St. Maries River Subbasin Assessment and Total Maximum Daily Loads

July 2003

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Cover photograph by Don St. George.

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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
µg/L	micrograms per liter
§	Section (usually a section of federal or state rules or statutes)
AFDM	Ash-free dry mass
BLM	United States Bureau of Land Management
BMP	best management practice
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
chl *a*	chlorophyll *a*
cm	centimeters
CWA	Clean Water Act
CWE	cumulative watershed effects
DEQ	Department of Environmental Quality
E. Coli	*Escherichia coli* bacteria
EPA	United States Environmental Protection Agency
GIS	Geographical Information Systems
GPD	Gallons per day
IDAPA	Refers to citations of Idaho administrative rules
IDL	Idaho Department of Lands
INFISH	The federal Inland Native Fish Strategy
KEA	Kootenai Environmental Alliance
km	kilometer
L	liter
LA	load allocation
LC	load capacity
m	meter
mg	milligram
mi	mile
mi^2	square miles
mg/L	milligrams per liter
mL	milliliter
mm	millimeter
MOS	margin of safety

MWMT maximum weekly maximum temperature

N/A not applicable

NB natural background

nd no data (data not available)

NPDES National Pollutant Discharge Elimination System

NRCS Natural Resource Conservation Service

NTU nephlometric turbidity unit

PCR primary contact recreation

RUSLE Revised Universal Soil Loss Equation

SCC Soil Conservation Commission

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

SSTEMP Stream Segment Temperature Model

STATSGO State Soil Geographic Database

TKN total Kjeldahl nitrogen

TMDL total maximum daily load

TSS total suspended solids

t/y tons per year

U.S. United States

USC United States Code

USDA United States Department of Agriculture

USFS United States Forest Service

USGS United States Geological Survey

WAG Watershed Advisory Group

WBAGII *Waterbody Assessment Guidance, Version II*

WLA wasteload allocation

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 (33 USC § 1251.101). 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 the water bodies in the St. Maries Subbasin that have been placed on what is known as the "303(d) list."

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 St. Maries Subbasin located in northern Idaho. The first part of this document, the subbasin assessment, is an important first step in leading to the TMDL. The starting point for this assessment was Idaho's current 303(d) list of water quality limited water bodies. Eighteen segments of the St. Maries Subbasin were listed on this list. 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. 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

Hydrologic Unit Code 17010304

Water Quality Limited Segments......18

Beneficial Uses Affected.....................Cold water, salmonid spawning, primary and secondary contact recreation

Pollutants of Concern..................Sediment, nutrients, bacteria, dissolved oxygen, temperature

Known Land Uses...............................Forestry, agriculture, recreation

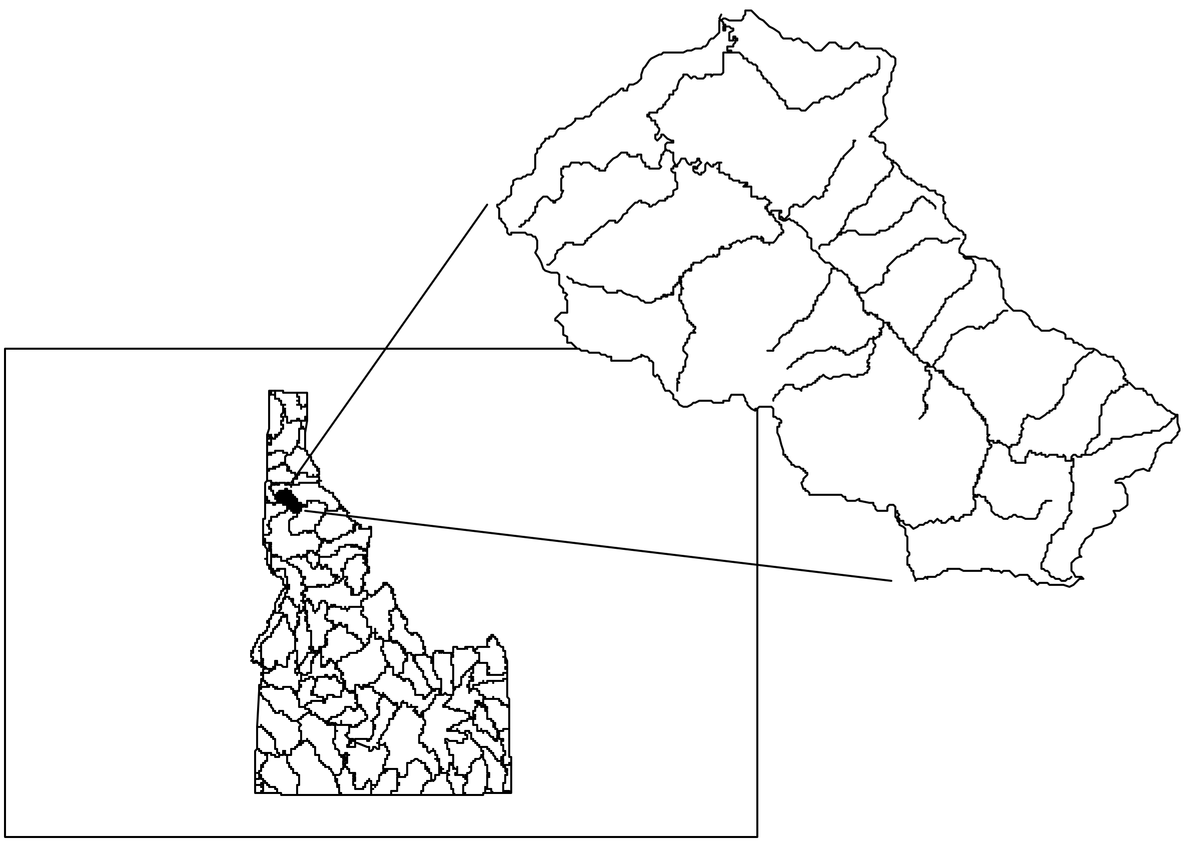

Figure A. Location of St. Maries Subbasin

Key Findings

The St. Maries River watershed remained in a relatively natural condition until the early twentieth century when miners, loggers, and ranchers began to settle the area. It has a history of timber harvest, grazing, and placer recovery of garnets and gold. Streams in the subbasin are 303(d) listed for sediment, temperature, habitat alteration, nutrients, bacteria and dissolved oxygen. Sixteen of the eighteen segments are listed for sediment, while nine are listed for temperature, eight are listed for habitat alteration, four for nutrients, and one each are listed for dissolved oxygen and bacteria. Sediment originates in the basin primarily from eroding banks, road crossings, and encroachments. Temperature is most affected by stream shading. Nutrients and bacteria arise from livestock and human wastes, while dissolved oxygen is affected by discharge of oxygen demanding materials that, in the St. Maries Subbasin, are discharged from wastewater treatment facilities. Impairment of cold water aquatic life has been demonstrated by composite scores of fish, macroinvertebrate and habitat indices. These scores generally indicate full support in the headwaters, but reveal use impairment in the downstream reaches of the both the tributaries and the river itself.

An assessment of temperature data indicates that all streams assessed exceed temperature standards. Dissolved oxygen was not found to be a limiting factor in Santa Creek, while bacteria were not found to limit contact recreation in Gramp Creek. Although segments are listed for habitat alteration, habitat alteration is not an effect that can be allocated in a TMDL. An assessment of nutrient data indicates that none of the stream segments listed for nutrients are impaired by nutrients. Sediment data and model results were assessed. Residual pool volumes generally indicate that many of the downstream reaches of the tributaries and the river have relatively low residual pool volumes. Sediment yield monitoring indicates that Alder, Charlie, Santa, Tyson, and Carpenter Creeks and the St. Maries River including its West and Middle Forks have yields well in excess of thresholds expected to cause water quality impairment. John, Emerald, Renfro, Crystal, and Thorn Creeks have sediment yields close to or slightly above the threshold found on streams supporting the cold water aquatic life.

Since the main stem of the St. Maries River is sediment limited, a sediment TMDL is required for the entire St. Maries Subbasin. Temperature TMDLs are required for Gold Center Creek, including Gramp, Flewsie, Emerald, and Santa Creeks as well as the St. Maries River and its West and Middle Forks.

Table A. Streams and pollutants for which TMDLs were developed.

Stream	Segment ID Number	1998 303(d) Boundaries	Pollutant(s)
St. Maries River	3579	Town of Mashburn to St. Joe River	Sediment, temperature
St. Maries River	3580	Town of Clarkia to town of Mashburn	Sediment, temperature
West Fork St. Maries River	3581	Headwaters to St. Maries River	Sediment, temperature
Middle Fork of the St. Maries River	3594	Headwaters to St. Maries River	Sediment, temperature
Santa Creek	3585	Headwaters to St. Maries River	Sediment, temperature
Carpenter Creek	3591	Headwaters to St. Maries River	Sediment
Emerald Creek	3593	East Fork – Headwaters to St. Maries River	Sediment, temperature
Gold Center Creek	3596	Windy Creek to Middle Fork of the St. Maries River	Temperature
Flewsie Creek	3596	Headwaters Creek to Middle Fork of the St. Maries River	Temperature
Alder Creek	3583	Headwaters to St. Maries River	Sediment
Tyson Creek	3589	North Fork Tyson Creek to St. Maries River	Sediment
Thorn Creek	3582	Headwater to St. Maries River	Sediment
Renfro Creek	3588	Headwaters to Davis Creek	Sediment
Crystal Creek	3590	Headwaters to St. Maries River	Sediment
Charlie Creek	3587	Headwaters to Santa Creek	Sediment
John Creek	3584	Unnamed tributary 7.5km upstream to St. Maries River	Sediment
Gramp Creek	3598	Headwaters to Gold Center Creek	Temperature

Table B. Summary of assessment outcomes.

Waterbody Segment	Assess-ment Unit	Pollutant	TMDL(s) Completed	Recommended Changes to 303(d) List	Recommended Schedule Changes	Justification/ Notes[1]
St. Maries River 17010304 3579 17010304 3580	PN015 _05	Sediment	1 (for entire watershed)	Change unknown pollutant to temperature and/or sediment	None	N/A
St. Maries River 17010304 3579 17010304 3580	PN015 _05	Temperature	1 (for entire watershed)	Change unknown pollutant to temperature and/or sediment	None	N/A
St. Maries River 17010304 3579 17010304 3580	PN015 _05	Nutrients	0	Delist for nutrients	None	Periphyton data do not indicate nuisance levels
West Fork St. Maries River 17010304 3581	PN017 _02	Sediment	1	None	None	Covered by St. Maries River Sediment TMDL
West Fork St. Maries River 17010304 3581	PN017 _02	Temperature	1	None	None	N/A
Middle Fork St. Maries River 17010304 3594	PN018 _02/ 04/05	Sediment	1	None	None	Covered by St. Maries River Sediment TMDL
Middle Fork St. Maries River 17010304 3594	PN018 _02/ 04/05	Temperature	1	None	None	N/A
Thorn Creek 17010304 3582	PN026 _02	Nutrients	0	Delist for nutrients	None	Periphyton data do not indicate nuisance levels
Thorn Creek 17010304 3582	PN026 _02	Sediment	1	None	None	Covered by St. Maries River Sediment TMDL
Alder Creek 17010304 3583	PN08_ 02	Nutrients	0	Delist for nutrients	None	Periphyton data do not indicate nuisance levels

Table B, continued.

Waterbody Segment	Assess-ment Unit	Pollutant	TMDL(s) Completed	Recommended Changes to 303(d) List	Recommended Schedule Changes	Justification/ Notes[1]
Alder Creek 17010304 3583	PN08_02	Sediment	1	None	None	Covered by St. Maries River Sediment TMDL
John Creek 17010304 3584	PN09_02	Sediment	1	None	None	Covered by St. Maries River Sediment TMDL
Santa Creek 17010304 3585	PN010_04	Dissolved oxygen	0	Delist for dissolved oxygen	None	Dissolved oxygen data meet standard
Santa Creek 17010304 3585	PN010_04	Nutrients	0	Delist for nutrients	None	Periphyton data do not indicate nuisance levels
Santa Creek 17010304 3585	PN010_04	Temperature	1	None	None	N/A
Santa Creek 17010304 3585	PN010_02	Sediment	1	None	None	Covered by St. Maries River Sediment TMDL
Charlie Creek 17010304 3587	PN011_02	Sediment	1	None	None	Covered by St. Maries River Sediment TMDL
Renfro Creek 17010304 3588	PN024_02/03	Sediment	1	None	None	Covered by St. Maries River Sediment TMDL
Tyson Creek 17010304 3589	PN013_02/03	Sediment	1	None	None	Covered by St. Maries River Sediment TMDL
Crystal Creek 17010304 3590	PN023_02	Sediment	1	None	None	Covered by St. Maries River Sediment TMDL
Carpenter Creek 17010304 3591	PN014_02	Sediment	1	None	None	Covered by St. Maries River Sediment TMDL

Table B, continued.

Waterbody Segment	Assess-ment Unit	Pollutant	TMDL(s) Completed	Recommended Changes to 303(d) List	Recommended Schedule Changes	Justification/ Notes[1]
Emerald Creek 17010304 3593	PN016 _03	Sediment	1	None	None	Covered by St. Maries River Sediment TMDL
Emerald Creek 17010304 3593	PN016 _03	Temperature	1	None	None	N/A
Gold Center Creek 17010304 3596	PN019 _02/03	Sediment	0	Delist for sediment	None	WBAGII and sediment model results
Gold Center Creek 17010304 3596	PN019 _02/03	Temperature	1	None	None	N/A
Flewsie Creek 17010304 7596	PN018 _02	Sediment	0	Delist for sediment	None	WBAGII and sediment model results
Flewsie Creek 17010304 7596	PN018 _02	Temperature	1	None	None	N/A
Gramp Creek 17010304 7598	PN019 _02	Bacteria	0	Delist for bacteria	None	Bacteria standard not exceeded
Gramp Creek 17010304 7598	PN019 _02	Sediment	0	Delist for sediment	None	WBAGII and sediment model results
Gramp Creek 17010304 7598	PN019 _02	Temperature	1	None	None	Covered by Gold Center Creek Temperature TMDL

[1]WBAGII – *Water Body Assessment Guidance*, Version II.

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 (33 USC § 1251.101). 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 the water bodies in the St. Maries River Subbasin that have been placed on what is known as the "303(d) list."

The overall purpose of this subbasin assessment and TMDL is to characterize and document pollutant loads within the St. Maries River Subbasin. The first portion of this document, the subbasin assessment, 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 (Chapters 1 – 4). This information was used to develop a TMDL for each pollutant of concern for the St. Maries River Subbasin (Chapter 5).

1.1 Introduction

In 1972, Congress passed public law 92-500, 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 Pollution Control Federation 1987). 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 Idaho 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, with EPA approval, water quality standards and to review those standards every three years. Additionally, DEQ must monitor waters to identify those not meeting water quality standards. For those waters not meeting standards, DEQ must establish TMDLs 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 subbasin assessment and TMDL provide a summary of the water quality status and allowable TMDL for water bodies on the 303(d) list. *St. Maries River Subbasin Assessment and Total Maximum Daily Loads* provides this summary for the waters currently listed in the St. Maries River Subbasin.

The subbasin assessment section of this report (Chapters 1 – 4) includes an evaluation and summary of the current water quality status, pollutant sources, and control actions in the St. Maries 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 waterbody and still allow that waterbody to meet water quality standards (40 CFR, Part 130). Consequently, a TMDL is waterbody- and pollutant-specific. The TMDL also includes individual pollutant allocations among various sources discharging the pollutant. The EPA considers certain unnatural conditions, such as flow alteration, a lack of flow, or habitat alteration, that are not the result of the discharge of a specific pollutants as “pollution.” A TMDL is not required for water bodies impaired by pollution, but not specific pollutants. 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.

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 waterbody 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:

-- Aquatic life support – cold water, seasonal cold water, warm water, salmonid spawning

-- 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 habitat, and aesthetics are designated beneficial uses for all water bodies in the state. If a waterbody 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 waterbody data, such as biological, physical/chemical, and landscape data to address several objectives:

-- Determine the degree of designated beneficial use support of the waterbody (i.e., attaining or not attaining water quality standards).

-- Determine the degree of achievement of biological integrity.

-- Compile descriptive information about the waterbody, particularly the identity and location of pollutant sources.

-- When water bodies are not attaining water quality standards, determine the causes and extent of the impairment.

1.2 Physical and Biological Characteristics

The St. Maries River and its major tributaries (Middle Fork of the St. Maries River; West Fork of the St. Maries River and Emerald, Carpenter, Crystal, Renfro, Tyson, Santa, Charlie, John, Alder, and Thorn Creeks) drain the entire St. Maries Subbasin into the St. Joe River (Figure 1).

Climate

Northern Idaho is located in the Northern Rocky Mountain physiographic region to the west of the Bitterroot Range. The Clearwater Mountains, which the St. Maries River drains, are a part of the Bitterroot Range. The local climate is influenced by both Pacific maritime air masses from the west as well as continental air masses from Canada to the north and the Great Basin to the South. The annual weather cycle generally consists of cool to warm summers with cold and wet winters. The relative warmth of winters depends on the dominance of the warmer, wetter Pacific or cooler dryer continental air masses. The relative warmth of summers depends on the dominance of the warmer, drier Great Basin or cooler, wetter Pacific air masses. Precipitation is greatest during the winter months.

In the city of St. Maries, for a period of record from 1897 to 2001, the average annual maximum temperature was 59.6 ^{o} F and the average annual minimum temperature was 35.5 ^{o}F (Inside Idaho 2002). For the same time period, the month with the lowest average maximum (49.3 ^{o}F) and lowest average minimum (22.2 ^{o} F) temperature was January. July had the highest average annual minimum temperature (34.8^{o}F) and the highest average annual maximum temperature (84.8 ^{o}F). In the town of Clarkia, for a period of record from 1948 to 1975, the annual minimum temperature was 30.1 ^{o}F and the average annual maximum temperature was 54.8 ^{o} F (Inside Idaho 2002). For the same time period, the month with the lowest average minimum (21.1 ^{o}F) and the lowest average maximum (41.7 ^{o}F) temperature was January. July had the highest average annual minimum temperature (31.1 ^{o}F) and the highest average annual maximum temperature (83.3 ^{o}F).

Although intervening mountain ranges progressively dry the Pacific maritime air masses, these air masses deposit appreciable moisture as rain and snow on the St. Maries watershed. Maritime air masses originating in the mid-Pacific are relatively warm, often yielding their precipitation as rain. Relief of the watershed is generally between 2,150 and 4,500 feet. Forty-one percent of the watershed's land mass consists of slopes in the rain-on-snow elevation range of 3,300 to 4,500 feet. Below 3,300 feet the snow pack is transitory, while above 4,500 feet the snow pack is sufficiently cool that warming by a maritime front is insufficient to cause a significant thaw. Much of the watershed is below 3,300 feet elevation. In the rain-on-snow elevation range (3,300 - 4,500 feet), a heavy snow pack accumulates each winter. A warm maritime front can sufficiently warm the snow pack making it isothermal and capable of yielding large volumes of water to a runoff event.

Data from the city of St. Maries shows that the 105-year average annual precipitation from 1897 to 2001 was reported at 28.4 inches (Inside Idaho 2002). December exhibited the largest amount of precipitation at 3.93 inches and July the lowest amount of precipitation at 0.98 inches. Data from Clarkia shows that the 27-year average annual precipitation from 1948 to 1975 was reported at 37.5 inches. January exhibited the largest amount of precipitation at 7.06 inches and August the lowest amount of precipitation at 1.07 inches.

Subbasin Characteristics

The St. Maries River drains the western flank of the Clearwater Mountains, a subset of the Bitterroot Mountains. The river flows from the southeast to the northwest to enter the St. Joe River at the town of St. Maries, Idaho (Figure 1). The watershed encompasses 481 square miles (307,840 acres) above St. Maries.

-- Hydrography

The U.S. Geological Survey has continuously operated the Santa Gauging Station on the St. Maries River since October 1965. A weather station has operated at the St. Maries Ranger Station near the city of St. Maries since 1897, while a weather station operated at the Clarkia Ranger Station from 1948 to 1975. Data from these stations are included in this assessment.

-- Geology and soils

The general land form in the St. Maries River Subbasin is steep, but generally stable. Mass failures are not a typical feature of the land form development, but are specific to a few land types located primarily on granitic and lacustrine land forms. Historically, the Clearwater Mountains were glaciated, but not covered by ice sheets. In the broad floodplain of the lower St. Maries, alluvial materials worked by the river comprise the valley bottoms. Some reaches of the St. Maries River are located on lacustrine deposits of a late Eocene Lake. Lower reaches of the St. Maries River are located on lacustrine deposits of Miocene Coeur d'Alene Lake. Wetlands and a few lateral lakes occur in the lower river valley above St. Maries.

Bedrock in the subbasin is primarily composed of metasedimentary rocks of the Proterozoic Belt Supergroup. The Belt formations of St. Maries River valley are mud and sandstone of the younger Missoulian series. Columbia Plateau basalt flows are common from the city of St. Maries to Fernwood. Granitic intrusions exist in a few areas. Bedrock underlying the upper end of the valley is likely Belt rock metamorphosed by emplacement of the Idaho Batholith to the south. Commercial placer deposits of garnet that have weathered from these materials are located in Carpenter and Emerald Creeks. Gold deposits were developed in Tyson Creek (Russell 1979).

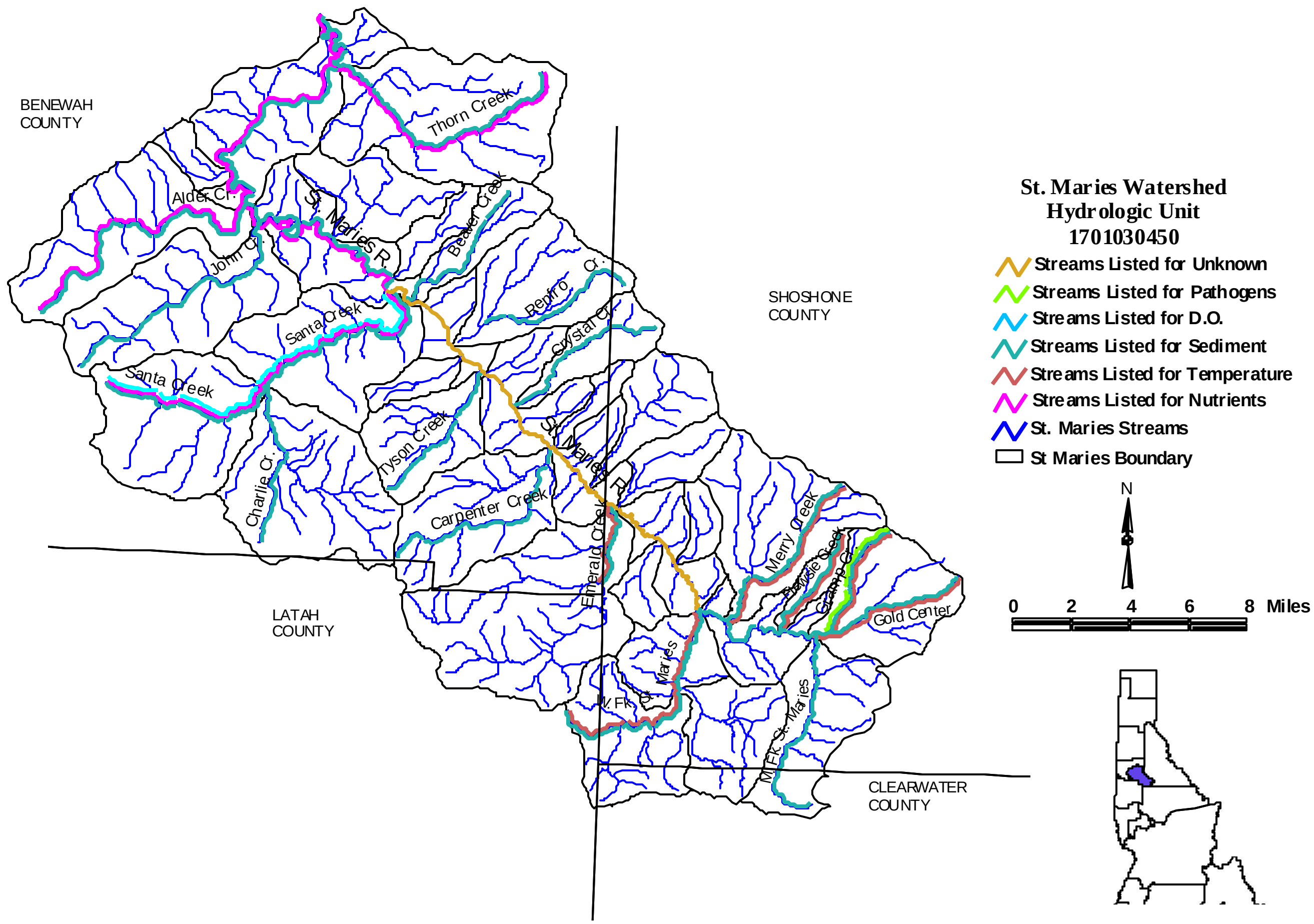

Figure 1. St. Maries Subbasin and 303(d) Listed Streams

The mountain slopes are generally underlain by silty to silt loam podsolic soils developed under cool conditions. Sandy granitic soils occur in a few areas. Palouse loess silt loam is found in the western watersheds of the subbasin. Volcanic ash deposits are variably found in the soil mantle. The soil mantle is thin to deep on slopes with A and B horizons of 3 to 4 inches. Soil mantle generally decreases with altitude. Soils in the bottomlands may be silty to sandy podsols developed under upland forest. Near streams and in some pockets, black mucky soils exist where western red cedar (*Thuja plicata*) stands are the dominant vegetation.

-- Topography

The western flank of the Clearwater Mountain range has low rounded mountains with relatively broad intermountain valleys. Valleys range down to 2,200 feet while most mountains reach over 4,000 feet. The slopes are moderately steep on the western flank of the valley and steeper on the east. The aspect of the St. Maries River valley is generally northwest facing. Tributary valleys have a predominance of north and south facing aspects.

-- Vegetation

The mountain slopes are mantled with a mixed coniferous forest of true fir (*Abies spp.*), Douglas fir (*Pseudotsuga menziesii*), larch (*Larix spp.*), and pine (*Pinus spp.*). Forest harvest has occurred at significant levels in all watersheds of the basin. Rivers and streams are flanked by riparian stands dominated by cottonwood (*Populus spp.*) at lower elevations and alder (*Alnus spp.*) in the higher valleys. The lower St. Maries valley floor is comprised of lands on lacustrine deposits. These lands have been converted to pasture to varying degrees. Lateral wetlands are found in the lower river floodplain. Aquatic vegetation species such as rush (*Juncus spp.*), sedges (*Carex spp.*), and cattail (*Typha latifolia*) are common in these wetlands. Some floodplain fields have been converted to the cultivation of wild rice (*Zizania spp.*).

-- Fisheries and aquatic fauna

The native salmonids of the streams of the subbasin are cutthroat trout (*Oncorhynchus clarki)* and mountain whitefish (*Prosopium williamsoni*). Sculpin (C*ottus spp.*) and shiners (*Notropis spp.*) are non-salmonid natives. The tailed frog (*Ascaphus truei*), Idaho giant salamander (*Dicamptodon aterrimus*), and painted turtle (*Chrysemys picta*) complete the vertebrate species living in the streams. The fish populations of the river and some of its tributaries have been altered by the introduction of rainbow trout (*Oncorhynchus mykiss*) and brook trout (*Salvelinus fontinalis*). Non-native pike (*Esox lucius*) and small mouth bass (*Micropterus dolomieu*) are present in the lower St. Maries River. The wide shallow nature of the St. Maries River channel results in high summer water temperatures. This situation depresses trout populations and favors warm water species. Macroinvertebrates, including the crayfish (*Pacifastacus spp.*), are common in the St. Maries River.

Idaho considers cutthroat trout a sensitive species. Bull trout (*Salvelinus confluentus*), a federally threatened species, have been reported on occasion in the basin. Idaho does not consider the St.

Maries River watershed as a key bull trout watershed (Batt 1996). No other sensitive, threatened or endangered species are known to exist in the subbasin.

Subwatershed Characteristics

The subwatershed characteristics are summarized in Table 1.

Table 1. Watershed characteristics of the fifth order watersheds of the St. Maries River Subbasin.

Fifth Order Watershed	Area (acres)	Land Form	Dominant Aspect	Relief Ratio[1]	Mean Elevation (m)	Dominant Slope (%)	Hydrologic Regimes	Estimated Water Yield (acre-feet/year)	Mass Wasting Potential
Middle Fork St. Maries River	16,190	Mountainous	West	0.0617	1,275	20%-30%	Spring snowmelt; rain-on-snow	24,053	low
Gold Center Creek	10,929	Mountainous	West	0.0939	1,307	>40%	Spring snowmelt; rain-on-snow	16,095	low
Flewsie Creek	2,049	Mountainous	West	0.0706	1,084	20%-30%	Spring snowmelt; rain-on-snow	3,017	low
Merry Creek	14,275	Mountainous	West	0.0726	1,797	20%-30%	Spring snowmelt; rain-on-snow	21,022	low
Cats Spur Creek	7,847	Mountainous	West	0.0658	1,140	20%-30%	Spring snowmelt; rain-on-snow	11,556	moderate
West Fork St. Maries River	15,902	Mountainous	East	0.0564	1,200	20%-30%	Spring snowmelt; rain-on-snow	23,420	moderate
Emerald Creek	11,137	Mountainous	East	0.0395	1,084	20%-30%	Spring snowmelt; rain-on-snow	16,401	moderate
Olsen-Childs Creeks	17,734	Mountainous	South	0.0598	959	0%-10%	Spring snowmelt; rain-on-snow	26,116	low
Carpenter Creek	12,852	Mountainous	East	0.0527	1,069	20%-30%	Spring snowmelt; rain-on-snow	18,928	moderate
Crystal Creek	5,340	Mountainous	West	0.0706	1,196	30%-40%	Spring snowmelt; rain-on-snow	7,864	low
Renfro Creek	11,165	Mountainous	West	0.0619	1,102	20%-30%	Spring snowmelt	16,443	low
Tyson Creek	8,035	Mountainous	East	0.0693	1,012	20%-30%	Spring snowmelt; rain-on-snow	11,834	low
Beaver Creek	8,677	Mountainous	West	0.0580	1,023	20%-30%	Spring snowmelt; rain-on-snow	7,330	low
Charlie Creek	17,385	Mountainous	West	0.0460	1,109	30%-40%	Spring snowmelt; rain-on-snow	25,603	low
Santa Creek	29,941	Mountainous	East	0.0409	991	20%-30%	Spring snowmelt; rain-on-snow	44,094	low
John Creek	16,209	Mountainous	East	0.0344	955	30%-40%	Spring snowmelt; rain-on-snow	23,871	low
Thorn Creek	11,925	mountainous	West	0.0404	956	0%-10%	Spring snowmelt; rain-on-snow	17,562	low
Lower St. Maries Sidewalls	23,514	mountainous	East	0.0322	874	>40%	Spring snowmelt; rain-on-snow	34,628	low

[1]$R_h = H/L$, where H is the difference between the highest and lowest point in the basin and L is the horizontal distance along the longest dimension of the basin parallel to the main stream line.

Stream Characteristics

Tributaries to the St. Maries River generally have V-shaped valleys as a result of the deeply dissected nature of the topography in their upper reaches. Near the valley bottoms the tributaries are of a lower gradient with meandering courses. The tributary valleys accommodate primarily Rosgen A and high gradient B channels in the upper watersheds and Rosgen C channels near their mouths. The tributaries are generally bound by boulder-bedrock substrate. The bedrock that underlies much of the subbasin weathers to soils fairly rich in fine fragments (70-80%) and rather poor in coarse materials (20-30%). There are exceptions where Belt Supergroup terrain predominates and coarse fragments constitute 50% of the soils. In the western subwatersheds where Palouse soils predominate, nearly all are fine grained. Silts dominate the valley bottom as the tributaries approach the river. In steep tributary gradients, boulders and cobble comprise the majority of the stream sediment particles. Width to depth ratios are low in these streams. The low gradient C channels of the tributaries have fine stream sediment particles and a higher width to depth ratio. Floodplains are narrow in most upper tributary channels. Broader floodplains are found in the lower reaches. Correspondingly, riparian communities are narrow in the narrow valleys and broader where valleys and floodplains widen.

The two forks of the St. Maries River above the town of Clarkia are primarily meandering Rosgen C channels except in their highest reaches. At Clarkia, the Middle and West Forks join to form the main stem of the St. Maries River. There the river traverses the bed of an Eocene lake. Consequently, the gradient generally accommodates a low (0.2-0.3%) Rosgen C channel, whose course meanders through a broad valley above the town of Mashburn. Miocene Columbia basalt flows constrict the river against Lindstrom Peak below Mashburn for approximately 10 miles. Although the river flows through this reach in a deep canyon, it maintains a meandering pattern that likely predates the basalt flows. In the canyon, the channel varies from a low gradient Rosgen B to a C channel (Rosgen 1985). The river valley widens progressively as the river swings northeast towards the town of St. Maries and its confluence with the St. Joe River. Here, the channel is a very low gradient (> 0.1%) Rosgen F channel that meanders through a broad floodplain with lateral wetlands. Sands dominate the river sediment throughout its upper course with the occasional cobble riffle, while silts are the dominant particle size of the lower river reach.

1.3 Cultural Characteristics

The St. Maries River Subbasin has timber, rangeland, and gemstone resources. These natural resources have been developed since the early 1900s. Timber harvest, placer garnet mining, and grazing of streamside pastures have affected nearly all of the tributaries and floodplains of the St. Maries Subbasin.

Additionally, the Coeur d'Alene Tribe's aboriginal territory takes in all of the St. Joe and St. Maries watersheds. Today, the Coeur d'Alene Tribal people return to this land just like their ancestors did to hunt, gather and practice cultural traditions. The Coeur d'Alene's used these waters for subsistence living in the past and will continue to do so in the future.

Land Use

Land use in the St. Maries Subbasin is divided between the uplands and the valley bottoms. The uplands are forested, while the valley bottoms are used for agriculture and grazing.

Forestlands are in multiple ownership (Figures 2a-h) with varying management direction. National Forest Lands are managed for multiple resource outputs (timber, water, and recreation). State Forest Lands are managed for timber values to support the state School Trust Fund. Commercial forestlands are managed primarily for timber production. Privately owned forestlands are managed for several resource outputs.

Farm and grazing lands are located in the lower reaches of the tributaries and in the bottomlands along the West Fork, Middle Fork and main stem of the St. Maries River. Land used for grazing is more common than cultivated farm fields.

Commercial placer mining of garnet-enriched sands occurs on the floodplains of Emerald and Carpenter Creeks. The mining activities have disrupted the channels and floodplains of these streams. In recent years, reclamation of mined lands and stream channel rehabilitation have occurred. Gold mining with hydraulic and placer methods occurred in Tyson Creek during the 1900s (Russell 1979).

Land Ownership, Cultural Features, and Population

Management of the 307,485-acre watershed is divided among land owned by private owners consisting primarily of timber companies (180,864 acres; 59%), the United States Forest Service (USFS) (66,467 acres; 22%), the State (54,939 acres; 18%), the Bureau of Land Management (BLM) (3,440 acres; 1%), and the Bureau of Indian Affairs (BIA) (1,552 acres; 0.5%). The remaining area consists of open water or riverbank (223 acres; 0.07%) (IDL GIS Database). Potlatch Corporation is the single largest commercial forest landowner, while Crown Pacific and Bennett Timber Companies have some holdings. A considerable amount of forestland is in small private tracts. Private properties, exclusive of those owned by timber companies, are situated on bottomland along the lower St. Maries River and tributaries such as Crystal, Flat, Santa, Charlie, Carpenter and Emerald Creeks. Many tributary watersheds supported large logging operations during the earlier part of the twentieth century.

Four recreation areas (three campgrounds and a recreational garnet panning area) are located in the watershed. There are three wastewater treatment facilities with National Pollutant Discharge Elimination System (NPDES) permits. These are the Santa-Fernwood, Emida, and Clarkia facilities. These permits were issued in the 1970s. The Emerald Creek Garnet Mill near Clarkia does not discharge. No dams are located in the watershed.

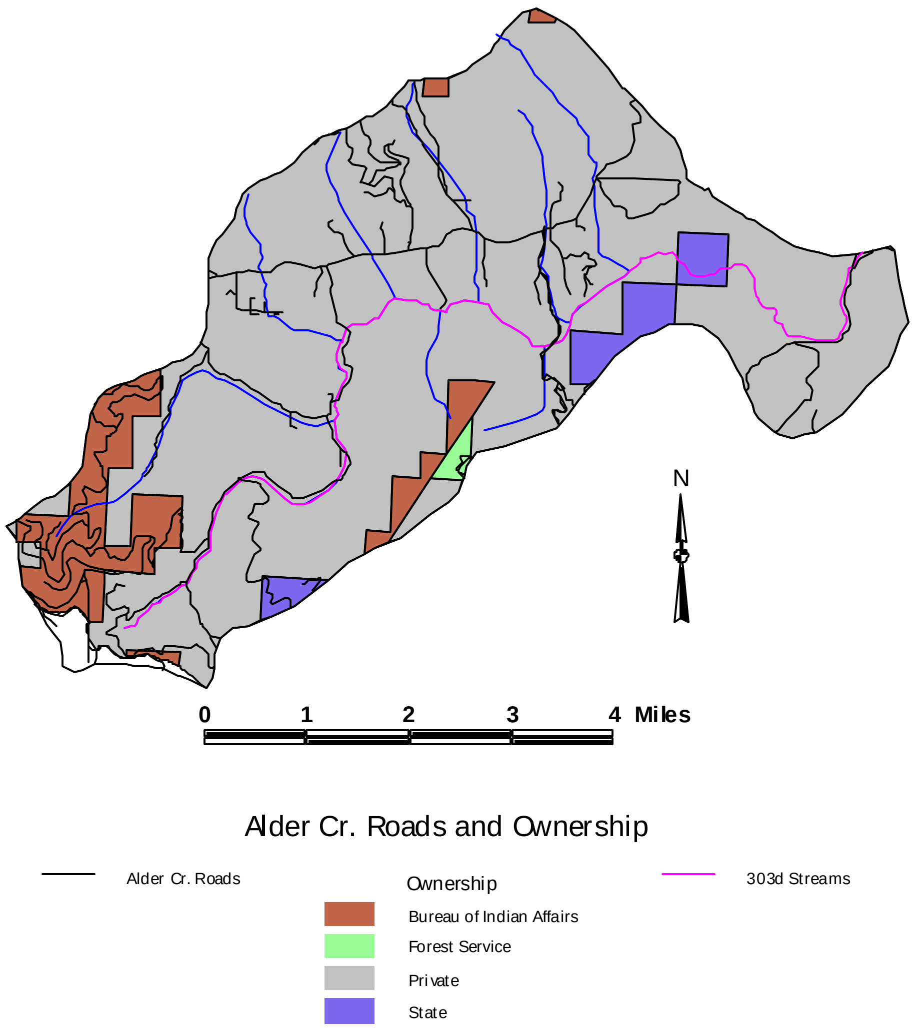

Figure 2-a. Roads and Ownership: Alder Creek

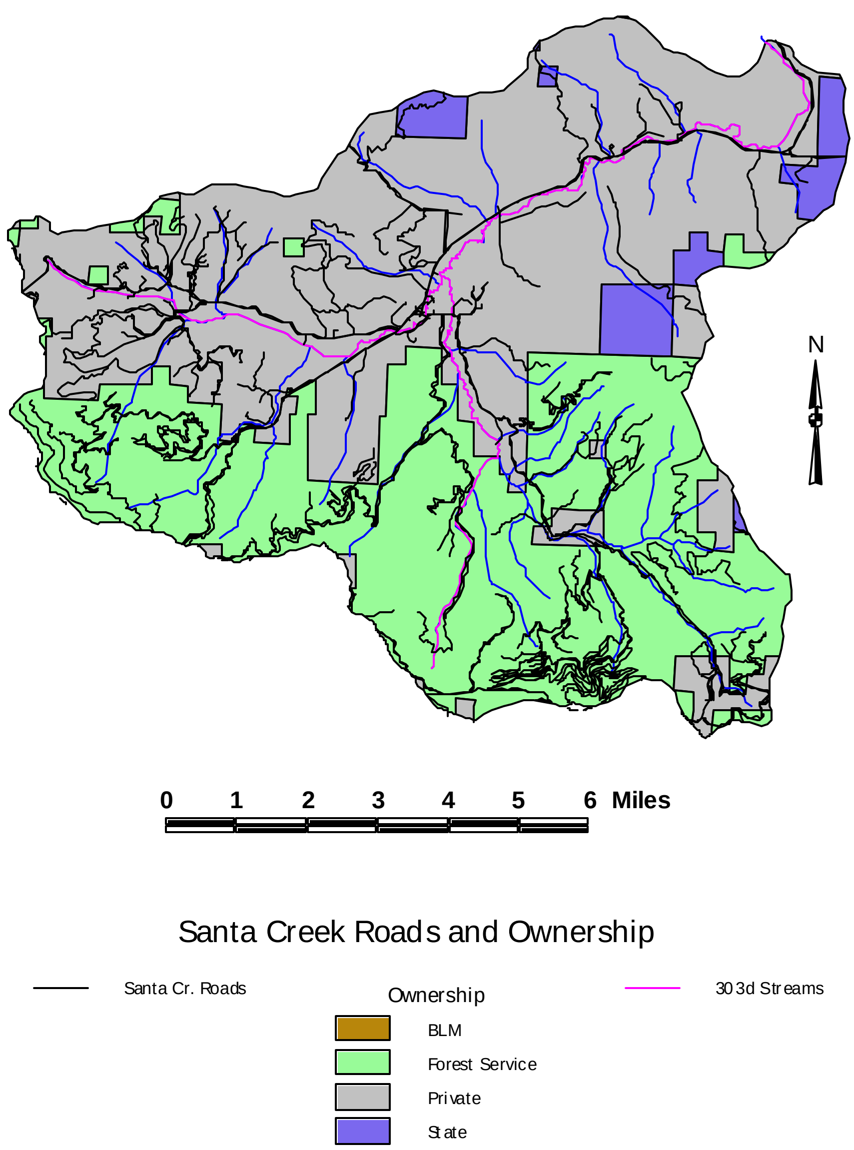

Figure 2-b. Roads and Ownership: Santa Creek

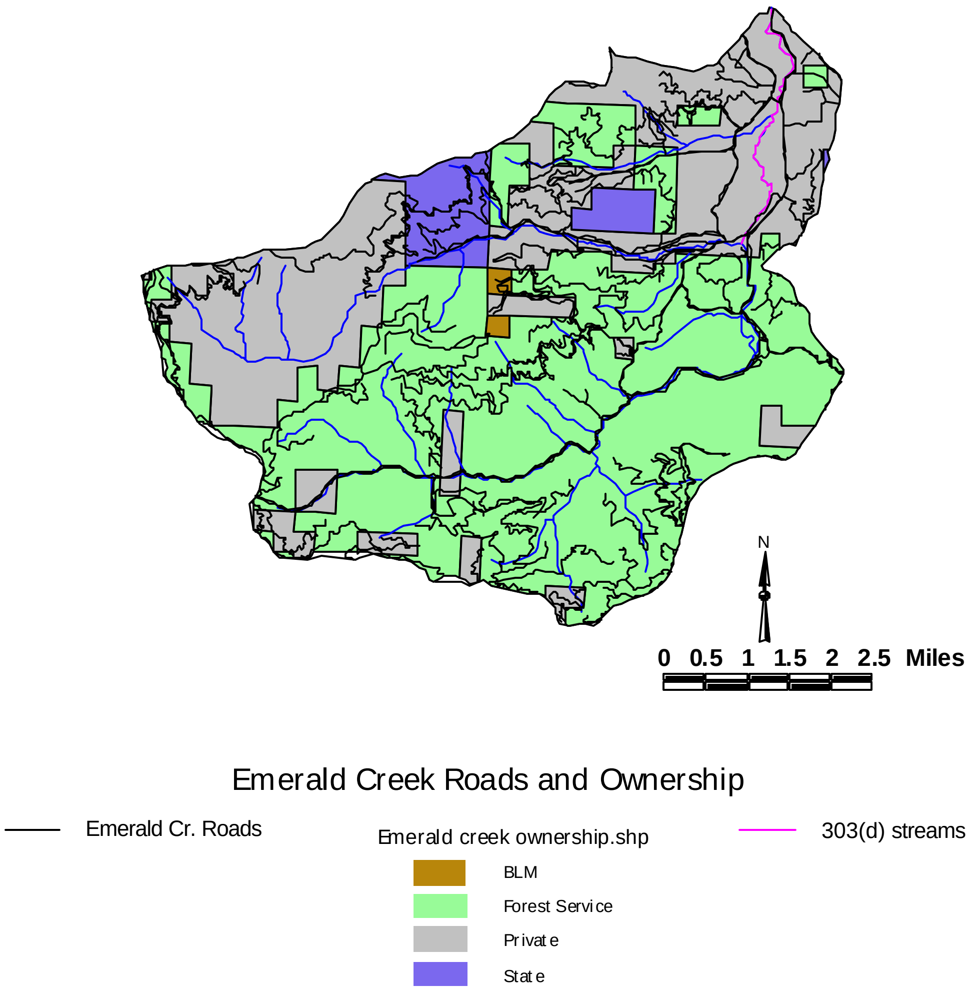

Figure 2-c. Roads and Ownership: Emerald Creek

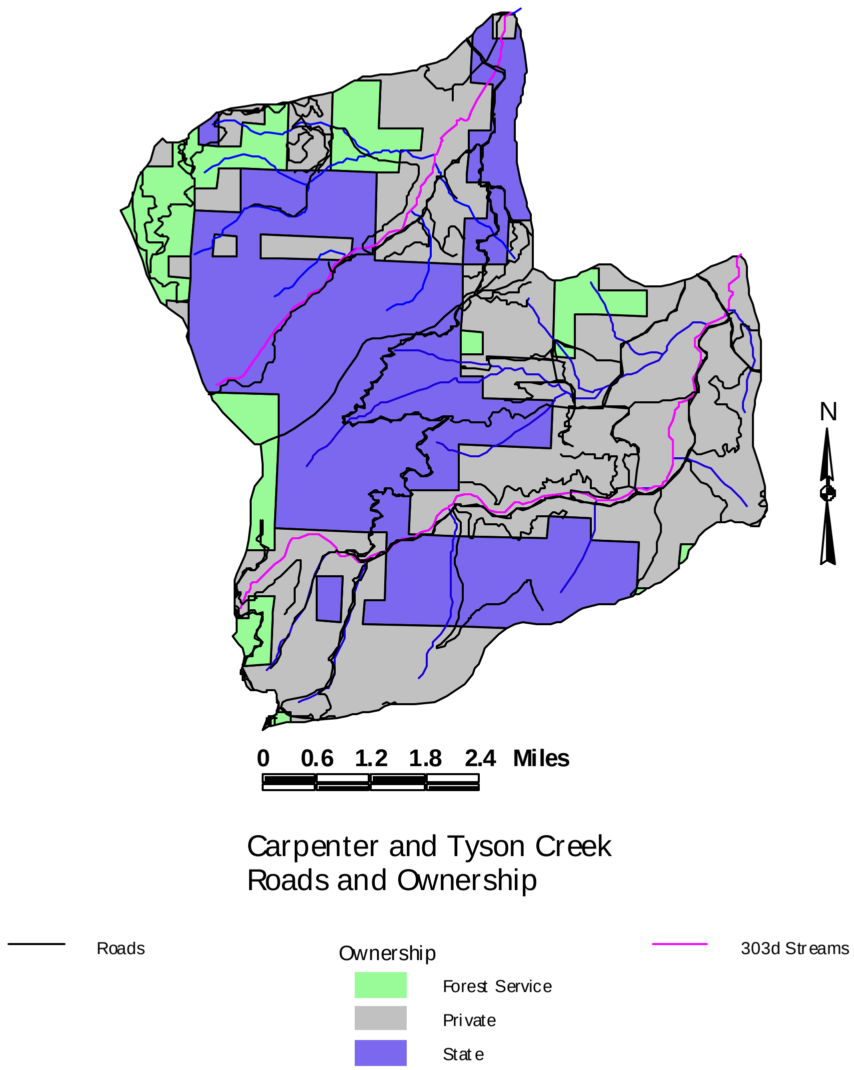

Figure 2-d. Roads and Ownership: Carpenter and Tyson Creeks

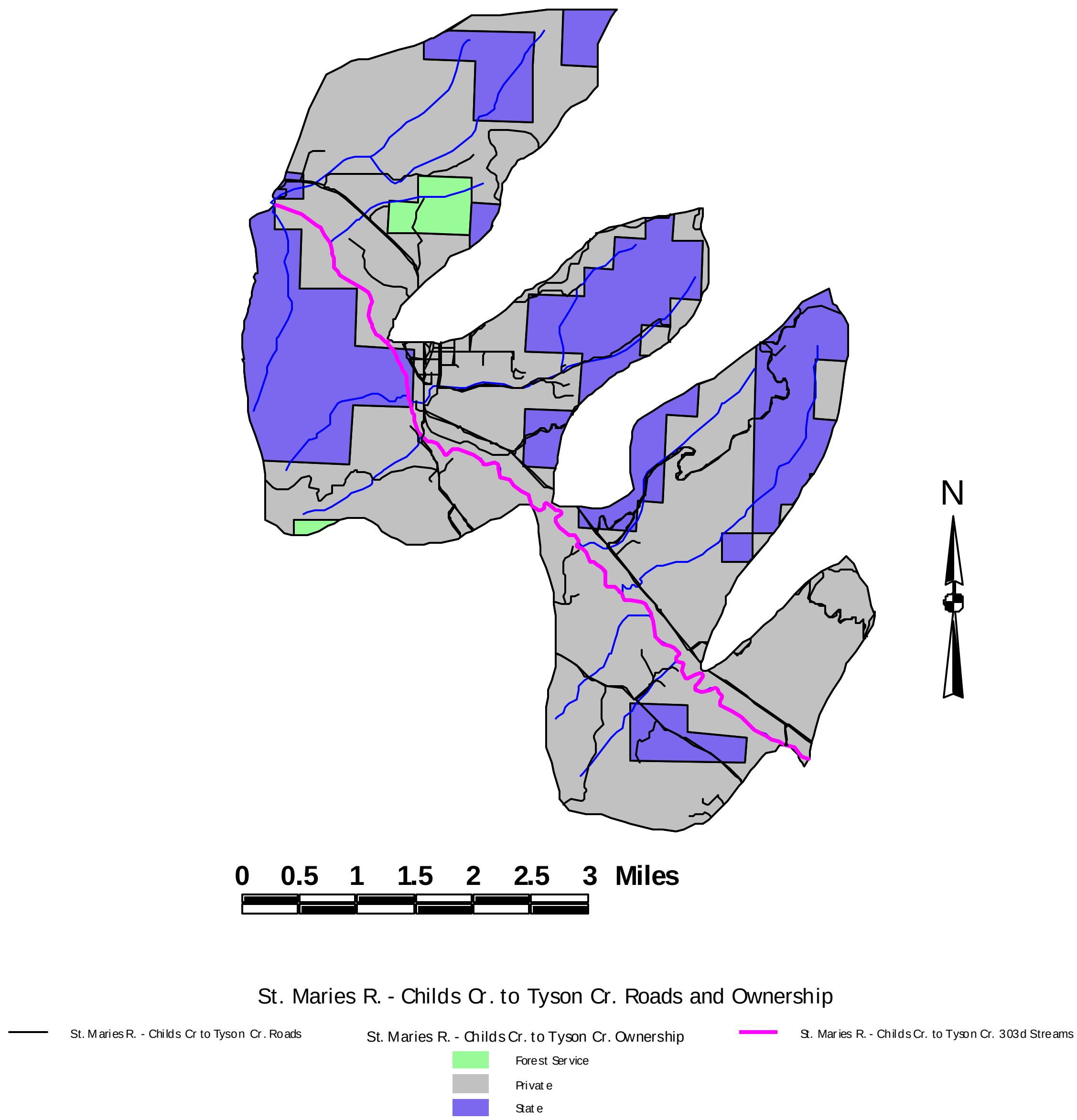

Figure 2-e. Roads and Ownership: St. Maries River, Childs Creek to Tyson Creek

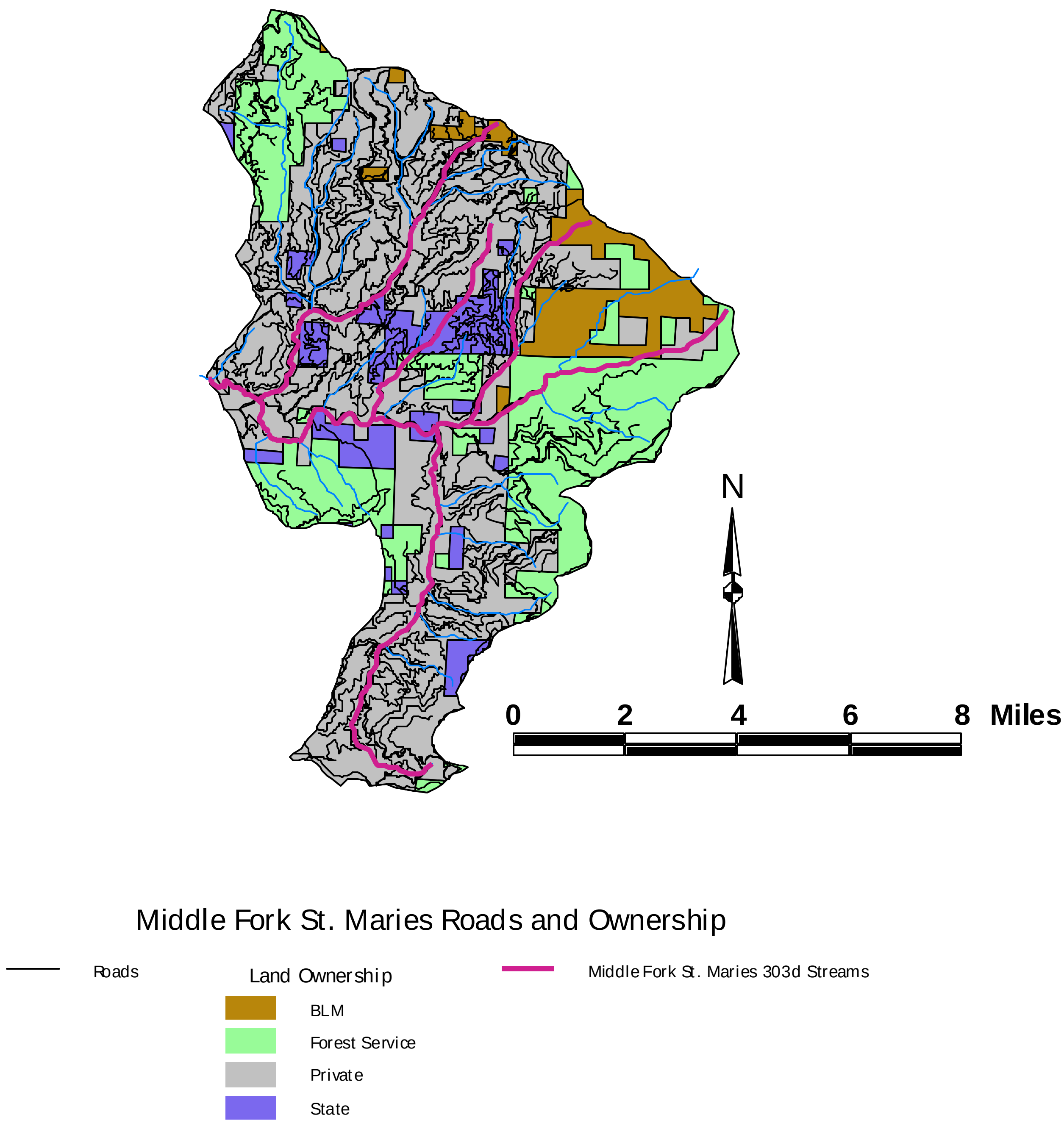

Figure 2-f. Roads and Ownership: Middle Fork of the St. Maries River

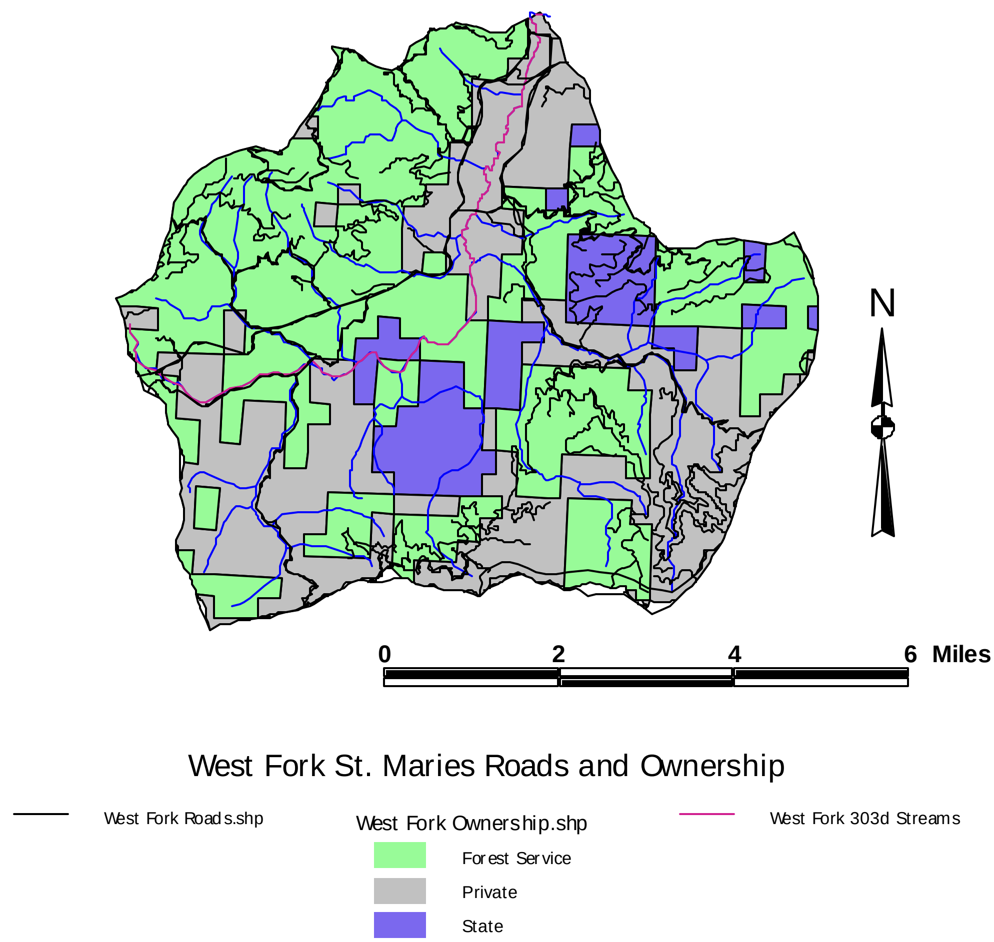

Figure 2-g. Roads and Ownership: West Fork of the St. Maries River

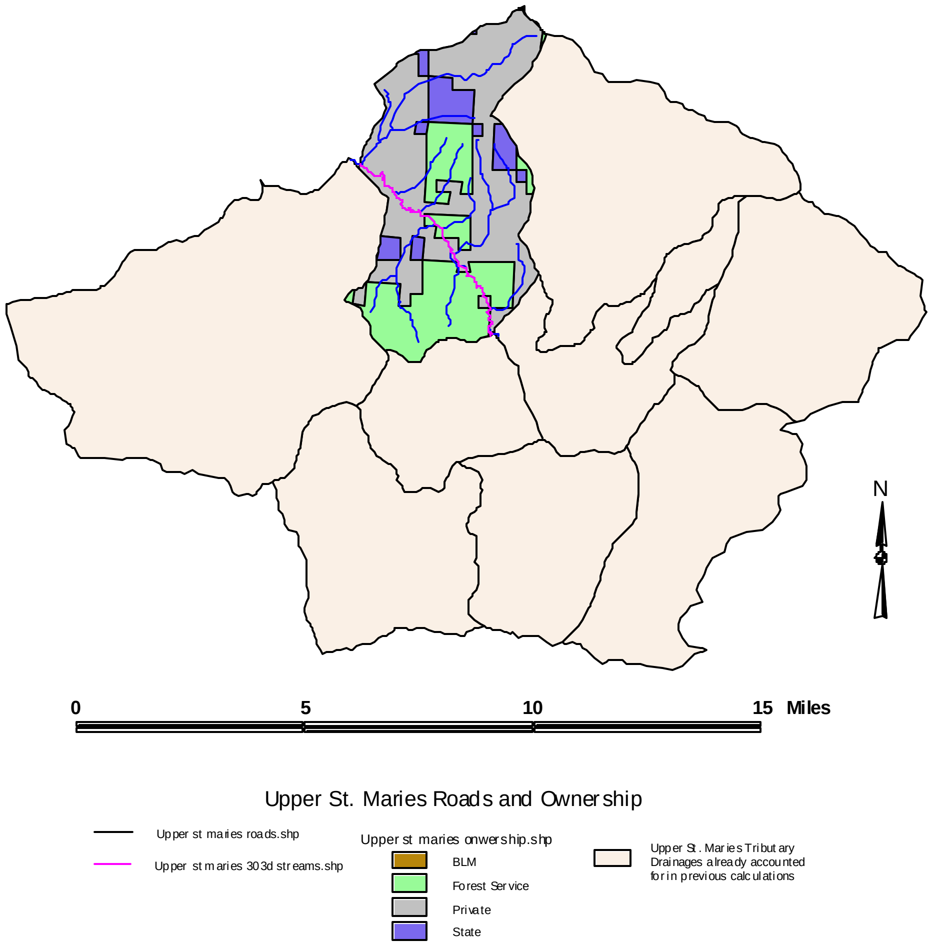

Figure 2-h. Roads and Ownership: Upper St. Maries River

Much of the St. Maries watershed is in Benewah County. The county's population is stable with approximately 9,200 residents. Roughly half of its residents live in the subbasin. St. Maries is the largest town in the subbasin and is the county seat. It has a population of 2,500. Additionally, five small towns are located in the St. Maries Subbasin: Mashburn, Fernwood, Santa, Emida, and Clarkia. None of these has a population in excess of 100. The resident and seasonal populations are sparse in the remainder of the watershed.

History and Economics

The St. Maries Subbasin was settled and developed during the early decades of the twentieth century (Russell 1979). Many watersheds within the subbasin have sustained appreciable timber harvest during the twentieth century. Logging companies initially used the waterways as the log transport system. Log flumes, some splash dams and log drives were used to move logs to mills near the city of St. Maries. Log transport by water was inefficient due to the low gradient of the river and ended by the early 1920s. However, splash dams and log drives caused some structural disruptions to the streams. Railroad logging was also practiced in some watersheds. Later, roads were built in the stream bottoms, fundamentally altering stream gradient and stability. From the 1940s to the 1970s, timber harvest depended on this extensive road network. Logging with the early jammer systems necessitated roads at approximately 100-yard intervals on the slopes. The result is a network of forgotten roads, which intercept the natural drainage system at numerous locations throughout its dendritic pattern. These mid-century harvests also relied heavily on clear-cut prescriptions.

Grazing in the St. Maries River Subbasin is restricted to the river valley and to the low gradient sections of tributary streams. Grazing impacts occur on Emerald Creek, Carpenter Creek, Santa Creek, Charlie Creek, West and Middle Forks, and the St. Maries River where cattle graze in large concentrations. Impacts typically include bank erosion caused by riparian vegetation damage.

Economically important deposits of garnet have been developed in Emerald and Carpenter Creeks. The garnet is processed for use in industrial abrasives. Garnets were mined by placer techniques in the past. In addition, stream courses were altered by dredge mining that was practiced on the floodplains. Altered stream courses are likely a source of sediment. Gold was mined by hydraulic and placer methods in Tyson Creek (Russell 1979). In recent years reclamation of stream channels and floodplains has occurred.

The Benewah Soil and Water Conservation District has been active in addressing soil and water conservation issues in the subbasin for many years. The agency has also been active in stream bank stabilization efforts. They have recently formed the core of the St. Joe Subbasin Watershed Advisory Group (WAG) along with representatives of the Coeur d'Alene Tribe, Idaho Department of Fish and Game, Idaho Department of Lands (IDL), Potlatch, Corporation, Emerald Creek Garnet, Corporation, and the USFS. The St. Joe WAG is providing input regarding the St. Joe and St. Maries Subbasin assessments and will advise DEQ on required TMDLs and implementation plans.

2. Subbasin Assessment – Water Quality Concerns and Status

The St. Maries River and nearly all of the stream segments in its watershed are listed as water quality limited under Section 303(d) of the CWA. Sediment is uniformly listed as the pollutant of concern. Nutrients, temperature, dissolved oxygen depletion, and bacteria are also listed as pollutants of concern for some segments. Fish and macroinvertebrate population surveys (DEQ Beneficial Use Reconnaissance Program [BURP]) data indicate that sediments may have contributed to the decline of trout populations in the St. Maries River and its tributaries.

2.1 Water Quality Limited Segments Occurring in the Subbasin

The St. Maries River Subbasin has 17 water quality limited 303(d) listed stream segments according to the 1998 303(d) list. These segments make up the river, its forks, and the majority of its tributary streams. Segment identification numbers, designated boundaries, and reasons for listing are shown in Table 2 and mapped in Figure 1.

Sediment, temperature, and habitat alteration are the three most prevalent reasons that segments are listed. All segments are listed for sediment with the exception of the St. Maries River between Clarkia and Mashburn, where the pollutant is unknown. Five segments are listed for temperature, while eight segments are listed for habitat alteration. While degraded habitat is evidence of impairment, the EPA does not consider a waterbody to be polluted if the pollution is not a result of the introduction or presence of a pollutant. TMDLs are not required to be established for waterbodies impaired by pollution but not pollutants.

Four segments are listed for nutrients responsible for aquatic plant growth, while one segment each are listed for bacteria and dissolved oxygen.

Table 2. 303(d) listed segments in the St. Maries Subbasin.

Waterbody Name	Segment ID Number	Assessment Unit	1998 303(d)[1] Boundaries	Pollutants	Listing Basis[2]
St. Maries River	3579	PN015_05	Mashburn (town) to St. Joe River	Habitat alteration, nutrients, sediment, and temperature	Appedix A, 305(b) report; EPA addition
St. Maries River	3580	PN015_05	Clarkia to Mashburn	Unknown, temperature	BURP Data; EPA addition to 303(d) list
West Fork of the St. Maries River	3581	PN017_02/03 /04	Headwaters to St. Maries River	Sediment and temperature	Appendix A, 305(b) report
Middle Fork of the St. Maries River	3594	PN018_02/ 03/04/05	Headwaters to St. Maries River	Habitat alteration, sediment, and temperature	Appendix A, 305(b) report; EPA addition
Thorn Creek	3582	PN026_02/03	Headwaters to St. Maries River	Nutrients and sediment	Appendix A, 305(b) report
Alder Creek	3583	PN08_02	Headwaters to St. Maries River (trans-tribal boundary)	Nutrients and sediment	Appendix A, 305(b) report
John Creek	3584	PN09_02	Unnamed tributary (7.5 km upstream) to St. Maries River	Sediment	Appendix A, 305(b) report
Santa Creek	3585	PN010_02/ 03/04	Headwaters to St. Maries River	Dissolved oxygen, habitat alteration, nutrients, sediment, and temperature	Appendix A, 305(b) report; EPA addition
Charlie Creek	3587	PN011_02/03	Headwaters to Santa Creek	Habitat alteration and sediment	Appendix A, 305(b) report
Renfro Creek	3588	PN024_02	Headwaters to Davis Creek	Sediment	Appendix A, 305(b) report
Tyson Creek	3589	PN013_02/03	North Fork Tyson Creek to St. Maries River	Habitat alteration and sediment	Appendix A, 305(b) report
Crystal Creek	3590	PN023_02	Headwaters to St. Maries River	Sediment	Appendix A, 305(b) report
Carpenter Creek	3591	PN014_02/03	Headwaters to St. Maries River	Habitat alteration and sediment	Appendix A, 305(b) report
Emerald Creek	3593	PN016_03	East Fork –West Fork Confluence to St. Maries River	Habitat alteration, sediment, and temperature	Appendix A, 305(b) report; EPA addition
Gold Center Creek	3596	PN019_02/03	Windy Creek to Middle Fork of the St. Maries River	Habitat alteration, sediment, and temperature	Appendix A, 305(b) report
Flewsie Creek	3596	PN018_02	Headwaters Creek to Middle Fork of the St. Maries River	Sediment and temperature	Appendix A, 305(b) report
Gramp Creek	3598	PN019_02	Headwaters to Gold Center Creek	Bacteria, sediment, and temperature	Appendix A, 305(b) report

[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.
[2]305(b) report - a report on the condition of all Idaho surface waters; EPA addition - refers to EPA additions to the1ist created in 1998 of water bodies in Idaho that did not fully support at least one beneficial use.

2.2 Applicable Water Quality Standards

Water quality standards prescribe the use of the waterbody and establish the water quality criteria that must be met to protect designated uses. Designated uses for the St. Maries Subbasin and the applicable water quality standards appear below.

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 *Waterbody 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 waterbody 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 58.01.02.003.35, .050.02, and 051.01 and .053). Existing uses include uses actually occurring, whether or not the level of quality to fully support the uses exists. Practical application of this concept would be when a waterbody could support salmonid spawning, but salmonid spawning is not yet occurring.

Designated Uses

Designated uses under the CWA are "those uses specified in water quality standards for each waterbody or segment, whether or not they are being attained." Designated uses are simply uses officially recognized by the state. In Idaho these include things like aquatic life support, recreation in and on the water, domestic water supply, and agricultural use. 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 waterbodies in Idaho in tables in the Idaho water quality standards (see IDAPA 58.01.02.003.22 and .100, and IDAPA 58.01.02.109-160 in addition to citations for existing uses).

The St. Maries River has designated beneficial uses (Table 3) of cold water aquatic life and primary contact recreation. The portion of the river from the confluence of the West Fork and Middle Fork of the St. Maries River to the Carpenter Creek reach of the river has the additional designated uses of domestic water supply and special resource water. Santa Creek has designated beneficial uses of cold water aquatic life, salmonid spawning and primary contact recreation (IDAPA 58.01.02.101.11). Beneficial uses have not been designated for the other tributaries of the St. Maries River.

Presumed Uses

In Idaho, most waterbodies 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 criteria cold water 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 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).

Table 3. St. Maries Subbasin designated beneficial uses.

Waterbody Unit	Waterbody	Designated Uses[1]			On 303(d) List[2]
		Aquatic Life	Recreation	Other	
P-15	St. Maries River	CW	PCR	DWS, SRW	†
P-12	St. Maries River	CW	PCR	-	†
P-7	St. Maries River	CW	PCR	-	†
P-10	Santa Creek	CW, SS	PCR	-	†

[1]CW- Cold Water, SS- Salmonid Spawning, PCR- Primary Contact Recreation, DWS- Domestic Water Supply, SRW- Special Resource Water.
[2]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.

Table 4. St. Maries Subbasin beneficial uses of impaired streams without standard designated uses.

Waterbody Unit	Waterbody	Beneficial Uses[1]		On 303(d) List[2]
		Aquatic Life	Recreation	
P-8	Alder Creek	CW,SS	SCR	†
P-9	John Creek	CW,SS	SCR	†
P-11	Charlie Creek	CW,SS	SCR	†
P-13	Tyson Creek	CW,SS	SCR	†
P-14	Carpenter Creek	CW,SS	SCR	†

Table 4, continued.

P-16	Emerald Creek	CW,SS	SCR	†
P-17	West Fork St. Maries River	CW,SS	PCR	†
P-18	Middle Fork St. Maries River	CW,SS	PCR	†
P-19	Gold Center Creek	CW,SS	SCR	†
P-18	Flewsie Creek	CW,SS	SCR	†
P-19	Gramp Creek	CW,SS	SCR	†
P-23	Crystal Creek	CW,SS	SCR	†
P-24	Renfro Creek	CW,SS	SCR	†
P-26	Thorn Creek	CW,SS	SCR	†

[1]CW- Cold Water, SS- Salmonid Spawning, PCR- Primary Contact Recreation, SCR- Secondary Contact Recreation.
[2]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.

Water Quality Standards

Water quality criteria supportive of beneficial uses are stated in the Idaho Water Quality Standards and Wastewater Treatment Requirements (DEQ 2000a). The standards supporting beneficial uses are outlined in Table 5. In addition to these standards, cold water and salmonid spawning are supported by sediment and nutrient narrative standards. The narrative sediment standard states:

Sediment shall not exceed quantities specified in section 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 (IDAPA 58.01.02.200.08).

The excess nutrients standard states:

Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other aquatic growths impairing designated beneficial uses (IDAPA 58.01.02.200.06).

Table 5. Water quality standards supportive of beneficial uses (IDAPA 58.01.02.250). [1]

Pollutant	Primary Contact Recreation	Secondary Contact Recreation	Cold Water Aquatic Life	Salmonid Spawning
pH	-	-	pH between 6.5 and 9.5	pH between 6.5 and 9.5
Coliforms and dissolved gas	126 E. coli/100mL geometric mean over 30 days	126 E. coli/100mL geometric mean over 30 days	Dissolved gas not exceeding 110%	Dissolved gas not exceeding 110%
Chlorine	-	-	Total chlorine residual less than 19 ?g/L/hr or an average 11 ?g/L/4 day period	Total chlorine residual less than 19 ?g/L/hr or an average 11 ?g/L/4 day period
Toxic substances	-	-	Less than toxic substances set forth in 40 CFR 131.36(b)(1) Columns B1, B2, D2	Less than toxic substances set forth in 40 CFR 131.36(b)(1) Columns B1, B2, D2
Dissolved oxygen	-	-	Exceeding 6 mg/L D.O.	Exceeding 5 mg/L intergravel D. O.; exceeding 6 mg/L surface
Temperature	-	-	less than 22 °C (72 °F) instantaneous; 19 °C (66 °F) daily average or natural background, if greater	Less than 13 °C (55 °F) instantaneous; 9 °C (48 °F) daily average or natural background, if greater
Ammonia	-	-	Low ammonia (see formula/tables for exact concentration)	Low ammonia (see formula/tables for exact concentration)
Turbidity[2]	-	-	Less than 50 NTU instantaneous; 25 NTU over 10 days greater than background	-

[1]pH –negative logarithm of the hydrogen ion concentration; E. coli - *Escherichia coli;* ?g/L – micrograms per liter; D.O. – dissolved oxygen; mg/L – milligrams per liter; °C – degrees Celsius; °F – degrees Fahrenheit; NTU – nephelometric turbidity units.
[2] The turbidity standard is a standard applied to the mixing zones of point discharges in the standards (IDAPA 58.01.02.250.01.d). However, the standard is technically based on the ability of salmonids to sight feed. For this, it is applicable through the narrative sediment standard (IDAPA58.01.02.200.08) to impacts on salmonids (cold water aquatic life) wherever these may occur.

2.3 Summary and Analysis of Existing Water Quality Data

There are relatively few sources of existing water quality data for the St. Maries Subbasin. The USGS has operated a discharge gage on the St. Maries River near Santa since October 1965. Water quality data have been collected at this station intermittently since the late 1980s. These data include temperature, pH, dissolved oxygen, and aquatic plant growth nutrient measurements. Idaho Soil Conservation Commission (SCC) staff collected aquatic plant growth nutrients, dissolved oxygen and bacteria data at various sites on the St. Maries River, Thorn Creek and Santa Creek during water year 2000. Additional bacteria data were collected on Gramp Creek by DEQ in water year 2001. Beneficial Use Reconnaissance Program data was collected on all water quality limited streams. These data include habitat data, macroinvertebrate and fisheries data. The IDL Cumulative Watershed Effects (CWE) program collected data on sediment sources during the summers of 2000 and 2001.

Discharge Characteristics

The average annual discharge hydrograph (Figure 3) of the Santa gaging station indicates that the spring snowmelt event dominates the pattern of stream discharge (USGS 1996-2000). The mean high flow discharge for the past five years occurred in April at 1,213 cubic feet per second (cfs) and mean low flow discharge occurred in September at 64 cfs. Bank full discharge is in the range of 1,200 cfs. Rain-on-snow conditions can result in large flood events (Figure 4), as occurred during winter 1995-1996 (USGS 1997). The majority of the slopes in the St. Maries River watershed exist between 3,330 to 4,500 feet in elevation. Consequently, the watershed is prone to rain-on-snow events. Peak discharges during the third largest flood on record (February 1996) were estimated at 11,000 cfs.

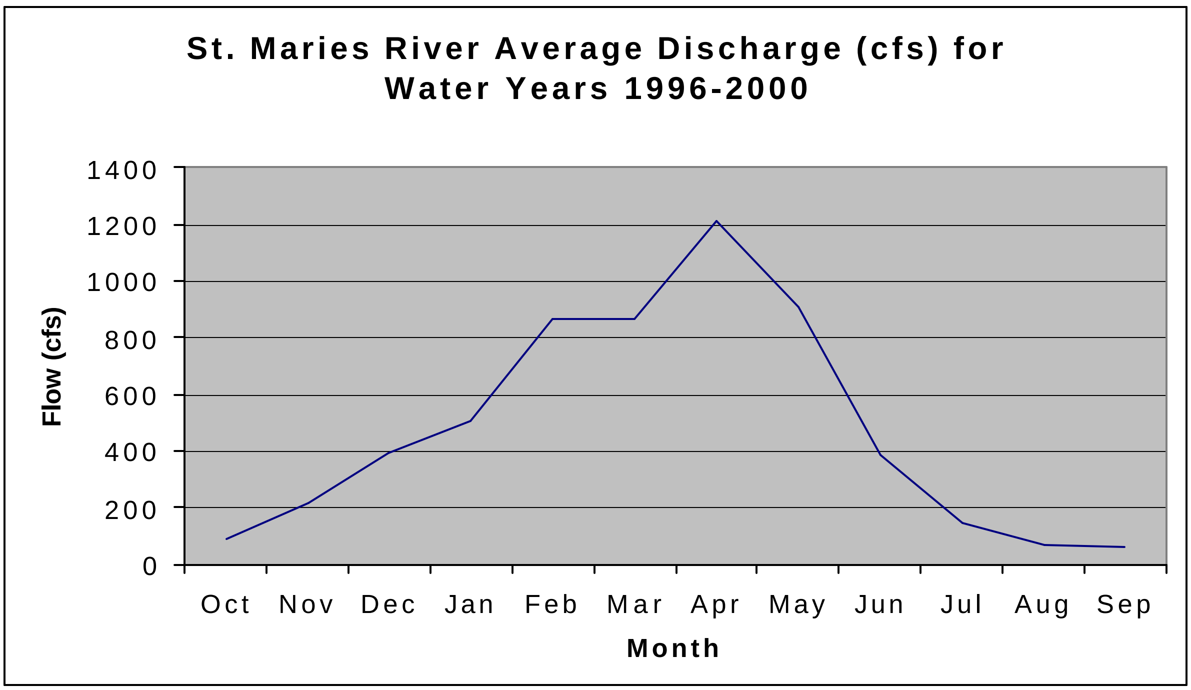

Figure 3. St. Maries River Discharge at Santa: Average Monthly Discharge for Water Years 1996-2000 (USGS 1996-2000)

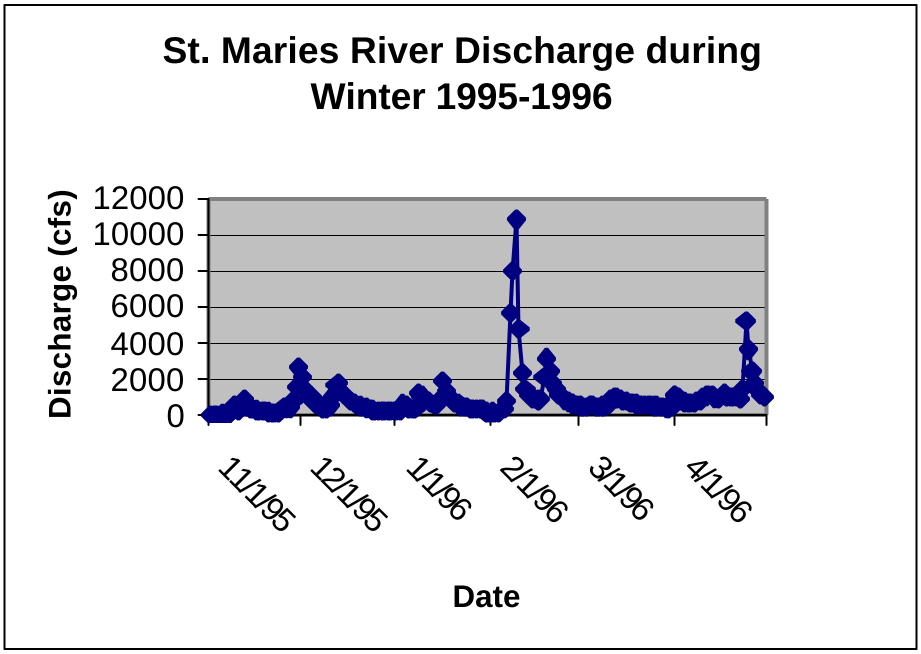

Figure 4. St. Maries River at Santa Daily Discharge During Winter 1995-1996 (USGS 1997)

Water Column Data

Water column data have been collected at the Santa gaging station by the USGS under contract with DEQ and EPA. The SCC collected aquatic plant growth nutrient and bacteria data at five locations in the subbasin. DEQ collected bacteria data at Gramp Creek to fill a data gap.

-- General data from the Santa gaging station

Selected water quality data collected by the USGS at the Santa gaging station between 1994 and 2000 are summarized in Table 7. The entire data set is provided in Appendix B.

-- Aquatic plant growth nutrients

The St. Maries River and Thorn, Alder, and Santa Creeks are listed for nutrients. Potential sources of nutrients in these watersheds include discharge from wastewater treatment facilities and livestock grazing. Three wastewater treatment facilities operate in the watershed at Clarkia, Emida, and Santa-Fernwood. The discharge monitoring records for water year 2000 from the Santa-Fernwood facility were examined. Clarkia and Emida do not assess discharge quality. Santa-Fernwood assesses total phosphorous and total Kjeldahl nitrogen in treated and receiving waters. Total phosphorous and Kjeldahl nitrogen concentrations in discharged water are low and the discharge volume is small. Stream concentration increases of phosphorous and nitrogen attributable to the discharge are negligible.

Water samples were collected on three dates during the summer of 2000 from two locations on the St. Maries River (both below the treated wastewater discharges), and at the mouths of Santa and Thorn Creeks. These samples were analyzed for total phosphorous, nitrate-nitrite and total Kjeldahl nitrogen. The analytical results are provided in Tables 8a-c. Nutrient concentrations were slightly higher at the Santa and Thorn Creek locations. Total Kjeldahl nitrogen data indicated that nitrogen was primarily in organic nitrogen forms.

The Coeur d'Alene Tribe has collected plant growth nutrient and other water column data on Alder Creek since 1997. Data is collected, on average, four to eight times a season. Nutrient data from Alder Creek is summarized in Table 9.

Gold Creek, Santa Creek, Thorn Creek, Alder Creek, and the St. Maries River were sampled for periphyton (benthic algae). High periphyton biomass may indicate eutrophic conditions. Periphyton biomass can be estimated by several methods, including determining chlorophyll *a* (chl *a*) and ash free dry mass (AFDM). The excess nutrients narrative standard requires that surface waters of the state be free from excess nutrients that can cause visible slime growths or other aquatic growths impairing designated beneficial uses. According to the EPA's *Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers* (1999), levels of algal biomass greater than 10 µg chl *a* cm^2 or greater than 5 mg AFDM cm^2 indicate nuisance levels of nutrients or organic enrichment. The periphyton samples collected from the St. Maries River and its tributaries showed levels of AFDM ranging from a low of 0.24 mg/cm^2 in Gold Creek to 1.89 mg/cm^2 in Thorn Creek. Chlorophyll *a* measured from .42 $µg/cm^2$ Gold Creek to a high of 6.68 $µg/cm^2$ in Alder Creek. All measurements were found to be well below levels causing visible slime growths or other aquatic growths impairing designated beneficial uses. It is therefore recommended that these streams be delisted for excess nutrients.

Table 6. Periphyton biomass in the St. Maries River and its tributaries.[1]

Waterbody	Sample Number	AFDM (mg/cm^2)	Chla (?/cm^2)
Gold Creek	1	0.24	0.42
Gold Creek	2	0.34	0.46
St. Maries River	1	1.83	2.68
St. Maries River	2	1.29	1.89
Santa Creek	1	1.05	2.23
Santa Creek	2	1.20	3.69
Thorn Creek	1	1.48	3.74
Thorn Creek	2	1.89	5.45
Alder Creek	1	1.11	6.68

[1]AFDM - ash free dry mass; Chla - Chlorophyll a.

Table 7. Water quality of the St. Maries River at the Santa gaging station.

Sample Date	Water Temp (?C)	Inst. Discharge (cfs)	Specific Conductance (microsiemens /cm)	pH (standard units)	Nitrogen, Ammonia Dissolved (mg/L as N)	Nitrogen, Ammonia + Organic Total (mg/L as N)	Nitrogen, nitrate, and nitrite Dissolved (mg/L as N)	Phosphorus Total (mg/L as P)	Phosphorus Ortho Dissolved (mg/L as P)	Alkalinity Water Dissolved FET Lab CaCO3 (mg/L)
10/27/93	2.0	56.1	58.0	-	-	-	-	-	-	-
12/15/93	0.0	98.6	53.0	-	-	-	-	-	-	-
02/23/94	0.0	84.9	58.0	-	-	-	-	-	-	-
02/24/94	0.0	91.9	58.0	-	-	-	-	-	-	-
04/20/94	8.0	605.0	34.0	-	-	-	-	-	-	-
07/19/94	25.5	45.6	59.0	8.6	0.06	0.5	0.05	0.02	0.01	-
10/23/95	6.0	83.4	58.0	-	-	-	-	-	-	-
11/30/95	5.5	2840.0	32.0	-	-	-	-	-	-	-
01/30/96	0	197.0	18.0	-	-	-	-	-	-	-
02/10/96	2.0	4060.0	26.0	-	-	-	-	-	-	-
03/14/96	5.5	868.0	38.0	-	-	-	-	-	-	-
05/17/96	7.5	957.0	38.0	-	-	-	-	-	-	-
06/19/96	9.0	209.0	43.0	-	-	-	-	-	-	-
-08/15/96	23.0	59.3	53.0	-	-	-	-	-	-	-
10/21/98	4.5	54.6	54.0	7.8	0.002	0.1	0.005	0.014	0.006	-
11/19/98	3.0	101.0	52.0	7.2	0.003	0.1	0.005	0.021	0.005	-
12/09/98	0.0	172.0	46.0	7.5	0.004	0.1	0.026	0.024	0.007	-
01/26/99	0.0	269.0	44.0	7.7	0.011	0.136	0.017	0.0306	0.011	-
02/09/99	0.5	428.0	40.0	7.0	0.009	0.205	0.013	0.0385	0.017	-
03/10/99	2.0	368.0	37.0	7.1	0.002	0.102	0.005	0.023	0.006	-
04/14/99	5.6	666.0	34.0	7.3	-	-	-	-	-	-
05/10/99	-	643.0	34.0	7.5	0.004	-	0.005	0.012	0.005	16.344
06/07/99	9.5	504.0	30.0	7.2	0.003	0.161	0.006	0.013	0.003	15.705
07/14/99	19.5	154.0	39.0	7.4	0.002	0.158	0.005	0.02	0.003	18.362
08/10/99	20.0	86.1	50.0	7.8	0.002	0.12	0.005	0.016	0.008	24.509
09/09/99	20.0	56.3	48.0	7.7	-	-	-	-	-	26.515
Average	**7.1**	**529.1**	**44.0**	**7.5**	**0.009**	**0.168**	**0.013**	**0.021**	**0.007**	**20.287**

Table 8. Plant growth nutrient concentrations at two locations on the St. Maries River, Santa Creek, and Thorn Creek.[1]

a) Total phosphorous (? g/L)

Waterbody	Location	7/29/00	8/29/00	9/13/00	Mean
St. Maries River	Near Mashburn	38	13	20	24
St. Maries River	Santa Bridge	26	15	20	20
Santa Creek	Near mouth	53	23	34	37
Thorn Creek	Near mouth	44	31	48	41

b) Total nitrite-nitrate (? g/L)

Waterbody	Location	7/29/00	8/29/00	9/13/00	Mean
St. Maries River	Near Mashburn	<10[1]	<10	<10	5
St. Maries River	Santa Bridge	<10	<10	<10	5
Santa Creek	Near mouth	<10	<10	<10	5
Thorn Creek	Near mouth	36	12	12	20

[1]Less than 10 treated as 5 ? g/L in means.

c) Total Kjeldahl Nitrogen (? g/L)

Waterbody	Location	7/29/00	8/29/00	9/13/00	Mean
St. Maries River	Near Mashburn	150	100	130	127
St. Maries River	Santa Bridge	190	80	120	130
Santa Creek	Near mouth	390	130	180	233
Thorn Creek	Near mouth	240	120	180	180

[1]Data collected by DEQ.

Table 9. Alder Creek nutrient levels (? g/L)[1]

Nutrient	1998	1999	2000	2001	Mean
Nitrate-Nitrite	27.5	19.8	9.5	48.9	26.4
Total Kjeldahl Nitrogen	109	104	101	331	116.3
Total Phosphorous	7.9	9.6	20.2	19.4	14.3

[1]Data collected by Coeur d'Alene Tribe.

?? Dissolved oxygen

Santa Creek is listed for a lack of dissolved oxygen. The dissolved oxygen concentrations of the stream were measured in late July, late August and mid September 2000 during and after a prolonged period of warm weather without precipitation. If oxygen deficiency occurs, it would be expected under these conditions. The dissolved oxygen concentrations and percent saturation measured are provided in Table 10. The values are higher than the minimum standard of 6 mg/L dissolved oxygen or 90% saturation. Based on this data, Santa Creek is not limited by low dissolved oxygen concentrations.

Table 10. Dissolved oxygen and percent saturation measured in Santa Creek near its mouth.

Date	Dissolved oxygen (mg/L)	Percent saturation
July 31, 2000	9.0	95%
August 29, 2000	10.5	103%
September 13, 2000	9.4	100%

-- Temperature

The West Fork of the St. Maries River and Emerald, Gold Center, Flewsie, and Gramp Creeks are listed as limited by temperature standard exceedences. Summer-fall temperatures were continuously monitored on these and additional tributaries of the St. Maries River. Temperature data for monitored streams are summarized in Table 11. The temperature profiles and the analyses of the data for exceedences of federal and state bull trout standards and cutthroat and bull trout spawning standards are provided in Appendix B.

Table 11. Percentage of temperature standards exceedence from federal and state bull trout standards and cutthroat and bull trout spawning standards during the period for which the standards apply.

Stream	Federal Bull Trout Exceedence: May 1 to Oct 31 (percent of days)	State Bull Trout Exceedence: May 1 to Oct 31 (percent of days)	Cutthroat Trout Spawning Exceedence: Week Post Hydrograph Peak to July 31 (percent of days)	Bull Trout Spawning Exceedence: Sept 1 to Oct 31 (percent of days)
Gramp Creek	48.4	30.4	31.0	48.4
Gold Center Creek	42.4	33.7	23.0	54.1
Flewsie Creek	57.1	48.9	54.0	32.8
MF St. Maries River	53.8	43.5	39.1	32.7
Emerald Creek – 1	58.2	51.6	66.7	41.0
Emerald Creek – 2	58.2	51.6	66.7	41.0
Emerald Creek – 3	54.9	37.5	49.4	26.2

None of the listed streams meet temperature standards. Exceedences occur between 20% and 70% of the time, depending on the standard. The BURP results employed to develop the 1998 303(d) list indicated that these streams support cold water aquatic life and salmonid spawning uses to some extent. The nearly uniform exceedence of the state and federal temperature standards during July, August, and early September suggests the standards may not be realistic. However, based on the current temperature monitoring results and temperature standards, Gramp, Gold Center, Flewsie, and Emerald Creeks, and the Middle Fork of the St. Maries River are limited by temperature. Given the results from these headwater streams, it is reasonable to assume that Santa Creek and the West Fork and main stem of the St. Maries River are also limited by temperature.

Biological and Other Data

Existing biological data include bacteria, macroinvertebrate and fisheries data. Habitat data, together with the macroinvertebrate and fisheries data, are available from the BURP database. Bacteria data were collected by the DEQ and SCC.

-- Bacteria

A single stream (Gramp Creek) is listed for bacteria. Discharge measurements of 1.3 cfs during mid-August 2000 and 1 cfs during mid-September 2001 indicate that the stream would support secondary contact recreation only. No evidence of a primary contact use was found. An assessment of *Escherichia coli* (*E. coli*) was conducted during August 2000 and September 2001. Results of the *E. coli* test indicated 13 and 17 colonies per 100 mL sample, respectively. These E. coli values are well below the criteria value of 126 E. coli/100mL for contact recreation (Table 12). Based on this data, the listing of Gramp Creek for bacteria is incorrect.

The SCC staff also collected bacteria samples in addition to nutrient samples. *E. coli* values are shown in Table 12 as *E. coli*/100 mL. These values are well below the criteria value for contact recreation of 126 *E. coli*/100 mL (Table 12). The data indicates that bacteria standards exceedence was not measured in the St. Maries River or two of its tributaries.

Table 12. *Escherichia coli* (*E. coli*/100 mL) at four locations in the St. Maries Subbasin.

Waterbody	Location	7/29/00	8/29/00	9/13/00	Mean
St. Maries River	Near Mashburn	9	62	28	33
St. Maries River	Santa Bridge	12	26	24	21
Santa Creek	Near mouth	50	24	10	28
Thorn Creek	Near mouth	10	17	42	23

-- Macroinvertebrate, fish, and habitat index data

Stream macroinvertebrate indices (SMI), stream fishery indices (SFI) and stream habitat index (SHI) scores are provided in Table 13. These data are available for several water bodies of the St. Maries River watershed. Fisheries data is the most limiting. The entire data set is provided in Appendix B. *Waterbody Assessment Guidance II* (Grafe et al. 2002) scores for the stream macroinvertebrate, fishery, and stream habitat indices based on the Northern Mountains Ecoregion are shown in the adjacent columns. These values are averaged to develop the score for the available indices. Average values of two or greater indicate support of the cold water aquatic life, while values less than two indicate nonsupport.

The data indicate that the upper reaches of the St. Maries River tributaries fully support the cold water aquatic life. Specifically, upper John, Charlie, middle Tyson, upper Carpenter, Gold Center, Gramp, Flewsie, upper Merry, upper Crystal and upper Renfro Creeks, along with the upper Middle Fork of the St. Maries River, support cold water aquatic life based on the indices and scoring system. Conversely, the following lower reaches of the tributaries and the St. Maries River do not support the cold water aquatic life: Santa, Emerald, and Thorn Creeks and the West Fork of the St. Maries River (Figure 5).

Table 13. Stream biotic indices and stream habitat index data of the St. Maries subbasin

STREAM	SMI[1]	SMI Score	SFI[2]	SFI Score	SHI	SHI[3] Score	Average SMI + SFI+ SHI	Supports Beneficial Uses
ALDER CREEK (UPPER)	35.7	0.0	-	-	52.0	1.0	0.5	No
ALDER CREEK (LOWER)	45.6	1.0	-	-	57.0	1.0	1.0	No
JOHN CREEK (UPPER)	40.1	1.0	79.0	2.0	71.0	3.0	2.0	Yes
JOHN CREEK (LOWER)	27.6	0.0	-	-	39.0	1.0	0.5	No
EAST FORK CHARLIE CREEK (UPPER)	40.7	1.0	-	-	73.0	3.0	2.0	Yes
EAST FORK CHARLIE CREEK (LOWER)	42.9	1.0	-	-	48.0	1.0	1.0	No
CHARLIE CREEK	61.4	2.0	82.0	3.0	59.0	2.0	2.3	Yes
CHARLIE CREEK	30.5	0.0	82.0	3.0	49.0	1.0	1.3	No
SANTA CREEK (UPPER)	44.7	1.0	-	-	45.0	1.0	1.0	No
SANTA CREEK (LOWER)	49.9	1.0	21.0	0.0	30.0	1.0	0.7	No
SANTA CREEK (LOWER)	42.5	1.0	21.0	0.0	37.0	1.0	0.7	No
TYSON CREEK (MIDDLE)	71.2	3.0	89.0	3.0	70.0	3.0	3.0	Yes
TYSON CREEK	33.0	0.0	-	-	33.0	1.0	0.5	No
CARPENTER CREEK (UPPER)	51.6	1.0	83.0	3.0	65.0	2.0	2.0	Yes
CARPENTER CREEK (UPPER)	46.3	1.0	83.0	3.0	71.0	3.0	2.3	Yes
CARPENTER CREEK (LOWER)	43.7	1.0	-	-	30.0	1.0	1.0	No
EMERALD CREEK (UPPER)	37.4	0.0	45.0	1.0	45.0	1.0	1.0	No
EMERALD CREEK (LOWER)	34.8	0.0	30.0	0.0	44.0	1.0	0.3	No
WFSAINT MARIES RIVER (UPPER)	82.1	3.0	67.0	2.0	44.0	1.0	2.0	Yes
MF SAINT MARIES RIVER (UPPER)	59.7	2.0	94.0	3.0	63.0	2.0	2.3	Yes
MF SAINT MARIES RIVER (UPPER)	68.4	3.0	63.0	1.0	55.0	1.0	1.7	No
MF SAINT MARIES RIVER (LOWER)	37.0	0.0	52.0	1.0	49.0	1.0	0.7	No
MF SAINT MARIES RIVER (LOWER)	59.8	2.0	48.0	1.0	46.0	1.0	1.3	No
MF SAINT MARIES RIVER (MIDDLE)	45.3	1.0	-	-	56.0	1.0	1.0	No
MF SAINT MARIES RIVER	70.0	3.0	-	-	42.0	1.0	2.0	Yes
GOLD CENTER CREEK (UPPER)	68.5	3.0	85.0	3.0	65.0	2.0	2.7	Yes
GOLD CENTER CREEK (UPPER)	82.9	3.0	91.0	3.0	68.0	3.0	3.0	Yes
GOLD CENTER CREEK (LOWER)	54.8	2.0	91.0	3.0	61.0	2.0	2.3	Yes
GOLD CENTER CREEK (LOWER)	60.6	2.0	91.0	3.0	30.0	1.0	2.0	Yes
GRAMP CREEK	42.8	1.0	91.0	3.0	75.0	3.0	2.3	Yes
FLEWSIE CREEK	60.3	2.0	84.0	3.0	68.0	3.0	2.7	Yes
MERRY CREEK (UPPER)	38.9	0.0	-	-	71.0	3.0	1.5	No
MERRY CREEK (UPPER)	70.7	3.0	88.0	3.0	27.0	1.0	2.3	Yes
MERRY CREEK (LOWER)	45.5	1.0	-	-	49.0	1.0	1.0	No
MERRY CREEK (LOWER)	75.0	3.0	95.0	3.0	58.0	1.0	2.3	Yes
OLSON CREEK	-	-	-	-	86.0	3.0	-	-
CRYSTAL CREEK (UPPER)	43.5	1.0	-	-	75.0	3.0	2.0	Yes

Table 13, continued.

STREAM	SMI	SMI Score	SFI	SFI Score	SHI	SHI Score	Average SMI + SFI+ SHI	Supports Beneficial Uses?
CRYSTAL CREEK (LOWER)	39.4	1.0	-	-	49.0	1.0	1.0	No
RENFRO CREEK (UPPER)	48.2	1.0	-	-	85.0	3.0	2.0	Yes
RENFRO CREEK (LOWER)	43.1	1.0	65.0	1.0	42.0	1.0	1.0	No
RENFRO CREEK	71.4	3.0	-	-	77.0	3.0	-	-
BEAVER CREEK (UPPER)	56.1	2.0	60.0	1.0	59.0	2.0	1.7	No
BEAVER CREEK (LOWER)	55.2	2.0	-	-	67.0	3.0	2.5	Yes
THORN CREEK (UPPER)	40.1	1.0	-	-	47.0	1.0	1.0	No
THORN CREEK (LOWER)	36.1	0.0	-	-	67.0	3.0	1.5	No
MAIN STEM ST. MARIES RIVER (CLARKIA TO MASHBURN)	-	-	-	-	52.0	1.0	-	-

[1] Stream Macroinvertebrate Index.
[2] Stream Fish Index (values provisional).
[3] Stream Habitat Index.

-- Additional fisheries data

Further analysis of fish populations and age class structures is shown in Table 14. John, upper Carpenter, Beaver, Tyson, upper Merry, Gramp, and Flewsie Creeks, as well as the West Fork of the St. Maries River have trout populations in the expected range of 0.1 – 0.3 trout per square meter per hour of electrofishing effort. Santa, Charlie, Renfro, Emerald, lower Merry, Gold Center, and the Middle Fork St. of the Maries River have low numbers of trout. Sculpin are present in most streams in numbers ranging from effort 0.1-0.4 fish per square meter per hour of electrofishing, with higher counts in tributary streams. Santa Creek, Charlie Creek, and the Middle and West Forks of the St. Maries river have lower than expected numbers of sculpin.

-- Sedimentation data

A visual inspection of the St. Maries River suggests bed load sediment is increased over natural background levels. The stream has a broad and shallow morphology with a very high width to depth ratio. Wetted width to depth ratios of 8.25 to 10.13 were measured at the lower and upper BURP stations, respectively, on the St. Maries River. Wetted width to depth ratios of 15.07 and 14.77 were measured at the lower Middle Fork and West Fork St. Maries River stations, respectively. A stream with a bank full flow of approximately 1,000 cfs should have a much lower width to depth ratio. Additional evidence of an increase in sediment includes a primary sediment class of fine sands on the stream bottom and point bars along the course of the river. Riffle armor stability has not been measured for streams of the St. Maries River Subbasin. However, the predominance of fine sand in the river suggests such measurement would reflect a high percentage of the bed material moving during two-year flow events.

The following sections examine quantitative information including pool volume and modeled sediment yield rates.

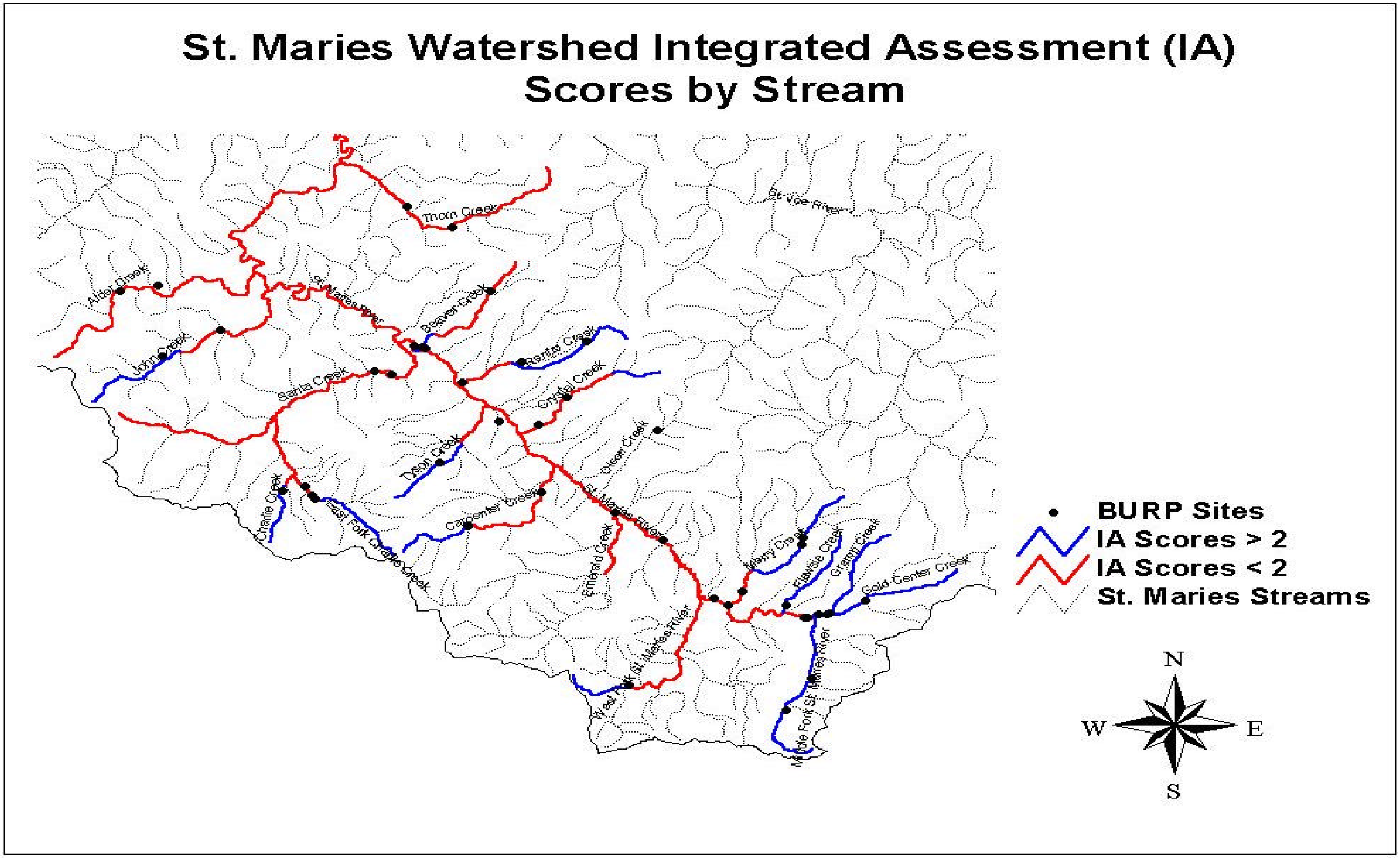

Figure 5. Stream Macroinvertebrate and Habitat Indices Scores at BURP Stations in the St. Maries Subbasin

Table 14. Fish population data in the St. Maries Subbasin.

Stream	Location	Date	Salmonids (fish/m^2/hr effort)	Sculpin (fish/m^2/hr effort)	Presence of Three Salmonid Age Classes	Presence of Tailed Frogs
John Creek	Upper	6/22/95	0.76	1.10	Yes	No
Emerald Creek	Lower	6/27/95	0.00	0.14	No	No
Emerald Creek	Upper	6/27/95	0.02	0.31	No	No
Carpenter Creek	Upper	9/9/95	0.19	0.29	Yes	No
Charlie Creek	-	7/9/96	0.04	0.07	Yes	No
Santa Creek	Lower	7/10/96	0.00	0.01	No	No
Renfro Creek	-	7/11/96	0.01	0.20	No	No
Beaver Creek	-	7/12/96	0.10	0.15	Yes	No
Tyson Creek	Middle	7/16/96	0.23	0.38	Yes	No
Merry Creek	Lower	7/18/96	0.02	0.10	Yes	No
Merry Creek	Upper	7/18/96	0.10	0.36	Yes	Yes
Middle Fork of the St. Maries River	-	7/17/96	0.00	0.01	No	No
Middle Fork of the St. Maries River	Lower	7/23/96	0.01	0.05	No	No
Middle Fork of the St. Maries River	Middle	7/23/96	0.02	0.12	Yes	Yes
Middle Fork of the St. Maries River	Upper	7/24/96	0.06	0.17	Yes	No
Middle Fork of the St. Maries River[1]	2 sites	10/7/95	0.05	0.07	No	N.D.
Gold Center Creek	Lower	7/24/96	0.01	0.14	Yes	Yes
Gold Center Creek	Upper	7/25/96	0.02	0.32	Yes	No
Gramp Creek	-	7/25/96	0.10	0.38	Yes	No
Flewsie Creek	-	7/25/96	0.83	1.09	Yes	No
West Fork St. Maries River	Upper	8/5/98	0.10	0.05	Yes	Yes

[1]Potlatch Corporation data.

Residual Pool Volume

Residual pool volume is a measure of the amount of the stream channel in pools. In theory, it is an estimate of the amount of the streambed that would hold water at zero discharge. Residual pool volume can be estimated from stream channel measurements collected by survey crews. The estimates are generally standardized on a volume per stream mile basis. Since the stream width affects the amount of pool volume possible, residual pool volume data are typically ordered based on the bank full width of the stream. Bank full width is the best measure of the typical stream discharge and ability to scour pools (DEQ 1989).

Residual pool data for the segments of the St. Maries Subbasin that are water quality limited are provided in Table 15. Streams are listed based on the bank full width of the streams. The larger the bank full width, the greater the possible residual pool volume. These streams are listed in order of increasing bank full width. Residual pool volume can be used as an indicator of the presence of fish habitat.

Table 15. Residual pool volume of St. Maries River water bodies.

Stream	Bank Full Width (ft)	Residual Pool Volume (ft^3/mi)
Crystal Creek	7.50	2,760
John Creek	8.10	11,433
Alder Creek	9.10	19,324
West Fork of the St. Maries River	9.53	7,843
Tyson Creek	10.05	6,454
Cats Spur Creek	10.50	7,495
Thorn Creek	11.30	16,501
Flewsie Creek	11.48	1,128
Carpenter Creek[1]	12.00	25,997
Emerald Creek	12.00	9,357
Charlie Creek	13.40	9,693
West Fork Emerald Creek[1]	14.00	22,268
Gramp Creek	14.98	889
Renfro Creek	15.64	3,500
Beaver Creek	17.72	9,180
Olson Creek	17.88	5,887
Middle Fork of the St. Maries River[1]	18.10	4,510
Gold Center Creek	24.89	1,535
Merry Creek	28.57	15,340
Emerald Creek[1]	31.69	93,311
Santa Creek	31.81	39,039
Middle Fork of the St. Maries River	37.02	14,780
St. Maries River	54.86	64,041

[1]Potlatch Corporation data; all other data DEQ BURP data

Point Sources of Sediment

Three permitted discharges have total suspended solid limits (TSS). Santa-Fernwood and Clarkia are allowed discharges up to 200,000 and 150,000 gallons per day (GPD), respectively. Santa-Fernwood is restricted from discharge between November 1 and January 31. Both Santa-Fernwood and Clarkia have 30 mg/L (TSS) limits; however, they are limited to 34 and 6 pounds per day, respectively. The Emida facility does not have an NPDES permit that requires monitoring of discharge, but serves a sized population similar in size to the population served by the Clarkia facility. Based on the above limits, the fine sediment contribution of the point sources was estimated (Table 16). These sources discharge a total of 14.1 tons per year of sediment. All of this sediment is very fine material that does not cause pool filling.

Table 16. Permitted sediment discharges to the St. Maries River Subbasin.

Permitted Discharge	Average Discharge (million gallons/ day)	Total Suspended Solids Limit (mg/L)	Potential Daily Sediment Load (pounds/day)	Potential Annual Sediment Load (tons/year)
Santa-Fernwood[1]	0.2	30	34.0	6.2
Emida[2]	0.15	30	37.5	6.8
Clarkia	0.15	30	6.0	1.1
Total	0.5	-	77.5	14.1

[1]Santa-Fernwood is permitted to discharge 273 days per year maximum
[2]Emida discharges are estimated to be 30 mg/L total suspended solids and 150,000 gallons per day

Sediment Modeling

Sediment monitoring in-stream is a very time consuming and costly undertaking. In-stream sediment data collection costs estimated by URS Greiner for the Spokane River in 2001, show that in-stream sediment monitoring completed quarterly at five sites would cost $400,000 (2001). Sediment monitoring should be conducted at least annually at a site for seven years to develop a database that accounts for the variance of discharge effects on sediment yield and transport from year to year. From the URS Greiner figures, the investment required to conduct annual sediment monitoring for seven years is estimated at $140,000 per site. The time necessary and costs involved do not make sediment monitoring a viable approach for DEQ. A sediment modeling approach uses coefficients developed over long periods in paired watersheds. A sediment modeling approach is the most time and cost efficient approach to estimating sediment for the purposes of TMDLs.

Land Use Data

Sediment loading can be attributed to the entire watershed. It is not necessarily restricted to the water quality limited segments of the St. Maries River Subbasin. In the following tables, sediment load is analyzed based on all contributing watersheds in the subbasin. Sediment yield is estimated from land use data developed by the USFS, Potlatch Corporation, and IDL. Fire and road coverages developed by the USFS and BLM were used to develop data for areas that had experienced two wildfires. The coverages also provided forest road mileage and road densities. After assessment by IDL specialists, CWE scores and land failure yield estimates were developed. Road land use acreage was estimated based on road length (GIS road coverage) and known right of way width. These values are reported in Table 17.

Table 17. Land use of the St. Maries River Subbasin.

Subwatershed[1]	Alder[2]	John	Santa	Santa Side Walls	Charlie	Tyson	Carpenter	Emerald	West Fork Side Walls	West Fork	Cats Spur	Carlin	Flat	Soldier	Sheep	Childs	Blair	Cedar
Agricultural land (acres)	1,080	0	2,379	825	952	303	1,129	1,125	0	774	0	0	0	0	0	0	0	0
Forest land (acres)	9,408	12,666	13,648	7,584	15,423	5,327	9,966	15,925	3,683.9	8,511	7,283	1,801	6,636	2,204	1,455	3,046	1,745	2,115
Unstocked forest (acres)	4,506	1,922	499	2,906	702	1,329	1,196	2,102	736	1,083	0	0	0	0	0	0	0	0
Double fires (acres)	0	0	0	0	2,046	172	0	350	0	0	0	0	0	0	0	0	0	0
Road (acres)	0	0	108	0	0	0	0	0	25	29	0	0	0	0	0	0	0	0
Total	14,994	14,588.5	16,634	11,315	19,123	7,131	12,291	19,502	4,444.9	10,397	7,283	1,801	6,636	2,204	1,455	3,046	1,745	2,115
Road Data																		
Forest roads (mi)	157.7	148.5	138.2	126.3	84.3	75.1	126.9	216	46.5	101.6	84	19	49	31	25.7	44.4	22.9	11.6
Ave. road density (mi/sq mi)	6.73122	6.51472	5.31730	7.14379	2.82131	6.74014	6.60776	7.08850	6.69531	6.25411	7.38157	6.75180	4.72573	9.00181	11.3044	9.32895	8.39885	3.5102
Road crossing number	176	217	532	360	273	192	290	392	60	429	103	14	49	35	8	68	19	12
Road crossing frequency	1.11604	1.46125	3.84949	2.85035	3.23843	2.55659	2.28526	1.81481	1.29032	4.22244	1.22619	0.73684	1	1.12903	0.31128	1.53153	0.82969	1.0345
Mass failure (tons/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Encroaching forest roads (mi)	9.37	11.34	16.441	12.19	8.08	5.4	10.651	15.22	2.096	13.113	4.352	0.929	2.46	1.86	0.239	2.315	0.646	0.754
Mean bank full width + two 3' banks	21.4	9	16	12.7	12.7	9	9.3	13.3	9.3	13.3	13.3	21.4	10.3	10.3	12	19.9	18.3	18.3
Cumulative Watershed Effects (CWE[3]) Score	12 [4]	14	13	13	10	15	15	12	24	24	24	15	17	17	13	12	10	10

Table 17, continued.

Subwatershed	Thorn	Beaver	Renfro	Crystal	Merry	Flewsie	Gold Center	Middle Fork Side Walls	Middle Fork	Olson	Adams
Agricultural land (acres)	51	0	214	0	0	0	0	0	1,300	0	0
Forest land (acres)	9,373	3,242	10,096	4,632	9,310	1,604	9,121	4,816	6,824	5,720	1,670
Unstocked forest (acres)	1,390	1,052	276	371	2,239	187	967	1.7	2,628	0	0
Double fires (acres)	0	0	0	0	0	0	0	0	0	0	0
Road (acres)	33	0	0	0	0	0	0	0	0	0	0
Total	10,847	4,294	10,586	5,003	11,549	1,791	10,088	4,817.7	10,752	5,720	1,670
Road Data											
Forest roads (mi)	143	44.1	97.6	47.5	184.3	30.9	63.6	52	104	47	11.9
Av. road density (mi/sq mi)	8.437356	6.5728924	5.9006235	6.0763542	10.213179	11.041876	4.0348929	6.9078606	6.1904762	5.2587413	4.560479
Road crossing number	193	56	136	57	184	34	76	30	148	65	28
Road crossing frequency	1.3496503	1.2698413	1.3934426	1.2	0.9983722	1.1003236	1.1949686	0.5769231	1.4230769	1.3829787	2.3529412
Mass failure (tons/yr)	0	0	0	0	0	0	10	0	5	0	0
Encroaching forest roads (mi)	10.364	2.23	4.96	1.52	8.96	1.22	2.685	1.9	5.9	0.891	1.56
Mean bank full width + two 3' banks	10.3	10.3	11.3	9.3	16	9.3	14.2	12.7	16.5	13.5	13.5
Cumulative Watershed Effects (CWE) Score	18	14	13	26	12	16	16	16	13	22	22

Table 17, continued.

Subwatershed	Clarkia-Childs	Childs-Tyson	Tyson-Beaver	Beaver-Alder	Alder-Mouth
Agricultural land (acres)	87	845	0	0	515
Forest land (acres)	4,472	9,565	2,363	6,345	10,159
Unstocked forest (acres)	287.7	728	339	1783	1,297
Double fires (acres)	0	0	0	0	0
Road (acres)	37	54	20	45	13
Total	4,883.7	11,192	2,722	8,173	11,984
Road Data					
Forest roads (mi)	64.7	106.1	34.6	66.6	121.6
Ave. road density (mi/sq mi)	8.47881729	6.0671909	8.1351947	5.2152208	6.493992
Road crossing number	90	192	34	83	115
Road crossing freq.	1.391035549	1.8096136	0.982659	1.2462462	0.9457237
Mass failure (tons/yr)	0	0	0	0	20
Encroaching forest roads (mi)	3.747	7.244	2.1	4.178	4.9
Mean bank full width + two 3' banks	18.3	21.4	21.4	21.4	21.4
Cumulative Watershed Effects (CWE) Score	10	14	12	16	17

[1]Data taken from CDASTDS, IDPNFIRE, CDAROADS, Potlatch Corporation and IDL databases cut for specific subwatersheds.
[2]Acreage supplied by the Coeur d'Alene Tribal staff.
[3]Carlin Creek CWE Score and mean bank full width + 2 3' banks values estimated according to Alder Creek and Alder-Joe Watersheds. Flat and Soldier Creeks CWE Score and mean bank full width + 2 3' banks values estimated according to Thorn Creek and Beaver-Alder Watersheds. Sheep Creek CWE Score and mean bank full width +2 3' banks values estimated according to Tyson and Tyson-Beaver values. Childs Creek CWE Score and mean bank full width + 2 3' banks values estimated according to Clarkia-Childs and Childs-Tyson Watersheds. Blair and Cedar Creeks CWE Score and mean bank full width + 2 3' banks values estimated according to Clarkia-Childs Watershed.
[4] CWE values extrapolated from John Creek.

Sediment Yield and Export

Sediment yields were developed separately for agriculture and forest types (Table 18). Sediment contributions from road surfaces, mass failures, road encroachment, and stream bank erosion were modeled with a separate set of algorithms. Sediment yield to the stream system was assumed to be 100%. Revised Universal Soil Loss Equation (RUSLE) Model assumptions and documentation of the sediment model are provided in Appendix C.

Table 18. Estimated sediment yield coefficients.

a) Agriculture land use

Watershed	Average RUSLE[1] Coefficient
John Creek	0.030
Santa Creek and side walls	0.055
Charlie Creek	0.060
Tyson Creek	0.090
Carpenter Creek	0.090
Emerald Creek	0.020
West Fork and side walls	0.054
Cats Spur Creek	0.020
Thorn Creek	0.030
Renfro Creek	0.060
Merry Creek	0.020
Gold Center Creek	0.020
Middle Fork and side walls	0.055
Land immediate to river	0.060

[1]Revised Universal Soil Loss Equation.

b) Forestland and road uses for the St. Maries River Subbasin

Land Use Type Sediment Export Coefficient	Belt Supergroup Precambrian Meta Sediments	Metamorphosed Belt Supergroup[1]
Conifer forest (ton/acre/year)	0.023	0.032
Non-stocked forest and waste rock piles (tons/acre/year)	0.027	0.040
Double wildfire burn (ton/acre/year)	0.004	0.006
Roads (tons/acre/year)	0.019	0.026

[1] Based on export coefficients provided for West Fork St. Maries River and Cats Spur Creek.

Sedimentation Estimates

Sedimentation estimates were developed by addition of the various sediment yields prorated for delivery to the channels (Table 19). Copies of the Excel? model spreadsheets are available in Appendix D.

Sediment model results (Table 19) indicate that several tributaries to the St. Maries River and its two forks exceed background sediment yield by greater than 50%. Sediment yield greater than 50% above background is used as a coarse filter to segregate streams in which sediment may be impairing water quality (Washington Forest Practices Board 1995). Santa and Carpenter Creeks and the St. Maries River and its West and Middle Forks exceed sediment yield thresholds (Tables 19a and b). Emerald, Tyson, and Merry Creeks may have sediment yields in a range that causes water quality impairment.

Table 19. Estimated sediment delivery to the St. Maries River Subbasin.

a) Estimated sediment delivery of the west-side tributaries to the St. Maries River[1]

Watershed	Alder	John	Santa	Santa Sidewalls	Charlie	Tyson	Carpenter	Emerald	West Fork Sidewalls	West Fork	Cats Spur	Carlin	Flat	Soldier	Sheep	Childs	Blair	Cedar
Agriculture (tons/yr)(fine)	32.4	0.0	130.8	45.4	57.1	27.3	101.6	22.5	0.0	41.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Conifer forest (tons/yr)(fine)	159.0	214.1	255.5	125.1	291.9	74.9	210.7	348.1	109.6	143.3	115.8	30.4	148.0	49.2	20.4	65.2	37.3	45.2
(coarse)	57.3	77.2	58.4	49.4	62.8	47.7	18.6	161.5	8.3	129.1	117.2	11.0	64.3	21.4	13.0	4.9	2.8	3.4
Unstocked forest (tons/yr)(fine)	89.4	38.1	11.0	56.3	15.6	21.9	29.7	57.4	27.4	22.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(coarse)	32.2	13.8	2.5	22.2	3.4	14.0	2.6	26.7	2.1	20.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Double fires (tons/yr)(fine)	0.0	0.0	0.0	0.0	6.7	0.4	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(coarse)	0.0	0.0	0.0	0.0	1.4	0.3	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Road (tons/yr)(fine)	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(coarse)	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total yield (tons/yr)(fine)	280.9	252.3	398.9	226.7	371.4	124.5	341.9	429.4	137.6	208.2	115.8	30.4	148	49.2	20.4	65.2	37.3	45.2
(coarse)	89.6	91.0	61.3	71.6	67.6	61.9	21.2	188.9	10.4	150.0	117.2	11.0	64.3	21.4	13.0	4.9	2.8	3.4

County, forest and private road sediment yield:

Watershed	Alder	John	Santa	Santa Sidewalls	Charlie	Tyson	Carpenter	Emerald	West Fork Sidewalls	West Fork	Cats Spur	Carlin	Flat	Soldier	Sheep	Childs	Blair	Cedar
Forest road Surface fine sediment (tons/yr)	34.7	49.8	113.5	76.4	45.5	48.0	72.5	77.6	29.5	211.3	50.7	3.5	14.0	10.0	1.7	13.5	3.2	2.0
Road failure fines (tons/yr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Road failure (coarse) (tons/yr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Encroachment fines (tons/yr)	131.5	66.9	191.0	99.0	75.3	26.5	81.2	123.3	16.2	81.8	25.7	13.0	15.8	11.9	1.6	38.2	9.8	11.4
Encroachment (coarse) (tons/yr)	47.4	24.1	43.6	39.1	16.2	16.9	7.2	57.2	1.2	73.7	26.0	4.7	6.8	5.2	1.0	2.9	0.7	0.9

Table 19-a, continued.

Watershed	Alder	John	Santa	Santa Sidewalls	Charlie	Tyson	Carpenter	Emerald	West Fork Sidewalls	West Fork	Cats Spur	Carlin	Flat	Soldier	Sheep	Childs	Blair	Cedar
Total fine yield (tons/yr)	166.1	116.7	304.5	175.4	120.8	74.5	153.7	200.9	45.7	293.1	76.4	16.5	29.8	21.9	3.3	51.7	13.0	13.5
Total coarse yield (tons/yr)	47.4	24.1	43.6	39.1	16.2	16.9	7.2	57.2	1.2	73.7	26.0	4.7	6.8	5.2	1.0	2.9	0.7	0.9
Total sediment (tons/yr)	584.0	484.1	808.3	512.7	576.0	277.7	524.0	876.4	194.9	725.0	335.4	62.6	249	97.6	37.7	124.6	53.9	63.0
Percent Fines[2]	0.735	0.735	0.814	0.717	0.823	0.611	0.919	0.683	0.93	0.526	0.497	0.735	0.69	0.697	0.611	0.93	0.93	0.93
Percent Coarse	0.265	0.265	0.186	0.283	0.177	0.389	0.081	0.317	0.07	0.474	0.503	0.265	0.30	0.303	0.389	0.07	0.07	0.07

[1]John Creek CWE scores, STATSCO Soils and ag coefficients applied to Alder Creek. Percent fines and percent coarse values for Carlin Creek are estimated based on Alder and John Creeks Watershed values. Percent fines and percent coarse values for Flat and Soldier Creeks are estimated based on Thorn Creek Watershed values. Percent fines and percent coarse values for Sheep Creek are estimated based on Tyson Creek Watershed values. Percent fines and percent coarse values for Childs, Blair, and Cedar Creeks are estimated based on Clarkia-Childs Watershed values.

[2] From weighted average of fines and stones in soils groups.

b) Estimated sediment delivery of the east-side tributaries to the St. Maries River

Watershed	Thorn	Beaver	Renfro	Crystal	Merry	Flewsie	Gold Center	Middle Fork Sidewalls	Middle Fork	Olson	Adams
Agriculture (tons/yr)(fine)	1.5	0.0	12.8	0.0	0.0	0.0	0.0	0.0	71.5	0.0	0.0
Conifer Forest (tons/yr)(fine)	150.3	57.9	129.3	56.5	199.1	34.3	195.1	103.0	91.2	69.7	20.4
(coarse)	65.3	16.6	102.9	50.1	15.0	2.6	14.7	7.8	65.8	61.8	18.1
Unstocked Forest (tons/yr)(fine)	26.2	22.1	4.2	5.3	56.2	4.7	24.3	0.0	41.2	0.0	0.0
(coarse)	11.4	6.3	3.3	4.7	4.2	0.4	1.8	0.0	29.7	0.0	0.0
Double Fires (tons/yr)(fine)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(coarse)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Road (tons/yr)(fine)	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(coarse)	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Yield (tons/yr)(fine)	178.4	80.0	146.3	61.8	255.4	39.0	219.4	103.1	203.9	69.7	20.4
(coarse)	76.9	23.0	106.2	54.8	19.2	2.9	16.5	7.8	95.5	61.8	18.1

County, forest and private road sediment yield:

Watershed	Thorn	Beaver	Renfro	Crystal	Merry	Flewsie	Gold Center	Middle Fork Sidewalls	Middle Fork	Olson[2]	Adams[2]
Forest road											
Surface fine sediment (tons/yr)	59.9	12.7	28.8	32.8	36.2	9.0	20.2	8.0	31.4	0.0	0.0
Road failure fines (tons/yr)	0.0	0.0	0.0	0.0	0.0	0.0	7.1	0.0	0.8	0.0	0.0
Road failure coarse (tons/yr)	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.6	0.0	0.0
Encroachment fines (tons/yr)#	66.4	15.9	27.8	6.7	118.9	9.4	31.6	20.0	50.4	5.7	10.0
Encroachment (coarse) (tons/yr)	28.8	4.6	22.1	5.9	9.0	0.7	2.4	1.5	36.4	5.0	8.8
Total fine yield (tons/yr)	126.3	28.6	56.7	39.5	155.2	18.4	58.9	28.0	82.7	5.7	10.0
Total coarse yield (tons/yr)	28.8	4.6	22.1	5.9	9.0	0.7	2.9	1.5	37.0	5.0	8.8
Total sediment (tons/yr)											
Percent Fines[1]	0.697	0.777	0.557	0.53	0.93	0.93	0.93	0.93	0.581	0.53	0.53
Percent Coarse	0.303	0.223	0.443	0.47	0.07	0.07	0.07	0.07	0.419	0.47	0.47

[1] From weighted average of fines and stones in soils groups.
[2] Percent fines and percent coarse values for Olson and Adams Creeks are estimates based on the adjacent Crystal Creek Watershed Values.

c) Estimated sediment delivery of the tributaries immediate to the St. Maries River

Watershed	Clarkia-Childs	Childs-Tyson	Tyson-Beaver	Beaver-Alder	Alder-Mouth
Agriculture (tons/yr)(fines)	5.2	50.7	0.0	0.0	30.9
Conifer Forest (tons/yr)(fine)	95.7	174.7	49.6	123.0	189.5
(coarse)	7.2	45.3	4.7	22.9	44.2
Unstocked Forest (tons/yr)(fine)	7.2	15.6	8.4	40.6	28.4
(coarse)	0.5	4.0	0.8	7.6	6.6
Double Fires (tons/yr)(fine)	0.0	0.0	0.0	0.0	0.0
(coarse)	0.0	0.0	0.0	0.0	0.0
Road (tons/year) (fine)	0.6	0.8	0.3	0.7	0.2
(coarse)	0.0	0.2	0.0	0.1	0.0

Table 19-c, continued.

Watershed	Clarkia-Childs	Childs-Tyson	Tyson-Beaver	Beaver-Alder	Alder-Mouth
Total Yield (tons/yr)(fine)	108.7	241.8	58.3	164.3	249.0
(coarse)	7.8	49.6	5.6	30.6	50.8
County, forest and private road sediment yield:					
Watershed	**Clarkia-Childs**	**Childs-Tyson**	**Tyson-Beaver**	**Beaver-Alder**	**Alder-Mouth**
Forest road					
Surface fine sediment (tons/yr)	15.0	43.6	6.7	22.0	33.1
Road failure fines (tons/yr)	0.0	0.0	0.0	0.0	24.4
Road failure coarse (tons/yr)	0.0	0.0	0.0	0.0	5.7
Encroachment fines (tons/yr)	56.9	109.8	36.6	67.2	75.9
Encroachment coarse) (tons/yr)	4.3	28.5	3.5	12.5	17.7
Total fine yield (tons/yr)	71.9	153.4	43.3	89.2	133.3
Total coarse yield (tons/yr)	4.3	28.5	3.5	12.5	23.4
Total sediment (tons/yr)					
Percent fines[1]	0.93	0.794	0.913	0.843	0.811
Percent coarse	0.07	0.206	0.087	0.157	0.189

[1]From weighted average of fines and stones in soils groups.

Status of Beneficial Uses

Nutrients were found to be at non-nuisance levels in Gold Center Creek, Santa Creek, Thorn Creek, Alder Creek, and the St. Maries River. The dissolved oxygen concentration is not limiting in Santa Creek.

Temperature standards are exceeded for significant periods in Gramp, Gold Center, Flewsie, Emerald, and Santa Creeks. The West and Middle Forks of the St. Maries River also exceed temperature standards for significant periods. The main stem of the St. Maries River likely exceeds the standards for significant periods. The unknown pollutant of the St. Maries River is likely temperature. Bacteria are not limiting Gramp Creek.

Sediment model results indicate that streams supporting their fishery uses are in a range of zero to 50% above background sediment yield. Santa and Carpenter Creeks, the West and Middle Forks, and the St. Maries River exceed this threshold and are sediment impaired. Emerald, Tyson, and Alder Creeks may exceed the threshold as well. Modeling suggests that stream bank erosion is the primary source of sediment. This sediment is primarily coarse sand that fills pools in the streams. Since the St. Maries River segments are impaired by sediment, a TMDL that addresses sediment in the entire St. Maries River Subbasin will be required. The assessed support status of the listed water bodies based on available data is provided in Table 20.

Table 20. Results of the St. Maries River Subbasin assessment based on application of the available data.

Waterbody Name and HUC Number	Assessed Support Status	Reasons Segment is to be De-listed for Pollutant
St. Maries River 17010304 3579 17010304 3580	Sediment modeling and WBAGII[1] scores indicate cold water aquatic life may not be supported by sediment levels, sediment TMDL required; Nutrient monitoring indicates levels within guidelines, delist for nutrients; Temperature standard exceeded, temperature TMDL required.	Monitoring of total phosphorous, nitrite-nitrate, and total nitrogen indicates concentrations during critical summer months below nuisance weed growth guidelines. Periphyton sampling results reveal biomass below nuisance levels[2].
West Fork of the St. Maries River 17010304 3581	Sediment modeling and WBAGII scores indicate cold water aquatic life may not be supported by sediment levels, sediment TMDL required, included in subbasin-wide sediment TMDL; Temperature standard exceeded, temperature TMDL required.	N/A
Middle Fork of the St. Maries River 17010304 3594	Sediment modeling and WBAGII scores indicate cold water aquatic life may not be supported by sediment levels, sediment TMDL required, included in subbasin-wide sediment TMDL; Temperature standard exceeded, temperature TMDL required.	N/A
Thorn Creek 17010304 3582	Nutrient monitoring indicates levels within guidelines, delist for nutrients. Sediment modeling and WBAGII scores indicate cold water aquatic life may not be supported by sediment levels, sediment TMDL required; included subbasin-wide sediment TMDL.	Monitoring of total phosphorous, nitrite-nitrate, and total nitrogen indicates concentrations during critical summer months below nuisance weed growth guidelines. Periphyton sampling results reveal biomass below nuisance levels.
Alder Creek 17010304 3583	Nutrient monitoring indicates levels within guidelines; Sediment modeling and WBAGII scores indicate cold water may not be supported by sediment levels, sediment TMDL required, included in subbasin-wide sediment TMDL.	Monitoring of total phosphorous, nitrite-nitrate, and total nitrogen indicates concentrations during critical summer months below nuisance weed growth guidelines[2]. Periphyton sampling results reveal biomass below nuisance levels.
John Creek 17010304 3584	Sediment modeling and WBAGII scores indicate cold water aquatic life may not be supported by sediment levels, sediment TMDL required, included in subbasin-wide sediment TMDL.	N/A
Santa Creek 17010304 3585	D.O.[3] standard supported, delist for D.O.; Nutrient monitoring indicates levels within guidelines, delist for nutrients; Sediment modeling and WBAGII scores indicate cold water aquatic life may not be supported by sediment levels, sediment TMDL required, included in subbasin-wide sediment TMDL; Temperature standard exceeded, temperature TMDL required.	D.O. above cold water aquatic life standard (Table 9); Monitoring of total phosphorous, nitrite-nitrate, and total nitrogen indicates concentrations during critical summer months below nuisance weed growth guidelines. Periphyton sampling results reveal biomass below nuisance levels.
Charlie Creek 17010304 3587	Sediment modeling and WBAGII scores indicate cold water aquatic life may not be supported by sediment levels, sediment TMDL required, included in subbasin-wide sediment TMDL.	N/A
Renfro Creek 17010304 3588	Sediment modeling and WBAGII scores indicate cold water aquatic life may not be supported by sediment levels, sediment TMDL required, included in subbasin-wide sediment TMDL.	N/A
Tyson Creek 17010304 3589	Sediment modeling and WBAGII scores indicate cold water aquatic life may not be supported by sediment levels, sediment TMDL required, included in subbasin-wide sediment TMDL.	N/A
Crystal Creek 17010304 3590	Sediment modeling and WBAGII scores indicate cold water aquatic life may not be supported by sediment levels, sediment TMDL required, included in subbasin-wide sediment TMDL.	N/A
Carpenter Creek 17010304 3591	Sediment modeling and WBAGII scores indicate cold water aquatic life may not be supported by sediment levels, sediment TMDL required, included in subbasin-wide sediment TMDL.	N/A
Emerald Creek 17010304 3593	Sediment modeling and WBAGII scores indicate cold water aquatic life may not be supported by sediment levels, sediment TMDL required, included in subbasin-wide sediment TMDL; Temperature standard exceeded, temperature TMDL required.	N/A

Table 20, continued.

Waterbody Name and HUC Number	Assessed Support Status	Reasons Segment is to be De-listed for Pollutant
Gold Center Creek 17010304 3596	Temperature standard exceeded, temperature TMDL required. Sediment modeling and WBAGII scores indicate cold water aquatic life supported by sediment levels, sediment TMDL is not required.	Sediment modeling and WBAGII scores indicate cold water aquatic life is supported by sediment levels.
Flewsie Creek 17010304 3596	Temperature standard exceeded, temperature TMDL required. Sediment modeling and WBAGII scores indicate cold water aquatic life supported by sediment levels, sediment TMDL is not required.	Sediment modeling and WBAGII scores indicate cold water aquatic life is supported by sediment levels.
Gramp Creek 17010304 3598	Monitoring of bacteria indicates full support of contact recreation, delist for bacteria. Temperature standard exceeded, temperature TMDL required. Sediment modeling and WBAGII scores indicate cold water aquatic life supported by sediment levels, sediment TMDL is not required.	Monitoring of *E.coli* indicates full support of contact recreation standard (Table 12). Sediment modeling and WBAGII scores indicate cold water aquatic life is supported by sediment levels.

[1] *Water Body Assessment Guidance*, Version II.
[2] IDAPA 58.01.02.05-06; According to the EPA's *Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers* (1999), levels of algal biomass greater than 10 µg chlorophyll *a* cm^2 or greater than 5 mg ash-free dry mass (AFDM) cm^2 indicate nuisance levels of nutrients or organic enrichment.
[3] Dissolved oxygen.

Conclusions

The TMDLs currently required in the St. Maries Subbasin are listed in Table 21.

Table 21. TMDLs required for the St. Maries River Subbasin and general specifications.

Waterbody	TMDL Required	Critical flow	Boundaries of Exceedence	Critical Reaches	Key indicator
St. Maries River[1]	Sediment	Episodic high flow	Entire watershed, including all tributaries	Rosgen B and C channels	Tons/year
St. Maries River	Temperature	Low summer flow	Main stem Clarkia to Mouth	Main stem Clarkia to mouth	Full potential shade
West Fork St. Maries River	Temperature	Low summer flow	Headwaters to St. Maries River	Entire length	Full potential shade
Middle Fork St. Maries River	Temperature	Low summer flow	Headwaters to St. Maries River	Entire length	Full potential shade
Santa Creek	Temperature	Low summer flow	Headwaters to St. Maries River	Entire length	Full potential shade
Emerald Creek	Temperature	Low summer flow	Headwaters to St. Maries River	Entire length	Full potential shade
Gold Center Creek	Temperature	Low summer flow	Headwaters to St. Maries River	Entire length	Full potential shade
Flewsie Creek	Temperature	Low summer flow	Headwaters to St. Maries River	Entire length	Full potential shade
Gramp Creek	Temperature	Low summer flow	Headwaters to Gold Center Creek	Entire length	Full potential shade

[1] Since the lowest reach of the St. Maries River is water quality limited due to sediment, the sediment TMDL covers the entire subbasin, regardless of individual streams' listing status.

2.4 Data Gaps

Additional CWE data or data from an equivalent procedure for Cats Spur, Emerald, and Flewsie Creeks would be supportive of the sediment modeling and temperature TMDLs.

Additional temperature data are required for all the segments of the subbasin. Spatial temperature data would better improve the scope of temperature exceedences.

3. Subbasin Assessment – Pollutant Source Inventory

Several sources of sediment exist in the St. Maries River watershed, including natural sediment loads. All significant sources of sediment are nonpoint sources. Sources of thermal input are restricted to loss of stream canopy cover.

3.1 Sources of Pollutants of Concern

Pollutant sources of sediment are discussed in the following sections. Sediment is contributed to the subbasin by a large number of sources, including natural erosion.

Point Sources

Point sources of sediment include the Santa-Fernwood, Emida, and Clarkia wastewater treatment facilities. These facilities have TSS limits of 30 mg/L. They may potentially discharge 14.1 tons per year, which is 0.10% of the modeled sediment load (Table 19c). Since these dischargers do not often approach their discharge limits, the sediment estimate for these sources is likely liberal. Compared to sediment loads modeled, actual point source loads are very small.

There are three thermal point sources present in the subbasin including the Santa-Fernwood, Emida, and Clarkia wastewater treatment facilities. There are no power or manufacturing plant cooling water facilities.

There are no Superfund or Resource Conservation Recovery Act sites in the subbasin. Petroleum spills have been addressed at three locations in the subbasin.

Nonpoint Sources

The primary disturbances causing stream temperatures to rise is non-natural canopy modification by placer mining for garnets and silvicultural and agricultural practices. The attainment of natural full potential canopy shade is the most that can be done to lower stream temperatures.

Nonpoint sources of sediment include placer mining for garnets, silvicultural practices (especially forest roads), agriculture, and stream bank erosion triggered by grazing or in-stream effects. The majority of the land use in the subbasin is forestland (Figure 6). Agricultural and silvicultural features such as road crossings and encroaching roads are accounted for in the sediment model (Appendix C) and are documented in the GIS coverages that were used to load the model.

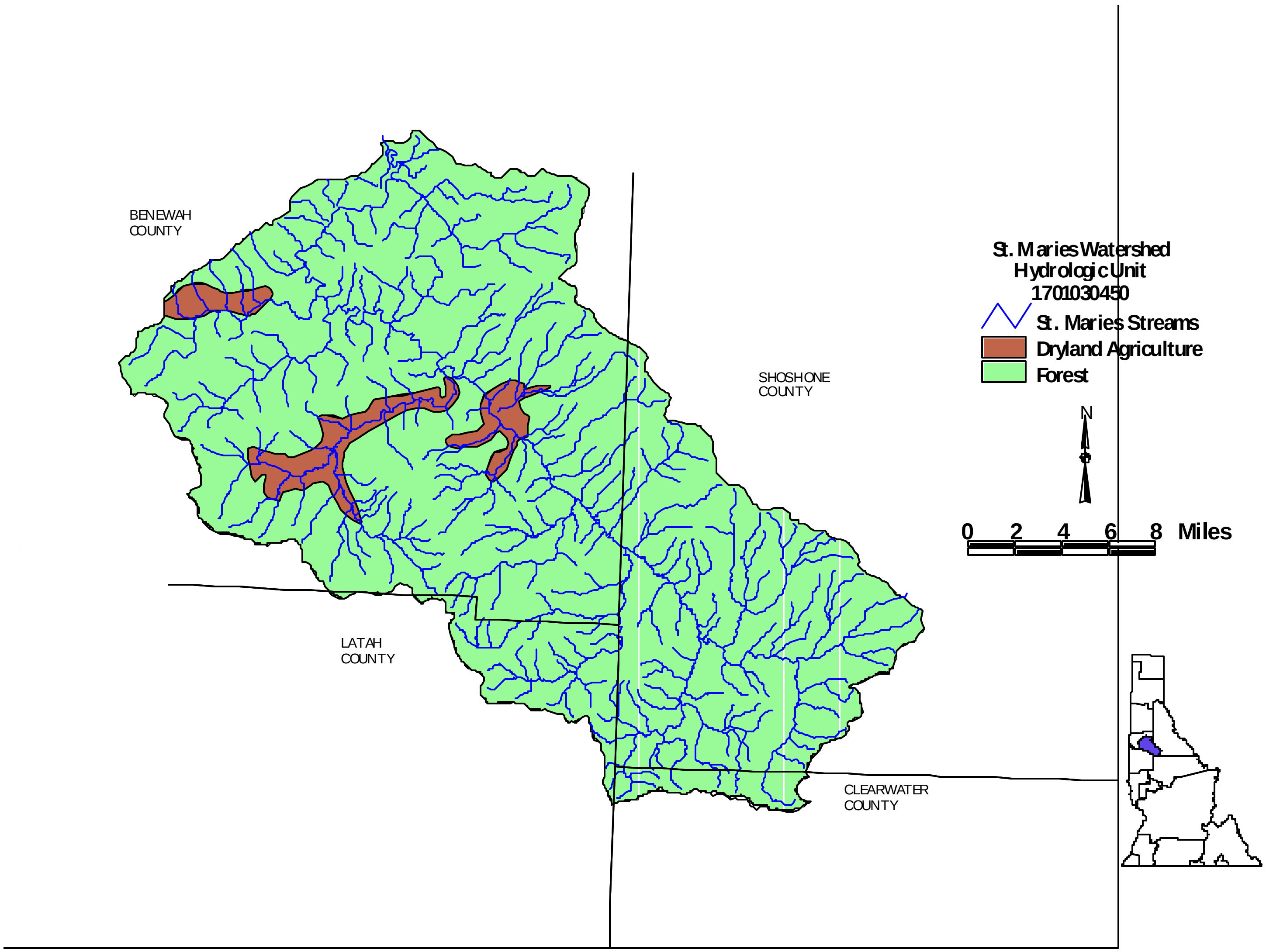

Figure 6. St. Maries Subbasin Land Use

Sediment sources can be described by land use category as follows:

-- The meta-sedimentary rocks of the Proterozoic Belt Supergroup and bed rock, as altered by extreme heat, form a terrain with a natural sediment yield rate of 0.026 – 0.040 tons per acre per year (17 – 26 tons per year per square mile). Mass wasting is not a typical feature of the terrain; however, it does occur on the lacustrine deposits of the late Eocene Lake bed in the vicinity of Clarkia and Miocene Lake Coeur d'Alene deposits. Mass wasting is directly estimated in the CWE process.

-- Timber harvest is a source of sediment, especially in the first year following the harvest when the cut area is void of cover. Forest ground cover regenerates rapidly in open areas where new plants are not competing with mature trees. Ground cover has been observed to return to 28-50% cover the first year after a harvest and near 75% in year two (Elliot and Robichaud 2001). Once vegetative cover is re-established to pre-harvest conditions, excess sedimentation associated with the harvest does not occur.

-- Timber harvest roads are a significant source of sediment. These can yield surface sediment, trigger mass wasting, constrain streams, and accelerate erosion. County and state roads, railroads, and highways can also constrain streams and accelerate erosion.

-- Stream bank erosion was assessed throughout the subbasin by the direct delivery method. Model results indicated that bank erosion was a significant source of sediment yield.

-- Placer-mined lands are a sediment source. Large areas of the Emerald and Carpenter Creek watersheds have been placer-mined for garnet. The relief of the mined areas is low, minimizing sediment yield from mined-over lands. Current surface mining best management practices also minimize erosion. However, raw banks are left from past mining and contribute to sediment yield. Hydraulic mining of gold occurred in Tyson Creek (Russell 1979). This activity occurred well before any surface mining rules or best management practices were in place.

Pollutant Transport

Pollutant transport is relevant only to sediment. Sediment is delivered to the stream system primarily during high precipitation/high discharge events or rapid snowmelt events. These are episodic events. Under these conditions, large volumes of sediment move in the stream systems. These conditions develop stream power and stage heights capable of channel alteration. Sediment trapped in upper low order watersheds moves quickly to the higher order streams of the subbasin. Areas where the stream gradient is constrained by roads have rapid erosion from bed and/or banks. The gradient of the St. Maries River and its two forks is insufficient to flush sediment larger than coarse sand from the stream channel. Coarse sand makes up a substantial percentage of the bed sediments found in the river. A sediment transport model is not available for the St. Maries River.

3.2 Data Gaps

The major data gap in temperature pollution is monitoring data from the entire length of the stream. The major data gap in sediment pollution stems from a lack of in-stream measurements of load and transport of sediment.

Point Sources

Point discharges of sediment have been identified in the subbasin. Three possible point discharges of heat have been documented, including the Santa-Fernwood, Emida, and Clarkia wastewater treatment facilities.

Nonpoint Sources

Nonpoint sources have been modeled rather than measured. In-stream monitoring of sediment load would be of value. Such monitoring is quite expensive (see Section 2.3, page 26), and is unlikely that this data gap will be filled. Model results continue to be the best available information at this time.

Current temperature data was collected through in-stream monitoring at set locations. Thermal imaging that provides a view of stream-wide temperatures would be of value, but is costly.

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

The wastewater point sources associated with community wastewater treatment in the watershed (Santa-Fernwood, Emida, and Clarkia wastewater treatment facilities) were permitted under NPDES during the 1970s. These permits were renewed last in 1988 and 1989. Renewal of these permits is currently underway.

All forest practices conducted in the subbasin are regulated under the Idaho Forest Practices Act rules and regulations. These rules are in part best management practices designed to abate erosion and retard sediment delivery to the streams. All USFS harvests must meet inland fish strategy (INFISH) guidelines. These guidelines prescribe 300 foot-wide buffers for streams with fishery uses. The USFS has relocated and obliterated approximately 55 road miles removing 187 stream crossings by roads from the subbasin (Patten 2002).

Most agricultural practices in the subbasin consist of livestock grazing and some hay harvesting. The USFS has installed riparian fencing to exclude 66 acres of its grazing allotments and planted these with riparian trees and shrubs (Patten 2002). The Benewah Soil and Water Conservation District has completed a stream bank erosion analysis on Santa Creek. The district has secured CWA Section 319 funding for additional riparian zone exclusion fencing and bank stabilization work, which was implemented during summer 2002.

The garnet mining operation in the subbasin has been brought under the Idaho Placer and Dredge Mining Rules and Regulations (IDAPA 16.01.02.350.03(f)). The operators have restored 3.7 miles of stream channels and have reclaimed 203 acres of mined floodplain lands.

These actions have been site- and project-specific. The actions are relatively few on a basin-wide perspective. None of these actions are part of an integrated program. It is unlikely that water quality will improve to a level of full beneficial use with current water quality improvement actions.

5. Total Maximum Daily Loads

A TMDL sets 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, which receive 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 (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 LC is determined. Then the LC is broken down into its components: the necessary MOS is determined and subtracted; then NB, if relevant, is quantified and subtracted; and then the remainder is allocated among pollutant sources. When the breakdown and allocation are complete we have a TMDL, which must equal the LC.

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. Also a required part of the loading analysis is that the LC 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 LC 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.

Some streams in the St. Maries River subbasin are impaired due to habitat alteration. While degraded habitat is evidence of impairment, the EPA does not consider a waterbody to be polluted if the pollution is not a result of the introduction or presence of a pollutant. Since TMDLs are not required to be established for waterbodies impaired by pollution but not pollutants, a TMDL has not been established for these streams for habitat alteration.

5.1 St. Maries River Sediment TMDL

This TMDL addresses the St. Maries River. Since the lowest reach of the St. Maries River is water quality limited due to sediment, the sediment TMDL covers the entire subbasin, regardless of individual streams' listing status.

5.1.1 In-Stream Water Quality Target

The in-stream water quality target for the St. Maries River sediment TMDL is full support of cold water aquatic life and salmonid spawning (Idaho Code 39.3611, 3615). The TMDL will develop loading capacities in terms of mass per unit time. The interim goals are for sub-watersheds to support cold water aquatic life and the final goal is for bio-monitoring to reveal full support of cold water aquatic life throughout the subbasin and salmonid spawning where that use is either designated or existing. The sources yielding sediment to the system can be reduced, but a substantial period (30-50 years) will be required for the stream to clear its current coarse sand sediment bed load and to create pools.

Design Conditions

The predominant sources of sediment to the St. Maries River and its tributaries are nonpoint sources. Three minor point sources discharge suspended solids. The TMDL addresses the point and nonpoint sediment yields within the watershed. Sediment from the point source discharges is loaded on a rather constant basis, while sediment from nonpoint sources is loaded episodically, primarily during high discharge events. These critical events coincide with critical conditions and occur during the November through May period. However, they may not occur for several years. The critical stream reaches are the Rosgen B channel types that naturally harbor the most robust cold water communities, but have gradients sufficiently low for coarse sand bedload to accumulate and fill pools. The return time of the largest events is 10-15 years (DEQ 2001). The key to nonpoint source sediment management is implementing remedial activities prior to the advent of a large discharge event. Once sediment is loaded into the stream, large discharge events are required to transport coarse sediments downstream.

Target Selection

The TMDL applies sediment allocations in tons per year and calculates sediment reduction goals. Several tributaries, the Middle Fork, the West Fork, and the St. Maries River were listed as impaired by sediment in 1998 (Table 21). Sediment yield reduction will be required from the entire watershed in order for the impaired watersheds to meet full support status.

The load capacity rate at which full support is exhibited has been set at various levels within TMDL documents developed by DEQ. These have ranged from setting an interim load capacity at the background level for some watersheds in the Coeur d'Alene Lake subbasin and the Pend Oreille basin, to over 200% above background in some areas of the state. Evidence is beginning to support that a target of 50% above background is protective of the beneficial uses. This target has already been used in the North Fork Coeur d'Alene TMDL (DEQ 2001) and the Priest River TMDL (Rothrock 2002). The rationale supplied in those TMDLs in support of the target was based on several premises (DEQ 2001).

-- Sediment yield below 50% above background will fully support the beneficial uses of cold water aquatic life and salmonid spawning,

-- The stream has some finite yet not quantified ability to process a sediment yield rate greater than 50% above background rates, and

-- Beneficial uses (cold water aquatic life and salmonid spawning) will be fully supported when the finite yet not quantified ability of the stream system to process (attenuate) sediment is met.

Data collected within the St. Joe and St. Maries Subbasins appear to support the target of 50% above background. A comparison of WBAGII scores of watersheds to modeled percent above background estimates is shown in Figure 7. Only watersheds that had WBAGII scores based on all three of the major components (macroinvertebrates, fish, and habitat) were included in the analysis. The green shaded area indicates the area of the graph where both the WBAG II score is full support and the modeled percent above background is less than 50%. The red area is the portion of the graph where the WBAGII scores shows that a stream is impaired and the modeled percent above background is greater than 50%. In all but two instances the WBAGII score and the target of 50% above background agree. The two watersheds that do not conform may be affected by conditions other than sediment and are therefore unresponsive to changes in sediment delivery to the stream. For instance, the St. Joe River's Blackjack Creek has a WBAGII score of less than 2, but has very little sediment being delivered to it. This is a first order watershed that is very small with a steep gradient. The low WBAG II scores are a result of poor macroinvertebrates and fish populations. The creek's habitat score was one of the highest in the subbasin. The poor macroinvertebrate score could be result of the small watershed size and relatively little disturbance making the system nutrient poor and therefore unable to support a good macroinvertebrate community. This low nutrient scenario could also affect the fish community due to a poor food base. The fish community may also be affected by the steep gradient of this watershed, which could make available fish habitat limited.

As such, the 50% above background target appears to be reasonable and very protective of the beneficial uses of the watersheds in the St. Joe and St. Maries Subbasins. Therefore, the target load capacity for the St. Maries River TMDL has been set at 50% above background.

The goal should be attained following three high flow events after implementation plan actions are in place. On average, three events occur every 50 years. This time is necessary to have the channel forming events to export sediment and to create pool structures.

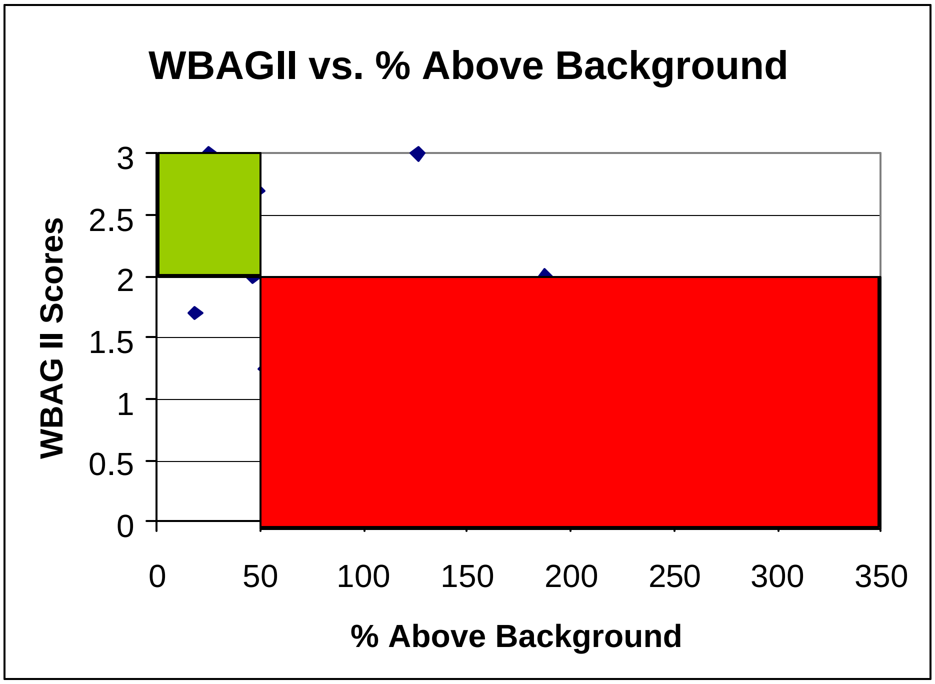

Figure 7. WBAGII Scores Versus Percent Above Background

Monitoring Points

Ten points of compliance are set. These are: the Middle Fork near the mouth (BURP site # 1996SCDAA040); the West Fork near the mouth (BURP site # 1998SCDAA021); Emerald Creek near the mouth (BURP site # 1995SCDAB008); the St. Maries River at Emerald Creek (BURP site # 1997SCDAA033); Carpenter Creek near the mouth (BURP site # 1995SCDAB054); the St. Maries River at Tyson Creek (BURP site to be established); Tyson Creek near the mouth (BURP site # 1995SCDAB055); Santa Creek near the mouth (BURP Site # 1995SCDAB005) Alder Creek near the mouth (BURP Site # 1995SCDAB004); and the St. Maries River below Thorn Creek (BURP Site to be established). Sediment load reduction from current levels toward the sediment yield reduction goal of 50% above background is expected to attain a sediment load that is not yet quantified, but will fully support the cold water beneficial use.

Beneficial use support status will be determined using the current assessment method accepted by DEQ at the time the waterbody is monitored. Monitoring will be completed using BURP protocols. When the final sediment load capacity is determined by these appropriate measures of full cold water aquatic life support, the TMDL will be revised to reflect the established supporting sediment yield.

5.1.2 Load Capacity

The load capacity for a TMDL designed to address a sediment-caused limitation to water quality is complicated by the fact that the state's water quality standard a narrative rather than quantitative. In the waters of the St. Maries River, the sediment interfering with the beneficial use (cold water) is most likely coarse sand bed load particles. Adequate quantitative measurements of the effect of excess sediment have not been developed. Given this difficulty, an exact sediment load capacity for the TMDL is difficult to develop.

The natural background sedimentation rate is the sediment yield prior to human development of the watershed. It was calculated by multiplying the watershed acreage by the appropriate sediment yield coefficient (0.023 tons/acre/year) for Belt Supergroup terrain vegetated by coniferous forests and 0.032 tons/acre/year) for watersheds with predominantly metamorphosed Belt Supergroup terrain. The estimate assumes the entire watershed was vegetated by coniferous forest prior to development. The calculated estimated natural background sediment yield values for the subbasins of the St. Maries River are provided in Table 22, as are the 50% above background sediment yield goals. The goals are estimated goals that will be replaced by the final sediment goal when the criteria for full support of cold water aquatic life are met. The load capacity based on the projected goal at the point of compliance is provided in Table 22. Loading capacities were developed by calculating background sedimentation based on acreage above the point of compliance, then adding an additional 50% to the value.

Critical Conditions

Critical conditions are part of the analysis of load capacity. The beneficial uses in this subbasin are impaired due to chronic sediment conditions. Due to the chronic condition, this TMDL deals with yearly sediment loads. The concept of critical conditions is difficult to reconcile with the impact caused by sediment. The critical condition concept assumes that under certain conditions, chronic pollution problems become acute pollution problems and therefore we need to ensure that acute conditions do not occur. The proposed sediment reductions in the TMDL will reduce the chronic sediment load and also reduce the likelihood that an acute sediment loading condition will exist. It is in this way that we have accounted for critical conditions in the TMDL.

Table 22. St. Maries River sediment background and load capacity at the points of compliance.

Location	Acreage of watershed	Background (tons/year)	Load capacity at 50% above background (tons/year)
Middle Fork St. Maries River	43,316	996	1,494
West Fork St. Maries River	23,654	757	1,136
Emerald Creek	23,239	744	1,116
St. Maries River at Emerald Creek	103,912	2,390	3,585
Carpenter Creek	12,857	296	444
St. Maries River at Tyson Creek	150,102	3,452	5,178
Tyson Creek	8,042	185	278
Santa Creek	47,212	1,086	1,629
Alder Creek	15,875	365	548
St. Maries River below Thorn Creek	307,485	7,072	10,608

5.1.3 Estimates of Existing Pollutant Loads

Point sources of sediment are from the three permitted wastewater treatment facilities (Table 16). As stated in Section 2.3, the point sources at maximum permitted discharge account for 14.1 tons per year of fine sediment. This amount is potentially 0.10% of the load. The point sources are not a significant source of sediment and will be allocated their existing loads.

Nonpoint sources of sediment yield were estimated in Section 2.3 (Tables 19a-c). These estimates were made using the assumptions and model approach fully documented in Appendix C. The model spreadsheets are provided in Appendix D. Loading rates are based on land use and road impacts (see Section 2.3, Tables 17a-c, and Appendices B and C). Estimated sediment loads from the watersheds above the points of compliance are shown in Table 23.

The sediment loading occurs as a result of forestland activities, agricultural land activities and stream bank erosion. Stream bank erosion is the single largest source of sediment in the watershed. The estimated current percentage of sediment delivery by the acres of land holdings is provided in Table 24.

Table 23. St. Maries River and tributary sediment loads from nonpoint sources in St. Maries River watershed.

Load Type	Location	Estimated Existing Load (tons/year)	Background (tons/year)	Percent Over Background (%)	Estimation Method
Sediment	Middle Fork of the St. Maries River	1,610	996	62	Model
Sediment	West Fork St. Maries River	1,484	757	96	Model
Sediment	Emerald Creek	1,001	744	35	Model
Sediment	St. Maries River at Emerald Creek	5,098	2,390	113	Model
Sediment	Carpenter Creek	648	296	119	Model
Sediment	St. Maries River at Tyson Creek	7,468	3,452	116	Model
Sediment	Tyson Creek	316	185	71	Model
Sediment	Santa Creek	2,899	1,086	167	Model
Sediment	Alder Creek	574	365	57	Model
Sediment	St. Maries River below Thorn Creek	13,740	7,072	94	Model

Table 24. St. Maries River sediment loading proportion based on area in various land uses.

Landowner	Watershed							
	Middle Fork St. Maries River		West Fork St. Maries River		Emerald Creek		St. Maries River at Emerald Creek	
	acres	%	acres	%	acres	%	acres	%
U.S. Forest Service	11,899	27.5	12,207	51.6	13,508	58.1	4,360	31.8
Idaho Dept. of Lands	3,582	8.3	2,503	10.6	1,104	4.8	1,284	9.4
Bureau of Land Management	3,129	7.2	-	-	100	0.4	2	-
Private Land - Forest	24,706	57.0	8,944	37.8	8,527	36.7	8,057	58.8
Total	43,316	100	23,654	100	23,239	100	13,703	100
	Carpenter Creek		St. Maries River at Tyson Creek		Tyson Creek		Santa Creek	
	acres	%	acres	%	acres	%	acres	%
U.S. Forest Service	716	5.6	479	1.9	1,523	18.9	19,853	42.1
Idaho Dept. of Lands	4,398	34.2	10,496	41.5	4,075	50.7	1,927	4.1
Bureau of Land Management	-	-	11	-	-	-	2	-
Private Land - Forest	7,743	60.2	14,278	56.5	1,908	23.7	17,532	37.1
Private Land – Agriculture	-	-	27	0.1	536	6.7	7,898	16.7
Total	12,857	100	25,291	100	8,042	100	47,212	100
	Alder Creek		St. Maries River below Thorn Creek					
	acres	%	acres	%				
U.S. Forest Service	72	0.5	1,850	2.0				
Idaho Dept. of Lands	557	3.5	13,501	14.3				
Bureau of Land Management	-	-	196	0.2				
Private Land- Forest	10,909	68.7	63,656	67.5				
Bureau of Indian Affairs	1,380	8.7	172	0.2				
Idaho Dept. of Fish and Game	-	-	11,512	12.2				
Private Land- Agriculture	2,957	18.6	3,186	3.4				
Water	-	-	223	0.2				
Total	15,875	100	94,296	100				

5.1.4 Sediment Load Allocation and Wasteload Allocation

The sediment allocation is equal to the load capacity minus the margin of safety and background. It is comprised of the wasteload allocation of point sources and the load allocation of nonpoint sources.

Margin of Safety

A margin of safety is implicit in the model used. The model is estimated to be 231% conservative when applied on Belt terrain and 164% conservative on metamorphosed Border Belt terrain (Appendix C). This level of conservative assumptions provides an over-estimation of sediment yield. The over-estimation is the implicit margin of safety. Given the conservatively high estimations developed by the model, no additional explicit margin of safety is deemed necessary.

Seasonal Variation

Sediment from nonpoint sources is not loaded seasonally. It is loaded episodically, primarily during high discharge events. These critical events coincide with the critical conditions and occur during November through May. However, they may not occur for several years. The return time of the largest events is 10-15 years (DEQ 2001).

Reasonable Assurance of TMDL Implementation

The sediment model identifies stream bank erosion and forest roads as primary sources of sediment in the subbasin. The federal government and IDL manage land in the subbasin. IDL has been directed by a gubernatorial executive order to directly implement state developed TMDLs on lands that they manage directly or to oversee implementation of the Forest Practices Act. Federal ownership and executive order should assure that implementation plans are developed for forest roads. A plan will be implemented for roads based primarily on the budgetary constraints of the federal and state agencies. Most eroding banks are on private land. Incentives provided to private landowners by the Benewah Soil and Water Conservation District might be necessary to address these eroding banks.

Background

Sediment background levels for the watersheds are shown above in Table 23. The backgrounds are allocated as part of the load capacity. Any unknown, unallocated point sources are included in the background portion of the allocation.

Reserve

No part of the load allocation is held for additional load. Any new infrastructure should be constructed or mitigated to allow no net increase in sediment yield to the watersheds.

Remaining Available Load

There is no remaining available load.

Wasteload Allocation

Sediment contribution from point sources is 0.10% of that estimated for the watershed. Since the contribution from point sources is negligible, the wasteload is set at current permit limits. These are provided below in Table 25.

Table 25. Wasteload allocation to the permitted point discharges of the St. Maries River Subbasin.

Permitted Discharge	Average Discharge (million gallons/day)	Total Suspended Solids Limit (mg/L)	Maximum Daily Sediment Load (pounds/day)	Maximum Annual Load (tons/year)
Santa-Fernwood	0.2	30	34.0	6.2
Emida	0.15	30	37.5	6.8
Clarkia	0.15	30	6.0	1.1
Total	0.5	-	77.5	14.1

Load Allocation

Load allocations required at the points of compliance are shown in Tables 26a-j. The allocation is based on a reduction to 50% above background and on the modeled estimate of nonpoint source sediment contribution in tons per year. The margin of safety is applied to the allocations at the points of compliance. The allocation includes background sediment yield. After implementation, the main channels of the tributaries and the St. Maries River are provided a 50-year time frame for meeting the allocations. This time frame allows for three large channel forming events to occur in the stream.

Table 26. Sediment load allocation and load reduction required at the points of compliance on the St. Maries River and its tributaries.

a) Middle Fork of the St. Maries River allocation

Source	Percentage of load source	Load allocation (tons/year)	Load reduction required (tons/year)	Time frame for meeting allocations
U.S. Forest Service	27.5	411	32	50 years
Idaho Dept. of Lands	8.3	124	10	50 years
Private Land (Forest)	57.0	852	66	50 years
Bureau of Land Management	7.2	107	8	50 years
Total	100	1,494	116	-

b) West Fork St. Maries River allocation

Source	Percentage of load source	Load allocation (tons/year)	Load reduction required (tons/year)	Time frame for meeting allocations
U.S. Forest Service	51.6	587	180	50 years
Idaho Dept. of Lands	10.6	120	37	50 years
Private Land (Forest)	37.8	429	131	50 years
Total	100	1,136	348	-

c) Emerald Creek allocation

Source	Percentage of load source	Load allocation (tons/year)	Load reduction required (tons/year)	Time frame for meeting allocations
U.S. Forest Service	58.1	648	0	50 years
Idaho Dept. of Lands	4.8	54	0	50 years
Private Land (Forest)	36.7	410	0	50 years
Bureau of Land Management	0.4	4	0	50 years
Total	100	1,116	0	-

d) St. Maries River at Emerald Creek allocation

Source	Percentage of load source	Load allocation (tons/year)	Load reduction required (tons/year)	Time frame for meeting allocations
U.S. Forest Service	31.8	1,140	481	50 years
Idaho Dept. of Lands	9.4	337	142	50 years
Private Land (Forest)	58.8	2,108	890	50 years
Total	100	3,585	1,513	-

e) Carpenter Creek allocation

Source	Percentage of load source	Load allocation (tons/year)	Load reduction required (tons/year)	Time frame for meeting allocations
U.S. Forest Service	5.6	25	11	50 years
Idaho Dept. of Lands	34.2	152	70	50 years
Private Land (Forest)	60.2	267	123	50 years
Total	100	444	204	-

f) St. Maries River at Tyson Creek allocation

Source	Percentage of load source	Load allocation (tons/year)	Load reduction required (tons/year)	Time frame for meeting allocations
U.S. Forest Service	1.9	98	44	50 years
Idaho Dept. of Lands	41.5	2,149	950	50 years
Private Land (Forest)	56.5	2,926	1,294	50 years
Private Land (Ag.)	0.1	5	2	50 years
Total	100	5,178	2,290	-

g) Tyson Creek allocation

Source	Percentage of load source	Load allocation (tons/year)	Load reduction required (tons/year)	Time frame for meeting allocations
U.S. Forest Service	18.9	52	7	50 years
Idaho Dept. of Lands	50.7	141	19	50 years
Private Land (Forest)	23.7	66	9	50 years
Private Land (Ag.)	6.7	19	3	50 years
Total	100	278	38	-

h) Santa Creek allocation

Source	Percentage of load source	Load allocation (tons/year)	Load reduction required (tons/year)	Time frame for meeting allocations
U.S. Forest Service	42.1	686	535	50 years
Idaho Dept. of Lands	4.1	67	52	50 years
Private Land (Forest)	37.1	604	471	50 years
Private Land (Ag.)	16.7	272	212	50 years
Total	100	1,629	1,270	-

i) Alder Creek allocation[1]

Source	Percentage of load source	Load allocation (tons/year)	Load reduction required (tons/year)	Time frame for meeting allocations
USFS	0.5	3	0.1	50 years
IDL	3.5	19	0.9	50 years
Private Land (Forest)	68.7	376	18	50 years
Private Land (Ag.)	18.6	102	5	50 years
Bureau of Indian Affairs	8.7	48	2	50 years
Total	100	548	26	-

[1]The allocation of the gross allocation and sediment reduction required is the responsibility of the EPA in consultation with the Coeur d'Alene Tribe.

j) St. Maries River below Thorn Creek allocation

Source	Percentage of load source	Load allocation (tons/year)	Load reduction required (tons/year)	Time frame for meeting allocations
U.S. Forest Service	2.0	212	63	50 years
Idaho Dept. of Lands	14.3	1,517	448	50 years
Private Land (Forest)	67.5	7,161	2,114	50 years
Private Land (Ag)	3.4	361	107	50 years
Bureau of Land Management	0.2	21	6	50 years
Bureau of Indian Affairs	0.2	21	6	50 years
Idaho Department of Fish and Game	12.2	1,294	382	50 years
Total	100	10,608	3,132	-
Water (included in Total)	0.2	21	6	

Monitoring Provisions

In-stream monitoring of beneficial use (cold water and salmonid spawning) support status during and after implementation of sediment abatement projects will establish the final sediment load reduction required by the TMDL. In-stream monitoring, which will determine if the threshold values identified in Section 5.1.1 (page 60) have been met, will be completed every year on a randomly selected 1% of the watershed's Rosgen B channel types. Independent monitoring parameters will be developed for the St. Maries River monitoring stations. Monitoring will assess stream reaches in length of at least 30 times bank full width. These reaches will be randomly selected from the total B type stream channels until at least

5% of these channels have been assessed after five years. Identical measurements will be made in appropriate reference streams where beneficial uses are supported. Data will be compiled after five years. The yearly increments of random testing that sum to 5% of the stream after five years should provide a database not biased by transit fish and macroinvertebrate population shifts. Based on this database the beneficial use support status will be determined.

Feedback Provisions

When beneficial use support meets the full attainment level, further sediment load reducing activities will not be required in the watershed. At that time a revised TMDL with an ambient sediment load will be developed. Best management practices for forest and surface mining operations will be prescribed by the revised TMDL with provisions to maintain erosion abatement structures. Regular monitoring of the beneficial uses will continue for an appropriate period to document maintenance of the full support of the use.

5.1.5 Conclusions

St. Maries River Subbasin assessment has revealed an array of fisheries, residual pool volume, and sediment modeling results that show the that the St. Maries River and several of its tributaries have sediment impairment of the cold water aquatic life.

A sediment TMDL was prepared for the entire St. Maries River watershed. The TMDL set a goal of 50% above natural background sediment yield based on an agreement between DEQ and EPA that recognizes the presence of watersheds fully supporting cold water beneficial use at levels well above natural background. The loading capacities were set for several points of compliance based on this goal. The load capacity was allocated on a gross land owner/manager basis. An implicit margin of safety of 231% was applied in the sediment model. Point sources of sediment are very minor (0.10%) and are negligible compared to the nonpoint sediment sources. The wasteload allocation was set at the level of the current NPDES permits for suspended solids.

5.2 St. Maries River Temperature TMDL

This TMDL addresses the St. Maries River and its tributaries that have been listed as water quality limited by temperature, including Gramp, Gold Center, Flewsie, Emerald, and Santa Creeks and the Middle and West Forks of the St. Maries River.

5.2.1 In-Stream Water Quality Targets

Neither the St. Maries River nor any of its tributaries listed for temperature are in the St. Joe bull trout recovery area (St. Joe River headwaters to Mica Creek) (Panhandle Bull Trout Technical Advisory Team 1998). The governing temperature standard for the watershed is Idaho's 9 ^{o}C daily maximum spawning standard from May through June. Prior to May, water temperature is expected to be well below 9 ^{o}C in the St. Joe Subbasin. In practice, the 10 ^{o}C seven-day running average from May 1 to September 1 and the state 9 ^{o}C daily maximum spawning standard are essentially the same (Dupont 2002). Monitoring of temperature in St.

Joe Subbasin streams with little or no human development and at relatively high elevation indicate that this standard is not attainable throughout the entire St. Joe Subbasin, including the St. Maries River (Table 12). Temperature assessments of Gramp, Gold Center, Flewsie, and Emerald Creeks and the Middle Fork of the St. Maries River indicates significant exceedences of the state salmonid spawning standards (Table 11; Appendix B). Similar exceedences are expected for the St. Maries River, West Fork of the St. Maries River, and Santa Creek. It is currently beyond technical ability to assess the sufficiency of cold water habitat during the late spring and early summer months.

Design Conditions

Stream temperature is affected by natural weather conditions and adjacent plant community potential, including disturbance and recovery. Vegetation manipulation to create access or as a result of timber harvest is the major anthropogenic cause of increased stream temperatures.

The environmental factors affecting stream temperature are local air temperature, stream depth, ground water inflow, and stream shading by riparian cover and/or topography (Sullivan and Adams 1990, Theurer *et al.* 1984, Beschta and Weatherred 1984). Topographic elevation affects ambient air temperature. Higher elevations have lower ambient air temperatures. In forest streams, ambient temperature and shading are believed to account for up to 90% of the stream temperature variability (Brown 1971). Of these two factors, riparian shade is the only one that can be modified by management.

Several models can be used to assess the impact of riparian shade on stream temperature. Heat Source (Boyd 1996) and the USGS Stream Segment Temperature Model (SSTEMP) (Theuer *et al.* 1984, Bartholow 1989) quantify the energy transfer mechanisms in streams. These models require extensive data inputs, many of which are not available for mountain streams. The use of process-based models was found a workable approach for the Upper North Fork Clearwater Temperature TMDLs (Dechert *et al.* 2001). It uses the IDL CWE Canopy Closure-Stream Temperature protocol. Energy loading values are developed using SSTEMP results as comparative data to the primary TMDL target measurement of percent canopy cover.

The CWE empirical model is based on continuous stream temperature measurements, topographic elevation, and the percent of vegetative canopy cover data collected throughout northern Idaho. The model calculation is as follows:

Equation (1) $$MWMT = 29.1 - 0.00262*E - 0.0849*C$$

where MWMT = maximum weekly maximum temperature (^{o}C)
E = stream reach elevation (feet)
C = riparian canopy cover (%)

The equation can be solved for canopy cover to predict the required canopy at a given elevation.

Equation (2) $$C = (29.1/0.085) - (MWMT/0.085) - (E * 0.0026/0.085)$$

To calculate required canopy cover for the water bodies, MWMT would be set at 10^{o}C.

$$\text{Equation (3)} \quad C = 224.7 - 0.031 * E$$

To satisfy the requirement for an analysis of heat loading (energy per unit area per unit time) to a stream due to insolation, the method of Dechert *et al*. (2001) was used. The approach uses SSTEMP (Bartholow 1997) to derive data for August 1, 2000 (median hottest day), for insolation rates and calculates heat loading for different levels of percent shade. The amount of solar radiation incident on a stream and its immediate surroundings at different shade levels for three non-redundant stream orientations are presented in Table 27. The fixed conditions used in SSTEMP to develop the solar radiation numbers, in this case for the Upper North Fork Clearwater River, were 47? north latitude, 5,000 feet elevation, 10 foot stream width, 60 foot buffer height, 30 foot buffer width, and 30? topographic shade (Dechert *et al*. 2001). Under these conditions, incident solar radiation decreases regularly by 21 watts per square meter for every 10% increase in canopy density for north-south oriented streams and 26 watts per square meter for east-west oriented streams. The St. Maries Subbasin is near the Upper North Fork Clearwater Subbasin where the model calculations were made. The St. Maries watershed is at a lower elevation (2,100 to 5,800 feet) than the Upper North Fork Clearwater Subbasin. Since solar radiation is stronger at higher elevations, the modeled energy inputs are conservative for these water bodies.

The heat flux amounts shown in Table 27 do not represent the entire heat budget of the streams, but only that from direct sunlight (insolation). This is the portion of heat flux the TMDL and, ultimately, vegetation management can address. Land management cannot significantly affect other environmental factors affecting temperature.

Table 27. Average daily solar radiation incident on a stream related to canopy closure as developed for the Upper North Fork Clearwater River.[1]

Canopy Density (percent)	Stream Orientation		
	North-South (watts/m^2)	East – West (watts/m^2)	SE-NW or SW-NE (watts/m^2)
0	226	274	250
10	205	248	227
20	185	223	204
30	164	197	181
40	143	172	197
50	122	146	134
60	101	120	111
70	80	95	87
80	59	69	64
90	38	43	41
100	17	18	17.5

[1]SSTEMP model output (Dechert *et al*. 2001) based on the following calculations:
North-South = (100-target canopy percent)*2.1+1.7
East-West = (100-target canopy percent)*2.56+18
SE-NW or SW-NE = (100-target canopy percent)*2.33+17.5

Target Selection

The TMDL selects canopy cover by stream reach elevation as the target for load capacity goals for reducing heat load. Canopy cover can be allocated as a surrogate for heat load reduction that can be affected in part by vegetation management. It can also be related to thermal load reduction by the SSTEMP estimates provided in Table 27. Canopy cover can be mapped on a stream reach basis to facilitate management prescriptions in a TMDL implementation plan. It can easily be assessed using aerial photography techniques. Milestones in the implementation plan can be set on a 10-year basis to coincide with the normal frequency of aerial photographic surveys.

Applicable reference streams can be found in the St. Joe Subbasin above the Mosquito Creek confluence. This area was burned during the 1910 fires and has recovered seral timber stands. However, timber harvest has been less intensive than in watersheds of the St. Maries Subbasin. Bacon, Bean, and Yankee Bar Creeks are streams that could be used as reference. The streams of the upper St. Joe Subbasin currently support bull trout populations and most approach the 10 ^{o}C standard during August, when stream temperatures peak. These streams also approach full support of the salmonid spawning temperature standard.

Monitoring Points

Points of compliance were selected for temperature monitoring. These are provided below in Table 28. These sites can used to assess both rearing and spawning temperatures.

Table 28. Points of compliance for the St. Maries River temperature TMDLs.

Waterbody	Location	Beneficial Use Reconnaissance Program Monitoring Site
Gramp Creek	Near mouth	1996SCDAA047
Gold Center Creek	Near mouth	1996SCDAA045
Flewsie Creek	Near mouth	1996SCDAA048
Middle Fork of the St. Maries River	Near mouth	1996SCDAA040
West Fork St. Maries River	Near mouth	1998SCDAA021
Emerald Creek	Near mouth	1995SCDAB008
Santa Creek	Near mouth	1995SCDAB005
St. Maries River	At Cedar Creek	1997SCDAA033
St. Maries River	At Emerald Creek	To be Determined

Primary TMDL monitoring will be with aerial photography interpretation of canopy recovery over the streams. Aerial photography is currently repeated on a ten-year time frame. This time frame will allow a sufficient period to assess canopy recovery. In addition, a set number of representative sites should be assessed on the ground on a periodic basis using canopy densiometer methodology to ground truth and calibrate the aerial photograph interpretation. These monitoring issues should be further addressed and specified in the monitoring section of the implementation plan.

5.2.2 Load Capacity

Load capacity is stated in terms of canopy cover and the insolation rate required to maintain a maximum weekly maximum temperature (MWMT) of 10 ^{o}C (Table 28). A load capacity has been developed for each stream reach covering 200 feet of elevation. Equation 2 (page 72) is used to calculate the percent cover required for each stream reach. Under elevations of 4,000 feet the CWE model predicts greater than 100% canopy closure to maintain the 10 ^{o}C MWMT goal. Since this is not possible, canopy closure is defaulted to 100%. The St. Maries River watershed has an elevation range of 2,200 to 5,800 feet. A 100% canopy cover is required on all streams between 2,200 and 4,000 feet to achieve the10 ^{o}C MWMT goal. Even this goal may not be achievable on some stream reaches due to natural plant community type, stream width, or habitat type restrictions. Canopy cover goals are currently only met on a few of the 200 feet elevation increment reaches of the St. Maries River watershed.

Use of the CWE model and corroboration of its accuracy for predicting relationships between canopy cover, thermal input, and stream temperature has been developed in the *Upper North Fork Clearwater Temperature TMDLs* (Dechert *et al.* 2001). The application of the thermal model to the St. Maries River watershed is appropriate.

Critical Conditions

Critical conditions are a part of the load capacity analysis. For the St. Maries River Subbasin, critical conditions for temperature are low discharge conditions in August and early September (mid to late summer). The goal is set to meet 10 ^{o}C MWMT during this time period and the manageable thermal input is modeled to achieve the goal. Acute and chronic violations of the 10 °C MWMT goal may contribute to the lack of sufficiently high trout numbers of trout in the St. Maries River watershed (Table 11; Appendix B).

Table 29. Cumulative watershed effect calculated canopy cover required at stated elevations to maintain the 10 °C maximum weekly maximum temperature and corresponding heat load capacity from insolation.

Elevation Range	CWE Target Canopy Cover (%)	Heat Load Capacity[2] North-South oriented stream (watts/sq m)	Heat Load Capacity[2] East-West oriented stream (watts/sq m)	Heat Load Capacity[2] SWNE or SENW oriented stream (watts/sq m)
4,800 – 4,999	71	79	93	86
4,600 – 4,799	77	66	77	71
4,400 – 4,599	83	53	62	57
4,200 – 4,399	89	40	46	43
4,000 – 4,199	95	27	30	28
3,800 –3,999	101	17	18	17.5
3,600 – 3,799	108	17	18	17.5
3,400 – 3,599	114[1]	17	18	17.5
3,200 – 3,399	120[1]	17	18	17.5
3,000 – 3,199	126[1]	17	18	17.5
2,800 – 2,999	132[1]	17	18	17.5
2,600 – 2,799	139[1]	17	18	17.5
2,400 – 2,599	145[1]	17	18	17.5
2,200 – 2,399	152[1]	17	18	17.5

[1] Below 4,000 feet elevation the CWE model predicts a need for greater than 100% canopy closure to protect a maximum stream temperature of 10 °C MWMT. Since this is not possible, 100% canopy closure is set as the surrogate heat load capacity. In some cases, 100% canopy closure may not be achievable because of plant community type or habitat type restrictions.
[2] SSTEMP predicts insolation rates of 17-18 watts/m^2 for 100% canopy closure.

5.2.3 Estimates of Existing Pollutant Loads

The Santa-Fernwood, Clarkia, and Emida wastewater treatment facilties are point sources of thermal input to the St. Maries River Subbasin. Natural inputs include ambient air temperature, inflow ground water temperature, and direct insolation. Of these factors, only direct insolation can be estimated and managed through the vegetation management of stream canopy cover.

Table 30. General canopy cover estimate guide for aerial photo interpretation.[1]

Visibility on Aerial Photographs	Percent Canopy
Stream surface not visible	>90%
Stream surface slightly visible	76-90%
Stream surface visible in patches	61-75%
Stream surface visible, but banks are mostly not visible	46-60%
Stream surface visible and banks visible in places	31-45%
Stream surface and banks visible in most places	16-30%
Stream surface and banks visible	0-15%

[1] Table from IDL.

Canopy cover was surveyed using aerial photometry, assessed using the guidelines in Table 30, and ground verified by CWE crews. Insufficient canopy cover is the primary manageable temperature input. Current canopy coverage of the reaches of the St. Maries River Subbasin is provided in Tables 31a-e.

5.2.4 Temperature Load Allocation and Wasteload Allocation

The temperature allocation is comprised of the wasteload allocation of point sources and the load allocation of nonpoint sources.

Margin of Safety

Between 2,200 and 4,000 feet elevation the required canopy cover is 100%. Much of the St. Maries River watershed does not exceed 4,000 feet elevation. For stream reaches above 4,000 feet, the margin of safety is the existing shade above that required to satisfy thermal equations. Canopy cover of 100% is both the requirement and the limit of management for temperature below 4,000 feet. The 10 ^{o}C MWMT standard used is the federal standard.

Seasonal Variation

Heat loading capacity applicable to the St. Maries River watershed in relation to the EPA bull trout temperature standard is primarily a consideration during August and early September. Because of the seasonal progression in stream temperature, if a stream's annual temperature peak is targeted, and this peak is brought down to within criteria limits, then it can safely be assumed that the criteria will also be met at cooler times of the year. This is the basis of using the MWMT metric for criteria. The 10 °C MWMT criteria calculations for bull trout translates closely to the 9 °C daily average criteria for cutthroat.

Wasteload allocations were determined with respect to salmonid spawning periods. Therefore, stream flow and effluent discharge during May through September were used in calculating maximum acceptable effluent temperature.

Reasonable Assurance

Reasonable assurance is provided by nonpoint source implementation of BMPs based on land management agencies' assurance that reductions will occur. Additionally, trend monitoring will be used to document relative changes in various aquatic organism populations and in physical and chemical water quality parameters. This data will be used to assess overall progress towards attainment of water quality standards and related beneficial uses.

Background

The background temperature and thermal input to the temperature-listed waters of the St. Maries Subbasin are not known. Pre-canopy removal stream temperature and stream canopy cover were not measured. Significant reaches of the St. Maries River are too broad and shallow to effectively shade with vegetation. This stream configuration may have existed prior to development. It would not have and will not support vegetation communities capable of providing 100% canopy cover to the stream. Any TMDL implementation plan should note and account for these areas of natural thermal loading.

Reserve

No reserve is developed for this TMDL. The thermal capacity of the watershed has been exceeded by canopy removal. Canopy restoration, to the degree possible, is required to address the thermal loading.

Wasteload Allocation

There are three point sources of thermal input to the temperature-listed streams of the St. Maries Subbasin. These point sources are the Santa-Fernwood, Clarkia, and Emida wastewater treatment facilities. They were assigned wasteload allocations as follows.

Idaho water quality standards (IDAPA 58.01.02.401.03.a.v.) provide that in waters where stream temperature naturally exceeds criteria, point source must not increase stream temperature greater than 0.3 ^{o}C.

The following temperature limit equation was used to determine the impact of the wastewater treatment facilities on stream temperature:

$$T_E = \frac{[Q_E + (0.25*Q_S)] * [T_C + 0.3\,^{o}C] - [(0.25 * Q_S) * T_C]}{Q_E}$$

where
T_E = effluent temperature
Q_E = effluent flow (cfs)
Q_S = stream flow (cfs)
T_C = applicable temperature criteria (^{o}C)
0.25 = 25% by volume mixing zone allowance

The 90th percentiles of effluent flows at each of the three locations were calculated using the facilities' Dishcarge Monitoring Reports. The Santa-Fernwood facility has an average high discharge of .278 cfs, while the Clarkia facility has an average high discharge of .130 cfs. Discharge values for the Emida facility were estimated from the Clarkia facility's discharge reports, as they are not required to monitor discharge. An average stream flow of 316 cfs, during the salmonid spawning period of May through September, was determined from Table 3 (page 27). The applicable temperature criteria of 9 ^{o}C was used. These values revealed that effluent temperatures of 95 ^{o}C and 188 ^{o}C for the Santa-Fernwood and Clarkia/Emida facilities, respectively, would be needed to cause an in-stream temperature increase of greater than 0.3 ^{o}C.

The St. Maries-area wastewater treatment facilities are not required to monitor and record effluent temperature, however, it was possible to examine maximum effluent temperatures at a nearby facility, Kootenai-Ponderay Sewer District. This system employs the same wastewater stabilization pond technology used by the St. Maries-area facilities. The maximum monthly effluent temperature for the time period examined (February 2002 through May 2003) was 30.32 ^{o}C. As such, the St. Maries-area wastewater treatment facilities are assigned wasteload allocations of 35 ^{o}C daily maximum effluent temperature. The facilities can be reasonably expected to meet this standard because, like the Kootenai-Ponderay facility, they are not likely to produce effluent at temperatures greater than 35 ^{o}C. Additionally, a 35 ^{o}C daily maximum allocation provides a built-in margin of safety as it is conservative when compared to the temperatures described above as necessary to increase stream temperature by 0.3 ^{o}C.

Load Allocation

Load allocations have been developed, establishing target load levels at which streams are expected to meet temperature criteria. The load allocations must result in 100 percent canopy cover in streams below 4,000 feet in elevation, with exceptions noted below. Load allocations for each steam segment in the subbasin are presented in Table 31.

Canopy Habitat Type Limitations

Some habitat types found along streams are not capable of sustaining sufficient stream canopy coverage. These habitat types either have physical limitations that preclude sufficient tree density to develop complete canopy coverage that do not support tree establishment to any significant degree. In addition, a stream may be too broad to be effectively shaded by trees. The St. Maries River below the Emerald Creek confluence has a broad and shallow channel that is sufficiently wide to preclude effective shading by vegetation during the mid-day hours. The channel morphology does not appear to be the result of sediment deposition. Accelerated sediment deposition would cause braiding in a generally low gradient stream like the St. Maries River. But no braiding is evident. The broad, shallow morphology between Emerald and Santa Creeks appears to be a natural feature. Although it is generally deep, the river is sufficiently broad to preclude effective shading below the Santa Creek confluence. Stream segments with canopy habitat type limitations are identified with a footnote in Table 31.

These segments were assigned interim target canopy cover levels. The actual maximum potential canopy for these streams will be determined by a committee of forest and riparian professionals during the implementation phase of TMDL development. After a determination is made, the temperature TMDL will be amended to reflect the new values.

Table 31. Watershed temperature TMDLs – Cumulative Watershed Effects (CWE) calculated percent canopy cover and heat loading.

a) Middle Fork of the St. Maries River including the tributaries: Gramp, Gold Center and Flewsie Creeks

Stream Segment	Elevation Range (ft)	Stream Segment length (ft)	Existing Canopy Cover Range (%)	CWE Target Canopy Cover (%)	Adjusted Target Canopy Cover (%)	Canopy Increase to Meet Target (%)	Stream Orientation	Target Heat Load (watts/m^2)	Current Heat Loading (watts/m^2)	Target Heat Load Reduction (%)
Upper MF St. Maries R.	3000-3200	5,502	50	126.2	100	50.0	NS	17.0	122.0	86.1
Upper MF St. Maries R.	3200-3400	2,339	50	120.0	100	50.0	NS	17.0	122.0	86.1
Upper MF St. Maries R.	3200-3400	8,010	50	120.0	100	50.0	NS	17.0	122.0	86.1
Upper MF St. Maries R.	3400-3600	3,390	50	113.8	100	50.0	NESW	17.5	134.0	86.9
Upper MF St. Maries R.	3400-3600	4,182	70	113.8	100	30.0	NESW	17.5	87.4	80.0
Upper MF St. Maries R.	3600-3800	3,638	70	107.7	100	30.0	NS	17.0	80.0	78.8
Upper MF St. Maries R.	3600-3800	3,448	50	107.7	100	50.0	NESW	17.5	134.0	86.9
Upper MF St. Maries R.	3800-4000	2,181	50	101.5	100	50.0	NESW	17.5	134.0	86.9
Upper MF St. Maries R.	3800-4000	2,666	15	101.5	100	85.0	NWSE	17.5	215.6	91.9
Upper MF St. Maries R.	4000-4200	898	15	95.3	95.3	80.3	NWSE	28.4	215.6	86.8
Upper MF St. Maries R.	3200-3400	1,346	80	120.0	100	20.0	EW	18.0	69.2	74.0
Upper MF St. Maries R.	3400-3600	1,024	80	113.8	100	20.0	NESW	17.5	64.1	72.7
Upper MF St. Maries R.	3400-3600	1,980	95	113.8	100	5.0	NESW	17.5	29.2	40.0
Upper MF St. Maries R.	3600-3800	496	95	107.7	100	5.0	NESW	17.5	29.2	40.0
Upper MF St. Maries R.	3600-3800	2,075	70	107.7	100	30.0	EW	18.0	94.8	81.0
Upper MF St. Maries R.	3800-4000	1,758	70	101.5	100	30.0	EW	18.0	94.8	81.0
Upper MF St. Maries R.	4000-4200	1,478	95	95.3	95.3	0.3	EW	30.0	30.8	2.7
Upper MF St. Maries R.	4200-4400	913	95	89.1	95.0	0.0	EW	30.8	30.8	0.0
Upper MF St. Maries R.	3600-3800	322	95	107.7	100	5.0	NWSE	17.5	29.2	40.0
Upper MF St. Maries R.	3800-4000	2,033	95	101.5	100	5.0	NWSE	17.5	29.2	40.0
Upper MF St. Maries R.	4000-4200	1,837	95	95.3	95.3	0.3	NWSE	28.4	29.2	2.6
Upper MF St. Maries R.	4200-4400	444	95	89.1	95.0	0.0	NWSE	29.2	29.2	0.0
Upper MF St. Maries R.	4200-4400	1,288	95	89.1	95.0	0.0	NWSE	29.2	29.2	0.0
Upper MF St. Maries R.	4400-4600	834	95	83.0	95.0	0.0	EW	30.8	30.8	0.0
Upper MF St. Maries R.	3200-3400	634	80	120.0	100	20.0	EW	18.0	69.2	74.0
Upper MF St. Maries R.	3400-3600	480	80	113.8	100	20.0	EW	18.0	69.2	74.0
Upper MF St. Maries R.	3400-3600	1,140	95	113.8	100	5.0	EW	18.0	30.8	41.6
Upper MF St. Maries R.	3600-3800	1,668	95	107.7	100	5.0	NWSE	17.5	29.2	40.0
Upper MF St. Maries R.	3800-4000	734	95	101.5	100	5.0	EW	18.0	30.8	41.6
Upper MF St. Maries R.	3800-4000	1,214	95	101.5	100	5.0	EW	18.0	30.8	41.6
Upper MF St. Maries R.	4000-4200	1,383	95	95.3	95.3	0.3	EW	30.0	30.8	2.7
Upper MF St. Maries R.	3400-3600	1,521	70	113.8	100	30.0	EW	18.0	94.8	81.0
Upper MF St. Maries R.	3600-3800	222	70	107.7	100	30.0	NWSE	17.5	87.4	80.0
Upper MF St. Maries R.	3600-3800	1,404	70	107.7	100	30.0	NESW	17.5	87.4	80.0
Upper MF St. Maries R.	3400-3600	2,666	50	113.8	100	50.0	NWSE	17.5	134.0	86.9
Upper MF St. Maries R.	3600-3800	1,790	65	107.7	100	35.0	EW	18.0	107.6	83.3
Upper MF St. Maries R.	3600-3800	1,515	65	107.7	100	35.0	NWSE	17.5	99.1	82.3
Upper MF St. Maries R.	3800-4000	396	65	101.5	100	35.0	EW	18.0	107.6	83.3
Upper MF St. Maries R.	3800-4000	1,922	80	101.5	100	20.0	EW	18.0	69.2	74.0
Upper MF St. Maries R.	4000-4200	1,156	80	95.3	95.3	15.3	EW	30.0	69.2	56.7
Upper MF St. Maries R.	3400-3600	1,668	70	113.8	100	30.0	EW	18.0	94.8	81.0
Upper MF St. Maries R.	3400-3600	3,337	50	113.8	100	50.0	NWSE	17.5	134.0	86.9
Upper MF St. Maries R.	3600-3800	581	50	107.7	100	50.0	EW	18.0	146.0	87.7
Upper MF St. Maries R.	3600-3800	3,406	70	107.7	100	30.0	NWSE	17.5	87.4	80.0
Upper MF St. Maries R.	3800-4000	1,177	80	101.5	100	20.0	EW	18.0	69.2	74.0
Upper MF St. Maries R.	3800-4000	1,874	50	101.5	100	50.0	NWSE	17.5	134.0	86.9
Upper MF St. Maries R.	3600-3800	612	80	107.7	100	20.0	EW	18.0	69.2	74.0
Upper MF St. Maries R.	3800-4000	634	80	101.5	100	20.0	EW	18.0	69.2	74.0
Gold Center Ck.	3000-3200	10,766	15	126.2	100	85.0	EW	18.0	235.6	92.4
Gold Center Ck.	3200-3400	6,737	20	120.0	100	80.0	NESW	17.5	203.9	91.4
Gold Center Ck.	3400-3600	634	20	113.8	100	80.0	EW	18.0	222.8	91.9
Gold Center Ck.	3400-3600	3,728	40	113.8	100	60.0	EW	18.0	171.6	89.5

Table 31-a, continued.

Gold Center Ck.	3600-3800	2,212	70	107.7	100	30.0	EW	18.0	94.8	81.0
Gold Center Ck.	3600-3800	935	95	107.7	100	5.0	EW	18.0	30.8	41.6
Gold Center Ck.	3800-4000	1,647	95	107.7	100	5.0	EW	18.0	30.8	41.6
Gramp Ck.	3000-3200	4,842	15	126.2	100	85.0	NESW	17.5	215.6	91.9
Gramp Ck.	3200-3400	5,137	20	120.0	100	80.0	NESW	17.5	203.9	91.4
Gramp Ck.	3400-3600	3,099	40	113.8	100	60.0	NS	17.0	143.0	88.1
Gramp Ck.	3600-3800	660	40	107.7	100	60.0	NS	17.0	143.0	88.1
Gramp Ck.	3600-3800	1,473	50	107.7	100	50.0	NESW	17.5	134.0	86.9
Gramp Ck.	3800-4000	824	50	101.5	100	50.0	NESW	17.5	134.0	86.9
Gramp Ck.	3800-4000	1,209	50	101.5	100	50.0	NESW	17.5	134.0	86.9
Placer Ck.	3200-3400	887	70	120.0	100	30.0	NS	17.0	80.0	78.8
Placer Ck.	3400-3600	496	70	113.8	100	30.0	NESW	17.5	87.4	80.0
Placer Ck.	3400-3600	2,545	70	113.8	100	30.0	NESW	17.5	87.4	80.0
Placer Ck.	3600-3800	2,561	70	107.7	100	30.0	NESW	17.5	87.4	80.0
Placer Ck.	3800-4000	275	70	101.5	100	30.0	NESW	17.5	87.4	80.0
Gold Center Ck.	3800-4000	2,255	50	101.5	100	50.0	NESW	17.5	134.0	86.9
Gold Center Ck.	4000-4200	1,800	65	95.3	95.3	30.3	NESW	28.4	99.1	71.3
Gold Center Ck.	4200-4400	275	65	89.1	89.1	24.1	NESW	42.8	99.1	56.8
Windy Ck.	3200-3400	2,365	95	120.0	100	5.0	NWSE	17.5	29.2	40.0
Windy Ck.	3400-3600	2,360	80	113.8	100	20.0	EW	18.0	69.2	74.0
Windy Ck.	3600-3800	1,135	95	107.7	100	5.0	EW	18.0	30.8	41.6
Flewsie Ck.	2800-3000	2,186	75	132.3	100	25.0	NS	17.0	69.5	75.5
Flewsie Ck.	3000-3200	1,816	75	126.2	100	25.0	NS	17.0	69.5	75.5
Flewsie Ck.	3000-3200	4,377	80	126.2	100	20.0	NESW	17.5	64.1	72.7
Flewsie Ck.	3200-3400	2,957	80	120.0	100	20.0	NESW	17.5	64.1	72.7
Flewsie Ck.	3200-3400	5,724	75	120.0	100	25.0	NESW	17.5	75.8	76.9
Flewsie Ck.	3400-3600	2,651	70	113.8	100	30.0	NS	17.0	80.0	78.8
Flewsie Ck.	3600-3800	3,532	70	107.7	100	30.0	NS	17.0	80.0	78.8
Lower MF St. Maries R.	2600-2800	3,031	10	138.5	100	90.0	NWSE	17.5	227.2	92.3
Lower MF St. Maries R.	2800-3000	17,889	10	132.3	100	90.0	EW	18.0	248.4	92.8
Lower MF St. Maries R.	2800-3000	4,140	20	132.3	100	80.0	EW	18.0	222.8	91.9
Lower MF St. Maries R.	2800-3000	3,612	10	132.3	100	90.0	EW	18.0	248.4	92.8
Lower MF St. Maries R.	3000-3200	2,751	10	126.2	100	90.0	EW	18.0	248.4	92.8

b) West Fork St. Maries River including its tributary, Cats Spur Creek

Stream Segment	Elevation Range (ft)	Stream Segment length (ft)	Existing Canopy Cover Range (%)	CWE Target Canopy Cover (%)	Adjusted Target Canopy Cover (%)	Canopy Increase to meet target (%)	Stream Orientation	Target Heat Load (watts/ sq m)	Current Heat Load (watts/sq m)	Target Heat Load Reduction (%)
Upper WF St. Maries River	2800-3000	19,995	20	132.3	100	80.0	EW	18.0	222.8	91.9
Upper WF St. Maries River	3000-3200	3,163	20	126.2	100	80.0	EW	18.0	222.8	91.9
Wood Ck.	2800-3000	3,648	80	132.3	100	20.0	NS	17.0	59.0	71.2
Wood Ck.	3000-3200	385	80	126.2	100	20.0	NS	17.0	59.0	71.2
Hidden Ck.	2800-3000	2,988	50	132.3	100	50.0	NWSE	17.5	134.0	86.9
Hidden Ck.	3000-3200	6,030	50	126.2	100	50.0	NWSE	17.5	134.0	86.9
Hidden Ck.	3000-3200	1,130	80	126.2	100	20.0	NWSE	17.5	64.1	72.7
Hidden Ck.	3200-3400	2,402	80	120.0	100	20.0	NWSE	17.5	64.1	72.7
Unnamed Trib 2	2800-3000	1,959	15	132.3	100	85.0	NS	17.0	195.5	91.3
Unnamed Trib 2	3000-3200	10,914	15	126.2	100	85.0	NS	17.0	195.5	91.3
Long Slim Ck.	2800-3000	3,062	40	132.3	100	60.0	NWSE	17.5	157.3	88.9
Long Slim Ck.	3000-3200	2,883	40	126.2	100	60.0	EW	18.0	171.6	89.5
Long Slim Ck.	3000-3200	2,101	70	126.2	100	30.0	NWSE	17.5	87.4	80.0
Long Slim Ck.	3200-3400	2,756	70	120.0	100	30.0	NS	17.0	80.0	78.8
Long Slim Ck.	3200-3400	2,207	80	120.0	100	20.0	NESW	17.5	64.1	72.7
Long Slim Ck.	3400-3600	2,022	80	113.8	100	20.0	NS	17.0	59.0	71.2
Long Slim Ck.	3400-3600	1,647	80	113.8	100	20.0	NS	17.0	59.0	71.2
Long Slim Ck.	3600-3800	1,098	80	107.7	100	20.0	NWSE	17.5	64.1	72.7
Unnamed Trib 1	2800-3000	2,049	80	132.3	100	20.0	NESW	17.5	64.1	72.7
Unnamed Trib 1	3000-3200	3,912	80	126.2	100	20.0	NS	17.0	59.0	71.2
Unnamed Trib 1	2800-3000	312	80	132.3	100	20.0	NS	17.0	59.0	71.2
Unnamed Trib 1	3000-3200	1,204	80	126.2	100	20.0	NWSE	17.5	64.1	72.7

Table 31-b, continued.

Lower WF St. Maries R.	2800-3000	23,148	10	132.3	100	90.0	NESW	17.5	227.2	92.3
Cats Spur Ck.	2800-3000	10,571	20	132.3	100	80.0	NWSE	17.5	203.9	91.4
Cats Spur Ck.	3000-3200	2,260	20	126.2	100	80.0	EW	18.0	222.8	91.9
Cats Spur Ck.	3000-3200	3,860	50	126.2	100	50.0	EW	18.0	146.0	87.7
Cats Spur Ck.	3000-3200	1,399	60	126.2	100	40.0	EW	18.0	120.4	85.0
Cats Spur Ck.	3200-3400	5,777	70	120.0	100	30.0	NESW	17.5	87.4	80.0
Cats Spur Ck.	3400-3600	2,804	70	113.8	100	30.0	NS	17.0	80.0	78.8
Cats Spur Ck.	3600-3800	2,497	70	107.7	100	30.0	NESW	17.5	87.4	80.0
Cats Spur Ck.	3600-3800	771	80	107.7	100	20.0	NESW	17.5	64.1	72.7
Cats Spur Ck.	3800-4000	771	80	101.5	100	20.0	NESW	17.5	64.1	72.7
Log Ck.	2800-3000	1,969	30	132.3	100	70.0	NESW	17.5	180.6	90.3
Log Ck.	3000-3200	3,717	50	126.2	100	50.0	NESW	17.5	134.0	86.9
Log Ck.	3200-3400	4,066	50	120.0	100	50.0	NWSE	17.5	134.0	86.9
Log Ck.	3400-3600	2,006	60	113.8	100	40.0	EW	18.0	120.4	85.0
Log Ck.	3600-3800	834	60	107.7	100	40.0	NWSE	17.5	110.7	84.2
Log Ck.	3600-3800	2,318	70	107.7	100	30.0	EW	18.0	94.8	81.0
Log Ck.	3800-4000	1,378	80	101.5	100	20.0	NWSE	17.5	64.1	72.7
Log Ck.	4000-4200	1,162	80	95.3	95.3	15.3	NWSE	28.4	64.1	55.7
Unnamed Trib 1	3600-3800	1,626	60	107.7	100	40.0	NWSE	17.5	110.7	84.2
Unnamed Trib 1	3800-4000	1,758	70	101.5	100	30.0	NWSE	17.5	87.4	80.0
Unnamed Trib 1	4000-4200	1,156	70	95.3	95.3	25.3	NS	26.8	80.0	66.5
Unnamed Trib 1	4000-4200	602	10	95.3	95.3	85.3	NWSE	28.4	227.2	87.5
Unnamed Trib 1	4200-4400	1,209	10	89.1	89.1	79.1	NS	39.8	206.0	80.7
Kitten Ck.	3000-3200	3,015	40	126.2	100	60.0	EW	18.0	171.6	89.5
Kitten Ck.	3200-3400	3,258	50	120.0	100	50.0	NESW	17.5	134.0	86.9
Kitten Ck.	3400-3600	2,307	50	113.8	100	50.0	NS	17.0	122.0	86.1
Kitten Ck.	3600-3800	2,508	50	107.7	100	50.0	NS	17.0	122.0	86.1
Kitten Ck.	3800-4000	1,077	50	101.5	100	50.0	NESW	17.5	134.0	86.9
Kitten Ck.	3800-4000	2,930	40	101.5	100	60.0	NS	17.0	143.0	88.1
Kitten Ck.	4000-4200	1,626	40	95.3	95.3	55.3	NS	26.8	143.0	81.2
Kitten Ck.	4200-4400	697	40	89.1	89.1	49.1	NS	39.8	143.0	72.2
Kitten Ck.	4400-4600	908	40	83.0	83.0	43.0	NS	52.7	143.0	63.1
Unnamed Trib 2	3000-3200	787	80	126.2	100	20.0	NWSE	17.5	64.1	72.7
Unnamed Trib 2	3200-3400	1,420	80	120.0	100	20.0	NWSE	17.5	64.1	72.7
Unnamed Trib 2	3400-3600	1,774	80	113.8	100	20.0	NS	17.0	59.0	71.2
Unnamed Trib 2	3600-3800	1,695	80	107.7	100	20.0	NWSE	17.5	64.1	72.7
Unnamed Trib 3	3200-3400	2,038	70	120.0	100	30.0	NESW	17.5	87.4	80.0
Unnamed Trib 3	3400-3600	834	70	113.8	100	30.0	NS	17.0	80.0	78.8
Unnamed Trib 3	3400-3600	2,038	50	113.8	100	50.0	NWSE	17.5	134.0	86.9
Unnamed Trib 3	3600-3800	1,341	50	107.7	100	50.0	NS	17.0	122.0	86.1
Unnamed Trib 3	3800-4000	1,146	30	101.5	100	70.0	NWSE	17.5	180.6	90.3
Unnamed Trib 4	3000-3200	507	80	126.2	100	20.0	NS	17.0	59.0	71.2
Unnamed Trib 4	3200-3400	3,395	80	120.0	100	20.0	NESW	17.5	64.1	72.7
Unnamed Trib 4	3400-3600	2,466	80	113.8	100	20.0	NESW	17.5	64.1	72.7
Unnamed Trib 4	3600-3800	1,748	80	107.7	100	20.0	NESW	17.5	64.1	72.7
Unnamed Trib 4	3800-4000	1,441	80	101.5	100	20.0	NESW	17.5	64.1	72.7
Unnamed Trib 5	3000-3200	1,024	70	126.2	100	30.0	NS	17.0	80.0	78.8
Unnamed Trib 5	3200-3400	1,162	70	120.0	100	30.0	NS	17.0	80.0	78.8
Unnamed Trib 5	3400-3600	2,777	80	113.8	100	20.0	NESW	17.5	64.1	72.7
Unnamed Trib 5	3600-3800	1,167	80	107.7	100	20.0	NS	17.0	59.0	71.2

c) Emerald Creek

Stream Segment	Elevation Range (ft)	Stream Segment length (ft)	Existing Canopy Cover Range (%)	CWE Target Canopy Cover (%)	Adjusted Target Canopy Cover (%)	Canopy Increase to meet target (%)	Stream Orientation	Target Heat Load (watts/ sq m)	Current Heat Load (watts/sq m)	Target Heat Load Reduction (%)
Emerald Ck.	2600-2800	23,823	15	138.5	100	85.0	NS	17.0	195.5	91.3
Emerald Ck.	2800-3000	602	15	132.3	100	85.0	EW	18.0	235.6	92.4
Emerald Ck.	2800-3000	21,965	15	132.3	100	85.0	EW	18.0	235.6	92.4
Emerald Ck.	2800-3000	3,485	85	132.3	100	15.0	EW	18.0	56.4	68.1
Emerald Ck.	3000-3200	3,992	85	126.2	100	15.0	NESW	17.5	52.5	66.6
Emerald Ck.	3200-3400	3,437	85	120.0	100	15.0	NESW	17.5	52.5	66.6
Emerald Ck.	3200-3400	4,990	20	120.0	100	80.0	NESW	17.5	203.9	91.4
Emerald Ck.	3400-3600	6,769	20	113.8	100	80.0	EW	18.0	222.8	91.9
Emerald Ck.	3600-3800	1,299	20	107.7	100	80.0	NWSE	17.5	203.9	91.4
Emerald Ck.	2600-2800	972	15	138.5	100	85.0	NS	17.0	195.5	91.3
Emerald Ck.	2800-3000	16,732	15	132.3	100	85.0	NESW	17.5	215.6	91.9
Emerald Ck.	2800-3000	15,602	20	132.3	100	80.0	NESW	17.5	203.9	91.4
Emerald Ck.	3000-3200	8,796	75	126.2	100	25.0	EW	18.0	82.0	78.0
Emerald Ck.	3200-3400	3,136	70	120.0	100	30.0	EW	18.0	94.8	81.0
Emerald Ck.	3400-3600	1,067	70	113.8	100	30.0	NESW	17.5	87.4	80.0
Emerald Ck.	3400-3600	3,960	75	113.8	100	25.0	NESW	17.5	75.8	76.9

d) Santa and Charlie Creeks, including tributaries

Stream Segment	Elevation Range (ft)	Stream Segment length (ft)	Existing Canopy Cover Range (%)	CWE Target Canopy Cover (%)	Adjusted Target Canopy Cover (%)	Canopy Increase to meet target (%)	Stream Orientation	Target Heat Load (watts/ sq m)	Current Heat Load (watts/sq m)	Target Heat Load Reduction (%)
Santa Creek	2400-2600	1,610	15	144.7	100	85.0	NS	17.0	195.5	91.3
Santa Creek	2600-2800	39,088	15	138.5	100	85.0	NESW	17.5	215.6	91.9
Santa Creek	2600-2800	2,635	15	138.5	100	85.0	EW	18.0	235.6	92.4
Santa Creek	2800-3000	4,858	15	132.3	100	85.0	NESW	17.5	215.6	91.9
Santa Creek	2600-2800	1,827	70	138.5	100	30.0	NS	17.0	80.0	78.8
Santa Creek	2800-3000	1,642	70	132.3	100	30.0	NS	17.0	80.0	78.8
Unnamed Trib 1	2600-2800	591	20	138.5	100	80.0	NWSE	17.5	203.9	91.4
Unnamed Trib 1	2800-3000	2,629	20	132.3	100	80.0	NWSE	17.5	203.9	91.4
Unnamed Trib 1	2800-3000	2,550	20	132.3	100	80.0	NWSE	17.5	203.9	91.4
Peterson Ck.	2600-2800	480	20	138.5	100	80.0	NESW	17.5	203.9	91.4
Peterson Ck.	2800-3000	4,884	20	132.3	100	80.0	NS	17.0	185.0	90.8
Peterson Ck.	3000-3200	4,171	15	126.2	100	85.0	NS	17.0	195.5	91.3
Peterson Ck.	3200-3400	1,061	45	120.0	100	55.0	NWSE	17.5	145.7	88.0
Unnamed Trib 2	2600-2800	861	20	138.5	100	80.0	NS	17.0	185.0	90.8
Unnamed Trib 2	2800-3000	7,540	20	132.3	100	80.0	NWSE	17.5	203.9	91.4
Santa Ck.	2800-3000	24,642	15	132.3	100	85.0	EW	18.0	235.6	92.4
Santa Ck.	2800-3000	9,884	50	132.3	100	50.0	EW	18.0	146.0	87.7
Santa Ck.	3000-3200	1,251	50	126.2	100	50.0	EW	18.0	146.0	87.7
Deep Ck.	2800-3000	2,043	15	132.3	100	85.0	NWSE	17.5	215.6	91.9
Deep Ck.	2800-3000	5,349	70	132.3	100	30.0	NS	17.0	80.0	78.8
Ramskill Ck.	2800-3000	4,694	20	132.3	100	80.0	NESW	17.5	203.9	91.4
Ramskill Ck.	2800-3000	7,635	45	132.3	100	55.0	NS	17.0	132.5	87.2
Willow Ck.	2800-3000	7,846	75	132.3	100	25.0	EW	18.0	82.0	78.0
Santa Ck.	3000-3200	1,399	85	126.2	100	15.0	EW	18.0	56.4	68.1
Santa Ck.	2800-3000	4,256	75	132.3	100	25.0	NESW	17.5	75.8	76.9
Santa Ck.	3000-3200	338	75	126.2	100	25.0	NWSE	17.5	75.8	76.9
Santa Ck.	3000-3200	4,609	80	126.2	100	20.0	NESW	17.5	64.1	72.7
SF Santa Ck.	3200-3400	2,302	95	120.0	100	5.0	NESW	17.5	29.2	40.0
Santa Ck.	2800-3000	4,018	75	132.3	100	25.0	NESW	17.5	75.8	76.9
Santa Ck.	3000-3200	1,690	75	126.2	100	25.0	EW	18.0	82.0	78.0
Bob Ck.	2800-3000	5,919	70	132.3	100	30.0	EW	18.0	94.8	81.0
Charlie Ck.	2800-3000	16,199	40	132.3	100	60.0	NS	17.0	143.0	88.1
Charlie Ck.	2800-3000	8,237	70	132.3	100	30.0	NWSE	17.5	87.4	80.0

Table 31-d, continued.

Charlie Ck.	3000-3200	10,365	40	126.2	100	60.0	NWSE	17.5	157.3	88.9
Charlie Ck.	3200-3400	4,071	40	120.0	100	60.0	NWSE	17.5	157.3	88.9
Ellis Ck.	3400-3600	7,191	30	113.8	100	70.0	NS	17.0	164.0	89.6
Ellis Ck.	3000-3200	2,365	80	126.2	100	20.0	NWSE	17.5	64.1	72.7
Charlie Ck.	3200-3400	1,737	95	120.0	100	5.0	NWSE	17.5	29.2	40.0
Hume Ck.	2800-3000	6,985	15	132.3	100	100.0	NESW	17.5	250.5	93.0
Hume Ck.	3000-3200	5,370	15	126.2	100	100.0	NESW	17.5	250.5	93.0
Charlie Ck.	2800-3000	4,171	40	132.3	100	60.0	NESW	17.5	157.3	88.9
Preston Ck.	3000-3200	4,240	80	126.2	100	20.0	NS	17.0	59.0	71.2
Preston Ck.	3200-3400	2,703	95	120.0	100	5.0	NS	17.0	27.5	38.2
Preston Ck.	3400-3600	644	95	113.8	100	5.0	NS	17.0	27.5	38.2
Unnamed Trib 1	3000-3200	5,016	65	126.2	100	35.0	NESW	17.5	99.1	82.3
Unnamed Trib 2	3000-3200	3,379	70	126.2	100	30.0	NWSE	17.5	87.4	80.0
Unnamed Trib 2	3200-3400	3,786	80	120.0	100	20.0	NESW	17.5	64.1	72.7
Fagen Ck.	3000-3200	4,319	95	126.2	100	5.0	NWSE	17.5	29.2	40.0
Fagen Ck.	3200-3400	549	95	120.0	100	5.0	NS	17.0	27.5	38.2
Fagen Ck.	3200-3400	2,302	95	120.0	100	5.0	NWSE	17.5	29.2	40.0
Moolock Ck.	3000-3200	3,189	80	126.2	100	20.0	NESW	17.5	64.1	72.7
Moolock Ck.	3200-3400	1,510	95	120.0	100	5.0	NS	17.0	27.5	38.2

e) St. Maries River

Stream Segment	Elevation Range (ft)	Stream Segment length (ft)	Existing Canopy Cover Range (%)	CWE Target Canopy Cover (%)	Adjusted Target Canopy Cover (%)	Canopy Increase to meet target (%)	Stream Orientation	Target Heat Load (watts/ sq m)	Current Heat Load (watts/sq m)	Target Heat Load Reduction (%)
St. Maries River	2800-3000	11,051	40	132.3	100	60.0	NWSE	17.5	157.3	88.9
St. Maries River	2600-2800	38,312	40	138.5	100	60.0	NWSE	17.5	157.3	88.9
St. Maries River	2600-2800	27,181	15	138.5	100[1]	85.0	NWSE	17.5	215.6	91.9
St. Maries River	2400-2600	18,987	15	144.7	100[1]	85.0	NWSE	17.5	215.6	91.9
St. Maries River	2600-2800	75,942	15	138.5	100[1]	85.0	NWSE	17.5	215.6	91.9
St. Maries River	2400-2600	18,100	20	144.7	100[1]	80.0	NWSE	17.5	203.9	91.4
St. Maries River	2400-2600	68,513	40	144.7	100[1]	60.0	NWSE	17.5	157.3	88.9
St. Maries River	2200-2400	17,223	40	150.9	100[1]	60.0	EW	18.0	171.6	89.5
St. Maries River	2200-2400	15,101	40	150.9	100[1]	60.0	NWSE	17.5	157.3	88.9
St. Maries River	2200-2400	8,464	15	150.9	100[1]	85.0	NS	17.0	195.5	91.3
St. Maries River	2000-2200	138,595	15	157.0	100[1]	85.0	NESW	17.5	215.6	91.9

[1]Interim target canopy cover; physical habitat limitations in these segments make it unlikely that current target levels will be reached. Final target canopy cover to be determined during the implementation phase.

Remaining Available Load

The remaining load is allocated to segments of the watershed based on canopy requirements. The elevation range of the stream segments is used to develop the target canopy cover using the CWE temperature relationship (Tables 31a-e). These targets are in many cases greater than 100% because the St. Maries watershed exceeds 4,000 feet elevation in only its upper stream reaches. These target values were revised to 100% canopy cover. Segments over 4,000 feet require less than 100% canopy cover. The required canopy is subtracted from 100% and the existing amount of canopy cover restoration required is calculated. Using the SSTEMP model outputs for canopy cover and stream orientation, the target heat load capacity was calculated for each segment. Based on current canopy cover and the SSTEMP model outputs for percentage canopy cover, current heat loading is estimated. Subtraction and division provide the target heat load reduction required for each segment. The level of canopy cover currently present is provided in Figures 8a-c. The target canopy cover for all segments is provided in Figures 9a-c.

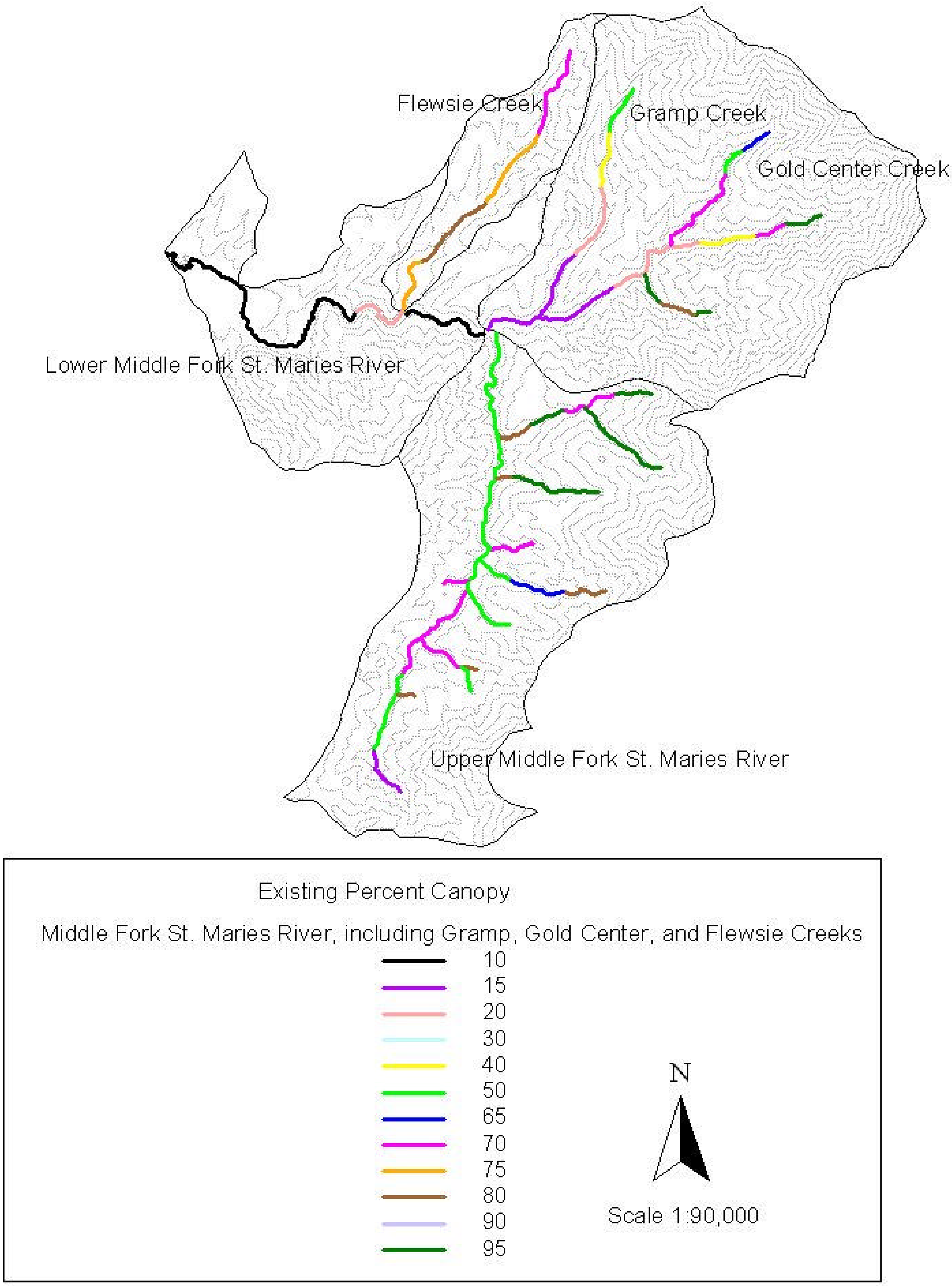

Figure 8-a. Existing Shade Canopy: Middle Fork of the St. Maries River Including Gramp, Gold Center, and Flewsie Creeks

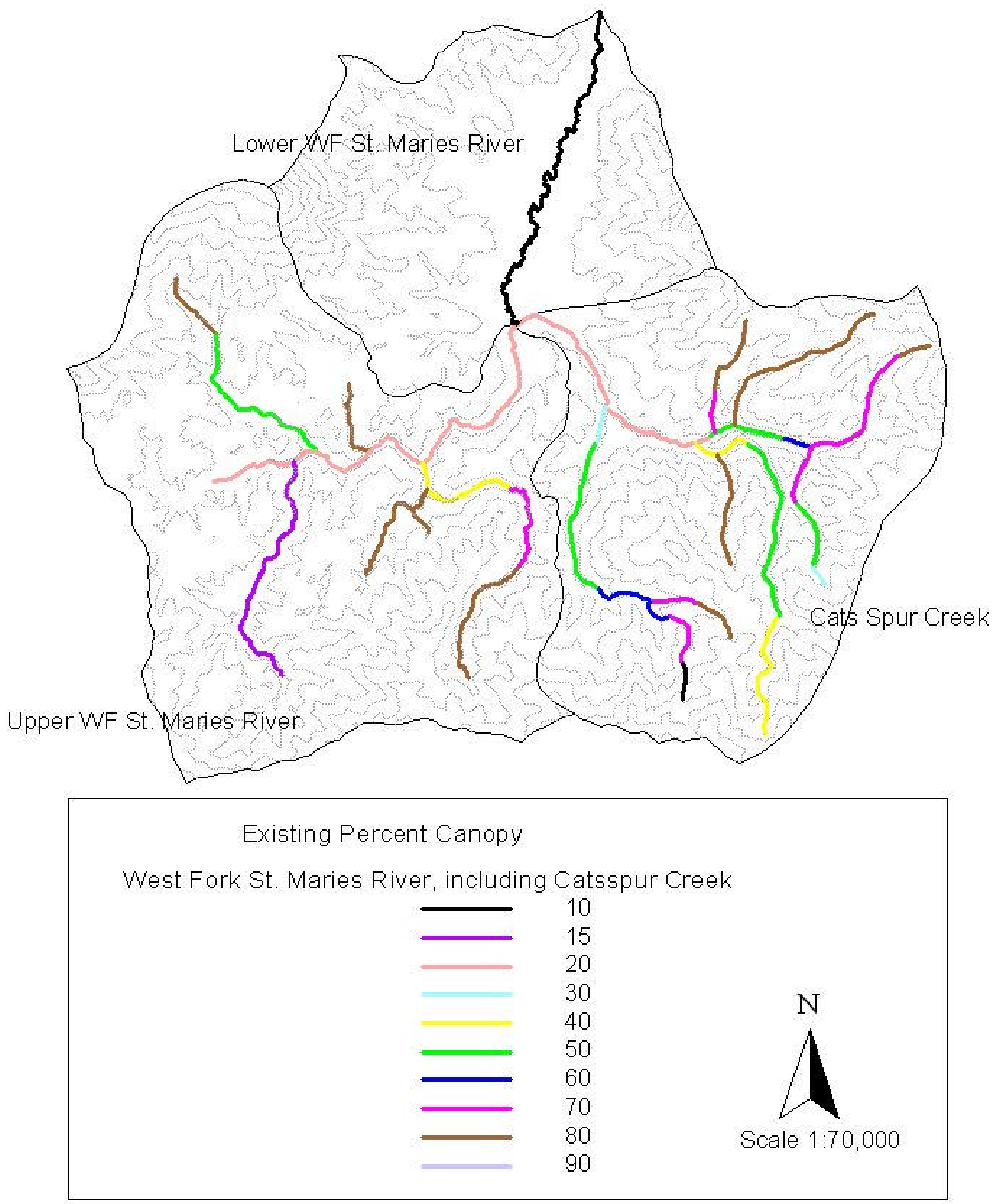

Figure 8-b. Existing Shade Canopy: West Fork of the St. Maries River Including its Tributary, Cats Spur Creek

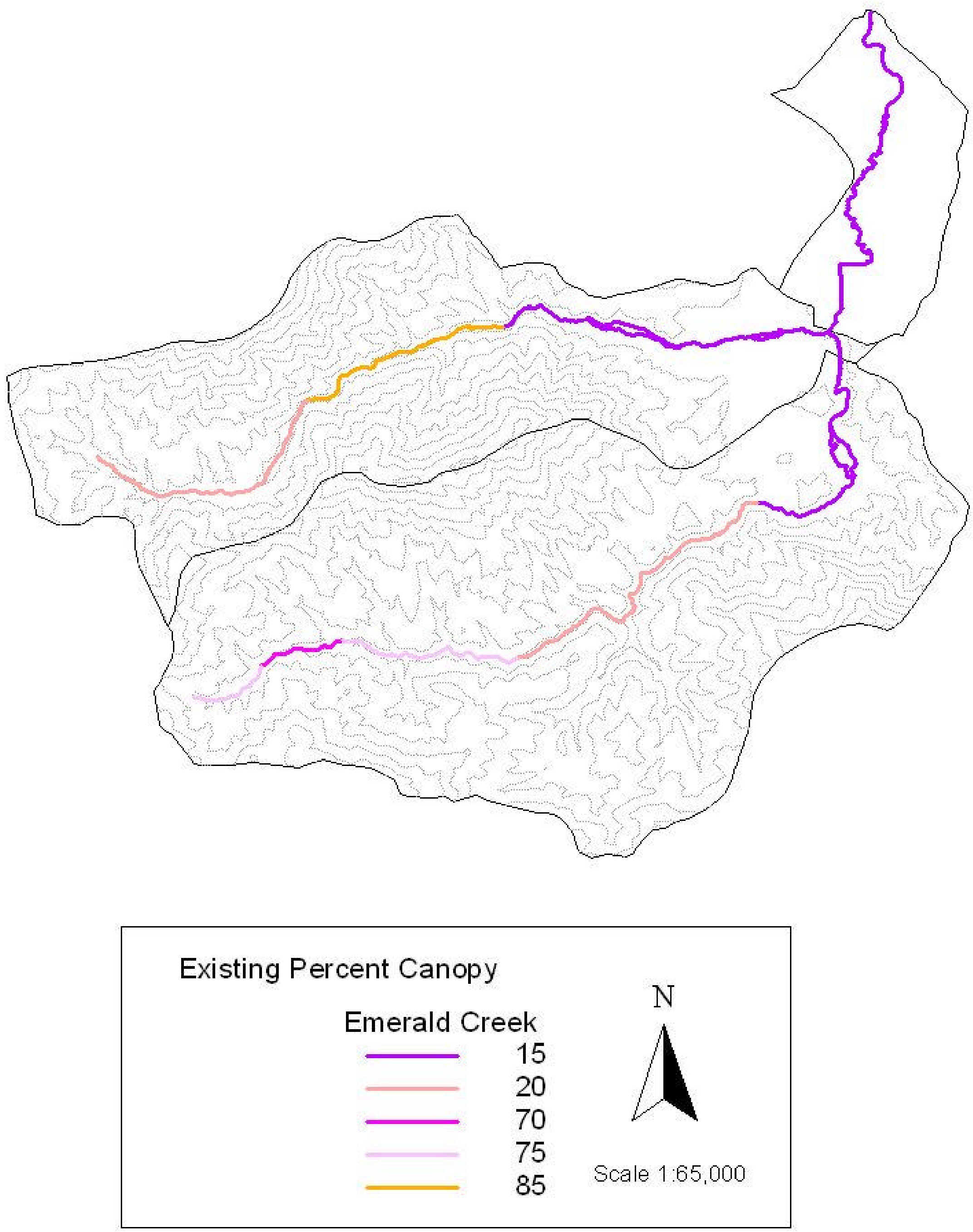

Figure 8-c. Existing Shade Canopy: Emerald Creek

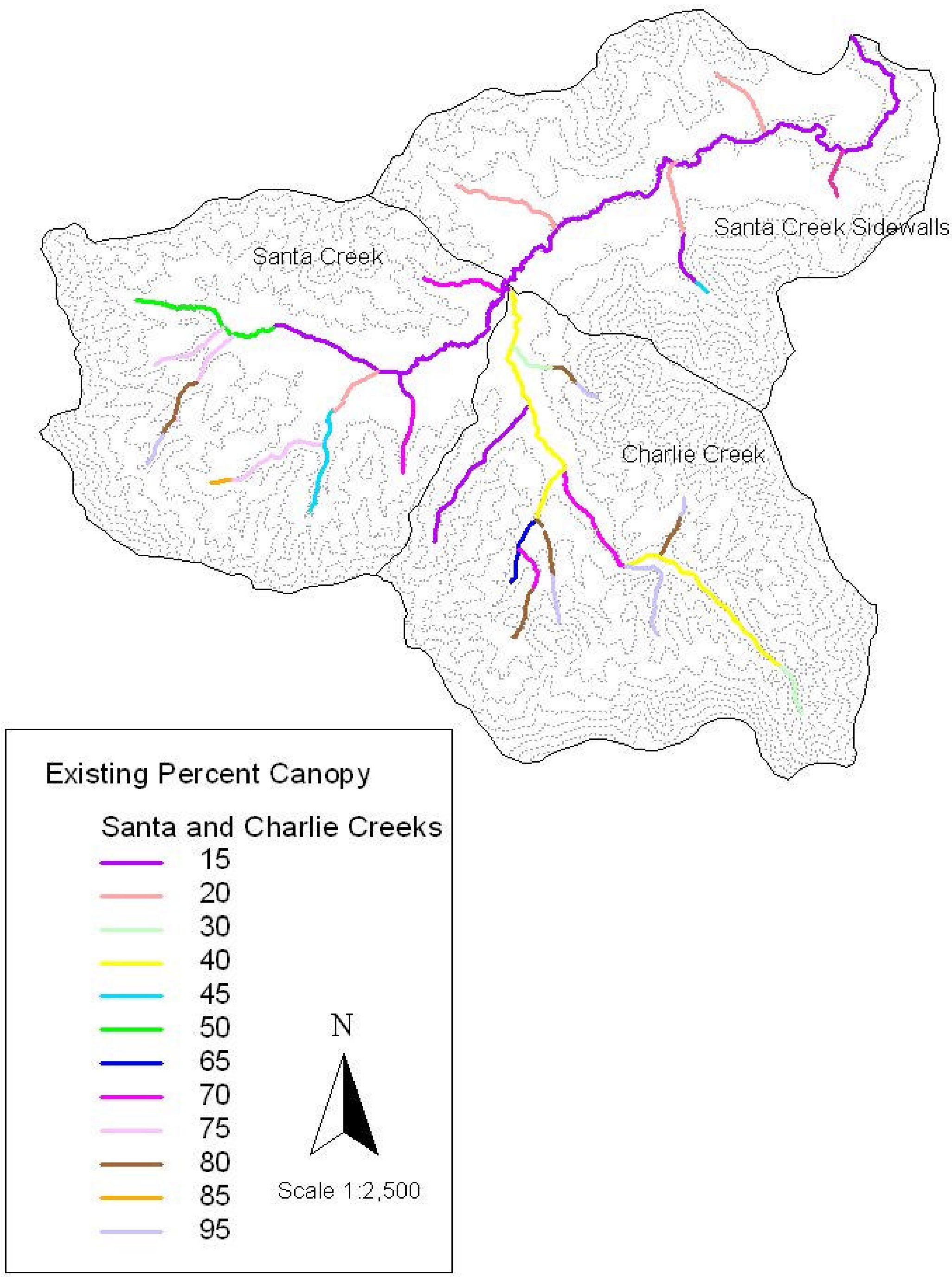

Figure 8-d. Existing Shade Canopy: Santa Creek Including its Tributary, Charlie Creek

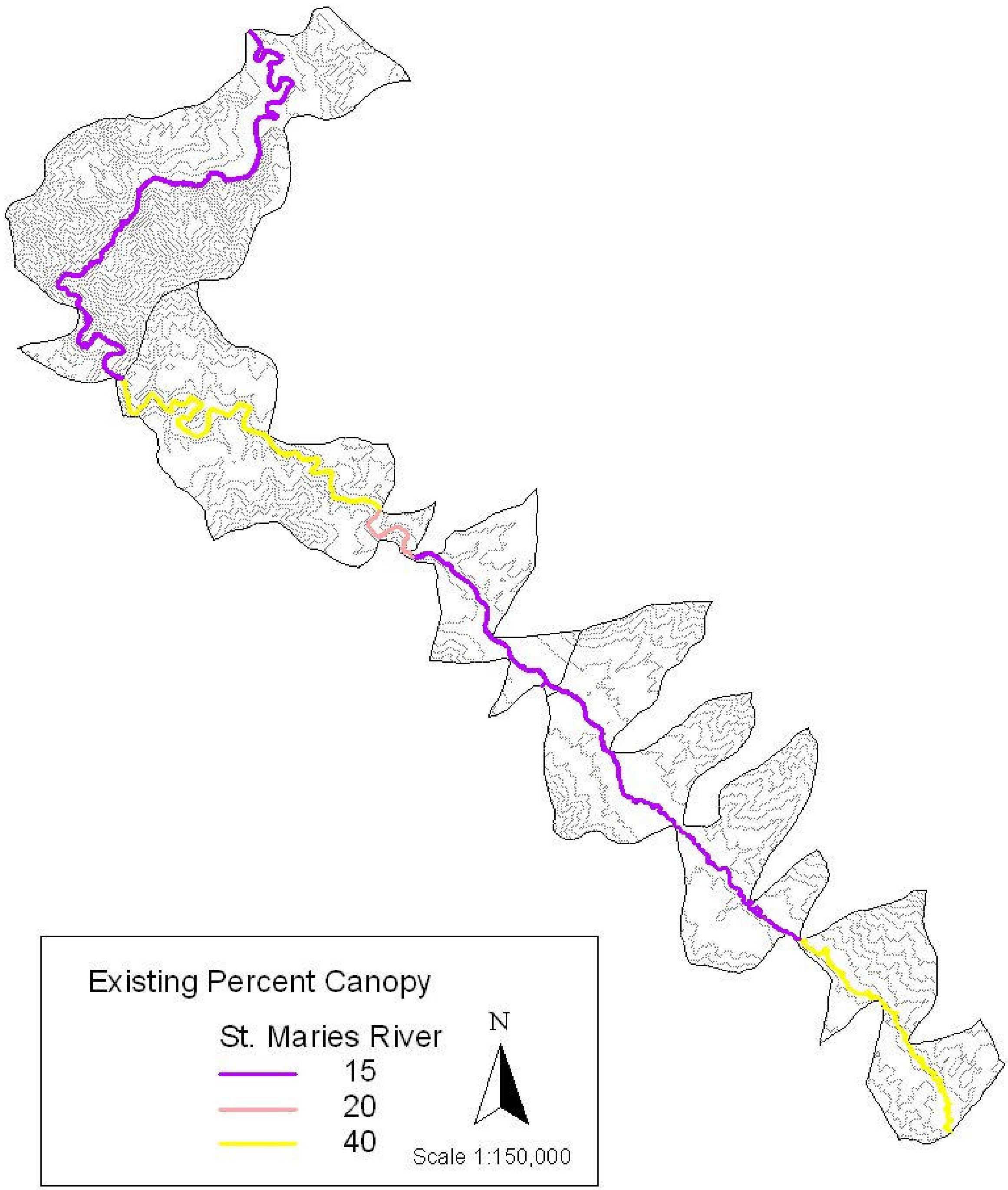

Figure 8-e. Existing Shade Canopy: St. Maries River

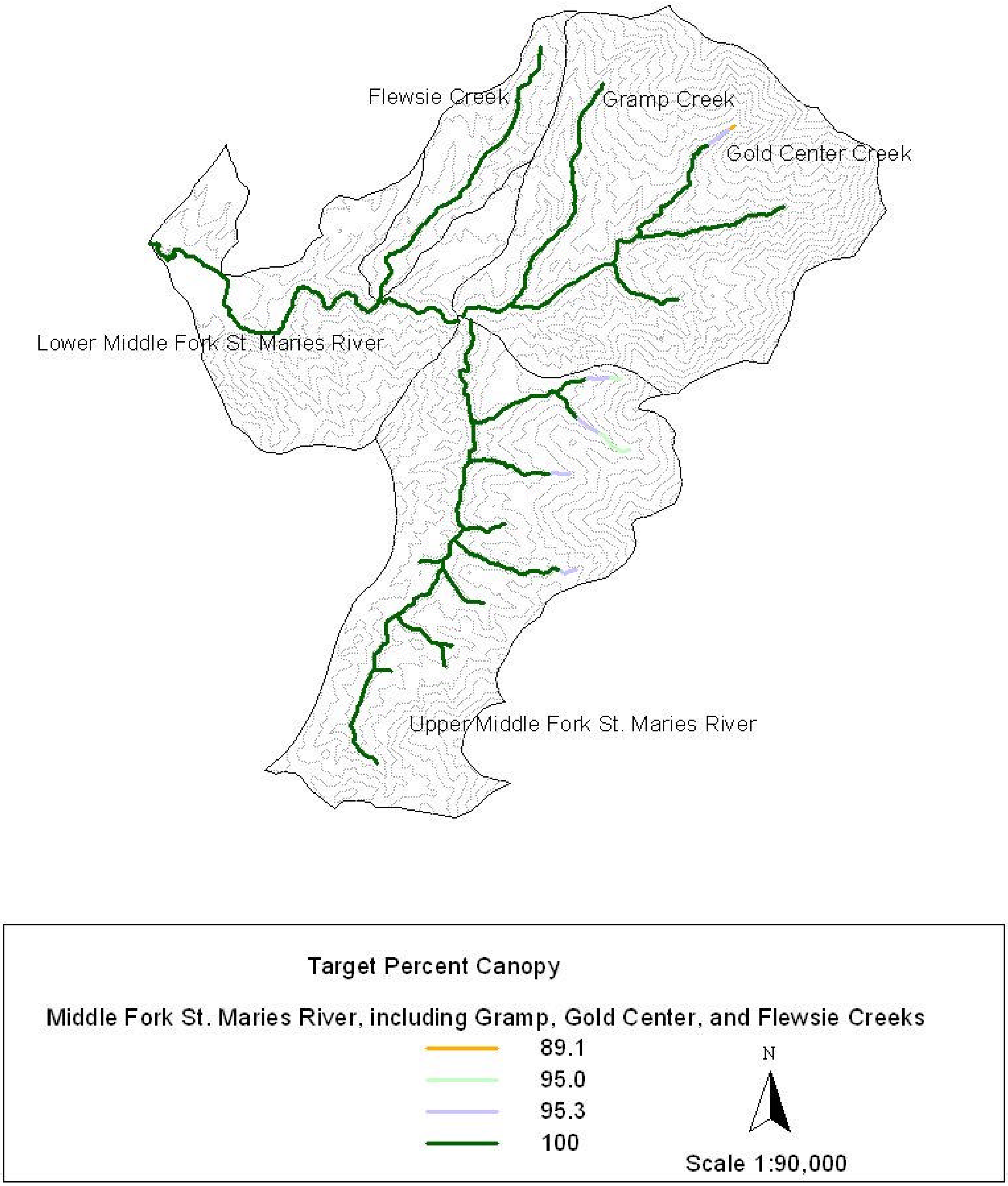

Figure 9-a. Target Shade Canopy: Middle Fork of the St. Maries River Including the Tributaries: Gramp, Gold Center and Flewsie Creeks

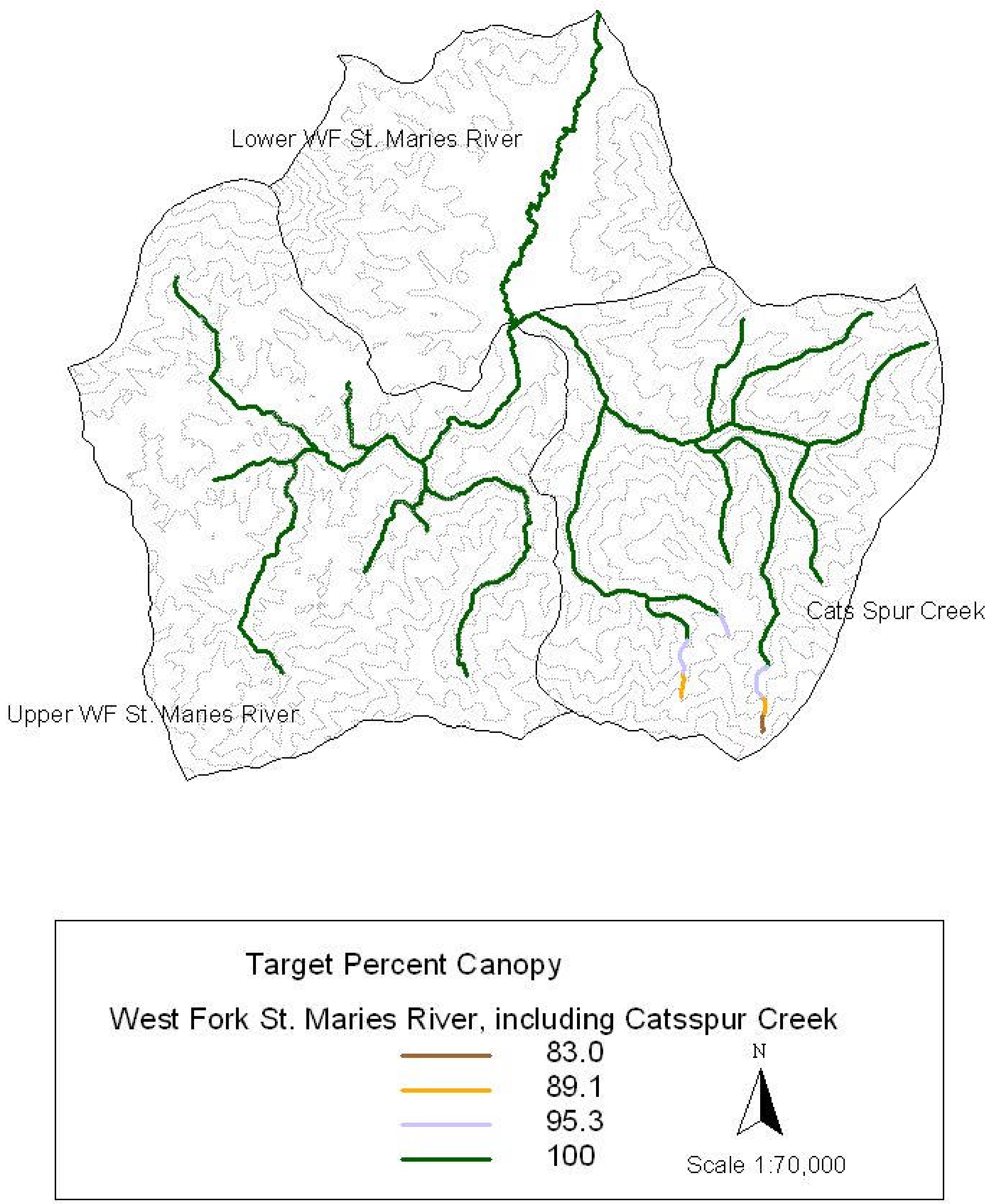

Figure 9-b. Target Shade Canopy: West Fork St. Maries River Including its Tributary, Cats Spur Creek

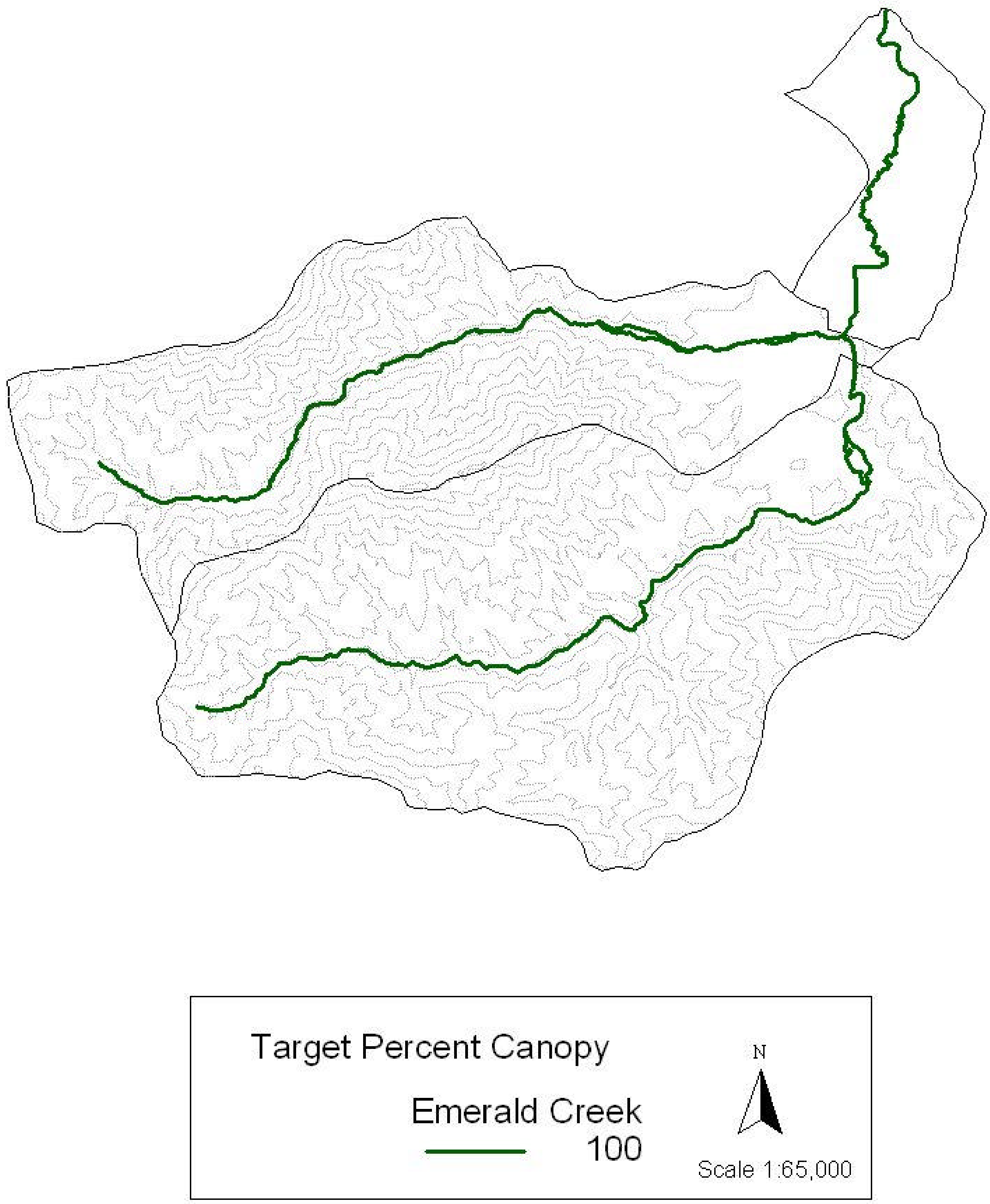

Figure 9-c. Target Shade Canopy: Emerald Creek

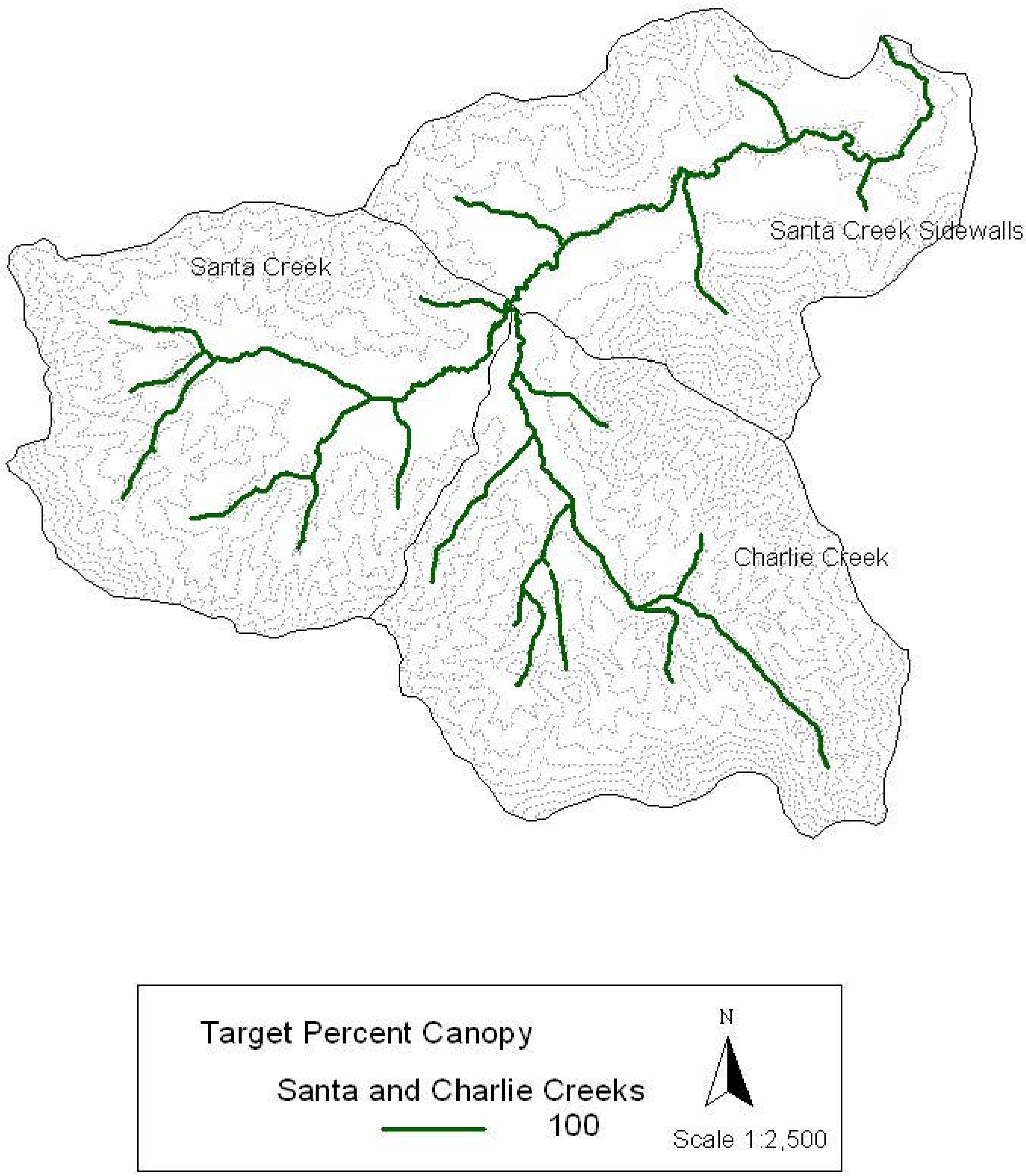

Figure 9-d. Target Shade Canopy: Santa Creek Including its Tributary, Charlie Creek

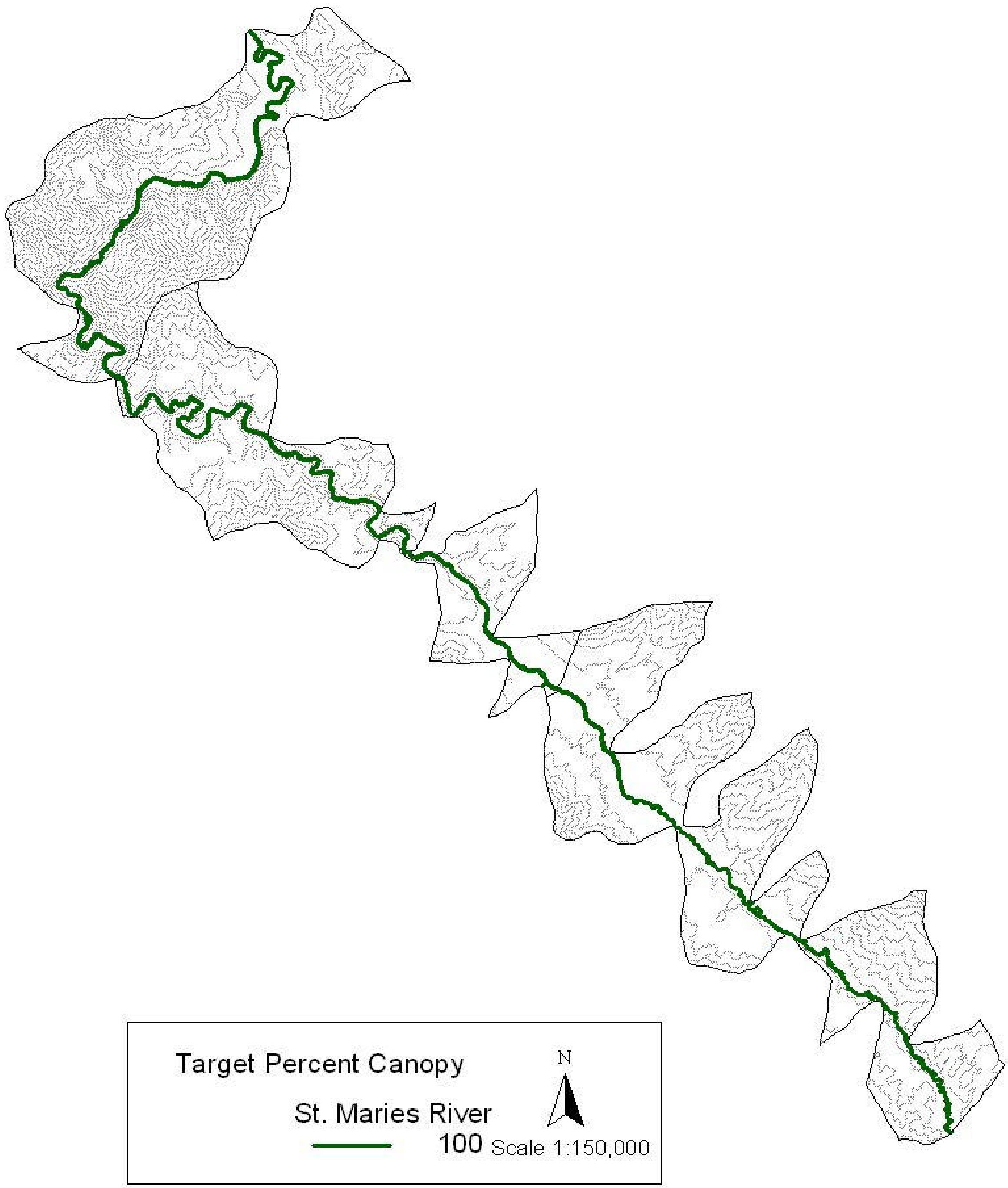

Figure 9-e. Target Shade Canopy: St. Maries River

Monitoring Provisions

Temperature will be monitored with continuous recorders in streams after the canopy has reached 70% of its potential in a given stream. Temperature recorders will be placed in representative locations on third order reaches of the streams as near as feasible to the points of compliance. Temperature data developed will be compared with the current temperature standards to assess temperature standard exceedences. Biomonitoring of macroinvertebrates and fish will be completed to assess the status of the cold water aquatic life.

Feedback Provisions

When temperatures meet the standard or natural background level, further canopy-increasing activities will not be required in the watershed. Best management practices will be prescribed by the revised TMDL with provisions to maintain and protect canopy cover of the streams. Regular monitoring of the beneficial use will be continued for an appropriate period to document maintenance of the full support of the use (cold water).

5.2.5 Conclusions

The St. Maries River Subbasin is not in the St. Joe bull trout recovery area where the federal temperature standard of 10 ^{o}C MWMT applies. However, continuous temperature monitoring in tributaries of the St. Maries River demonstrates that the salmonid spawning standard is violated for significant periods of the critical season. A temperature TMDL based on the CWE relationship between canopy cover, elevation, and direct insolation input to the streams was developed. The watershed topography is between 2,200 and 5,800 feet elevation. The shade requirement between 2,400 and 4,000 feet is 100% or full potential shade. Lesser amounts of shade are progressively necessary above 4,000 feet. Figures 8a-e provide the current level of canopy cover provided the streams, while Figures 9a-e depict the canopy cover required. The St. Maries River below the Emerald Creek confluence is sufficiently broad that only 30% shading is possible, except in a 19 mile stretch, where 40% shading is possible (Figure 9-e).

5.3 Implementation Strategies

DEQ and designated lead agencies responsible for TMDL implementation will make every effort to address past, present, and future pollution problems in an attempt to link them to watershed characteristics and management practices designed to improve water quality and restore the beneficial uses of the water body. Any and all solutions to help restore beneficial uses of a stream will be considered as part of a TMDL implementation plan in an effort to make the process as effective and cost efficient as possible. Using additional information collected during the implementation phase of the TMDL, DEQ and the designated agencies will continue to evaluate suspect sources of impairment and develop management actions appropriate to deal with these issues.

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

For sediment TMDLs, 30 years have been allotted for meeting load allocations. This time frame will permit two or three large channel forming events to occur in the stream.

Primary TMDL monitoring of temperature TMDLs will be with aerial photograph interpretation of canopy recovery over the streams. Aerial photography is repeated by the USFS on a 10-year time frame. This time frame will allow a sufficient period to assess canopy recovery. In addition, a set number of representative sites should be assessed on a periodic basis using canopy densiometer methodology to ground truth and calibrate the aerial photograph interpretation.

Approach

TMDLs will be implemented through continuation of ongoing pollution control activities in the subbasin. The designated agencies, WAG, and other appropriate public process participants are expected to:

-- Develop BMPs to achieve load allocations
-- Give reasonable assurance that management measures will meet load allocations through both quantitative and qualitative analysis of management measures
-- Adhere to measurable milestones for progress
-- Develop a timeline for implementation, with reference to costs and funding
-- Develop a monitoring plan to determine if BMPs are being implemented, if individual BMPs are effective, if load allocations and waste load allocations are being met, and whether or not water quality standards are being met

The designated agencies will recommend specific control actions and will then submit the implementation plan to DEQ. DEQ will act as a repository for approved implementation plans.

Responsible Parties

Development of the final implementation plan for the St. Joe River TMDL will proceed under the existing practice established for the state of Idaho. The plan will be cooperatively developed by DEQ, the St. Joe WAG, the affected private landowners, and other “designated agencies” with input from the established public process. Of the three entities, the WAG will act as the integral part of the implementation planning process to identify appropriate implementation measures. In addition to the designated agencies, the public, through the WAG and other equivalent processes, will be provided with opportunities to be involved in developing the implementation plan to the maximum extent practical.

Monitoring Strategy

In-stream monitoring of the beneficial uses (cold water and salmonid spawning) support status during and after implementation of sediment abatement projects will establish the final sediment load reduction required by the TMDL. In-stream monitoring, which will determine if the threshold values have been met, will be completed every year on randomly selected sites on each stream order in the subbasin after 70% of the plan has been implemented. Monitoring will be conducted using the DEQ-approved monitoring procedure at the time of sampling. Identical measurements will be made in appropriate reference streams where beneficial uses are supported.

Temperature will be monitored on the streams with continuous recorders after the canopy has reached 70% of its potential. Temperature recorders will be placed in representative locations on third order reaches of the streams as near as feasible to the points of compliance. Temperature data developed will be compared with the current temperature standards to assess temperature standard exceedences. Biomonitoring of macroinvertebrates and fish will be completed to assess the status of the cold water aquatic life.

5.4 Conclusion

Two TMDLs were developed for streams in the St. Maries River Subbasin. The TMDLs addressed sediment and temperature only, as no other pollutants were found to be limiting the support of beneficial uses in the subbasin.

DEQ recommends that Gramp Creek be delisted for bacteria and that Santa Creek be delisted for dissolved oxygen limitation.

None of the streams in the subbasin were found to be impaired by excess nutrients. As such, it is recommended that the St. Maries River and Thorn, Alder, and Santa Creeks be delisted for excess nutrients.

Sediment modeling and WBAGII score analysis revealed that the St. Maries River, including the West and Middle Forks, and Alder, John, Charlie, Santa, Tyson, Carpenter, Emerald, Renfro, Thorn, and Crystal Creeks are impaired by sediment. A single sediment TMDL was written for the entire subbasin. Gold Center, Flewsie, and Gramp Creeks were not found to be impaired by sediment. It is recommended that they be delisted for this pollutant.

A temperature TMDL was developed for the St. Maries River, including the West and Middle Forks, and Santa, Emerald, Gold Center, Flewsie, and Gramp Creeks.

Conditions in all of the water bodies listed above will be monitored on an ongoing basis. This will ensure that beneficial uses currently supported remain that way and that water bodies not in full support of their beneficial uses are making progress through the implementation process.

References Cited

33 USC § 1251-1387. Federal Water Pollution Control Act (Clean Water Act).

40 CFR 130. Water Quality Planning and Management.

Armantrout, N.B. (compiler). 1998. Glossary of Aquatic Habitat Inventory Terminology. American Fisheries Society, Bethesda, MD. 136 pp.

Bartholow, J. 1997. Stream Segment Temperature Model (SSTEMP) Version 3.9 Program and Documentation Revised September 1997. Temperature Model Technical Note #2. USGS River Systems Management Section, Midcontinent Ecological Science Center, Fort Collins, CO. 14 pp.

Batt, P. E. 1996. Governor Philip E. Batt's Idaho Bull Trout Conservation Plan. State of Idaho, Office of the Governor, Boise, ID. 20 pp. + appendices.

Beschta, R.L. and J. Weatherred. 1984. A Computer Model for Predicting Stream Temperatures Resulting from Management of Streamside Vegetation. Report WSDG-AD-00009. USDA Forest Service.

Boyd, M.S. 1996. Heat Source: Stream Temperature Prediction. Master's Thesis. Department of Civil and Bioresource Engineering, Oregon State University, Corvallis OR.

Brown, G.W. 1971. Water Temperature in Small Streams as Influenced by Environmental Factors and Logging. Proceedings of Synposium for Land Uses and Stream Environment. Oregon State University, Oct 19-21, 1970. 175-181 pp.

Dechert, T., K. Baker, and J. Cardwell. 2001. Upper North Fork Clearwater Temperature TMDL. Idaho Department of Environmental Quality, Lewiston Regional Office.

DEQ. 1989. Technical Review of Sediment Criteria. Idaho Department of Health and Welfare, Division of Environmental Quality, Boise, ID. 29 pp.

DEQ. 1998. 1998 303(d) List. Idaho Division of Environmental Quality, Boise, Idaho. 138 pp.

DEQ. 2000. Idaho Water Quality Standards and Wastewater Treatment Requirements. Idaho Department of Environmental Quality, Boise, ID. 157 pp.

DEQ. 2001. North Fork Coeur d'Alene River Subbasin Assessment. Idaho Department of Environmental Quality, Coeur d'Alene Regional Office. 51 pp.

DuPont, J. 2002. Personal Communication. Bull Char Temperature Requirements.

Elliot, W.J. and P.R. Robichaud. 2001. Comparing Erosion Risks from Forest Operations to Wildfire. USFS, Rocky Mountain Research Station, Moscow, ID. 12 pp.

EPA. 1999. Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers. EPA 841-B-99-002. U. S. Environmental Protection Agency, Office of Water, Washington, DC.

EPA. 1996. Biological Criteria: Technical Guidance for Streams and Small Rivers. EPA 822-B-96-001. U. S. Environmental Protection Agency, Office of Water, Washington, DC. 162 pp.

Grafe, C.S., C.A. Mebane, M.J. McEntyre, D.A. Essig, D.H. Brandt, D.T. Mosier. 2002. The Idaho Department of Environmental Quality Waterbody Assessment Guidance, Second Edition. Department of Environmental Quality, Boise, ID. 114 pp.

Greenborg, A.E., L.S. Clescevi, and A.D. Eaton, editors. 1992. Standard Methods for the Examination of Water and Wastewater, 18th Edition. American Public Health Association, Washington, D.C. 900pp.

Hughes, R.M. 1995. Defining Acceptable Biological Status by Comparing with Reference Condition. *In*: Davis W.S. and T.P. Simon (editors). Biological Assessment and Criteria: Tools for Water Resource Planning. CRC Press, Boca Raton, FL. 31-48 pp.

IDAPA 58.01.02. Idaho Water Quality Standards and Wastewater Treatment Requirements.

Inside Idaho. 2002. URL: http://www.insideidaho.org/.

Panhandle Bull Trout Technical Advisory Team. 1998. Coeur d'Alene Lake Basin Bull Trout Problem Assessment. Department of Environmental Quality, Coeur d'Alene Regional Office, Coeur d'Alene, ID. 70 pp.

Patten, R. 2002. Personal Communication. Restoration actions taken by the U.S. Forest Service in the St. Maries River.

Public Law 92-500. Federal Water Pollution Control Act (Clean Water Act).

Public Law 100-4. Water Quality Act of 1987.

Rand, G.W. (editor). 1995. Fundamentals of Aquatic Toxicology: Effects, Environmental Fate, and Risk Assessment. Second edition. Taylor and Francis, Washington, DC. 1125 pp.

Renard, K.G., Foster, G.R., Weesies, G.A., McCool, D.K., and Yoder, D.C. 1997. Predicting soil erosion by water: a guide to conservation planning with the revised universal soil loss equation (RUSLE). U.S. Department of Agriculture. 384 pp.

Rothrock, G. 2001. Priest River Subbasin Assessment and Total Maximum Daily Load. Idaho Department of Environmental Quality, Boise, ID. 218 pp.

Rosgen, D.L. 1985. A Stream Channel Classification System. In: Riparian Ecosystems and their Management Reconciling Conflicting Uses. USDA-Forest Service, General Technical Report RM-120.

Russell, B. 1979. Swiftwater People. Lacon Publishers, Harrison, ID. 407 pp.

Sullivan, K. and T.N. Adams. 1990. The Physics of Forest Stream Heating: An Analysis of Temperature Patterns in Stream Environments Based on Physical Principles and Field Data. Report 044-5002/90/1. Weyerhaeuser Tech. Weyerhaeuser Co., Tacoma, WA. 50+ pp.

Theurer, F.D., K.A. Voos, and W.J. Miller. 1984. Instream Water Temperature Model. Instream Flow Information Paper No. 16. Report FWS/OBS-84/15. U.S. Department of Interior, Fish and Wildlife Service.

U.S. Department of Agriculture. 1994. State Soil Geographic (STATSGO) database for Idaho. U.S. Department of Agriculture, Fort Worth, Texas.

URS Greiner. 2001. Coeur d'Alene River Basin Remedial Investigation/Feasibility Study. CSM Unit-2 mid-gradient watersheds North Fork Coeur d'Alene River, section 3 sediment fate and transport. URS Corp, Seattle, WA. Final Remedial Investigation Report.

USGS. 1996-2000. Water Resources Data Idaho Water Year 1994-99. Water Data Report ID-94-99-2. U.S. Geological Survey, Boise, ID.

USGS. 1997. Water Resources Data Idaho Water Year 1996. U.S. Geological Survey, Boise, ID. Water Data Report ID-96-2. 67 pp.

USGS. 1987. Hydrologic Unit Maps. United States Geological Survey Water-Supply Paper 2294. U.S. Geological Survey, Denver, CO. 63 pp.

Water Pollution Control Federation. 1987. The Clean Water Act of 1987. Water Pollution Control Federation, Alexandria, VA. 306 pp.

Washington Forest Practices Board. 1995. Board Manual: Standard Methodology for Conducting Watershed Analysis Under Chapter 222-22 WAC Version 3.0.

GIS Coverages: IDL GIS Database. IDL, Northern Idaho Office, Coeur d'Alene, ID.

county.shp	owner.shp	state.shp	IPNF Roads	HUCadmin.shp	nwstates.shp	STATSGO	citybnd.shp
IPNF Fires	panstrm.shp	gage.shp	npdes.shp	wqlstr.shp	lanuse.shp	realtime.shp	

Other Related Documents: DEQ. 2002. St. Joe River Subbasin Assessment and TMDLs. Idaho Department of Environmental Quality, Boise, ID.

Glossary

305(b)	Refers to section 305 subsection "b" of the Clean Water Act. 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.
Ambient	General conditions in the environment. 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 (Armantrout 1998, EPA 1996).
Aquatic	Occurring, growing, or living in water.
Assemblage (aquatic)	An association of interacting populations of organisms in a given waterbody; for example, a fish assemblage, or a benthic macroinvertebrate assemblage (also see Community) (EPA 1996).
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.
Best Management Practices (BMPs)	Structural, nonstructural, and managerial techniques that are effective and practical means to control nonpoint source pollutants.
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 (Public Law 92-50, commonly known as the Clean Water Act), as last reauthorized by the Water Quality Act of 1987 (Public Law 100-4), 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 bacterial organisms (also see Fecal Coliform Bacteria).

Community A group of interacting organisms living together in a given place.

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.

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. Their presence is often indicative of fecal contamination.

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.

Eocene An epoch of the early Tertiary period, after the Paleocene and before the Oligocene.

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 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).

Fauna Animal life, especially the animals characteristic of a region, period, or special environment.

Flow See Discharge.

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 *Waterbody Assessment Guidance* (Grafe et al. 2000).

Fully Supporting Cold Water Reliable data indicate functioning, sustainable cold water biological assemblages (e.g., fish, macroinvertebrates, or algae), none of which has been modified significantly beyond the natural range of reference conditions (EPA 1997).

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 slopes 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.
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.
Load Allocation (LA)	A portion of a waterbody'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 capacity (LC)	A determination of how much pollutant a waterbody 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.
Macroinvertebrate	An invertebrate animal (without a backbone) large enough to be seen without magnification and retained by a 500µm mesh (U.S. #30) screen.

Margin of Safety (MOS)	An implicit or explicit portion of a waterbody's load capacity set aside to allow the uncertainly about the relationship between the pollutant loads and the quality of the receiving waterbody. 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; and 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, 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.
Miocene	Of, relating to, or being an epoch of, the Tertiary between the Pliocene and the Oligocene periods, or the corresponding system of rocks.
Monitoring	A periodic or continuous measurement of the properties or conditions of some medium of interest, such as monitoring a waterbody.
Mouth	The location where flowing water enters into a larger waterbody.
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	A condition indistinguishable from that without human-caused disruptions.
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 Attainable	A concept and an assessment category describing water bodies that demonstrate characteristics that make it unlikely that a beneficial use can be attained (e.g., a stream that is dry but designated for salmonid spawning).
Parameter	A variable, measurable property whose value is a determinant of the characteristics of a system; e.g., temperature, dissolved oxygen, and fish populations are parameters of a stream or lake.
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.
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 affect 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 waterbody that is minimally impaired and is representative of reference conditions for similar water bodies.

Resident A term that describes fish that do not migrate.

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 waterbody.

River A large, natural, or human-modified stream that flows in a defined course or channel, or 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.

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.
Stream	A natural watercourse containing flowing water, 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.
Subbasin	A large watershed of several hundred thousand acres. This is the name commonly given to 4^{th} 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 6^{th} field hydrologic units.
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.
Total Maximum Daily Load (TMDL)	A TMDL is a waterbody'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 basis. TMDL = Load capacity = Load Allocation + Wasteload Allocation + Margin of Safety. 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 (Greenborg, Clescevi, and Eaton 1992) call for using a filter of 2.0 micron 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.

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 load 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 waterbody.

Waterbody 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 Standards	State-adopted and U.S. Environmental Protection Agency-approved ambient standards for water bodies. The standards prescribe the use of the waterbody and establish the water quality criteria that must be met to protect designated uses.
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 waterbody.
Wetland	An area that is at least some of the time saturated by surface or ground water so as to support with vegetation adapted to saturated soil conditions. Examples include swamps, bogs, fens, and marshes.

Appendix A

Unit Conversions Chart

Appendix A. Unit Conversions Chart

	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 (g) Cubic Feet (ft^3)	Liters (L) Cubic Meters (m^3)	1 g = 3.78 l 1 l = 0.26 g 1 ft^3 = 0.03 m^3 1 m^3 = 35.32 ft^3	3 g = 11.35 l 3 l = 0.79 g 3 ft^3 = 0.09 m^3 3 m^3 = 105.94 ft^3
Flow Rate	Cubic Feet per Second (ft^3/sec)[1]	Cubic Meters per Second (m^3/sec)	1 ft^3/sec = 0.03 m^3/sec 1 m^3/sec = ft^3/sec	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[2]	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 kg
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

[1] 1 ft^3/sec = 0.65 million gallons per day; 1 million gallons per day is equal to 1.55 ft^3/sec.
[2] The ratio of 1 ppm = 1 mg/L is approximate and is only accurate for water.

Appendix B

Water Quality Data

Appendix B. Water Quality Data

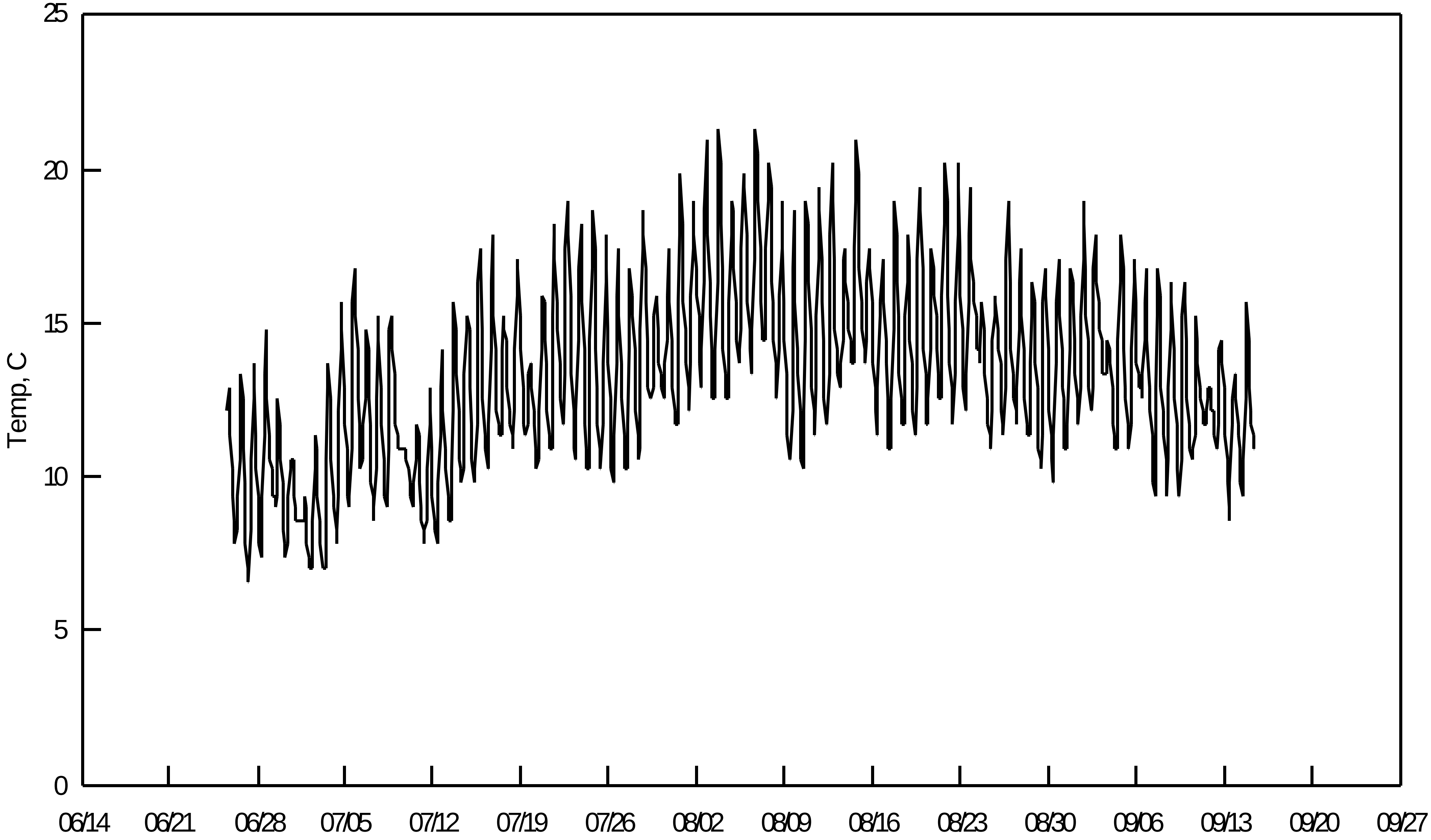

Figure B-1. Middle Fork of the St. Maries River Temperature Profile, Summer 1997

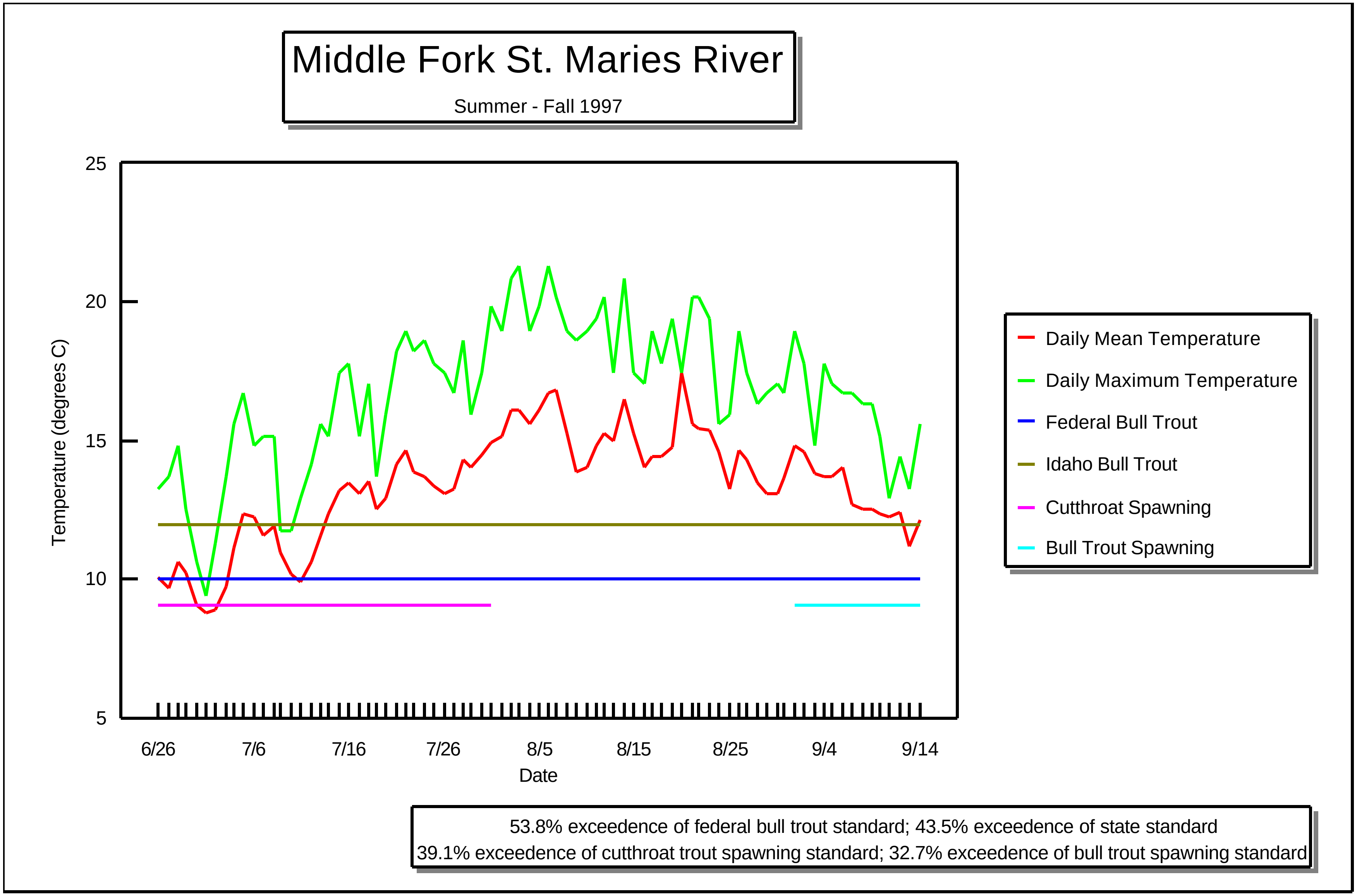

Figure B-2. Middle Fork of the St. Maries River Water Temperature Analysis, 1997

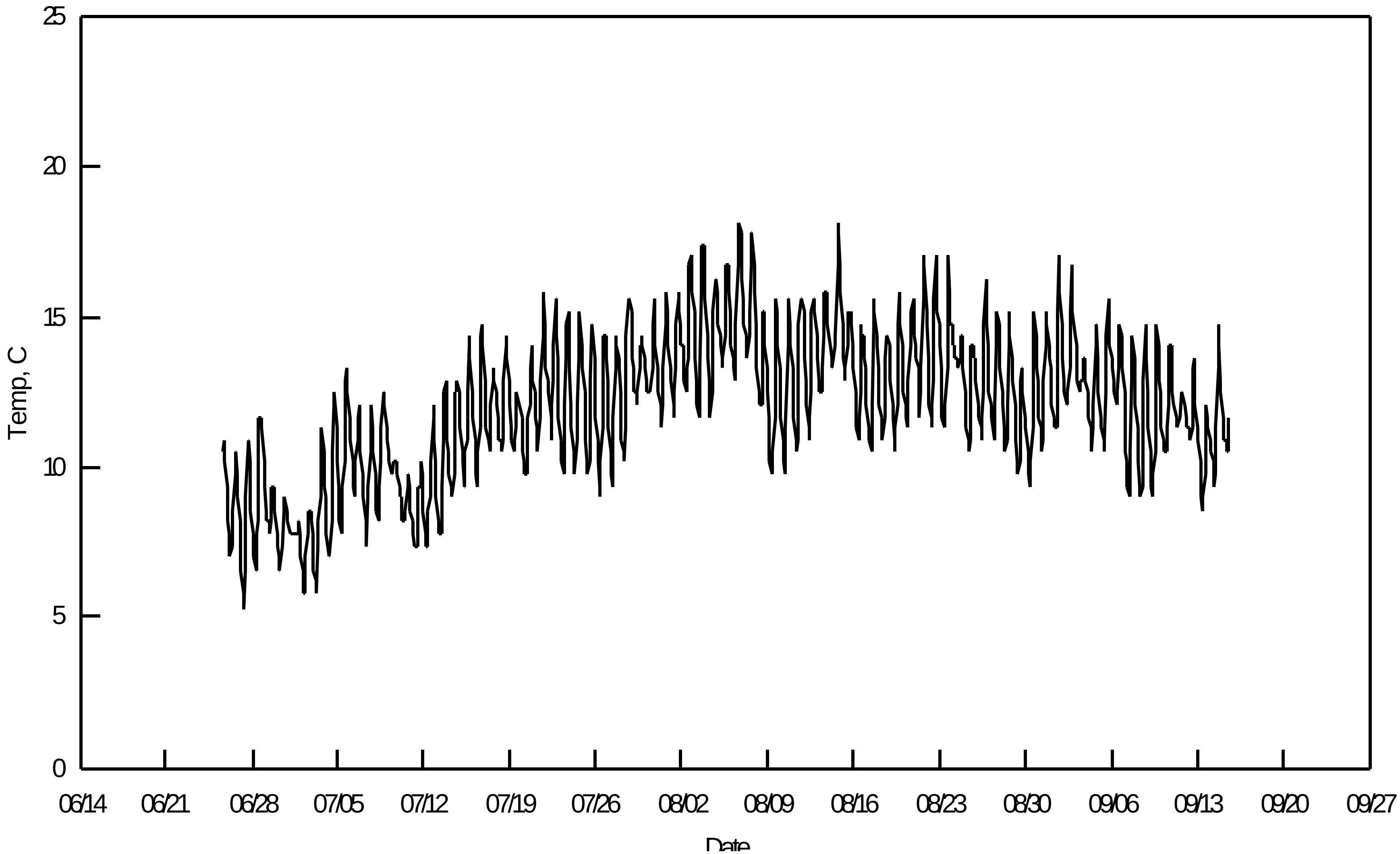

Figure B-3. Gramp Creek Temperature Profile, Summer 1997

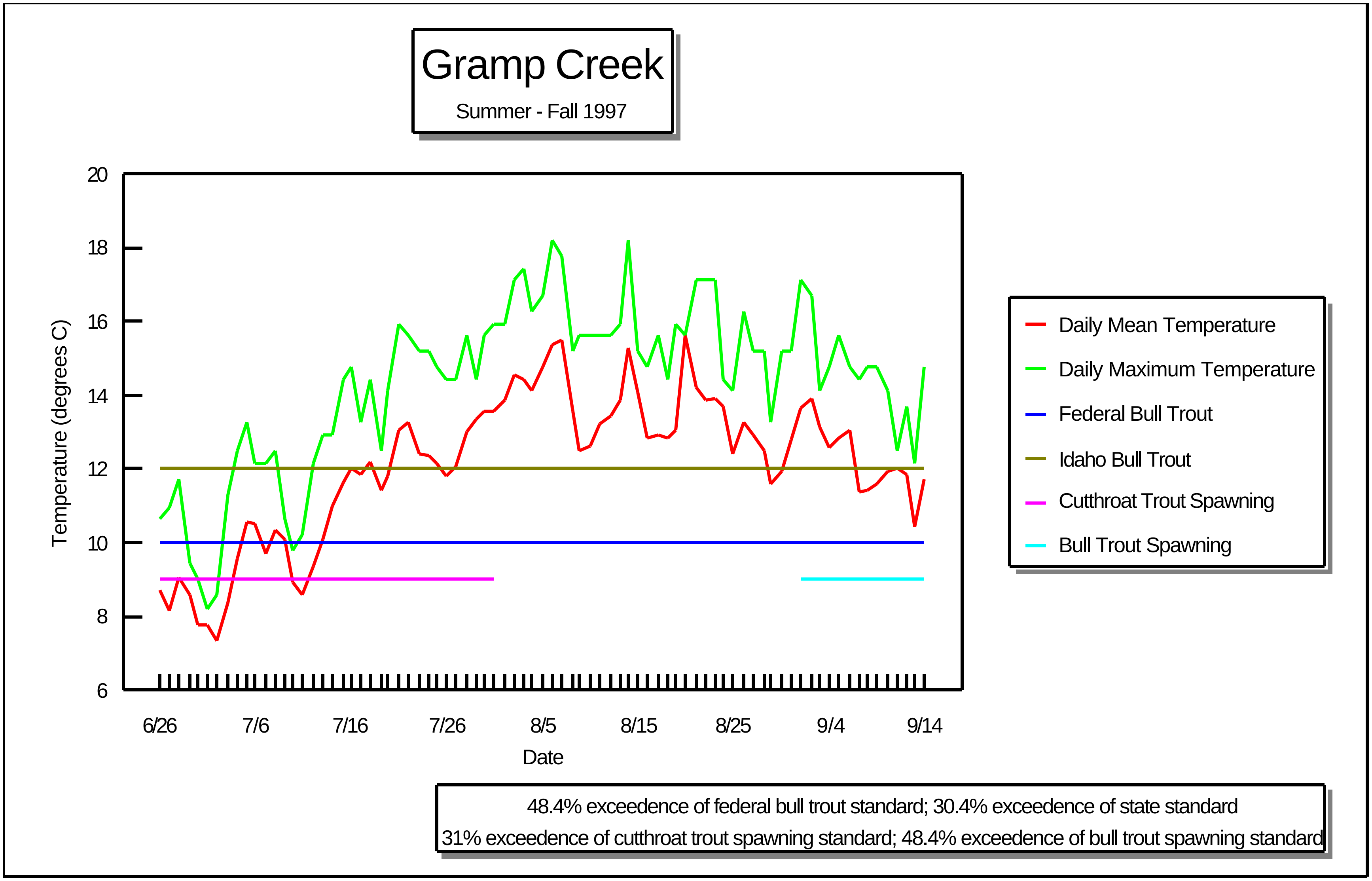

Figure B-4. Gramp Creek Water Temperature Analysis, 1997

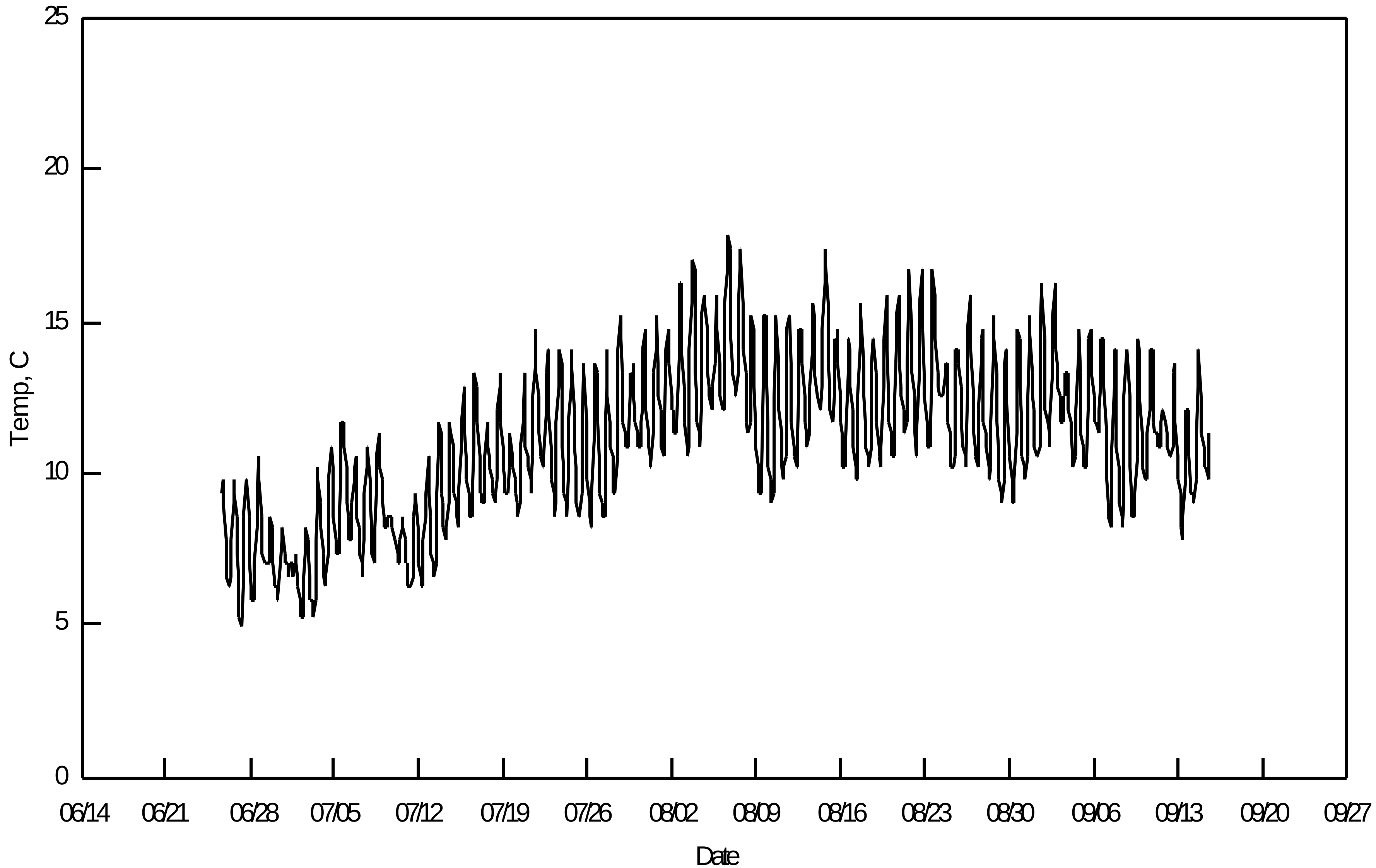

Figure B-5. Gold Center Creek Temperature Profile, Summer 1997

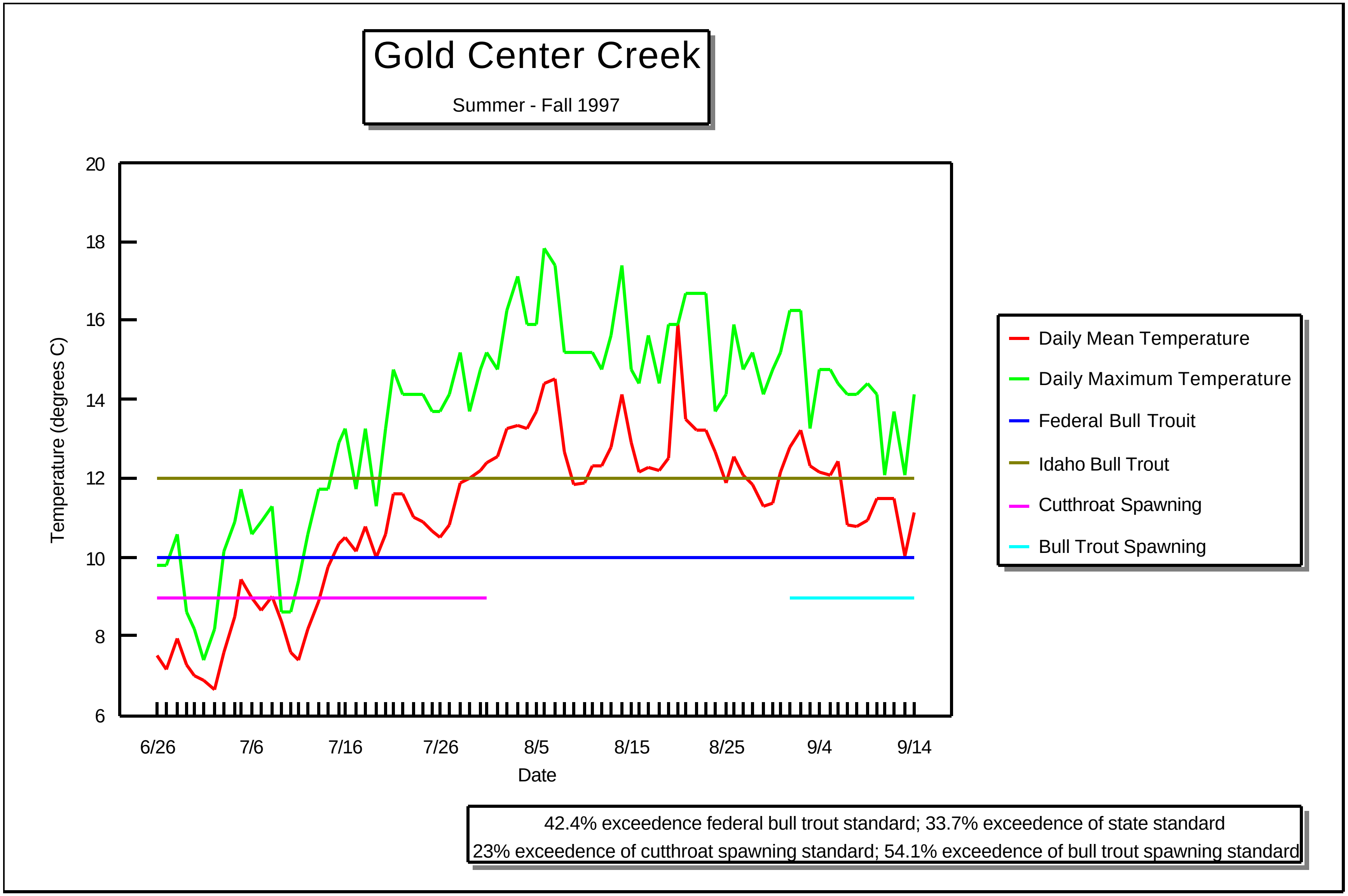

Figure B-6. Gold Center Creek Water Temperature Analysis, 1997

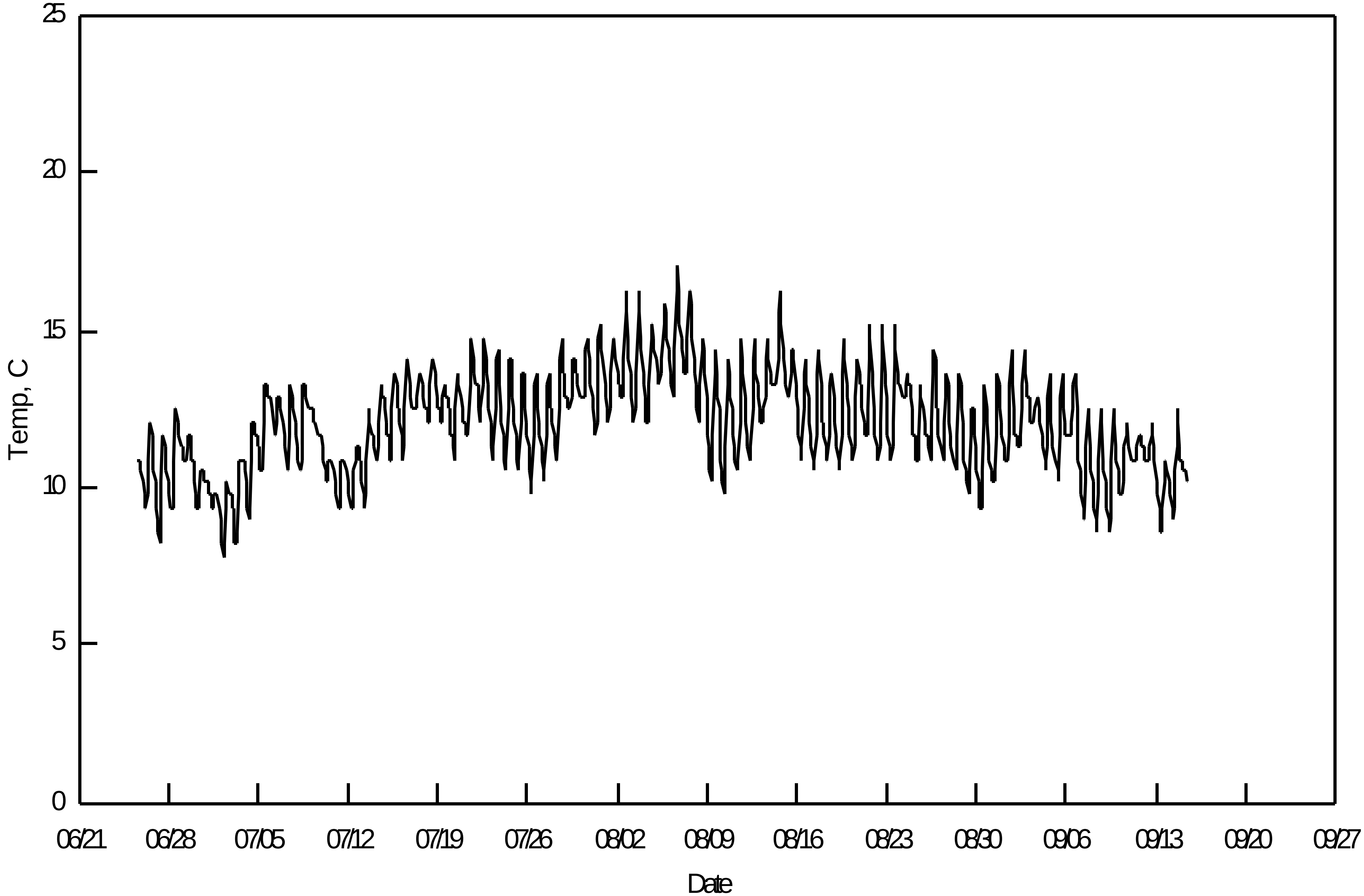

Figure B-7. Flewsie Creek Temperature Profile, Summer 1997

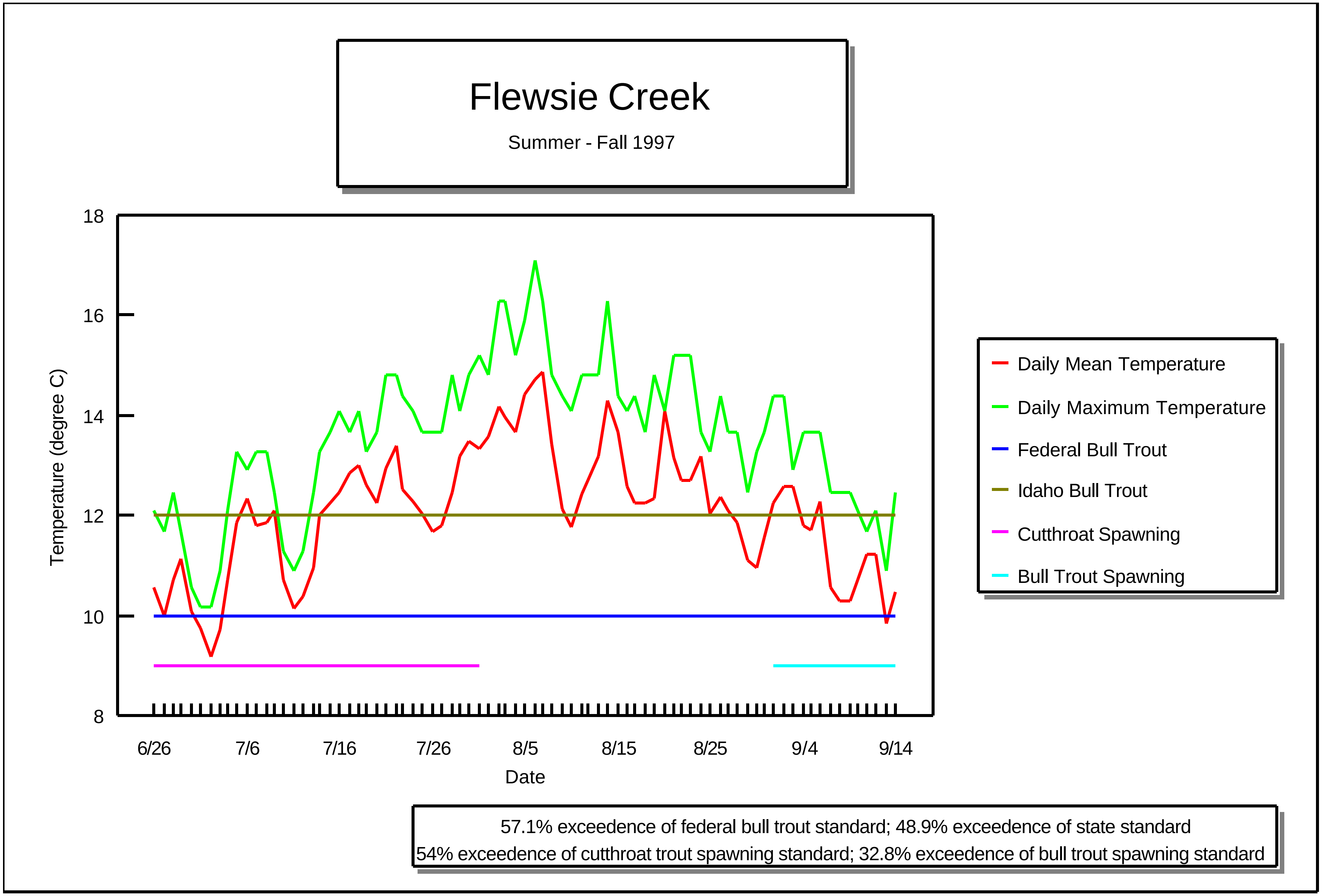

Figure B-8. Flewsie Creek Water Temperature Analysis, 1997

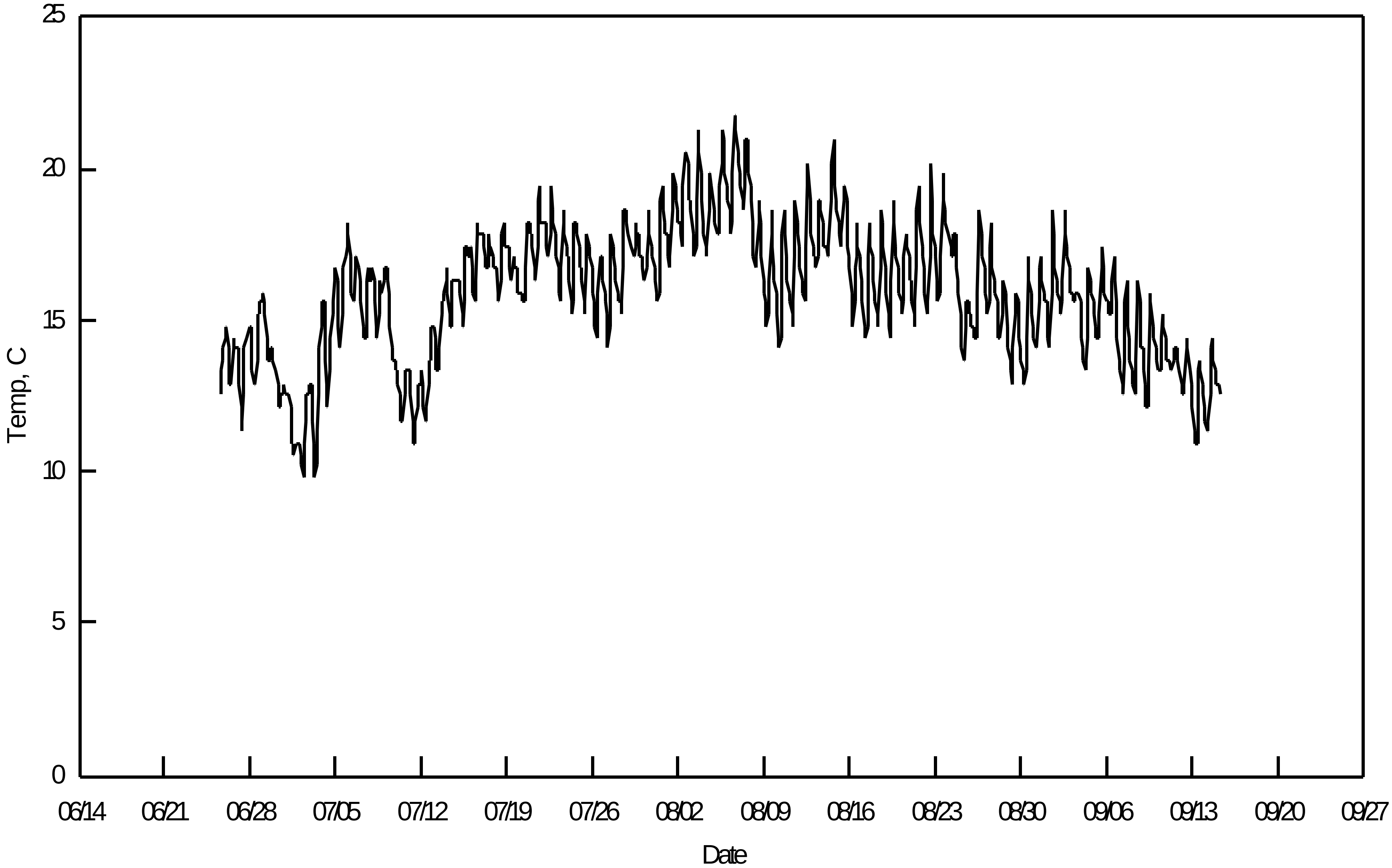

Figure B-9. Emerald Creek - 1 Temperature Profile, Summer 1997

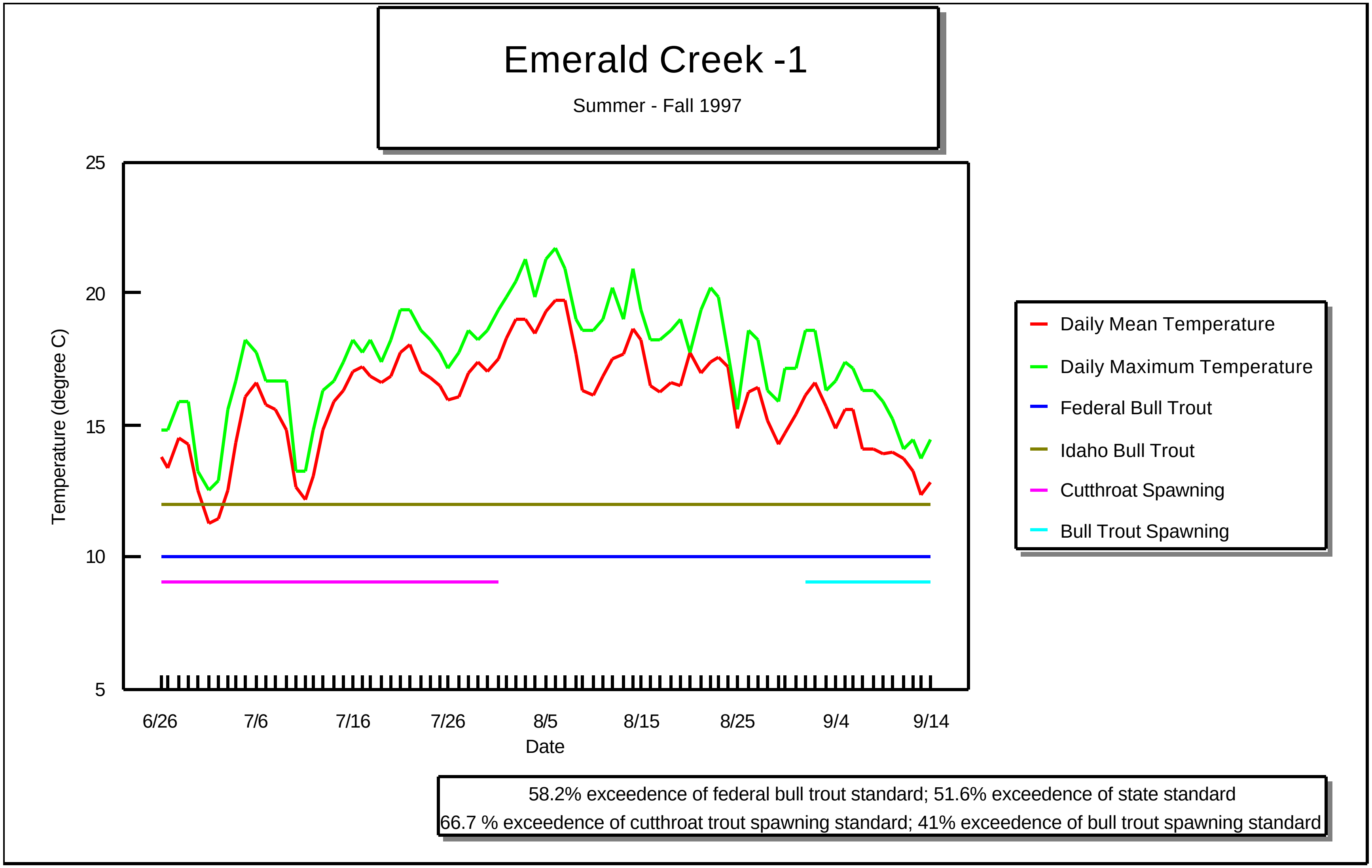

Figure B-10. Emerald Creek – 1 Water Temperature Analysis, 1997

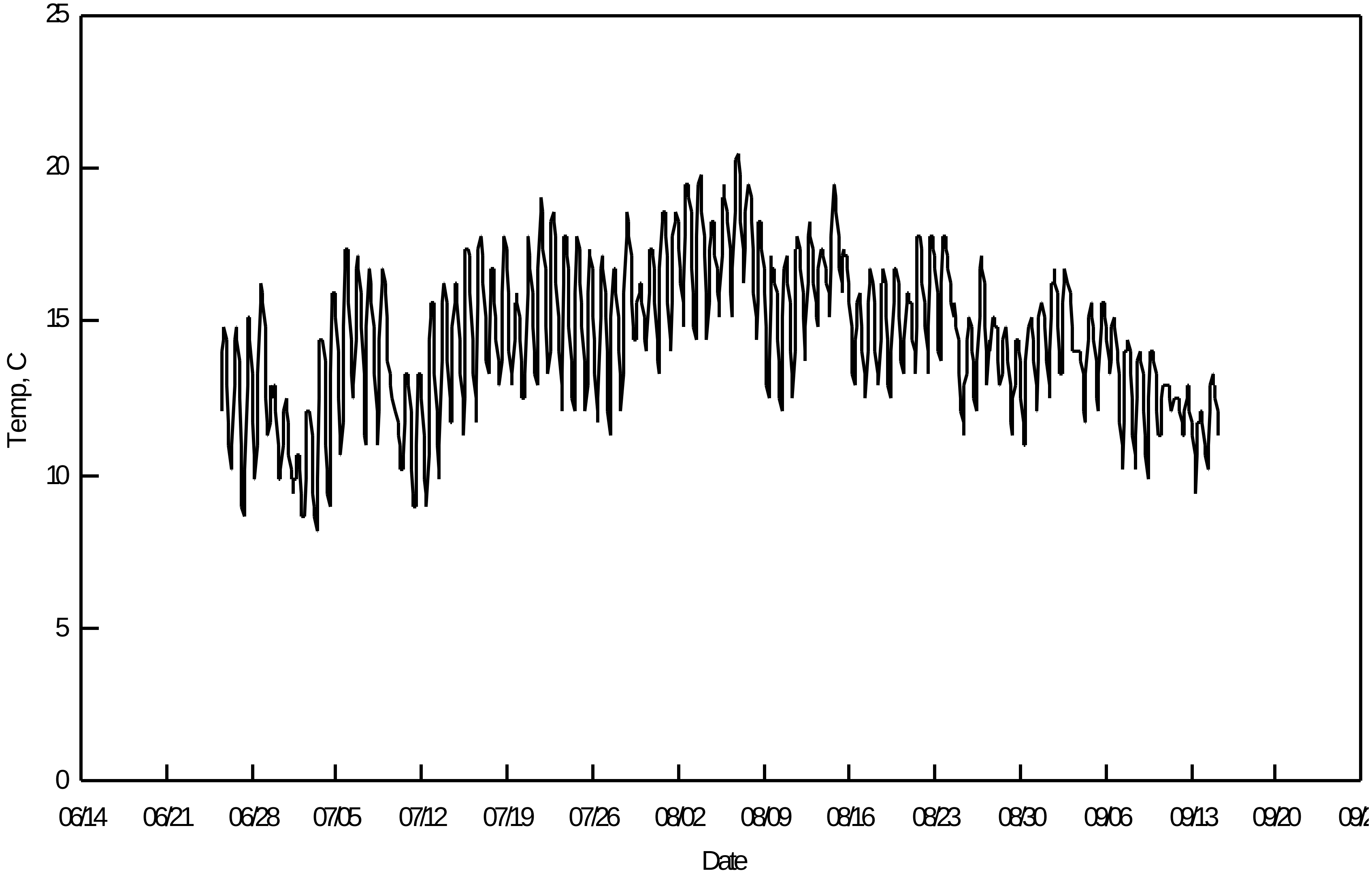

Figure B-11. Emerald Creek - 2 Temperature Profile, Summer 1997

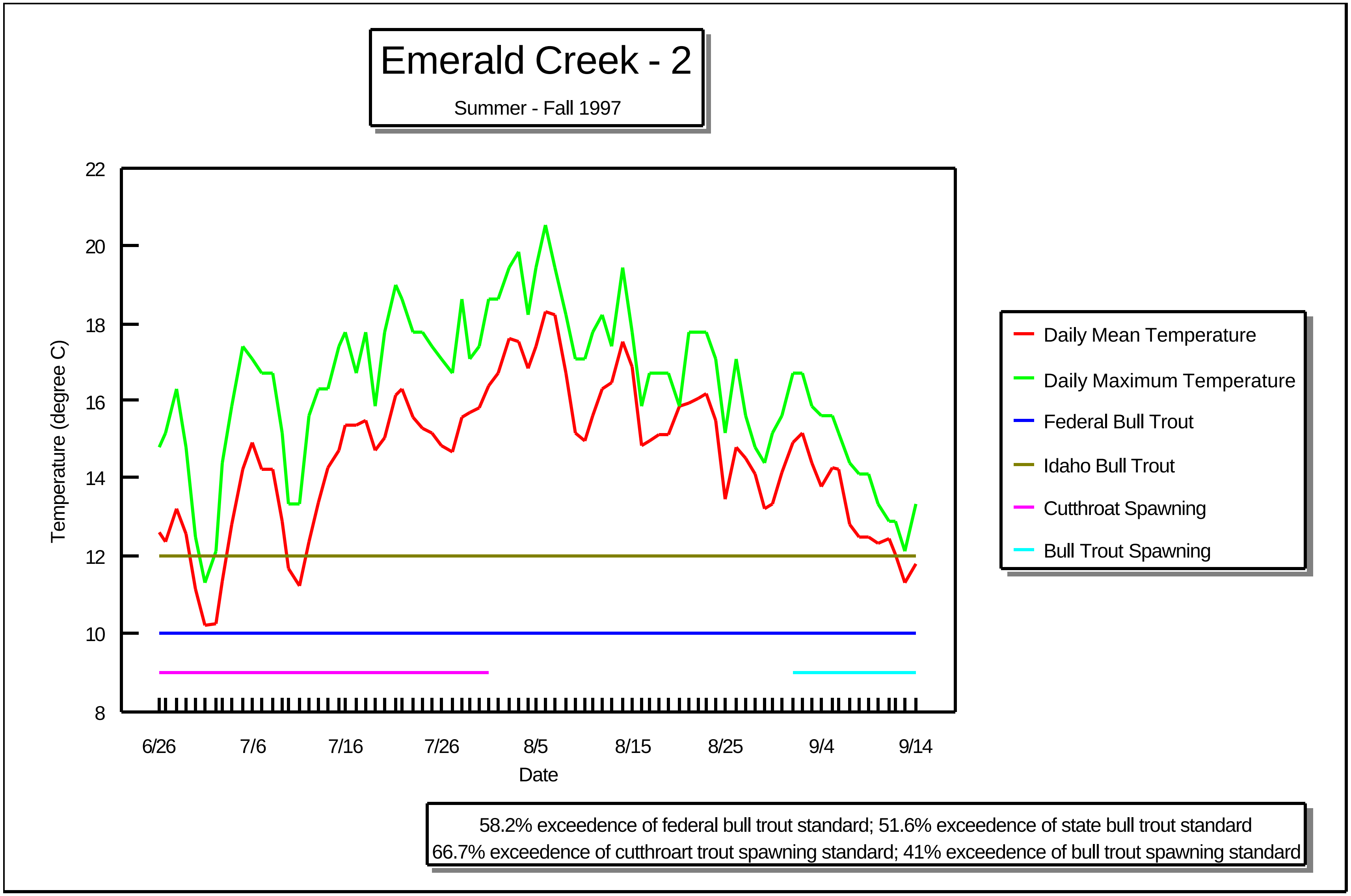

Figure B-12. Emerald Creek – 2 Water Temperature Analysis, 1997

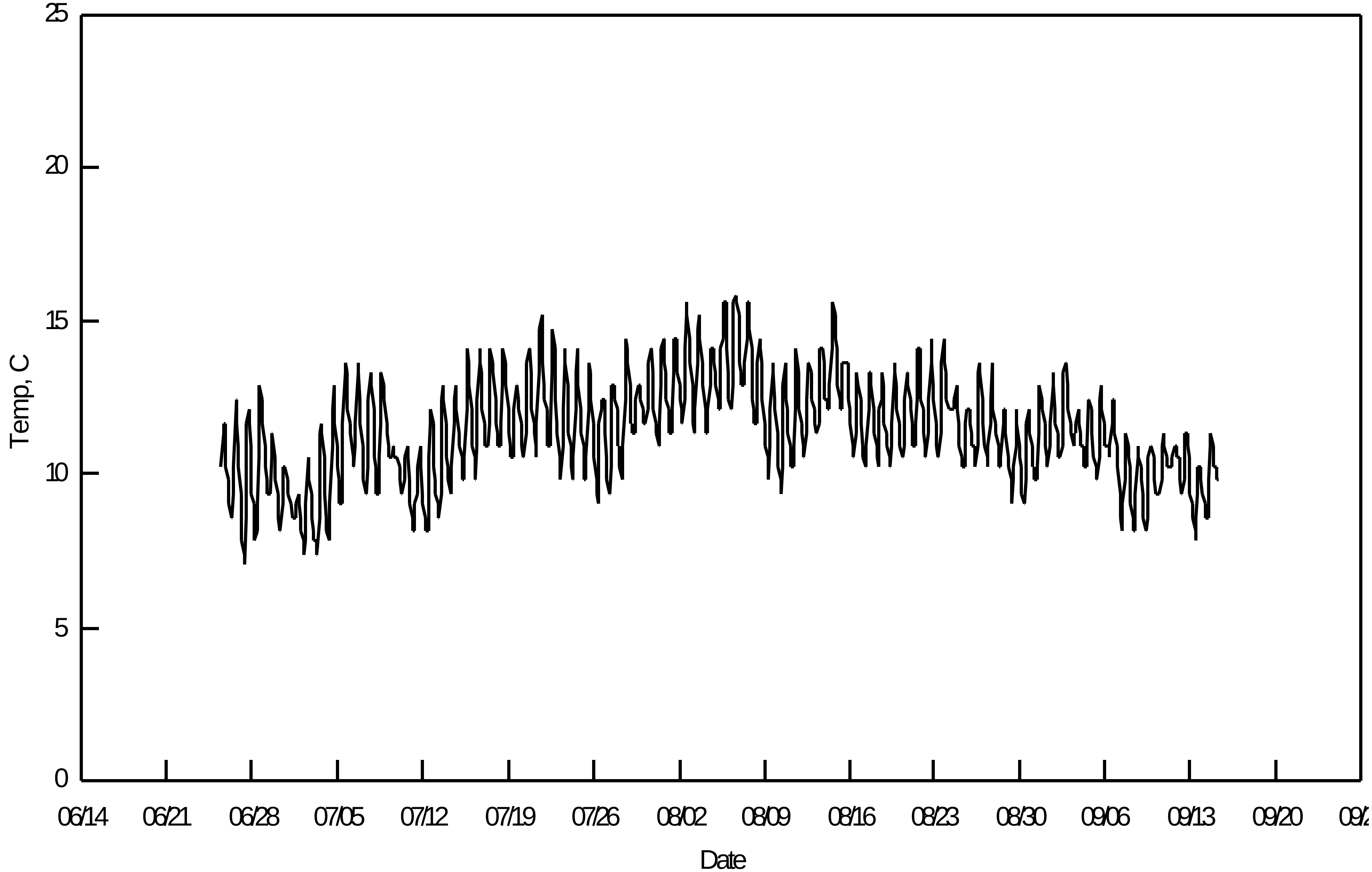

Figure B-13. Emerald Creek - 3 Temperature Profile, Summer 1997

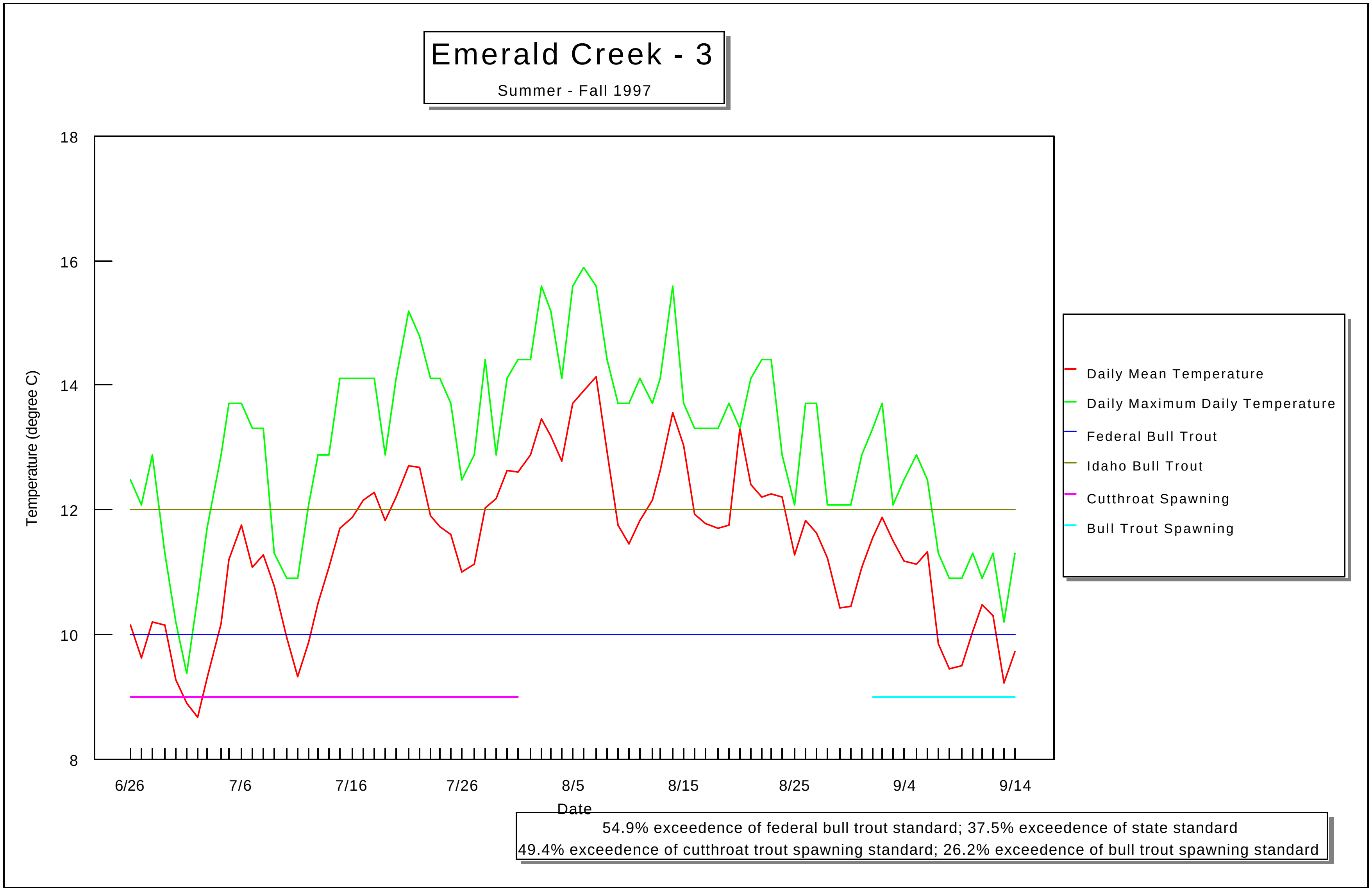

Figure B-14. Emerald Creek – 3 Water Temperature Analysis, 1997

Table B-1. USGS water quality data, Santa gaging station.

Sample Date	Sample Time	Water Temperature (Degrees C)	Air Temperature (Degrees C)	Barometric Pressure (mm of Mercury)	Inst. Discharge (cubic feet/second)	Gage Height (ft)	Specific Conductance (microsiemens/cm)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (percent saturation)
10/27/93	8:27	2	-1.5		56.1		58		
12/15/93	9:45	0	-6		98.6		53		
02/23/94	14:57	0	4.5		84.9		58		
02/24/94	14:34	0	3		91.9		58		
04/20/94	7:55	8	8.5		605		34		
07/19/94	14:10	25.5	28	698	45.6		59	8.8	118
10/23/95	13:55	6	7.5		83.4		58		
11/30/95	8:33	5.5	7.5		2840		32		
01/30/96	9:30	0	-15		197		18		
02/10/96	15:30	2	-1		4060		26		
03/14/96	14:10	5.5	16.5		868		38		
05/17/96	10:02	7.5	10.5		957		38		
06/19/96	5:58	9	10.5		209		43		
08/15/96	14:20	23	30.5		59.3		53		
10/21/98	10:00	4.5	5.5		54.6		54		
11/19/98	8:40	3	5		101		52		
12/09/98	9:50	0	0		172		46		
01/26/99	10:10	0	-3		269		44		
02/09/99	8:55	0.5	-1		428		40		
03/10/99	11:50	2	6		368		37		
04/14/99	13:15	5.6	10.5		666		34		
05/10/99	14:40		5.5		643		34		
06/07/99	17:00	9.5	12.5		504		30		
07/14/99	12:30	19.5	18.5		154	4.43	39		
08/10/99	12:15	20	30		86.1	4.13	50		
09/09/99	13:15	20	23.5		56.3	3.96	48		

Table B-1, continued.

Sample Date	Nitrogen, Nitrite Dissolved (mg/L as N)	Nitrogen, Ammonia + Organic Total (mg/L as N)	Nitrogen, Nitrate + Nitrite Dissolved (mg/L as N)	Phosphorus Total (mg/L as P)	Phosphorus, Ortho Dissolved (mg/L as P)	Calcium Dissolved (mg/L as Ca)	Magnesium Dissolved (mg/L as Mg)	Sodium Dissolved (mg/L as Na)	Chloride Dissolved (mg/L as Cl)
10/27/93									
12/15/93									
02/23/94									
02/24/94									
04/20/94									
07/19/94	0.010	0.500	0.050	0.020	0.010				
10/23/95									
11/30/95									
01/30/96									
02/10/96									
03/14/96									
05/17/96									
06/19/96									
08/15/96									
10/21/98		0.100	0.005	0.014	0.006	6.103	1.357		
11/19/98		0.100	0.005	0.021	0.005	5.799	1.346		
12/09/98		0.100	0.026	0.024	0.007	4.313	1.153		
01/26/99		0.136	0.017	0.031	0.011	3.678	1.048		
02/09/99		0.205	0.013	0.039	0.017	3.623	1.029		
03/10/99		0.102	0.005	0.023	0.006	3.433	0.927		
04/14/99						3.280	0.843		
05/10/99			0.005	0.012	0.005	3.282	0.754	1.700	0.409
06/07/99		0.161	0.006	0.013	0.003	3.261	0.686	1.470	0.315
07/14/99		0.158	0.005	0.020	0.003	4.511	0.923	1.789	0.370
08/10/99		0.120	0.005	0.016	0.008	5.634	1.225	2.134	0.640
09/09/99						6.028	1.284	2.209	0.350

Table B-1, continued.

Sample Date	Sulfate Dissolved (mg/L as SO_4)	Fluoride Dissolved (mg/L as F)	Silica Dissolved (mg/L as SiO_2)	Cadmium Dissolved (? g/L as Cd)	Cadmium Water Unfiltered Total (? g/L as Cd)	Iron Total Recoverable (? g/L as Fe)	Iron Dissolved (? g/L as Fe)	Lead Dissolved (? g/L as Pb)	Lead Total Recoverable (? g/L as Pb)
10/27/93									
12/15/93									
02/23/94									
02/24/94									
04/20/94									
07/19/94									
10/23/95									
11/30/95									
01/30/96									
02/10/96									
03/14/96									
05/17/96									
06/19/96									
08/15/96									
10/21/98				1	1			1	1
11/19/98				1	1			1	1
12/09/98				1	1			1	1
01/26/99				1	1			1	1
02/09/99				1	1			1	1
03/10/99				1	1			1	1
04/14/99				1	1			1	1
05/10/99	1.04	0.1	16.88	1	0.1	210.54	42.11	1	0.105
06/07/99	1.08	0.1	13.65	1	0.1	215.91	54.33	1	0.2
07/14/99	0.53	0.1	15.66	1	0.1	224.22	97.50	1	0.175
08/10/99	0.53	0.1	17.05	1	0.1	258.87	147.14	1	0.1
09/09/99	0.86	0.1	17.44	1	0.1	229.26	152.08	1	0.1

Table B-1, continued.

Sample Date	Manganese Total Recoverable (? g/L as Mn)	Manganese Dissolved (? g/L as Mn)	Zinc Dissolved (? g/L as Zn)	Zinc Total Recoverable (? g/L as Zn)	Coliform Fecal 0.7 UM-MF (COL/100mL)	Fecal Strep Water (COL/100mL)	Specific Conductance Lab (? s/cm)	pH (Standard Units)
10/27/93								
12/15/93								
02/23/94								
02/24/94								
04/20/94								
07/19/94					22	56		8.55
10/23/95								
11/30/95								
01/30/96								
02/10/96								
03/14/96								
05/17/96								
06/19/96								
08/15/96								
10/21/98			20	10.0				7.83
11/19/98			20	10.0				7.22
12/09/98			20	10.0				7.46
01/26/99			20	10.0				7.68
02/09/99			20	10.0				7.00
03/10/99			20	40.0				7.10
04/14/99			20	40.0				7.32
05/10/99	10.314	6.191	1.0	1.182			34.8	7.46
06/07/99	10.550	5.105	1.0	56.95			31.9	7.21
07/14/99	15.653	6.580	1.0	1.074			42.1	7.44
08/10/99	14.516	7.259	1.0	1.00			51.7	7.81
09/09/99	9.5970	5.483	1.0	1.00			53.4	7.67

Table B-2a. Coeur d'Alene Tribe data on Alder Creek, 1997.

Alder Creek	6/30/97	7/28/97	9/4/97	10/1/97	11/12/97
Sulfate (mg/L)	1.32	1.73	1.35	2.79	1.61
Chloride (mg/L)	0.77	0.73	0.84	0.81	0.80
Nitrate (mg/L)	0.34	<0.10	<0.10	<0.10	0.02
Phosphate(mg/L)	<0.10	<0.10	<0.10	<0.10	<0.03
Nitrite (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.029
Fluoride (mg/L)	0.05	0.04	0.01	<0.01	<0.02
Total Suspended Solids (mg/L)	110	10	2	2	0.5
Turbidity (NTU[1])	45.2	2.12	2.31	1.58	3.96

[1]Nephelometric Turbidity Unit

Table B-2b. Coeur d'Alene Tribe data on Alder Creek, 1998.

Alder Creek	4/29/98	5/29/98	6/25/98	7/8/98	8/13/98	9/01/98	10/19/98	11/13/98
Total Suspended Solids (mg/L)	<2	4	3	2	3	3	<2	9
Turbidity (NTU[1])	2.5	6.6	2.4	1.8	2.2	2.6	2.6	14.2
Chloride (mg/L)	0.43	0.46	0.49	0.47	0.67	0.44	0.79	1.08
Fluoride (mg/L)	0.04	0.02	0.05	0.04	0.26	0.03	<0.02	<0.02
Nitrate as N (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.134
Nitrite as N (mg/L)	<0.029	<0.029	<0.029	<0.010	<0.010	<0.010	<0.010	<0.010
Total Phosphorous (mg/L)	<0.005	0.014	0.008	0.007	0.008	0.011	<0.005	0.010
Ortho-Phosphate as P (mg/L)	<0.026	<0.026	<0.026	<0.020	<0.020	<0.020	<0.020	<0.020
Sulfate (mg/L)	1.495	1.328	1.446	0.908	1.241	1.085	1.539	1.744
TKN[2] (mg/L)	-	-	-	<0.12	<0.12	-	0.21	-

[1]Nephelometric Turbidity Unit
[2] Total Kjeldahl Nitrogen

Table B-2c. Coeur d'Alene Tribe data on Alder Creek, 1999.

Alder Creek									
			SAMPLE DATE	03/10/99	03/26/99	4/12/99	5/14/99	6/3/99	7/13/99
ANALYSIS PARAMETERS		**METHOD**	**UNITS**						
PHYSICAL PROPERTIES									
Total Dissolved Solids		EPA 160.1	mg/L						
Total Suspended Solids		EPA 160.2	mg/L	4.67	28.5	2.20	<2.00	<2.0	<2.0
Turbidity		EPA 180.1	NTU	4.68	18.2	4.22	2.73	3.41	2.20
Hardness as $CaCO_3$[1]		EPA 200.7	mg/L						
INORGANIC, NON-METALLICS									
Chloride		EPA 300.0	mg/L	0.660	1.23	0.530	0.366	0.434	3.53
Fluoride		EPA 300.0	mg/L	<0.020	0.040	<0.020	<0.020	0.044	0.022
Nitrate as N		EPA 300.0	mg/L	0.020	0.050	0.010	<0.005	<0.005	0.009
Nitrite as N		EPA 300.0	mg/L	<0.010	<0.010	<0.010	<0.005	<0.005	<0.010
Total Phosphorous		EPA 200.7	mg/L	<0.005	0.007	<0.005	0.026	<0.005	0.017
Ortho-Phosphate as P		EPA 300.0	mg/L	<0.020	<0.020	<0.020	<0.010	<0.010	<0.020
Sulfate		EPA 300.0	mg/L	1.52	1.56	1.34	1.50	1.33	1.31
TKN[2]		EPA 351.4	mg/L	0.100	<0.100	0.223	<0.100	<0.100	0.152

[1]calcium carbonate
[2]Total Kjeldahl Nitrogen

Table B-2d. Coeur d'Alene Tribe data on Alder Creek, 2000.

Alder Creek							
			SAMPLE DATE	04/07/00	04/19/00	05/18/00	6/7/00	9/26/00
ANALYSIS PARAMETERS		**METHOD**	**UNITS**					
PHYSICAL PROPERTIES								
Total Dissolved Solids		EPA 160.1	mg/L					
Total Suspended Solids		EPA 160.2	mg/L	5.0	9.0	<2.0	3.0	5.00
Turbidity		EPA 180.1	NTU	3.35	5.57	3.60	2.03	2.30
Hardness as $CaCO_3$[1]		EPA 200.7	mg/L					
INORGANIC, NON-METALLICS								
Chloride		EPA 300.0	mg/L	0.433	0.325	0.319	0.428	0.707
Fluoride		EPA 300.0	mg/L	<0.020	<0.020	0.032	<0.020	<0.020
Nitrate as N		EPA 300.0	mg/L	0.008	0.007	<0.005	<0.005	<0.005
Nitrite as N		EPA 300.0	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010
Total Phosphorous		EPA 200.7	mg/L	<0.005	<0.005	0.035	0.038	0.023
Ortho-Phosphate as P		EPA 300.0	mg/L	<0.006	<0.006	<0.006	<0.006	<0.006
Sulfate		EPA 300.0	mg/L	1.35	1.22	1.26	1.33	1.63
TKN[2]		EPA 351.4	mg/L	0.122	0.133	0.082	0.057	0.111

[1]calcium carbonate
[2]Total Kjeldahl Nitrogen

Table B-2e. Coeur d’Alene Tribe data on Alder Creek, 2001.

Sample Date			**1/9/01**	**2/7/01**	**3/7/01**	**4/2/01**	**4/18/01**	**5/9/01**	**5/21/01**
Detection Limit	**Method**	**Units**							
2	EPA 160.2	mg/L	2.30	<2.0	5.60	4.40	5.00	11.0	2.00
0.02	EPA 180.1	NTU	2.75	7.20	7.86	7.13	6.63	4.95	2.93
0.02	EPA 300.0	mg/L	0.481	0.636	0.480	0.397	0.432	0.413	0.426
0.02	EPA 300.0	mg/L	<0.020	<0.020	<0.020	0.063	<0.020	0.222	<0.020
0.005	EPA 300.0	mg/L	0.075	.0156	0.075	0.028	0.010	<0.005	<0.005
0.01	EPA 300.0	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
0.005	EPA 200.7	mg/L	0.009	0.024	0.032	0.020	0.020	0.015	0.026
0.01	EPA 300.0	mg/L	<0.010	0.019	<0.010	<0.010	<0.010	<0.010	<0.010
0.03	EPA 300.0	mg/L	2.00	2.15	1.63	1.28	1.32	1.60	1.43
0.02	EPA 351.2	mg/L	0.217	0.463	0.107	<0.030	0.030	0.859	0.704

Appendix C

Sediment Model Assumptions and Documentation

Appendix C. Sediment Model and Assumptions and Documentation

Background:

Sediment is the pollutant of concern on the majority of the water quality limited streams of the Panhandle Region. The lithology or terrain of the region most often governs the form the sediment takes. Two major types of terrain dominate in northern Idaho. These are the meta-sedimentary Belt Supergroup and granitics present either in the Kaniksu batholith or in smaller intrusions such as the Round Top Pluton and the Gem Stocks. In some locations Columbia River Basalt formations are important, but these tend to be to the south and west, primarily on the Coeur d'Alene Reservation. Granitics mainly weather to sandy materials, but also weather to pebbles or larger sized particles. Pebbles and larger particles with significant amounts of sand remain in the higher gradient stream bedload. The Belt terrain produces silt size particles, pebbles, and larger particles. Silt particles are transported to low gradient reaches, while the larger particles comprise the majority of the higher gradient stream bedload. Basalts erode to silt and particles similar in size to those in the Belt terrain. Large basalt particles are less resistant and weather to smaller particles.

Any attempt to model the sediment output of watersheds will provide relative, rather than exact, sediment yields. The model documented here attempts to account for all significant sources of sediment separately. This approach is used to identify the primary sources of sediment in a watershed. This identification of primary sources will be useful as implementation plans designed to remedy these sources are developed. If additional investigation indicates sources quantified as minor are not, the model input can be altered to incorporate this new information.

Model Assumptions:

Assumptions used in the model are described below.

Land use and sediment delivery:

Revised Universal Soil Loss Equation (RUSLE) is the correct model for pastureland as it accounts for production and delivery of fine-grained sediment.

Sediment yield coefficients measured in-stream on geologies of northern and north central Idaho cover production and delivery of sediment from forested areas. These sediment yield coefficients reflect both fine and coarse sediment.

Sparse and heavy forests of all age classes, including seedling-sapling, should be assigned mid-range sediment yield coefficient values for the geologies, while areas not fully stocked by Forest Practices Act standards should be assigned values in the upper end of the range.

Sediment yield coefficients can be modified within the range observed to estimate road corridor land use and the effects of repeated wild fires.

Double burned areas have eroded significantly to the stream channel but are not now eroding; a residual sediment load in the channels is possible from previous catastrophic burns.

Erosion from stream bank lateral recession can be estimated with the direct volume method (Erosion and Sediment Yield 1983).

Road sediment production and delivery:

Road erosion using the Cumulative Watershed Effects (CWE) approach should be limited to the 200 feet of road on either side of road crossings, not tied to total road mileage.

The use of the McGreer relationship between the CWE score and road surface erosion is a valid estimate of road surface fines production and yield. In the case of Belt terrain, it is a conservative (overestimate) estimate.

The CWE data collected for actual road fill failures and sediment delivery reflect the situation throughout the watershed. Since the great majority of road failures occur during episodic high discharge events with a 10- to 15-year return period, road failures reflect the actions of the last large event and must be divided by ten for an annualized estimate.

Fines and coarse loading can be estimated for stream reaches where roads encroach on the stream using estimated erosion rates on defined model cross-sections. Erosion resulting from encroachment occurs primarily during episodic high discharge events with a 10- to15-year return period, so road encroachment erosion must be divided by ten for an annualized estimate.

Failing road fill and eroding bank material is composed of fines and coarse material. The proportions of fines and coarse material can be estimated from the soil series descriptions of the watershed.

Sediment delivery:

One hundred percent delivery from forestlands with sediment yield coefficients measured in-stream on geologies of northern and north central Idaho.

One hundred percent delivery from agricultural lands estimated with RUSLE.

One hundred percent delivery from all road miles up to 200 feet from a stream crossing as estimated by the McGreer relationship.

Fines and coarse materials are delivered at the same rate from fill failures and from erosion resulting from road encroachment and bank erosion.

Model Approach:

The sediment model attempts to account for all sources of sediment by partitioning these sources into broad categories.

Land use is the primary broad category. It is treated separate from other characteristics such as stream bank erosion and roads. Land use types are divided into agricultural, forest, urban, and roads.

Agriculture may be subdivided into working farms and ranches and small ranchettes, which currently exist on subdivided agriculture land. Sediment yields from agricultural lands that receive any tillage, even on an infrequent basis, are modeled with RUSLE. Sediment yields were estimated from agricultural lands (rangeland, pasture, and dry agriculture) using RUSLE (equation 1)(Hogan 1998).

Equation 1: A = (R)(K)(LS)(C)(D) tons per acre per year where:
: A is the average annual soil loss from sheet and rill erosion
: R is climate erosivity
: K is the soil erodibility
: LS is the slope length and steepness
: C is the cover management
: D is the support practices

The RUSLE does not take into account stream bank erosion, gully erosion, or scour. It applies to cropland, pasture, hay land, or other land that has some vegetative development by tilling or seeding. Based on the soils, characteristics of the agriculture, and the slope, sediment yields were developed for the agricultural lands of each watershed. The RUSLE develops values that reflect the amount of sediment eroded and delivered to the active channel of the stream system annually.

Forestlands and some land in road rights of way are modeled using the mean sediment export coefficients measured in-stream on geologies of northern and north central Idaho (USFS 1994). The values developed by these sediment yield coefficients are the amount of sediment eroded and the amount of sediment delivered to the stream courses annually. Forestlands that are fully stocked with trees are treated with the median coefficient for sediment yields ascribed to that terrain. Lands not fully stocked by Idaho Forest Practices Act standards are assigned the highest coefficient of the range. Paved road rights of ways are assigned the lowest coefficient of the range. Areas that were burned by two large wild fires as delineated in the IPFIRES model are adjusted by a coefficient that is the difference between the highest value of the coefficient for the geologic type and the median.

All coefficients are expressed as tons per acre per year and are applied to the acreage of each land type developed from Geographical Information System (GIS) coverages. All land uses are displayed with estimated sediment delivery. Land use sediment delivery is totaled.

Roads are treated separately by the model. Forest haul roads are differentiated from county and private residential roads. County roads often have larger stream passage structures and are normally much wider and have gravel or pavement surfacing. Private residential roads are often limited in length, but can have poor stream crossing structures. Sediment yields from county and private roads are modeled using a newer RUSLE model (Sandlund 1999). Road relief, slope length, surfacing, soil material, and width are the most critical factors. The sediment yield was applied only to the 200 feet on either side of stream crossings. Failure of county and private road fills was assumed nonexistent, because such roads are often on gentle terrain. As a consequence, road fill failures are rare.

Forest roads were modeled using data developed with the cumulative watershed effects (CWE) protocol. A watershed CWE score was used to estimate surface erosion from the road surface. Forest road sediment yield was estimated using the relationship between the CWE score and the sediment yield per mile of road (Figure B-1). The relationship was developed for roads on a Kaniksu granitic terrain in the LaClerc Creek watershed (McGreer 1998). Its application to roads on Belt terrain conservatively estimates sediment yields from these systems. The watershed CWE score was used to develop a sediment tons per mile value, which was multiplied by the estimated road mileage affecting the streams. It was assumed that all sediment was delivered to the stream system. This is a conservative estimate of actual delivery.

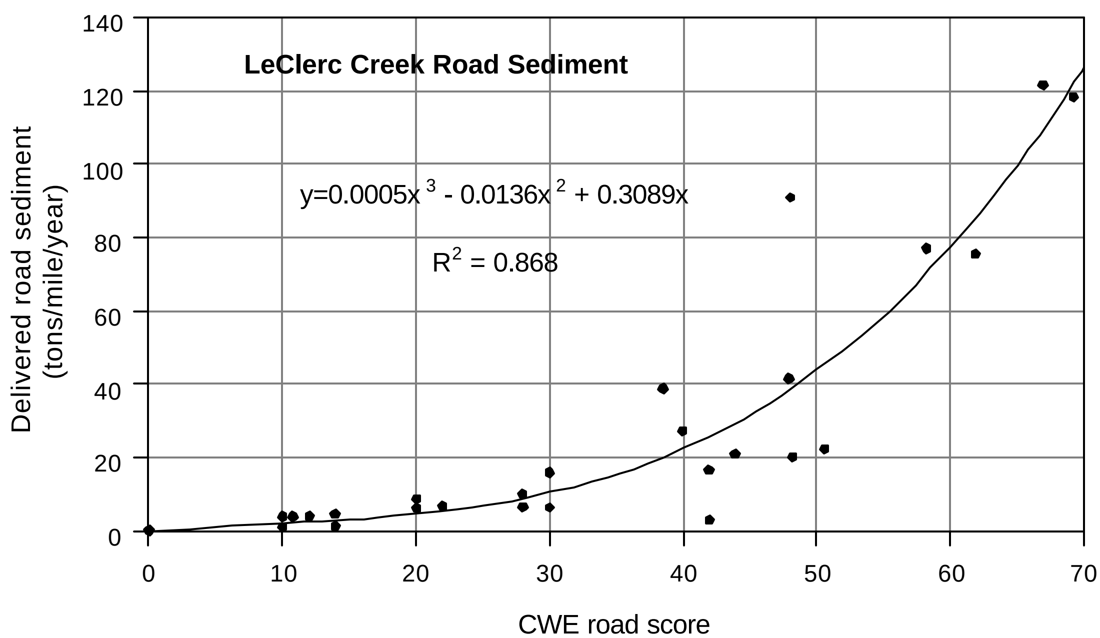

Figure C-1. Sediment Export of Roads Based on Cumulative Watershed Effects Scores

Forest road failure was estimated from actual CWE road fill failure and delivery data. These failures were interpreted as primarily the result of large discharge events that occur on a 10- to 15-year return period (McClelland *et. al* 1997). The estimates were annualized by dividing the measured values by 10. The data are typically from a subset of the roads in a watershed. The sediment delivery value was scaled using a factor reflecting the watershed road mileage divided by the road mileage assessed. The sediments delivered through this mechanism contain both fine (material including, and smaller than, pebbles) and coarse material (larger sizes). The percentages of fine and coarse particles were estimated using the described characteristics of the soil series found in the watershed. The weighted average of the fines and coarse composition of the B and C soil horizons to a depth of 36 inches was developed using the soils GIS coverage STATSGO, which contains the soils composition data provided by soils survey documents. The B and C horizons' composition was used because these are the strata from which forest roads are normally constructed. Based on the developed soil composition percentage and the estimated probable yield, the tons of fine and coarse material delivered to the streams by fill failure were calculated. This approach assumes equal delivery of fine and coarse materials.

Roads cause stream sedimentation by an additional mechanism. The presence of roads in the floodplain of a stream most often interferes with the stream's natural tendency to seek a steady state gradient. During high discharge periods, the constrained stream often erodes at the roadbed, or, if the bed is armored, erodes at the opposite bank or its bed. The erosion resulting from a road imposed gradient change results in stream sedimentation. The model assumes the roads causing gradient effects to be those within 50 feet of the stream. The model then assumes 0.25-inch erosion per lineal foot of bed and bank up to 3 feet in height. The 0.25-inch cross-section erosion is assumed to be uniform over the bed and banks. The erosion rate was selected from a model curve of erosion in inches compared to modeled sediment yields from a channel 10 feet in width (Figure B-2). The stream cross-section used was based on the weighted bank full width for all measurements made of streams in the Beneficial Use Reconnaissance and Use Attainability programs. The erosion is from the soil types in the basin with the weighted percentages of fine and coarse material. A bulk soil density of 2.6 grams per cubic centimeter is used to convert soil volume into weight in tons. The tons of fine and coarse material are totaled for all road segments within 50 linear feet of the stream. The bulk of this erosion is assumed to occur during large discharge events, which occur on a 10- to 15-year return period (McClelland *et. al* 1997). The estimates were annualized by dividing the measured values by 10.

Estimates of bank recession are appropriate primarily along low gradient Rosgen B and C channels (Rosgen 1985). The direct volume method as discussed in the *Erosion and Sediment Yield: Channel Evaluation Workshop* (1983) was employed to make the estimates. The method relies on measurements of eroding bank length, lateral recession rate, soil type, and particle size to make these estimates. A field crew collected these data. The fine and coarse material fractions of the bank material based on STATSGO GIS coverage are used to estimate fine and coarse material delivery to the stream. These values are added into the watershed sediment load.

The model does not consider sediment routing, nor does it attempt to estimate the erosion to streambeds and banks resulting from localized sediment deposition in the streambed. The model does not attempt to measure the effects of additional water capture at road crossings. It is assumed, that on the balance, the additional stream power created by additional water capture over a shorter period would increase net export of sediment, even though some erosion would be caused by this watershed effect.

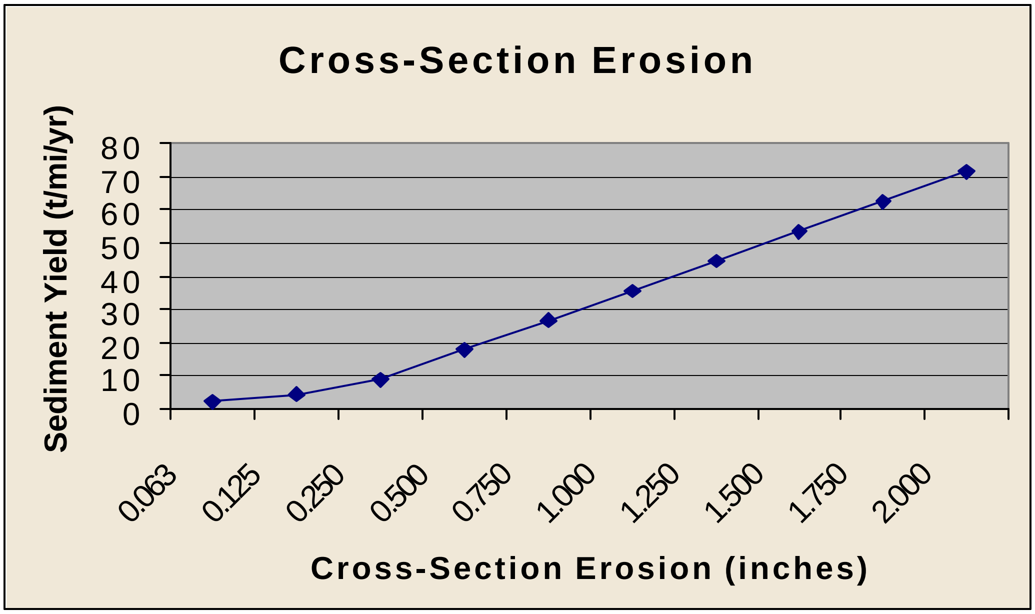

Figure C-2. Modeled Sediment Yield from Thickness of Cross-Section Erosion

Model Operation:

The model is an Excel workbook composed of four spreadsheets. Key data, such as acreages and percentages, are entered into sheets one and two of the model. The total estimated sediment from the varied sources is calculated in spreadsheet three. County and private road data are supplied in sheet four.

Assessment of Model's Conservative Estimate:

Several conservative assumptions were made in the model construction, which cause it to develop conservatively high estimations of sedimentation of the streams modeled. These assumptions are listed in the following paragraphs and a numerical assessment of the magnitude of the conservatism is assigned.

The model uses RUSLE and forest sediment yield coefficients to develop land use sediment delivery estimates. The output values are treated as delivery to the stream. The RUSLE assumes delivery if the slope assessed is immediately up gradient from the stream system. This is not the case on the majority of the agricultural land assessed. Estimates made in the Lake Creek Sediment Study indicate that at most 25% of the erosion modeled was delivered as sediment to the stream (Bauer, Golden, and Pettit 1998). A similar local estimate has not been made with sediment yield coefficients, but it is likely that this estimate would be 25% as well. The land use model component is 75% conservative.

The roads crossing component of the model assumes 100% delivery of fine sediment from the 200 feet on either side of a stream crossing. It is more likely that some fine sediment remains in ditches. A reasonable level of delivery is 80%. The model is likely 20% conservative in this component. On Belt terrain, use of the McGreer model is conservative. Since the sediment yield coefficients measured in-stream for Kaniksu granites is 167% of the coefficient for Belt terrain, this factor is estimated to be 67% conservative.

Road encroachment is defined as the existence of a road within 50 feet of either side of the stream, primarily because this is near the resolution of commonly used GIS mapping techniques. A road 50 feet from a stream, but on a side hill, would not affect the stream gradient. The model is likely incorrect on encroachment 20% of the time and is conservative by this factor.

Fill failure data is developed from actual CWE field assessments. The CWE assessment does not assess all the roads in the watershed. The failure rate data is scaled up by the factor of the roads assessed divided into the actual watershed road mileage. The roads assessed are typically those remote from the stream system, which are very unlikely to deliver sediment to the stream. The percentage of watershed roads assessed varies, but it is commonly 60% or less of the watershed roads. The model is 40% conservative in this component.

Table B-1 summarizes the conservative assumptions and assesses its numerical level of over-estimation.

Table C-1. Conservative estimate of stream sedimentation provided by the sediment model.

Model Factor	Kaniksu Granites (% Conservative)	Belt Supergroup (% Conservative)
100% RUSLE[1] and forest land sediment yield delivery	75%	75%
Crossing delivery	29%	20%
McGreer model	0%	67%
Road encroachment at 50 feet	20%	20%
Road failure	40%	40%
Total overestimate	164%	231%

[1] Revised Universal Soil Loss Equation

The model provides an overestimate by factors of 1.6 and 2.3 for the Kaniksu and Belt terrain, respectively. This overestimation is a built-in margin of safety.

Model Verification:

Some verification of the model can be developed by comparing measured sediment loads with those predicted by the model. For example, the U.S. Geological Survey measured sediment load at the Enaville Station on the Coeur d'Alene River during water year 1999. Based on these measured estimates, the sediment load per square mile of the basin above this point was calculated to be 28 tons (URS Greiner 2001). The middle value of the Belt geology sediment yield coefficient range is 14.7 tons per square mile. The model outputs for several watersheds of the North Fork Coeur d'Alene River are provided in Table B-2. The model predicted a sediment yield of 33.6 tons/square mile for the entire subbasin. The agreement between the measured estimates and the modeled estimates is good.

Table C-2. Modeled sediment output from selected North Fork Coeur d'Alene River watersheds, reflecting agreement between measured estimates and modeled estimates.

Watershed	Square miles	Modeled sediment (tons)	Tons/square mile
Deer	10.0	153.1	15.3
Alden	7.9	158.5	20.1
Independence	59.5	1,156.1	19.4
Trail	25.2	976.1	38.7
Flat	17.6	711.9	40.5
Prichard	53.6	1,636.5	30.6
Burnt Cabin	28.8	1,325.7	46.0
Skookum	7.1	191.2	26.9
Bumblebee	24.9	901.2	36.2
Streamboat	41.4	1,955.3	47.2
Graham	9.3	138.4	14.9
Little North Fork	169.0	6,769.2	40.1
North Fork Total[1]	903.2	30,369.7	33.6

[1]Total includes watersheds not listed above.

References Cited

Bauer, S.B., J. Golden, and S. Pettit. 1998. Lake Creek Agricultural Project, Summary of Baseline Water Quality Data. Pocketwater Incorporated, Boise, ID. 138 pp.

Erosion and Sediment Yield: Channel Evaluation Workshop. 1983. Ventura, CA. 54 pp.

Hogan, M. 1998. Personal Communication. Soil Loss Estimates Methodology Using the RUSLE Method. Natural Resource Conservation Service, Coeur d'Alene, ID.

McClelland, D.E., et al. 1997. Assessment of the 1995 and 1996 Floods and Landslides on the Clearwater National Forest, Part I: Landslide Assessment. A Report to the Regional Forester, Northern Region, U.S. Forest Service, Coeur d'Alene, ID.

McGreer, D. 1998. Personal Communication of Results of the LaClerc Creek Assessment of Road Surface Erosion as Related to CWE Scores. Western Watershed Analysts, Lewiston, ID.

Rosgen, D.L. 1985. A Stream Channel Classification System. In: Riparian Ecosystems and their Management Reconciling Conflicting Uses. USDA-Forest Service, General Technical Report RM-120. 91-95 pp.

Sandlund, R. 1999. Personal Communication. RUSLE Modeling Results on County and Private Roads. Natural Resource Conservation Service, Grangeville, ID.

URS Greiner. 2001. Final Remedial Investigation Report Coeur d'Alene River Basin Remedial Investigation/Feasibility Study. CSM Unit-2 mid-gradient watersheds North Fork Coeur d'Alene River, section 3 sediment fate and transport. URS Corp, Seattle, WA.

U.S. Department of Agriculture. 1994. State Soil Geographic (STATSGO) database for Idaho. U.S. Department of Agriculture, Fort Worth, Texas

USFS. 1994. WATSED - Water and Sediment Yield Mode. Developed by Range, Air, Watershed, and Ecology Staff Unit, Region 1, USDA-Forest Service and Montana Cumulative Watershed Effects Cooperative.

Appendix D

Sediment Model Spreadsheets

Appendix D. Sediment Model Spreadsheets

Table D-1. St. Maries west side watersheds land use.

St. Maries West Side Watersheds Land Use

Watershed	Alder[1]	John	Santa	Santa Sidewalls	Charlie	Tyson	Carpenter	Emerald	West Fork Sidewalls	West Fork	Cats Spur	Carlin	Sheep	Childs	Cedar
Agricultural Land (ac)	1,080	0	2,379	825	952	303	1,129	1,125	0	774	0	0	0	0	0
Forest Land (ac)	9,408	12,666	13,648	7,584	15,423	5,327	9,966	15,925	3,683.9	8,511	7,283	1,801	1,455	3,046	2,115
Unstocked forest (ac)	4506	1,922	499	2,906	702	1,329	1,196	2,102	736	1,083	0	0	0	0	0
Double Fires (ac)	0	0	0	0	2,046	172	0	350	0	0	0	0	0	0	0
Highway (ac)	0	0	108	0	0	0	0	0	25	29	0	0	0	0	0
	14,994	14,588	16,634	11,315	19,123	7,131	12,291	19,502	4,445	10,397	7,283	1,801	1,455	3,046	2,115
Road Data															
Forest Roads (mi)	157.7	148.5	138.2	126.3	84.3	75.1	126.9	216	46.5	101.6	84	19	25.7	44.4	11.6
Ave. Road Density (mi/sq mi)	6.73123	6.51473	5.31730	7.1438	2.8213	6.7401	6.6078	7.0885	6.6953	6.2541	7.3816	6.7518	11.304	9.3289	3.5102
Road Crossing Number	176	217	532	360	273	192	290	392	60	429	103	14	8	68	12
Road Crossing Freq.	1.11604	1.46128	3.84949	2.8503	3.2384	2.5566	2.2853	1.8148	1.2903	4.2224	1.2262	0.7368	0.3113	1.5315	1.0345
Mass Failure (tons/yr)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Encroaching Forest Roads (mi)	9.37	11.34	16.441	12.19	8.08	5.4	10.651	15.22	2.096	13.113	4.352	0.929	0.239	2.315	0.754
Mean Bank full Width + two 3 foot banks	21.4	9	16	12.7	12.7	9	9.3	13.3	9.3	13.3	13.3	21.4	12	19.9	18.3
CWE Score	12 [2]	14	13	13	10	15	15	12	24	24	24	15	13	12	10
Tons/Mile CWE	2.6	3.031	2.8158	2.8	2.2	3.3	3.3	2.6124	6.5	6.5	6.5	3.261	2.8158	2.6124	2.229
Miles CWE[3]	0	33.8	21.9	25.3	32.1	17.4	9.9	25.8	1	13.4	1	0.1	0.1	0.1	0.1

[1]Acreage supplied by the Coeur d'Alene Tribal staff.
[2]CWE values extrapolated from John Creek.
[3]The Carlin Creek CWE Score and Bank full Width + two, 3 foot Banks values assumed according to Alder Creek and Alder-Joe Watersheds. Flat and Soldier Creeks CWE Score and Bank full Width + two, 3 foot Banks values assumed according to Thorn Creek and Beaver-Alder Watersheds. Sheep Creek CWE Score and Bank full Width + two, 3 foot Banks values assumed according to Tyson Creek and Tyson-Beaver values. The Childs Creek CWE Score and Bank full Width + two, 3 foot Banks values assumed according to Clarkia-Childs and Childs-Tyson Watersheds. Blair and Cedar Creeks CWE Score and Bank full Width + two, 3 foot Banks values assumed according to Clarkia-Childs Watershed.

Table D-2. St. Maries River west side segments sediment yield.[1]

St. Maries River West Side Segments Sediment Yield

Watershed	Alder	John	Santa	Santa Sidewalls	Charlie	Tyson	Carpenter	Emerald	West Fork Sidewalls	West Fork	Cats Spur	Carlin	Sheep	Childs	Cedar
Agriculture (tons/yr)(fine)	32.4	0.0	130.8	45.4	57.1	27.3	101.6	22.5	0.0	41.8	0.0	0.0	0.0	0.0	0.0
Conifer Forest (tons/yr)(fine)	159.0	214.1	255.5	125.1	291.9	74.9	210.7	348.1	109.6	143.3	115.8	30.4	20.4	65.2	45.2
(coarse)	57.3	77.2	58.4	49.4	62.8	47.7	18.6	161.5	8.3	129.1	117.2	11.0	13.0	4.9	3.4
Unstocked Forest (tons/yr)(fine)	89.4	38.1	11.0	56.3	15.6	21.9	29.7	57.4	27.4	22.8	0.0	0.0	0.0	0.0	0.0
(coarse)	32.2	13.8	2.5	22.2	3.4	14.0	2.6	26.7	2.1	20.5	0.0	0.0	0.0	0.0	0.0
Double Fires (tons/yr)(fine)	0.0	0.0	0.0	0.0	6.7	0.4	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(coarse)	0.0	0.0	0.0	0.0	1.4	0.3	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highway (tons/yr)(fine)	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.6	0.4	0.0	0.0	0.0	0.0	0.0
(coarse)	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0
Total Yield (tons/yr)(fine)	280.9	252.3	398.9	226.7	371.4	124.5	341.9	429.4	137.6	208.2	115.8	30.4	20.4	65.2	45.2
(coarse)	89.6	91.0	61.3	71.6	67.6	61.9	21.2	188.9	10.4	150.0	117.2	11.0	13.0	4.9	3.4

County, Forest, and Private Road Sediment Yield

Watershed	Alder	John	Santa	Santa Sidewalls	Charlie	Tyson	Carpenter	Emerald	West Fork Sidewalls	West Fork	Cats Spur	Carlin	Sheep	Childs	Cedar
Forest Road															
Surface fine sediment (tons/yr)	34.7	49.8	113.5	76.4	45.5	48.0	72.5	77.6	29.5	211.3	50.7	3.5	1.7	13.5	2.0
Road failure fines (tons/yr) [2]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Road failure coarse (tons/yr) [2]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Encroachment fines (tons/yr) [3]	131.5	66.9	191.0	99.0	75.3	26.5	81.2	123.3	16.2	81.8	25.7	13.0	1.6	38.2	11.4
Encroachment coarse (tons/yr) [3]	47.4	24.1	43.6	39.1	16.2	16.9	7.2	57.2	1.2	73.7	26.0	4.7	1.0	2.9	0.9
Total Fine Yield (tons/yr)	166.1	116.7	304.5	175.4	120.8	74.5	153.7	200.9	45.7	293.1	76.4	16.5	3.3	51.7	13.5
Total Coarse Yield (tons/yr)	47.4	24.1	43.6	39.1	16.2	16.9	7.2	57.2	1.2	73.7	26.0	4.7	1.0	2.9	0.9
Total Sediment (tons/yr)	584.0	484.1	808.3	512.7	576.0	277.7	524.0	876.4	194.9	725.0	335.4	62.6	37.7	124.6	63.0
Percent Fines[4]	0.735	0.735	0.814	0.717	0.823	0.611	0.919	0.683	0.93	0.526	0.497	0.735	0.611	0.93	0.93
Percent Coarse	0.265	0.265	0.186	0.283	0.177	0.389	0.081	0.317	0.07	0.474	0.503	0.265	0.389	0.07	0.07

Table D-2, continued.

Belt Yield Coeff.	Meto-Belt (tons/ac/year)		Ag coeff.	t/ac/yr
			John	0.03
0.023	0.032	forest	Santa+Sidewalls	0.055
			Charlie	0.06
0.027	0.04	unstocked	Tyson	0.09
			Carpenter	0.09
0.004	0.006	double fire	Emerald	0.02
			West Fork+Sidewalls	0.054
0.018	0.026	highway	Catspur	0.02

[1]John Creek CWE scores and STATSCO soils and ag coefficients applied to Alder Creek. Percent fines and percent coarse values for Carlin Creek are estimated based on Alder and John Creeks Watershed values. Percent fines and percent coarse values for Flat and Soldier Creeks are estimated based on Thorn Creek Watershed values. Percent fines and percent coarse values for Sheep Creek are estimated based on Tyson Creek Watershed values. Percent fines and percent coarse values for Childs, Blair, and Cedar Creeks are estimated based on Clarkia-Childs Watershed values.

[2] From weighted average of fines and stones in soils groups.

[3] Uses mass failure and delivery rates developed from CWE protocol pro-rated for road miles and annualized tons delivered x (road mileage/road mileage assessed)/10 years.

[4] Assume: 0.25” from 3-foot banks; density = 2.6 g/cc

0.020833 0.25" yr/12"

8098662 Q24*y*5280*28317cc/ft3*2.6 g/cc = g/10 year

0.891923 t/mile

Table D-3. St. Maries west side watersheds sediment export.

Subwatershed	Alder	John	Santa	Santa Sidewalls	Charlie	Tyson	Carpenter	Emerald	West Fork Sidewalls	West Fork	Cats Spur	Carlin	Sheep	Childs	Cedar
Land use fines export (tons/yr)	280.9	252.3	398.9	226.7	371.4	124.5	341.9	429.4	137.6	208.2	115.8	30.4	20.4	65.2	45.2
Land use coarse export (tons/yr)	89.6	91.0	61.3	71.6	67.6	61.9	21.2	188.9	10.4	150.0	117.2	11.0	13.0	4.9	3.4
Road fines export (tons/yr)	166.1	116.7	304.5	175.4	120.8	74.5	153.7	200.9	45.7	293.1	76.4	16.5	3.3	51.7	13.5
Road coarse export (tons/yr)	47.4	24.1	43.6	39.1	16.2	16.9	7.2	57.2	1.2	73.7	26.0	4.7	1.0	2.9	0.9
Bank erosion fines (tons/yr)	53.7	20.9	580.0	0.0	237.8	24.1	113.8	85.8	0.0	222.1	0.0	0.0	0.0	0.0	0.0
Bank erosion coarse (tons/yr)	19.4	7.5	132.5	0.0	51.2	14.1	10.0	39.2	0.0	6.3	0.0	0.0	0.0	0.0	0.0
Total fines export (tons/yr)	500.7	389.9	1283.4	402.1	730.0	223.1	609.4	716.1	183.3	723.4	192.2	46.9	23.7	116.8	58.7
Total coarse export (tons/yr)	156.4	122.6	237.4	110.6	135.0	92.8	38.3	285.3	11.6	230.0	143.2	15.7	14.0	7.8	4.3
Total (tons/yr)	657.1	512.5	1520.8	512.7	865.0	315.9	647.8	1001.4	194.9	953.4	335.4	62.6	37.7	124.6	63.0
Natural Background	344.9	335.5	380.1	260.2	392.8	160.1	282.7	612.9	141.4	331.8	233.1	41.4	33.5	70.1	48.6
Percent above background	90.5	52.7	300.1	97.0	120.2	97.4	129.1	63.4	37.8	187.4	43.9	51.2	12.7	77.9	29.5

Table D-4. St. Maries east side watersheds land use.

St Maries East Side Watersheds

Land Use

Watershed	Thorn	Beaver	Renfro	Crystal	Merry	Flewsie	Gold Center	Middle Fork Sidewalls	Middle Fork	Olson	Adams	Flat	Soldier	Blair
Agricultural Land (ac)	51	0	214	0	0	0	0	0	1,300	0	0	0	0	0
Forest Land (ac)	9,373	3,242	10,096	4,632	9,310	1,604	9,121	4,816	6,824	5,720	1,670	6,636	2,204	1,745
Unstocked Forest (ac)	1,390	1,052	276	371	2,239	187	967	1.7	2,628	0	0	0	0	0
Double Fires (ac)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Highway (ac)	33	0	0	0	0	0	0	0	0	0	0	0	0	0
	10,847	4,294	10,586	5,003	11,549	1,791	10,088	4,817.7	10,752	5,720	1,670	6,636	2,204	1,745

Table D-4, continued.

Watershed	Thorn	Beaver	Renfro	Crystal	Merry	Flewsie	Gold Center	Middle Fork Sidewalls	Middle Fork	Olson	Adams	Flat	Soldier	Blair
Forest Roads (mi)	143	44.1	97.6	47.5	184.3	30.9	63.6	52	104	47	11.9	49	31	22.9
Ave. Road Density (mi/sq mi)	8.437356	6.572892	5.90062	6.076354	10.2131	11.04188	4.034893	6.90786	6.190476	5.258741	4.560479	4.7257	9.0018	8.3988
Road Crossing Number	193	56	136	57	184	34	76	30	148	65	28	49	35	19
Road Crossing Freq.	1.34965	1.269841	1.39344	1.2	0.99837	1.100324	1.194969	0.57692	1.423077	1.382979	2.352941	1	1.1290	0.8297
Mass Failure (tons/yr)	0	0	0	0	0	0	10	0	5	0	0	0	0	0
Encroaching Forest Roads (mi)	10.364	2.23	4.96	1.52	8.96	1.22	2.685	1.9	5.9	0.891	1.56	2.46	1.86	0.646
Mean Bank full width + two 3 foot banks	10.3	10.3	11.3	9.3	16	9.3	14.2	12.7	16.5	13.5	13.5	10.3	10.3	18.3
CWE Score	18	14	13	26	12	16	16	16	13	22	22	17	17	10
Tons/Mile CWE	4.1	3	2.8	7.6	2.6	3.5	3.5	3.5	2.8	0	0	3.7774	3.7774	2.229
Miles CWE	20.6	7.1	15	17.5	26.8	11.8	8.3	0.1	36.2	0.1	0.1	0.1	0.1	0.1

Table D-5. St. Maries River east side watershed sediment yield.[1]

St. Maries River East Side Watershed Sediment Yield

Watershed	Thorn	Beaver	Renfro	Crystal	Merry	Flewsie	Gold Center	Middle Fork Sidewalls	Middle Fork	Olson	Adams	Flat	Soldier	Blair
Agriculture (tons/yr)(fine)	1.5	0.0	12.8	0.0	0.0	0.0	0.0	0.0	71.5	0.0	0.0	0.0	0.0	0.0
Conifer Forest (tons/yr)(fine)		150.3	57.9	129.3	56.5	199.1	34.3	195.1	103.0	91.2	69.7	148.0	49.2	37.3
(coarse)	65.3	16.6	102.9	50.1	15.0	2.6	14.7	7.8	65.8	61.8	18.1	64.3	21.4	2.8
Unstocked Forest (tons/yr)(fine)	26.2	22.1	4.2	5.3	56.2	4.7	24.3	0.0	41.2	0.0	0.0	0.0	0.0	0.0
(coarse)	11.4	6.3	3.3	4.7	4.2	0.4	1.8	0.0	29.7	0.0	0.0	0.0	0.0	0.0
Double Fires (tons/yr)(fine)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(coarse)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highway (tons/yr)(fine	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(coarse)	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Yield (tons/yr)(fine)	178.4	80.0	146.3	61.8	255.4	39.0	219.4	103.1	203.9	69.7	20.4	148.0	49.2	37.3
(coarse)	76.9	23.0	106.2	54.8	19.2	2.9	16.5	7.8	95.5	61.8	18.1	64.3	21.4	2.8

Table D-5, continued.

County, Forest, and Private Road Sediment Yield

Watershed	Thorn	Beaver	Renfro	Crystal	Merry	Flewsie	Gold Center	Middle Fork Sidewalls	Middle Fork	Olson	Adams	Flat	Soldier	Blair
Forest road														
Surface fine sediment (tons/yr)	59.9	12.7	28.8	32.8	36.2	9.0	20.2	8.0	31.4	0.0	0.0	14.0	10.0	3.2
Road failure fines (tons/yr)[2]	0.0	0.0	0.0	0.0	0.0	0.0	7.1	0.0	0.8	0.0	0.0	0.0	0.0	0.0
Road failure coarse (tons/yr)[2]	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.6	0.0	0.0	0.0	0.0	0.0
Encroachment fines (tons/yr)[3]	66.4	15.9	27.8	6.7	118.9	9.4	31.6	20.0	50.4	5.7	10.0	15.8	11.9	9.8
Encroachment coarse (tons/yr)[3]	28.8	4.6	22.1	5.9	9.0	0.7	2.4	1.5	36.4	5.0	8.8	6.8	5.2	0.7
Total fine yield (tons/yr)	126.3	28.6	56.7	39.5	155.2	18.4	58.9	28.0	82.7	5.7	10.0	29.8	21.9	13.0
Total coarse yield (tons/yr)	28.8	4.6	22.1	5.9	9.0	0.7	2.9	1.5	37.0	5.0	8.8	6.8	5.2	0.7
Total sediment (t/yr)	440.5	136.2	399.0	164.5	438.7	61.1	305.3	140.3	664.3	142.3	57.2	249.0	97.6	53.9
Percent fines[4]	0.697	0.777	0.557	0.53	0.93	0.93	0.93	0.93	0.581	0.53	0.53	0.697	0.697	0.93
Percent coarse	0.303	0.223	0.443	0.47	0.07	0.07	0.07	0.07	0.419	0.47	0.47	0.303	0.303	0.07

Belt Yield Coeff.	Meto-Belt (tons/ac/year)		Ag Coeff	(t/ac/yr)
			Thorn	0.03
0.023	0.032	forest	Beaver	NA
			Renfro	0.06
0.027	0.04	unstocked	Crystal	NA
			Merry	0.02
0.004	0.006	double fire	Flewsie	NA
			Gold Center	0.02
0.018	0.026	highway	Middle Fork + Sidewalls	0.055

[1]Percent fines and percent coarse values for Olson and Adams Creeks are estimates based on the adjacent Crystal Creek Watershed Values.

[2]Uses mass failure and delivery rates developed from CWE protocol pro-rated for road miles and annualized tons deliv

[3]Assume: one -quarter inch from three feet banks; density = 2.6 g/cc.

0.020833	0.25"yr/12"
	Q24*y*5280*28317cc/ft3*2.6
8098662	g/cc = g/10 yr
9080000	454g/lb* 2000 lb/t*10 year
0.891923	t/mile

[4]From weighted average of fines and stones in soils groups.

Table D-6. St. Maries River east side watersheds sediment export.

St. Maries River East Side Watersheds Sediment Export

Watershed	Thorn	Beaver	Renfro	Crystal	Merry	Flewsie	Gold Center	Middle Fork Sidewalls	Middle Fork	Olson	Adams	Flat	Soldier	Blair
Land use fines export (tons/yr)	178.4	80.0	146.3	61.8	255.4	39.0	219.4	103.1	203.9	69.7	20.4	148.0	49.2	37.3
Land use coarse export (tons/yr)	76.9	23.0	106.2	54.8	19.2	2.9	16.5	7.8	95.5	61.8	18.1	64.3	21.4	2.8
Road fines export (tons/yr)	126.3	28.6	56.7	39.5	155.2	18.4	58.9	28.0	82.7	5.7	10.0	29.8	21.9	13.0
Road coarse export (tons/yr)	28.8	4.6	22.1	5.9	9.0	0.7	2.9	1.5	37.0	5.0	8.8	6.8	5.2	0.7
Bank erosion fines (tons/yr)	21.0	0.0	37.7	1.3	0.0	0.0	7.1	0.0	142.5	0.0	0.0	0.0	0.0	0.0
Bank erosion course (tons/yr)	9.1	0.0	30.0	1.2	0.0	0.0	0.5	0.0	102.7	0.0	0.0	0.0	0.0	0.0
Total fines export (tons/yr)	325.7	108.7	240.7	102.6	410.5	57.4	285.4	131.0	429.1	75.4	30.3	177.8	71.1	50.3
Total coarse export (tons/yr)	114.8	27.5	158.3	61.9	28.2	3.6	19.9	9.3	235.2	66.9	26.9	71.2	26.5	3.5
Total (tons/yr)	440.5	136.2	399.0	164.5	438.7	61.1	305.3	140.3	664.3	142.3	57.2	249.0	97.6	53.9
Natural Background	248.7	98.8	243.5	115.1	265.6	41.2	232.0	110.8	247.3	131.6	38.4	212.4	70.5	40.1
Percent Above Background	77.1	37.9	63.9	42.9	65.2	48.3	31.6	26.6	168.6	8.2	48.9	17.2	38.4	34.3

Table D-7. St. Maries immediate watersheds land use.

St Maries Immediate Watersheds Land Use

Subwatershed	Clarkia-Childs	Childs-Tyson	Tyson-Beaver	Beaver-Alder	Alder-Mouth
Agricultural Land (ac)	87	845	0	0	515
Forest Land (ac)	4,472	9,565	2,363	6,345	10,159
Unstocked Forest (ac)	287.7	728	339	1,783	1,297
Double Fires (ac)	0	0	0	0	0
Highway (ac)	37	54	20	45	13
	4,883.7	11,192	2,722	8,173	11,984
Road Data					
Forest roads (mi)	64.7	106.1	34.6	66.6	121.6
Ave. road density (mi/sq mi)	8.4788173	6.067191	8.135195	5.215221	6.493992
Road crossing number	90	192	34	83	115

Table D-7, continued.

Watershed	Clarkia-Childs	Childs-Tyson	Tyson-Beaver	Beaver-Alder	Alder-Mouth
Road crossing freq.	1.39103555	1.809614	0.982659	1.246246	0.945724
Mass Failure (tons/yr)	0	0	0	0	20
Encroaching Forest Roads (mi)	3.747	7.244	2.1	4.178	4.9
Mean Bank full width + two 3 foot banks	18.3	21.4	21.4	21.4	21.4
CWE score	10	14	12	16	17
Tons/Mile CWE	2.2	3.0	2.6	3.5	3.8
Miles CWE	7	11.8	6.2	2.3	8.1

Table D-8. St. Maries River immediate watershed sediment yield.

St. Maries River Immediate Watershed Sediment Yield

Watershed	Clarkia-Childs	Childs-Tyson	Tyson-Beaver	Beaver-Alder	Alder-Mouth
Agriculture (tons/yr)(fines)	5.2	50.7	0.0	0.0	30.9
Conifer Forest (tons/yr)(fine)	95.7	174.7	49.6	123.0	189.5
(coarse)	7.2	45.3	4.7	22.9	44.2
Unstocked Forest (tons/yr)(fine)	7.2	15.6	8.4	40.6	28.4
(coarse)	0.5	4.0	0.8	7.6	6.6
Double Fires (tons/yr)(fine)	0.0	0.0	0.0	0.0	0.0
(coarse)	0.0	0.0	0.0	0.0	0.0
Highway (tons/year) (fine)	0.6	0.8	0.3	0.7	0.2
(coarse)	0.0	0.2	0.0	0.1	0.0
Total Yield (tons/yr)(fine)	108.7	241.8	58.3	164.3	249.0
(coarse)	7.8	49.6	5.6	30.6	50.8

County, Forest and Private Road Sediment Yield

Watershed	Clarkia-Childs	Childs-Tyson	Tyson-Beaver	Beaver-Alder	Alder-Mouth
Forest road					
Surface fine sediment (tons/yr)	15.0	43.6	6.7	22.0	33.1
Road failure fines (tons/yr) [1]	0.0	0.0	0.0	0.0	24.4
Road failure coarse (tons/yr) [1]	0.0	0.0	0.0	0.0	5.7

Table D-8, continued.

Watershed	Clarkia-Childs	Childs-Tyson	Tyson-Beaver	Beaver-Alder	Alder-Mouth
Encroachment fines (tons/yr) [2]	56.9	109.8	36.6	67.2	75.9
Encroachment coarse (tons/yr) [2]	4.3	28.5	3.5	12.5	17.7
Total fine yield (tons/yr)	71.9	153.4	43.3	89.2	133.3
Total coarse yield (tons/yr)	4.3	28.5	3.5	12.5	23.4
Total sediment (tons/yr)					
Percent fines[3]	0.93	0.794	0.913	0.843	0.811
Percent Coarse	0.07	0.206	0.087	0.157	0.189

[1]Uses mass failure and delivery rates developed from CWE protocol pro-rated for road miles and annualized tons delivered x (road mileage/road mileage assessed)/10 years.
[2]Assume: one -quarter inch from three feet banks; density = 2.6 g/cc.

0.020833	0.25"yr/12"
8098662	Q24*y*5280*28317cc/ft3*2.6 g/cc = g/10 year
9080000	454g/lb* 2000 lb/t*10 year
0.891923	t/mile

[3]From weighted average of fines and stones in soils groups.

Table D-9. St. Maries River immediate watersheds sediment export.

St. Maries River Immediate Watersheds Sediment Export

Watershed	Clarkia-Childs	Childs-Tyson	Tyson-Beaver	Beaver-Alder	Alder-Mouth
Land use fines export (tons/yr)	108.7	241.8	58.3	164.3	249.0
Land use coarse export (tons/yr)	7.8	49.6	5.6	30.6	50.8
Road fines export (tons/yr)	71.9	153.4	43.3	89.2	133.3
Road coarse export (tons/yr)	4.3	28.5	3.5	12.5	23.4
Bank erosion fines (tons/yr)	529.4	452.0	0.0	0.0	0.0
Bank erosion coarse (tons/yr)	39.8	117.3	0.0	0.0	0.0
Total fines export (tons/yr)	710.0	847.2	101.6	253.5	382.3
Total coarse export (tons/yr)	51.9	195.4	9.0	43.1	74.2
Total (tons/yr)	761.9	1042.5	110.6	296.6	456.5
Natural Background	111.5	256.2	62.1	186.9	275.3
Percent Above Background	583.4	307.0	78.0	58.7	65.8

Appendix E

Distribution List

Appendix E. Distribution List

Department of Environmental Quality, State Office

Environmental Protection Agency

St. Joe Watershed Advisory Group (WAG) participants, including:

Name	Affiliation
Mark Addy	Natural Resources Conservation Service
Bob Anderson	Avista Corporation
George Bain	United States Forest Service
Dee Bailey	Coeur d'Alene Tribe
Fred Bear	Idaho Department of Parks and Recreation
Tony Bennett	Idaho Soils Conservation Commission
Lew Brown	Bureau of Land Management
Jack Buell	Benewah County Commissioner
Marti Calabretta	Idaho State Senator
Jon Cantamessa	Shoshone County Commissioner
Jerry Collins	Idaho Conservatoin League
John Ferris	Small Timber Grower
Scott Fields	Coeur d'Alene Tribe
Bob Flagor	Benewah Soil and Water Conservation District/Shoshone Soil and Water Conservation District
Bart Gingerich	Klaveano Ranch
Dolly Hartman	St. Joe Valley Association
Ray Hennekey	Idaho Department of Fish and Game
Dave Johnson	Benewah County Commissioner
Dean Johnson	Idaho Department of Lands
Jim Kingery	University of Idaho
Norm Linton	Potlatch Corporation
Mark Liter	Idaho Department of Fish and Game
Russell Lowry	Citizen
John Macy	United States Forest Service
Bud McCall	Benewah County Commissioner
Jeff McCreary	Ducks Unlimited
Mike Mihelich	Kootenai Environmental Alliance
Alfred Nomee	Coeur d' Alene Tribe
Steve Osburn	Emerald Creek Garnet
Tasha Ozark	Benewah Soil and Water Conservation District
Dell Rust	Idaho Farm Bureau
Fred Schoenick	Benewah Cattlemen's Association
Kelly Scott	Benewah Soil and Water Conservation District
Phoebe Shelden	Benewah Soil and Water Conservation District
Neil Smith	Potlatch Corporation
John Straw	Crown Pacific Inland
Greg Tourtlotte	Idaho Department of Fish and Game
Larry Wright	Potlatch Corporation

Appendix F

Public Comments

Appendix F. Public Comments

Table F-1 summarizes the public comments received regarding the St. Maries River Subbasin Assessment and Total Maximum Daily Loads and DEQ's response to these comments.

Table F-1. Public comments and responses to the St. Maries River Subbasin Assessment and Total Maximum Daily Loads.

Source and Comments	DEQ's Response to Comments
Kootenai Environmental Alliance (KEA)	
KEA 1: The final assessment should state how much of the Floodwood State Forest is in the St. Maries Subbasin.	The Floodwood State Forest is wholly contained in the Little North Fork Clearwater Subbasin. It was not deemed necessary to note this fact.
KEA 2: The final assessment should supply data on how much land of the largest three owners/managers is in the rain-on-snow zone.	Since rain-on-snow is a trigger (not a cause of erosion) such information does not appear relevant.
KEA 3: The final assessment and TMDL should supply a detailed assessment of the sediment risk model used by the USFS.	It is not the purpose of the Subbasin Assessment (SBA) or the TMDL to assess the methods not used in the SBA or TMDL. As part of implementation plan development a technical group might want to make the suggested assessment, if the USFS proposed to use the model to assess proposed sediment reductions.
KEA 4: The relationship between CWE analysis of roads and roads in rain-on-snow prone topography is not made in the SBA.	The CWE analysis analyzes the watershed for several factors, among which are the location and condition of roads and sediment yield from those roads or failures to the stream. In all this analysis CWE examines the conditions as they existed when the survey was completed. Rain-on-snow events are transient phenomena that have their genesis most often in the elevation range of 3,300 to 4,500 feet. We know of no direct relationship between CWE and rain-on-snow events. Specifically CWE does not identify roads or other features in this guideline elevation range. Although rain-on-snow events may be a trigger for erosion related to

	roads, the location and condition of the roads and road features as measured by CWE is the primary factor. The watersheds developed under periodic rain-on-snow conditions as a stressor. This has not changed. The placement of roads on the landscape is what has changed.
KEA 5: Road obliteration should be defined.	In earlier documents, road decommissioning was used as the term of choice. This is defined as culvert removal and lay back of slopes at crossings that are part of the active stream channel or expected to be during high discharge conditions and ripping of the road to the first cross drain that vents to forest floor in both directions from that crossing. It does not require total road obliteration. This definition will be placed as a minimum for road removal.
KEA 6: Specific regulations for TMDL monitoring should be stated.	The regulations under which the SBA and TMDLs were developed and implemented are cited in the SBA and TMDLs. If monitoring is not required by these cited regulations it is so stated by inference.
United States Forest Service (USFS)	
USFS 1: Road coverages used are not up to date.	DEQ and Idaho Department of Lands update the roads coverage periodically. In the time frame of SBA development roads coverage may change. This is a mechanical problem. The implementation plan should catch any changes to the positive or negative and credit or delete the analogous loadings accordingly.
USFS 2: Background stream bank erosion measurements have not been made.	Background stream bank erosion has not been accounted for to date. The NRCS is exploring methods for accomplishing this, but to date has found them unsatisfactory. Such background erosion is considered in the basin wide export coefficients.
USFS 3: Temperature standards require revision before 303(d) listings and TMDL development.	The data available in this and other SBAs call the temperature standards into question. This matter was examined by the EPA and three states in EPA Region 10 (Idaho, Oregon, and Washington). The states and EPA did not alter the standard except to add a natural background consideration to it. Thus, the standard remains in place and must

	be addressed by both 303(d) listing and TMDL preparation. The states, including Idaho, are working with the USFS to identify INFISH in forest plans as water quality protection Best Management Practices (BMPs) that include thermal protection. If actions such as INFISH management of a stream are implemented, and the forest plan specifically states that BMPs are in place to meet state water quality standards, and fully meet existing and designated beneficial uses, listing may not be required.
Idaho Department of Lands (IDL)	
IDL 1: The agencies are set up by the temperature standards to fail. The TMDLs will not be achievable or will not achieve the standard.	The temperature standard now has natural background conditions language as a default if the absolute standard cannot be met. Given this language, the temperature TMDLs very quickly point out that stream canopy coverage is the only factor that can reasonably be managed on the landscape and that, on some landscapes, site or vegetation conditions preclude or restrict shading. Thus the TMDLs are designed to provide full shading where this is possible and to identify those areas where less than 100% shading is possible. The state believes these TMDLs will provide thermal protection to the level of natural background. It is possible to manage stream canopy for the goals placed in the temperature TMDLs. Even natural loss of canopy shade can be included as natural background. The state believes these TMDLs are practical and achievable over time.
Coeur d’Alene Tribe (Tribe)	
Tribe 1: Multiple editorial comments.	All editorial comments were noted and corrected as necessary.
Tribe 2: Request addition of scientific names for flora and fauna.	Scientific names were added where requested.
Tribe 3: Is it possible to have a *warm* and heavy snow pack?	The descriptive term “warm” was irrelevant and deleted.
Tribe 4: Are there mountain whitefish in the St. Maries River?	Yes. DEQ BURP data from 1996 show that multiple mountain whitefish were collected by electrofishing the St. Maries River.

Tribe 5: Does the Post Falls Dam influence the lower reaches of the St. Maries River?	DEQ has not determined the effects of the Post Falls Dam on the St. Maries River, and any possible effects appear to be irrelevant in terms of completing the TMDL.
Tribe 6: May want to explain foraging.	The descriptive term "foraging" was irrelevant and deleted.
Tribe 7. Is it necessary that the public know that (county) population is stable?	Yes. Population growth may affect watershed characteristics.
Tribe 8: Data show in Table 8-d is supposed to be collected from 1997 to the present. Why is the data from 1997 not included in the table?	The data collected in 1997 does not measure the same parameters shown in Table 8-d and could not be used to calculate the averages shown in that table. However, the 1997 data is included in Appendix B, Table B-2a.
Tribe 9: Don't believe Alder Creek should be listed as not supporting cold water aquatic life.	This stream will remain listed until conflicting data can be reconciled.
Tribe 10: In Table 16-c what are Highway Miles?	"Highway Miles" refers to total road miles. This term was changed to reflect its meaning.
Tribe 11: Would like a better description of how background sediment delivery is calculated.	This information can be found on pages 61-62.
Tribe 12: In regard to forest regeneration in the St. Maries basin, define "rapidly."	This paragraph has been changed to better reflect DEQ's position on soil erosion following disturbance, while addressing the term "rapidly".
Tribe 13: Would like to assume non-compliance with temperature criteria due to lack of monitoring data.	Non-compliance will not be assumed without sufficient data to support the non-compliance decision. This stream will remain not assessed until sufficient data are procured.
Tribe 14: Please provide further information on the Erosion and Sediment Yield in Channels workshop.	This statement refers to a technical work group made up of members from USFS, BLM, Idaho Department of Fish and Game, Potlach Corporation, The Lands Council, SCC, and chaired by Geoff Harvey, DEQ. The work group developed the sediment model process referred to in Appendix C.