.
4. Determinations of Four Mile, Three Mile and	The executive summary will be changed to

Comment	Response
Martin Creeks were made with limited data collected only in upper, forested reaches. The assessment of Six Mile Creek relied on one survey in the forested reach and one in the upstream section of private pasture land, approximately one mile upstream from the confluence with the Little Salmon River. In the conclusions in Section 2, it is stated that " A beneficial use support status call cannot be made on the lower sections of these creeks due to lack of information." Yet your executive summary categorizes these streams as simply 'not impaired'. This is an incorrect statement. The statement should be corrected to state that the status of these streams is 'undetermined.'	better reflect the assessments made further in the document.
5. I question as to why additional data were not collected in the lower reaches of these four streams. The reason given is that they were not on the 303(d) list, however a fairly thorough assessment was completed in Goose Creek, also not on the original list.	Additional data was not collected on Six Mile Creek due to several factors including the presence of a BURP site that showed full support and lack of access during the 2005 field season. Data was collected on Four Mile Creek for the purposes of looking at nutrient loading to the Little Salmon River. Four Mile, Three Mile and Martin Creeks were assumed to be similar to Six Mile Creeks. A BURP site was selected on Goose Creek by our stream inventory program by a similar process that resulted in the site selection for Six Mile Creek. The analysis of Goose Creek and Six Mile Creek are relatively similar with the exception that the forested reaches of Goose Creek were used for ground truthing of the aerial photography analysis of shading.
Association of Idaho Cities	
The SBA and TMDL needs to include temperature data and analyses that have been collected by USGS in the Little Salmon Basin. The USGS report titles are: *A Statistical Model for Estimating Stream Temperatures in the Salmon and Clearwater River*	Thank you for this information. Where pertinent, this information will be added to the final submittal. Much of the temperature information presented in the TMDL is more recent than that from the USGS report and thus, not all the USGS data will be incorporated.

Comment	Response
Basins, Central Idaho by Mary M. Donato, Water Resources-Investigations Report 02-4195 *Aquatic Assemblages and Their Relation to Temperature Variables of Least-Disturbed Streams in the Salmon River Basin, Central Idaho, 2001*by Douglas S. Ott and Terry R. Maret, Water Resources-Investigations Report 03-4076	The fact that this report shows that reference streams do exceed bull trout temperature criteria is relevant and we appreciate that you passed this information on to DEQ.
2. The AIC recommends that DEQ employ the SNTEMP model to determine the natural background temperature of the river. This would allow a better calculation of the temperature effluent limit for the wastewater treatment plant.	The endpoint of the potential shade model and SNTEMP are the same—both result in determining the % shade necessary to cool the stream. However, the point is well taken that determining the natural background temperature at the site of the wastewater treatment plant outfall would be useful. DEQ has employed QUAL 2K in the LSR watershed which DEQ believes is a better model than SNTEMP and will look into the applicability of the information for modeling temperature at that point in the stream.
A "least cost" allocation approach would allow the waste water facility planning efforts to target the cost effective nutrient removal technologies and work collaboratively with the non-point source control programs in order to achieve the water body support targets.	At the time of the writing of this TMDL, DEQ understood that the WWTP plant would not discharge during the critical period even at full capacity. Thus, the load allocation would easily be met. If information is provided by the city that shows that this is not the case, a new wasteload allocation will be determined in consultation with the WAG. Only gross allocations were presented in this TMDL, allocation strategies are to be further worked out during the implementation plan (i.e. tributary reductions).
The TMDLs do not provide any reserve for future growth or allowance for discharge of stormwater for any of the pollutants proposed for controls. As New Meadows and other portions of rural Idaho grow and highways are built, increases in wastewater and/or stormwater discharges to surfaces waters are likely. If the TMDL contains no municipal reserve for growth (e.g. wastewater and/or stormwater) , the TMDLs will function as effective caps on growth and development in the Little Salmon Basin and statewide and drive up	The TMDLs do provide a reserve for growth in the wasteload allocation by designing the allocation to be at maximum design capacity—the treatment plant is not at that level now. New Meadows is not regulated as a municipality (MS 4) by the EPA nor is it likely to be unless the population reaches 50,000. These statements refer to a situation

Comment	Response
the costs of highway design and construction (e.g. 100% retain on site, no surface water discharge…).	where a town is regulated as an MSR. This is not the case in New Meadows and thus, the statements that the TMDL will cap development or increase the cost of highway development are erroneous. The nutrient and bacteria targets are reasonable and can be met. Stormwater can be discharged but it must meet the bacteria and nutrient standards. There is no sediment TMDL which would be the primary pollutant present in highway discharge.
Jim Blair, LSR WAG Member	
1.It is stated on page 98 that beneficial use support status cannot be determined for 6, 4, & 3 mile creek below the Forest Service boundary due to lack of information. Is there a plan in this somewhere to monitor it in the future? My concerns are surface irrigation waste water being superheated by solar influences and returning to these creeks and thus to the Little Salmon River. I also feel this could be a contributing source of TP and E. Coli pollutants. 2.I do not see a implementation plan to address how T.P. and E. Coli levels are going to be reduced at Big Creek and the Little Salmon River. Is that yet to be decided by the WAG? 3.On page 169 in the 1st sentence it should include heated surface irrigation waste water return to the streams and river as a contributing source of heat due to super heating of surface water while on the fields, from solar radiation. I am sure there is a substantial amount of surface waste water returning to the streams and river since the valley is irrigated predominantly by flood irrigation, the most inefficient form of irrigation when it comes to waste water control and conservation of water. I would be inclined to think this waste water be a major contributor of the high organophosphates, E.Coli from manure, and heated water, although the phosphates and E. Coli can also come from the percolated irrigation subsurface ground water that reaches the streams and river. If air temperatures in the shade are in the 80's and 90's in July and August and the water is coming into the system already heated, I don't think that shade is	Monitoring may occur if access to the streams can be obtained. However, it is important to note that TMDLs cannot be written for flow alteration. Although diversions may affect heating, DEQ cannot regulate water rights and the ensuing flow management. However, if there are stakeholders that want to address heating of water due to flow modification, they can do so in the implementation phase. The implementation portion of the TMDL will be written separately within 18 months of TMDL approval. Additional monitoring may occur as part of implementation planning. A sentence will be added that states that flow alteration may result in a contribution of heat. Phosphorus and bacteria may come from both surface and groundwater sources. Shade will help not only by preventing solar radiation from heating the stream surface but the vegetation will also act as a filter, provide bank storage (water stored in the banks that is released later in the season), and provide bank stability preventing excess widening of the stream.

Comment	Response
going to solve the problem. Granted, it will help reduce further heating of the water, but it won't reduce it if it is already to warm.	
EPA	
Little Salmon River ID17060210SL007_04 was listed on the 2002 303(d) for temperature. It is not included in Table A, Table C, Table 8. Also, you noted on page 57 that the Little Salmon River is split into two assessment units on the 2002 303(d) list. The list sent by Mike Edmonston shows three assessment units: ID17060210SL001_02 Little Salmon River – Round Valley Creek to mouth sediment; ID17060210SL007_05 Little Salmon River - 5th order unknown; and ID17060210SL007_04 Little Salmon River - 4th order temperature (see attached). Please explain this discrepancy.	The 2002 303(d) list used by the Boise Regional Office did not include that section of the Little Salmon River. The oversight has been corrected. That section of the Little Salmon River did receive a temperature allocation and this oversight will be corrected.
Pages xix and 41 You have named agencies under listing basis instead of the actual basis or justification for the listing (WBAG, exceedance documented, low metric scores, 1996 carryover etc.) for Table A and Table 8.	Comment noted
Page xxiii Table C does not include all the waters assessed by IDEQ, either include all the waters assessed or rename the table. Is this a table that Summarizes Assessment Outcomes for Waters Included on the 2002 303(d) List? Brundage Reservoir's assessment unit should be SL011L-0L. The 2002 303(d) list shows Brundage Reservoir listed for temperature so it should be delisted for temperature not an unknown pollutant.	The Table has been renamed since it refers to streams on the 303(d) list.. The listing for Brundage Reservoir has been corrected to reflect that it is for temperature not unknown and the assessment unit notation has also been corrected.
Pages 41-44 Include IDEQ's natural condition water quality standard provisions in the section on "Applicable Water Quality Standards" as you refer to them in other parts of the document including the executive summary.	IDEQ's natural condition water quality standard has been incorporated
Page 43 Under Table 9 Little Salmon River Subbasin beneficial uses of 303(d) listed streams, you include Boulder Creek. You also include this same creek on the following table of assessed non-listed waters. Is Boulder Creek on the 2002 303(d) list? If not, please remove Boulder Creek from Table 9.	This mistake has been corrected—Boulder Creek is not on the 303(d) list.

Comment	Response
Page 74 On Table 15, you indicate the Mud Creek is "Not Full Support" and later state "Beneficial uses appear to be supported in the upper reaches of Mud Creek." Please explain this discrepancy.	The score you are referring to precedes a later full support score. DEQ assumed that the more recent data had precedence over the old data and thus stated that beneficial uses were supported.
Page 107 Hazard Creek and Hard Creek are listed in the July 31, 1997 Federal Register Notice on temperature criteria for bull trout in Idaho. Do these creeks meet the EPA WQ criteria for bull trout or does this criteria not apply and why not?	The criteria does apply and DEQ will collect solar pathfinder information this summer to demonstrate whether or not there is excess heat load. This is a fairly pristine stream in which beneficial uses appear to be fully supported. Natural background temperatures may be above the standard.
Pages 146 149 IDEQ listed Shingle Creek for sediment. IDEQ states "1995 Biological Assessment reported extensive grazing on private lands in the lower watershed, with severe riparian impacts…The 1995 Biological Assessment noted that a youth mission camp development along Shingle Creek has caused severe impact to the riparian area." IDEQ concludes "The beneficial uses in Shingle Creek are not impaired" based on extrapolated water body assessment scores from other nearby creeks--South Fork Shingle Creek and upper Shingle Creek. Given the "severe impacts to the riparian area," no rationale provided on why these other creeks' water body assessment results are appropriate to use for extrapolation to the rest of the watershed, and no explanation on why sediment is no longer a problem in Shingle Creek, it seems like a water body assessment should be conducted before concluding that the entire watershed is not impaired, no TMDL needs to be developed and Shingle Creek should be removed from the 303(d) list.	Various sediment metrics were calculated for Shingle Creek on a reach adjacent to the former youth camp. This information has been added to the TMDL. At the time the assessment was conducted it was too late in the season to conduct macroinvertebrate surveys so only sediment metrics were examined. Impairment was not evident.
Page 180 Please provide the calculation used to determine the wasteload allocation for temperature for the New Meadows Wastewater Treatment Plant shown in Table 37.	The wasteload calculation used an incorrect target which has been corrected (this did not effect the overall load reduction). The calculations were provided to EPA during the public comment period and will be included in an appendix in the final document
Page 181, 183, 185, 186 Please provide the data and calculations for determining existing loads, natural background, loading capacity and load allocations.	

Comment	Response
. Page 185 4th paragraph, you stated Nonpoint source allocations and WLAs are presented in Table 38 and 39. Actually they are presented in Tables 39 and 40. Page 186 Please title Table 40 New Meadows WWTP Wasteload Allocation and the middle column wasteload allocation, as load allocation are for nonpoint sources and WWTP is considered a point source.	This has been corrected. This has been corrected.

WAG Consultation

DEQ has complied with the WAG consultation requirements set forth in Idaho Code § 39-3611. A WAG was officially formed in May 2004 for the Little Salmon River TMDL. DEQ provided the WAG with information concerning applicable water quality standards, water quality data, monitoring, assessments, reports, procedures, and schedules. The Little Salmon River WAG was officially recognized by DEQ in May of 2004. The group met regularly over the course of the development of the TMDL in New Meadows. In 2005, the WAG met January 31st, April 5th, June 14th, August 23rd, September 15th and December 8th. In 2004, the WAG met on May 17th , July 12th and September 15th.

DEQ utilized the knowledge, expertise, experience and information of the WAG in developing this TMDL. DEQ also provided the WAG with an adequate opportunity to participate in drafting the TMDL, reviewing draft versions of the TMDL and suggesting changes to the document.

Concern from some WAG members was expressed at the high reductions required for Big Creek for bacteria. In particular, those WAG members wondered if these reductions were possible. A WAG member pointed out that the E. coli present from the largely grass fed cows in the Meadows Valley area are far less virulent then the strains of E. coli that are excreted from grain fed cows.

At the end of the September 15, 2005 meeting of the Little Salmon River WAG, the WAG members present voted their approval to go out for public comment with the Little Salmon River TMDL. A public meeting was held on November 10th, 2005. The three WAG members present at a meeting on February 9, 2006 voted their approval to submit the final draft to EPA. Since a majority was not present, a majority vote was solicited by DEQ by mail and email. A majority vote was obtained on February 22nd .

One WAG voting member voted against submitting the TMDL to EPA because he felt that the sections on Mud Creek, Three Mile Creek, Four Mile Creek, Six Mile Creek and Martin

Creek were impaired for beneficial uses and that additional data needed to be collected to ascertain whether on not this is the case. He stated that there had been significant discussion of these creeks and whether or not they were impaired but additional monitoring was not conducted during the course of TMDL development.

He stated that Kirk Campbell from the Idaho Department of Agriculture in his report "Little Salmon River Year Two Water Quality Report April 2005 through October 2005" that beneficial uses are impaired from data he collected on the Four Mile Creek site as well as other sites to be higher amounts than what meets the state tolerances. Mr. Campbell also stated at the December 2005 WAG meeting that Four Mile Creek was impaired rather than undetermined. The WAG member stated at that meeting that Leslie Freeman from DEQ said she would check into the alternatives of listing Three Mile, Four Mile and Martin Creek. That has not been done to this member's satisfaction.

The WAG member went on to state that these creeks are likely to be elevated nutrient/bacteria/temperature transporting streams that flow into the Little Salmon River as described by Kirk Campbell in his report on Four Mile Creek because of their similarity.

Also, DEQ did not include information in the TMDL on proposed monitoring in 2006 of Four Mile, Three Mile, Martin, Squaw and Six Mile Creeks (monitoring that was supported by a vote of the WAG). The member also stated that DEQ did not clearly delineate that lack of information prevented the agency from making a beneficial use support status call on the lower reaches of these creeks (see section 2 for more details on these specific streams). In addition, 2005 monitoring information was not presented in the TMDL.

The Idaho Department of Agriculture will monitor those streams if they can obtain access to them from the landowners in 2006. The WAG member emphasized that documentation of whether or not access was granted by landowners needed to occur in the TMDL in order to lend credibility to the document. Four Mile Creek was monitored sporadically in 2005 but not enough data was collected to make a determination on beneficial use impairment or unimpairment. This past and future monitoring will help delineate nutrient/bacteria loading to the system for the purposes of implementation planning for the mainstem Little Salmon River. If information regarding beneficial use impairment is gathered during this monitoring, it may be submitted to DEQ for 303(d) (integrated report) listing.

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