Camas Creek Subbasin Assessment and Total Maximum Daily Load

Department of Environmental Quality

Final, August 2005

Camas Creek Subbasin Assessment and TMDL

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Abbreviations, Acronyms, and Symbols

§303(d)	Refers to section 303 subsection (d) of the Clean Water Act, or a list of impaired water bodies required by this section
µ	micro, one-one thousandth
§	Section (usually a section of federal or state rules or statutes)
ADB	assessment database
AU	assessment unit
AWS	agricultural water supply
BLM	United States Bureau of Land Management
BMP	Best Management Practice
BOD	biochemical oxygen demand
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
cfu	colony forming units
cm	centimeters
CWA	Clean Water Act
CWAL	cold water aquatic life
DEQ	Department of Environmental Quality
DO	dissolved oxygen
DWS	domestic water supply
EPA	United States Environmental Protection Agency
F	Fahrenheit
GIS	Geographical Information Systems
HUC	Hydrologic Unit Code
IDAPA	Refers to citations of Idaho administrative rules
IDFG	Idaho Department of Fish and Game
IDWR	Idaho Department of Water Resources
km	kilometer
km^2	square kilometer
kWh/day	kilowatt hours per day
LA	load allocation
LC	load capacity
m	meter
m^3	cubic meter
mi	mile
mi^2	square miles

mg/L milligrams per liter

mm millimeter

MOS margin of safety

n.a. not applicable

NA not assessed

NB natural background

NPDES National Pollutant Discharge Elimination System

NRCS Natural Resources Conservation Service

NTU nephlometric turbidity unit

PCR primary contact recreation

ppm part(s) per million

SBA subbasin assessment

SCR secondary contact recreation

SFI DEQ's stream fish index

SHI DEQ's stream habitat index

SMI DEQ's stream macroinvertebrate index

SS salmonid spawning

TIN total inorganic nitrogen

TMDL total maximum daily load

TP total phosphorus

TSS total suspended solids

t/yr tons per year

U.S. United States

U.S.C. United States Code

USDA United States Department of Agriculture

USFS United States Forest Service

USGS United States Geological Survey

WAG Watershed Advisory Group

WBAG *Waterbody Assessment Guidance*

WLA wasteload allocation

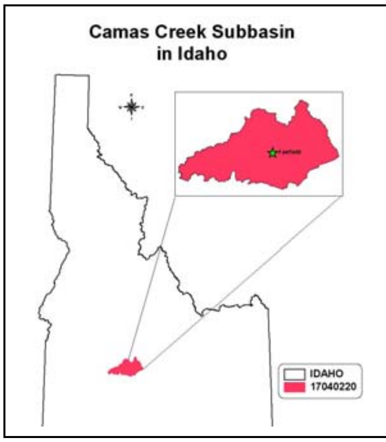
Executive Summary

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. 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 Camas Creek 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 Camas Creek Subbasin located in south central 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. Twelve segments of the Camas Creek 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

The Camas Subbasin lies in south central Idaho (Figure 1). Camas Creek is the main water body that drains the subbasin. The headwaters of the creek originate in the flat Camas Prairie, flow through the Camas Prairie, and then discharge into Magic Reservoir. There are two ecoregions within the subbasin: the headwaters of the tributaries that feed into Camas Creek from the north originate in the Northern Rockies, while the remainder of the subbasin lies in the Snake River Plain/high deserts. Transitional zones exist between the two ecoregions.



TMDL AT A GLANCE

Subbasin : Camas Creek Subbasin 17040220

Uses affected: Cold Water Aquatic Life
Salmonid Spawning
Secondary Contact Recreation

Pollutants: Temperature
Sediment
Nutrients
Bacteria

Figure 1. Subbasin at a glance.

Hydrologically there is a great deal of activity occurring within the subbasin:

- Snow runoff events in the spring months feed the water bodies. These runoff events are large and rapid as the majority of the tributaries drain south facing slopes.
- Ground water is likely to play an important role in maintaining perennial flows, as the majority of the subbasin lies over the Camas Prairie aquifer.
- Water in the creek is more likely to continue as surface flow if water tables are higher and prevent the surface water from dissipating into the ground.
- The land uses of the subbasin require the diversion of water from their natural channels and in the past have led to the straightening of many channels.
- Many of the perennial water bodies in the subbasin have segments that act more as intermittent streams.

Hydrology is the most important factor contributing to impacts in the water bodies of the Camas Creek Subbasin.

The land of the subbasin is used in a number of ways by a number of entities:

- The largest land use coverage within the subbasin is rangeland followed by dry land agriculture.
- The largest land ownership coverage within the subbasin is private land followed by federally managed public lands.
- The largest vegetation coverage within the subbasin is shrub land followed by agricultural land.
- Most activity within the subbasin is nonpoint source activity.
- The City of Fairfield discharges its wastewater to a ditch that discharges to Soldier Creek.

In 1998, twelve water body segments of the Camas Creek Subbasin were identified as being impaired (Table 1 and Figure 2). Many of these water bodies have been identified within the 1998 303(d) list as being impaired by unknown pollutants; a couple have been identified as being impaired by bacteria, dissolved oxygen, nutrients, sediment, and flow alteration. The beneficial uses that were being impacted by pollutants were cold water aquatic life, salmonid spawning, primary contact recreation, and secondary contact recreation.

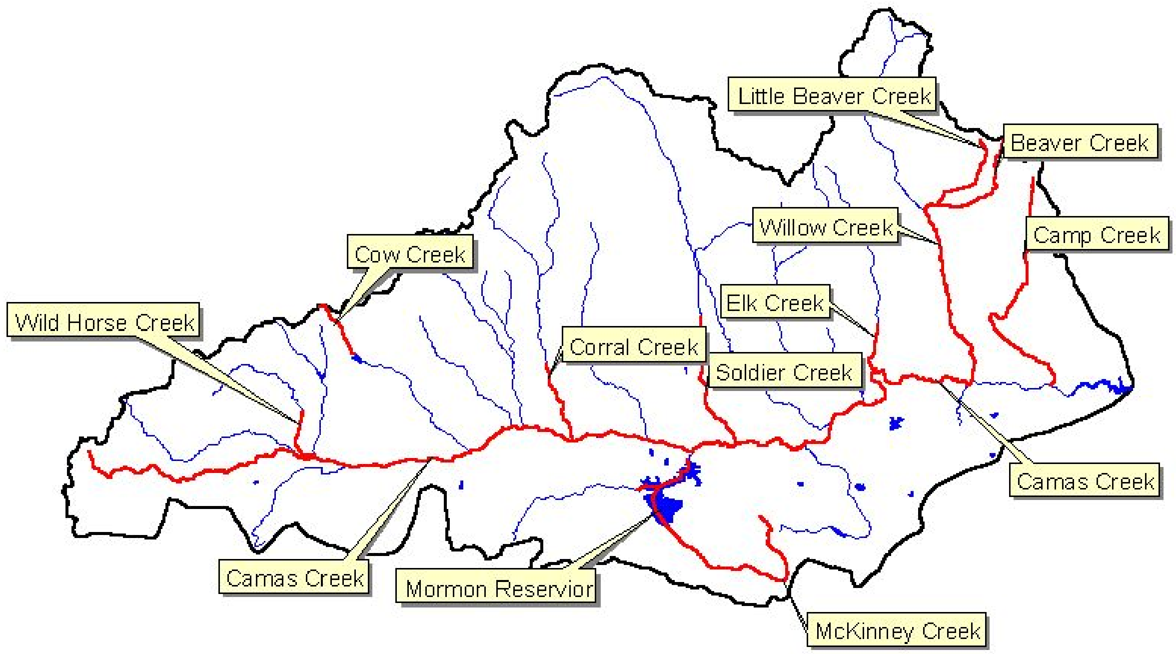
Table 1. Impaired waters of the Camas Creek Subbasin.

Water body Name	Assessment Unit	1998 §303(d) Boundaries	Pollutants
Camas Creek	ID17040220SK013_05 ID17040220SK001_05 ID17040220SK007_05 ID17040220SK018_04 ID17040220SK018_03 ID17040220SK018_02	Headwaters to Macon Flat Bridge	SED
Soldier Creek	ID17040220SK011_02	Baseline to Camas Creek	BAC, DO, NUT, QALT, SED
Mormon Reservoir	ID17040220SK023L_0L		BAC, DO, NUT, QALT, SED
Little Beaver Creek	ID17040220SK004_02	Headwaters to Beaver Creek	UNKN
Camp Creek	ID17040220SK002_02 ID17040220SK002_03	Headwater to Camas Creek	UNKN
Willow Creek	ID17040220SK003_04	Beaver Creek to Camas Creek	UNKN
Elk Creek	ID17040220SK006_02	Baseline Road to Camas Creek	UNKN
McKinney Creek	ID17040220SK025_02	Headwaters to Mormon Reservoir	UNKN
Corral Creek	ID17040220SK015_03	Highway 20 to Camas Creek	UNKN
Cow Creek	ID17040220SK018_02	Headwaters to Cow Creek Reservoir	UNKN
Wild Horse Creek	ID17040220SK021_03	Highway 20 to Camas Creek	UNKN
Beaver Creek	ID17040220SK004_02	Headwaters to Willow Creek	UNKN

[a]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.
[b]SED-sediment, BAC-bacteria, DO-dissolved oxygen, NUT-nutrients, QALT-flow alteration, UNKN-unknown.

Through the subbasin assessment, it has been identified which pollutants are impacting the beneficial uses of the listed water bodies in the Camas Creek Subbasin. These findings will be discussed in the following section.

Camas Creek Subbasin
1998 303(d) Listed Waterbodies



Number	Name	Miles
1	Beaver Creek	5.9800
2	Camas Creek	51.3200
3	Camp Creek	12.6500
4	Corral Creek	3.9800
5	Cow Creek	2.9100
6	Elk Creek	2.4600
7	Little Beaver Creek	4.3400
8	McKinney Creek	10.1100
9	Mormon Reservoir	0.0000
10	Soldier Creek	6.7000
11	Wild Horse Creek	2.7100
12	Willow Creek	9.0400

Prepared by Rob Sharpnack - October 2000

Figure 2. Impaired water bodies of the Camas Subbasin.

Key Findings

Data of various types were used to identify whether beneficial uses were fully supported in the 303(d) listed water bodies of the Camas Creek Subbasin:

- Biological data, including fish, macroinvertebrate, and habitat data.
- Water chemistry data, including pH, dissolved oxygen (DO), and turbidity
- Water chemistry data for nutrients, including total phosphorous (TP), total inorganic nitrogen (TIN), and chlorophyll.
- Water chemistry data and habitat data for sediment including total suspended solids (TSS), percent fines, and stream bank erosion inventories.
- Water chemistry data and habitat data for temperature including daily maximum and daily average temperatures and canopy cover.
- Water chemistry data for bacteria including *Escherichia coli* (*E. coli*) data.

These data were analyzed as described in Section 2 of this document and conclusions were drawn from the findings. Table 2 shows those water bodies requiring TMDLs. Table 2 summarizes the findings for each water body that was analyzed.

Table 2. Streams and pollutants for which TMDLs were developed.

Stream	Pollutant(s)
Camp Creek	Sediment , Temperature
Elk Creek	Sediment,
Soldier Creek	Sediment, Temperature
Corral Creek	Sediment, Temperature
Cow Creek	Sediment, Nutrients
Wild Horse Creek	Sediment, Bacteria, Temperature
Dairy Creek	Sediment, Nutrients
McKinney Creek	Sediment
Camas Creek	Sediment, Nutrients, Temperature
Mormon Reservoir	See Dairy and McKinney Creek

Table 3. Summary of assessment outcomes.

Water body Segment	Assessment Unit	Pollutant	TMDL Done	Recommended Changes to §303(d) List	Justification
Camas Creek	ID17040220SK013_05 ID17040220SK001_05 ID17040220SK007_05 ID17040220SK018_04 ID17040220SK018_03 ID17040220SK018_02	SED, TEMP, NUT	Yes	Add TEMP, NUT, and QALT,	Not meeting standards, delivery to storage system, channelization and diversion
Soldier Creek	ID17040220SK011_02	SED, TEMP	Yes	Remove DO, BACT, NUT Add TEMP	Meeting standards or criteria, Not meeting standards
Mormon Reservoir	ID17040220SK023L_0L	SED, TEMP	Yes	Remove BAC	Meeting standards
Little Beaver Creek	ID17040220SK004_02	TEMP	Yes	Add TEMP	Not meeting standards
Camp Creek	ID17040220SK002_02 ID17040220SK002_03	SED, TEMP	Yes	Remove UNK, Add SED, TEMP, QALT	Not meeting standards or criteria, channelization and storage
Willow Creek	ID17040220SK003_04	TEMP	Yes	Remove UNK, Add TEMP	Not meeting standards
Elk Creek	ID17040220SK006_02	SED	Yes	Remove UNK, Add SED	Not meeting criteria
McKinney Creek	ID17040220SK025_02	SED	Yes	Remove UNK, Add SED	Not meeting criteria
Corral Creek	ID17040220SK015_03	SED, TEMP	Yes	Remove UNK, Add SED, TEMP	Not meeting criteria or standards
Cow Creek	ID17040220SK018_02	SED, NUT	Yes	Remove UNK, Add SED, NUT	Delivering to storage system, not meeting criteria
Wild Horse Creek	ID17040220SK021_03	SED, BACT, TEMP	Yes	Remove UNK, Add SED, BACT, TEMP	Not meeting criteria or standards
Beaver Creek	ID17040220SK004_02	TEMP	Yes	Remove UNK, Add TEMP	Not meeting standards
Dairy Creek	ID17040220SK024_02	SED, NUT	Yes	Add SED, NUT	Delivering to storage system, not meeting criteria

[a]1998 303(d) 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.
[b]AU- assessment unit (assessment unit prefix to values in table is Id17040221), SED- sediment, NUT- nutrient, BAC- bacteria, TEMP- temperature, DO- dissolved oxygen, QALT- flow alteration, UNK-Unknown.
[c]303(d) listed segments will remain the same; however TMDLs are completed on the entire length of the creek.

Total Maximum Daily Loads have been completed on all of the listed segments:

- Nutrient TMDLs have been completed on Cow Creek, Dairy Creek, and Camas Creek to aid in protecting water quality of the receiving reservoirs.
- Stream bank erosion TMDLs for sediment have been completed on Camp Creek, Elk Creek, Soldier Creek, Corral Creek, Wild Horse Creek, Cow Creek, Camas Creek, Dairy Creek, and McKinney Creek.
- A bacteria TMDL has been completed on Wild Horse Creek.
- Canopy cover TMDLs for temperature elevations have been completed on Willow Creek, Beaver Creek, Little Beaver Creek, Camp Creek, Soldier Creek, Corral Creek, Wild Horse Creek, and Camas Creek.
- Nutrient and/or sediment TMDLs on McKinney Creek and Dairy Creek have been completed to aid in improving the water quality of Mormon Reservoir.
- Flow alteration or lack of flow has been identified as pollution for many of the water bodies, although TMDLs are not developed for flow alteration. Water bodies listed as impacted by flow alteration include Camp Creek, Elk Creek, Soldier Creek, Corral Creek, Wild Horse Creek, Dairy Creek, Camas Creek, McKinney Creek, and Mormon Reservoir. The flow on these creeks during summer months is minimal; water usage and ground water pumping likely contributes to their dry state.
- Three of the water bodies (Willow Creek, Beaver Creek, and Little Beaver Creek) that were listed on the 303(d) list had sufficient biological data indicating that beneficial uses were fully supported. Sediment TMDLs were not completed on them as beneficial uses are fully supported. However, temperature TMDLs were completed on them as their temperature data (a numeric standard) indicates that water quality was not capable of fully supporting beneficial uses.

More detailed discussions of the data analyses are presented in the following.

Conclusions Drawn from Analysis of Biological Data

Conclusions made in relation to biological data and aquatic life beneficial uses support status for Camas Creek Subbasin are as follows:

- Biological data indicates that aquatic life beneficial uses of Willow Creek, Beaver Creek, and Little Beaver Creek are fully supported.
- Biological data indicates that aquatic life beneficial uses of McKinney Creek are not fully supported.
- Biological data on Soldier Creek, Camp Creek, and Corral Creek were not assessed because sites were located on intermittent reaches of the water bodies. There is a biological data gap on perennial segments of these water bodies.
- Biological data on Cow Creek was not assessed because the upper portion of this water body is not consistently perennial.

- Biological data on Wild Horse Creek was not assessed because the water body is an intermittent water body although there are a series of perennial beaver dam pools.
- Biological data has not been collected on Dairy Creek and should not be used to assess beneficial uses as it is an intermittent water body.
- Biological data collected on intermittent reaches of Camas Creek were not assessed, but biological data on the perennial reaches of Camas Creek indicate aquatic life beneficial uses are not fully supported.

Conclusions Drawn from Analysis of pH, DO, and Turbidity

Conclusions made in relation to water chemistry data (pH, DO, and turbidity) are as follows:

- Water chemistry data (pH, DO, and turbidity) indicated that water quality was sufficient to support beneficial uses in Soldier Creek, Willow Creek, Beaver Creek, Camp Creek, Corral Creek, Cow Creek, Wild Horse Creek, McKinney Creek, and Dairy Creek.
- Water chemistry data (pH, DO, and turbidity) were data gaps in Little Beaver Creek due to site inaccessibility and drought conditions.
- Water chemistry data (DO) indicated that water quality was not sufficient to support beneficial uses in Camas Creek.

Conclusions Drawn from Analysis of Temperature Data

Conclusions made in relation to water temperature for Cold Water Aquatic Life Uses (CWAL) and Salmonid Spawning (SS) critical periods are as follows:

- Maximum daily temperature data was elevated more than 10% of the time for CWAL critical periods on Willow Creek, Beaver Creek, Little Beaver Creek, Camp Creek, Corral Creek, Wild Horse Creek, and Camas Creek.
- Average daily temperature data was elevated more than 10% of the time for CWAL critical periods on Camp Creek, Wild Horse Creek, and Camas Creek.
- Maximum and average daily temperature data was elevated more than 10% of the time for SS critical periods on Soldier Creek, Willow Creek, Beaver Creek, Little Beaver Creek, Camp Creek, Corral Creek, and Camas Creek.
- Temperature data is a data gap for CWAL critical periods on a number of creeks due to the lack of water in the stream, these creeks include Soldier Creek, Elk Creek, Cow Creek, McKinney Creek, and Dairy Creek.
- A number of factors likely contribute to these temperature elevations, including canopy cover deficiencies resulting from land management practices, beaver dam complexes, geologic formations—such as basalt canyons that retain heat and may inhibit sufficient riparian development—flow alteration, ground water influences, and desert conditions of south central Idaho.

Conclusions Drawn from Analysis of *E. coli* Data

Conclusions made in relation to support status of the contact recreation beneficial uses based on analysis of *E. coli* data are as follows:

- Primary Contact Recreation beneficial uses are fully supported (< 406 cfu/100ml of *E. coli*)on Soldier Creek, Willow Creek, and Camas Creek.
- Secondary Contact Recreation beneficial uses are fully supported (<576 cfu/100ml of *E. coli*) on Beaver Creek, Little Beaver Creek, Camp Creek, Elk Creek, Corral Creek, Cow Creek, McKinney Creek, and Dairy Creek.
- Secondary Contact Recreation beneficial uses are not fully supported (>576 cfu/100 ml of *E. coli*) on Wild Horse Creek. Follow up samples also yielded geometric mean values (> 126 cfu/100ml of *E. coli*) that confirmed the elevation of *E. coli*.
-

Conclusions Drawn from Analysis of Sediment Data

Conclusions made in relation to the impact of sediment as a pollutant on aquatic life beneficial uses are as follows:

- The average annual TSS values and daily maximum TSS values were not elevated above assessment criteria on Soldier Creek, Willow Creek, Beaver Creek, Little Beaver Creek, Camp Creek, Elk Creek, Corral Creek, Cow Creek, Wild Horse Creek, McKinney Creek, Dairy Creek, and Camas Creek.
- Percent fines data was elevated above assessment criteria on Soldier Creek, Willow Creek, Beaver Creek, Little Beaver Creek, Camp Creek, Elk Creek, Corral Creek, Cow Creek, Wild Horse Creek, McKinney Creek, Dairy Creek, and Camas Creek.
- Stream bank inventories indicate that there is an excessive source of sediment coming from the stream banks on Soldier Creek, Willow Creek, Little Beaver Creek, Camp Creek, Elk Creek, Corral Creek, Cow Creek, Wild Horse Creek, McKinney Creek, Dairy Creek, and Camas Creek.
- Stream bank inventories indicate that there is not an excessive source of sediment coming from the stream banks on Beaver Creek.

Conclusions Drawn from the Analysis of Nutrient Data

Conclusions made in relation to the impact of nutrients as a pollutant on the water bodies are as follows:

- Chlorophyll data was not elevated indicating that nuisance aquatic vegetation is not occurring in Soldier Creek, Willow Creek, Beaver Creek, Little Beaver Creek, Camp Creek, Elk Creek, Corral Creek, Cow Creek, Wild Horse Creek, McKinney Creek, Dairy Creek, and Camas Creek.
- Nuisance aquatic vegetation is not going to be a problem on most of these water bodies because there is a distinct lack of water in the water bodies during the growing season.

- Nutrients are not impairing water quality or beneficial uses in Soldier Creek, Willow Creek, Beaver Creek, Camp Creek, Elk Creek, Corral Creek, Wild Horse Creek, McKinney Creek, or Dairy Creek.
- Nutrient data is a data gap on Little Beaver Creek.
- Excessive nutrients (TP values > than the annual average of 0.50 mg/L) are being delivered to the receiving storage waters of Dairy Creek, Camas Creek, and Cow Creek.

1. Subbasin Assessment – Watershed Characterization

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the CWA are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the 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 Camas Creek 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 Camas Creek 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 (Sections 1 – 4). This information will then be used to develop a TMDL for each pollutant of concern for the Camas Creek Subbasin (Section 5).

1.1 Introduction

In 1972, Congress passed the Federal Water Pollution Control Act, more commonly called the Clean Water Act. The goal of this act was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Water 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 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. *Camas Creek Subbasin Assessment and TMDL* provides this summary for the currently listed waters in the Camas Creek Subbasin.

The subbasin assessment section of this report (Sections 1 – 4) includes an evaluation and summary of the current water quality status, pollutant sources, and control actions in the Camas Creek Subbasin to date. While this assessment is not a requirement of the TMDL, DEQ performs the assessment to ensure impairment listings are up to date and accurate. The TMDL is a plan to improve water quality by limiting pollutant loads. Specifically, a TMDL is an estimation of the maximum pollutant amount that can be present in a water body and still allow that water body to meet water quality standards (Water quality planning and management, 40 CFR 130). Consequently, a TMDL is water body- 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." TMDLs are 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 water body by designating the use or uses for the water, setting criteria necessary to protect those uses, and preventing degradation of water quality through antidegradation provisions.

The state may assign or designate beneficial uses for particular Idaho water bodies to support. These beneficial uses are identified in the Idaho water quality standards and include:

- Aquatic life support – cold water, seasonal cold water, warm water, salmonid spawning, modified
- Contact recreation – primary (swimming), secondary (boating)
- Water supply – domestic, agricultural, industrial
- Wildlife habitats, aesthetics

The Idaho legislature designates uses for water bodies. Industrial water supply, wildlife habitat, and aesthetics are designated beneficial uses for all water bodies in the state. If a water body is unclassified, then cold water and primary contact recreation are used as additional default designated uses when water bodies are assessed.

A subbasin assessment entails analyzing and integrating multiple types of water body data, such as biological, physical/chemical, and landscape data to address several objectives:

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

- Determine the degree of achievement of biological integrity.

- Compile descriptive information about the water body, 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 Camas Creek Subbasin runs from the headwaters of Camas Creek (west of Packer Butte in the Camas Prairie of Elmore County) to its mouth, where the creek empties into Magic Reservoir. The subbasin lies along the western border of the Upper Snake River Basin in Idaho, with the Big Wood River and Upper Snake-Rock Subbasins surrounding it. The southern border of the Camas Subbasin runs from the mouth of Camas Creek, in a southwest direction along the southern edge of Macon Flat, then west within the Camas Prairie along the northern edge of the Mount Bennett Hills to the headwaters. From here, the Camas Creek Subbasin begins to run in a northeast direction, moving gradually into the Sawtooth National Forest. The northern border runs above Smoky Dome and Cannonball Mountain and then further north along Willow Creek to the Camas County Line. From here, the eastern border runs in a southeast direction along the county line, then just south of the Kelly Mountains, continuing southeast to the mouth of Camas Creek.

Climate

The Camas Creek Subbasin can be divided into two elevation ranges. The low elevation range is equal to or less than 5,250 feet (this accounts for the valley floor and 48.1% of the subbasin area), while the high elevation range is greater than 5,250 feet (51.9% of the subbasin area) (ArcView Coverage 1992-1996). These elevation ranges were used in describing much of the climate of the subbasin. Air temperature, snowfall, and snow depth data have been collected from similar data sources and elevations. The low elevation data is an average of data from three sites within the subbasin at this elevation range. The low elevation sites include two Fairfield sites and Hill City. The high elevation data is collected from one site, Soldier Ranger Station.

Precipitation

The weighted mean precipitation for the Camas Creek Subbasin is 18.8 inches (WRCC 2001, NRCS 2001a). The majority of the precipitation occurs in the winter and spring months. Table 4 describes seasonal precipitation data for the elevation ranges.

Table 4. Average precipitation (inches) in the Camas Creek Subbasin.

Elevation	Winter Average	Spring Average	Summer Average	Fall Average	Total Annual
Upper	3.5	2.1	0.6	1.5	23.1
Lower	1.9	1.2	0.6	1.1	14.2

[a]Data collected from Western Regional Climate Center (WRCC) and U.S. Department of Agriculture (USDA) National Resources Conservation Service (NRCS) Web sites.

Air Temperature and Available Sunlight

The highest monthly average maximums and minimums for temperature occur in the summer months, especially July. The lowest monthly average maximums and minimums for temperature occur in the winter months, most notably in January (WRCC 2001, NRCS 2001a). Table 5 describes the estimated midrange temperatures for the low and high elevations of the subbasin.

Table 5. Camas Creek Subbasin air temperature.

Elevation Range	Midrange Temperature (º C)	Midrange Temperature (º F)
Upper	-4.96 to 17.65	23.07 to 63.77
Lower	-8.19 to 17.78	17.25 to 64.00

[a]Data collected from Western Regional Climate Center (WRCC) and U.S. Department of Agriculture (USDA) National Resources Conservation Service (NRCS) Web sites.

The estimated average annual available sunlight for this region is 12.9 hours, with the greatest amount of average available light occurring in the summer months at 14.0 hours, and the least amount occurring in the winter months at 10.2 hours (USNO 2001).

Snow Depth and Snowfall

The lower elevations of the Camas Creek Subbasin receive an average total snowfall of 66 inches. The majority of this snowfall occurs from December to February, when the average snow depth for the low elevations is 13.5 inches.

The majority of this snowfall in the upper elevation range occurs from January to April, when the average snow depth for the high elevations is 29.5 inches (WRCC 2001).

Evaporation and Wind Erosion

The annual evaporation for the Camas Creek Subbasin is 6 *millimeters per month* (mm/month), with the majority of evaporation occurring in the months of May through September (CPC 2001). The largest amount of evaporation occurs in June and July with 20 mm/month.

Wind erosion in the Camas Creek Subbasin has been found to be so minimal as to be insignificant in its effect on the water quality of the water bodies. It has been estimated that only 3.35% of the subbasin area exceeds the threshold for wind erosion (NRCS 2001b).

Subbasin Characteristics

The Camas Creek Subbasin has its main water body, Camas Creek, lying in the flat and lower elevations of the Camas Prairie. Many of the Camas Creek tributaries originate in the higher mountainous and foothill elevations; they then flow down through the flat prairie region of the subbasin before emptying into Camas Creek.

Hydrography

A number of natural and anthropogenic activities or conditions occur in the Camas Creek Subbasin that impact the hydrology of the subbasin. Figure 3 depicts the average annual hydrograph for several of the water bodies (this data includes flow data collected from 1970 to 2003).

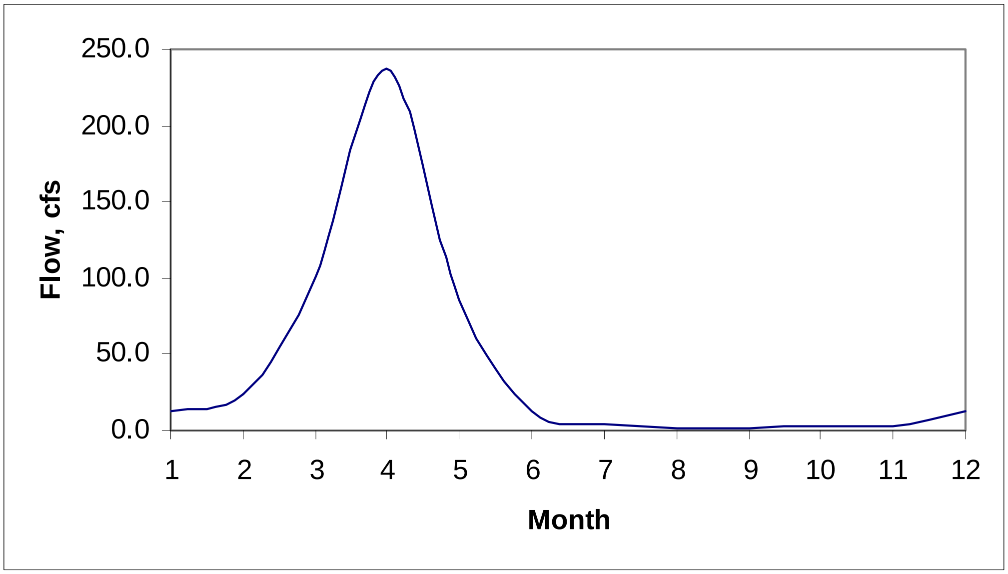


Figure 3. Camas Creek Subbasin average hydrology.

Spring runoff in the subbasin is early and rapid. The majority of the flow occurs in March and April. Less than 1 cubic feet per second (cfs) of flow occurred in July, August, September, and November.

A number of streams are dry throughout the summer and into the spring months in the lower prairie reaches of the water body, and a few water bodies have small segments that are perennial due to ground water influences (water tables and beaver dams) despite the remainder of the water body being dry. The hydrology of the individual water bodies within the subbasin is discussed in Section 2: Subbasin Assessment – Water Quality Concerns and Status, page 33.

Camas Creek is the natural outlet for all of the water of the Camas Creek Subbasin, although there are seven water bodies that retain some of the water of the subbasin. These water bodies include Mormon Reservoir, Macon Lake, Kelly Reservoir, Spring Creek Reservoir, McHan Reservoir, Negro Creek Reservoir, and Cow Creek Reservoir. All of these reservoirs, except Macon Lake, are privately owned.

The predicted hydrographs of Camas Creek and its tributaries were developed from *United States Geological Survey* (USGS) gauge data and flow records collected by DEQ and other agencies. To date there is one active gauge station in the Camas Creek Subbasin, USGS 13141500 Camas Creek near Blaine Idaho (Figure 4). ArcView coverage identifies one other gauge in the subbasin, however, this station no longer exists and/or recorded data has not been located (ArcView Coverage 1992-1996).

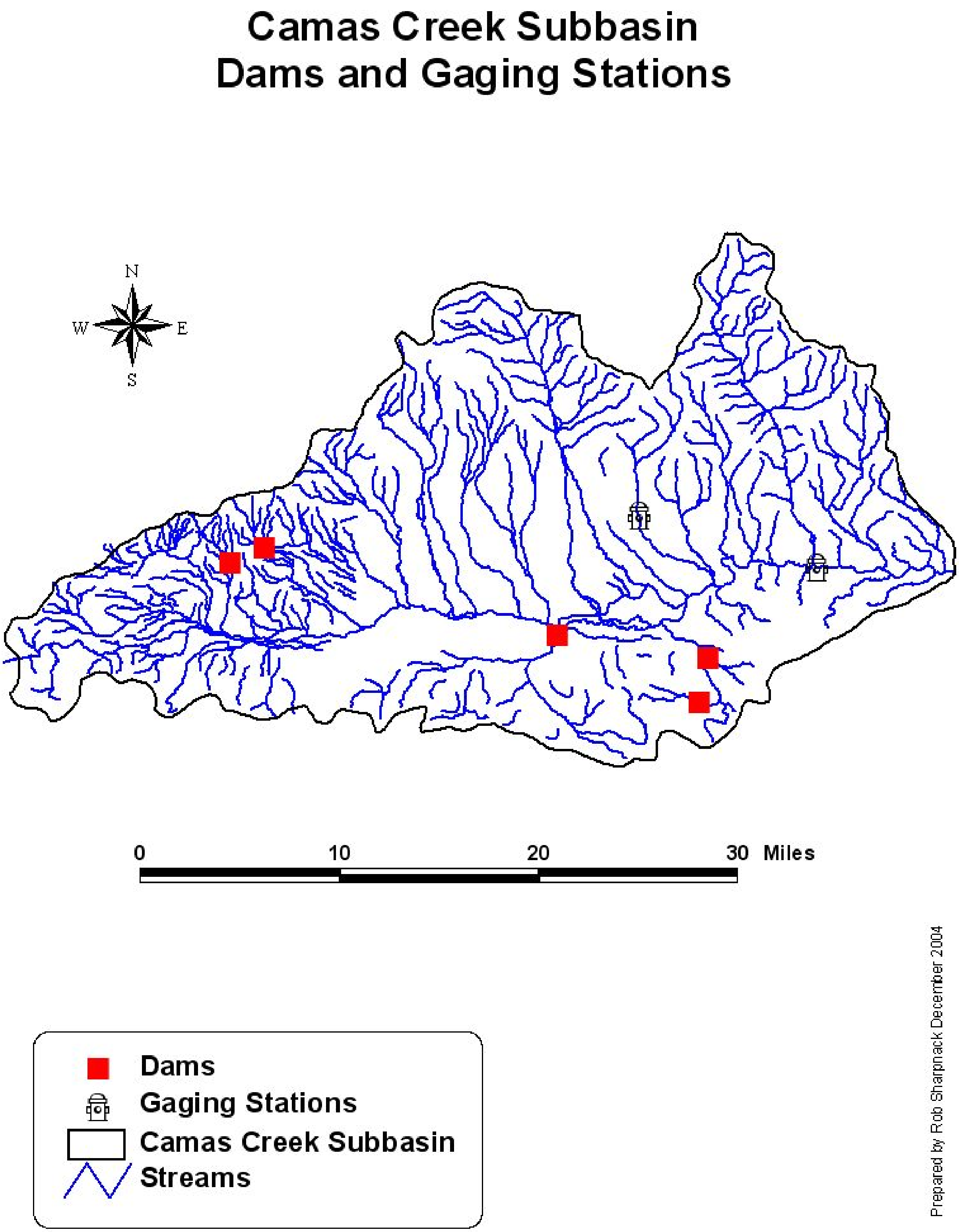


Figure 4. Dams and gauging stations in the Camas Creek Subbasin.

Geology and/or soils

The Camas Creek Subbasin consists of two ecoregions: Snake River Basin/High Desert and Northern Rockies. The Northern Rockies ecoregion exists in the northern region of the subbasin and covers 24.7% of the subbasin area. The Snake River Basin/High Desert ecoregion exists in the middle and southern portion of the subbasin and covers 75.3% of the subbasin area. (ArcView Coverage, 1992-1996). There exist transitional zones between the two ecoregions, but these make up only a very small portion of the area.

There are three geomorphology types in the Camas Creek Subbasin. The high mountainous elevations are alpine glacial (erosional), while the hills to the north and south of the subbasin are fluvial. Finally, the prairie area of the Camas Creek Subbasin is plateau (ArcView Coverage, 1992-1996).

There are 15 different geologic formations in the Camas Creek Subbasin (Table 6 and Figure 5). The central portion of the Camas Creek Subbasin consists of Quaternary alluvium (29.5% of the area) and Middle Pleistocene plateau and canyon filling basalt (18.8% of the area). The northern regions of the subbasin have mostly Cretaceous plutons (21.4% of the subbasin area) and Eocene mixed silicic and basaltic volcanic ejecta flows, which occur in 12.6% of the subbasin area. The southern portion of the subbasin, which lies below Camas Creek, has various different formations in small, scattered quantities (ArcView Coverage, 1992-1996).

Table 6. Geologic formations of the Camas Creek Subbasin.

Name	Description	Area (km^2)	Percent of subbasin
Ki	Cretaceous plutons	124.8	7.0
Ki?	Cretaceous plutons	26.9	1.5
Kii	Cretaceous plutons-intermediate	227.9	12.9
OW	Open water	10.4	0.6
PPNc	Lower Permian to Middle Pennsylvanian thrusted marine detritus	24.9	1.4
Qa	Quaternary alluvium	523.4	29.5
Qg	Quaternary colluvium fanglomerate and talus	3.6	0.2
Qp?g	Pleistocene outwash fanglomerate flood and terrace gravels	32.4	1.8
Qpmb	Middle Pleistocene plateau and canyon-filling basalt in and near Snake Plains	332.8	16.8
Qpmg	Middle Pleistocene deposits	58.8	3.3
Qpug	Upper Pleistocene deposits	2.1	0.1
Tei	Eocene intrusions	36.0	2.0
Tev	Eocene mixed silicic and basaltic volcanic ejecta flows and reworked debris	223.3	12.6
Tpb	Pliocene olivine basalt flows and associated tuff and detritus	47.4	2.7
Tpf	Pliocene silicic welded tuff ash and flow rocks	97.1	5.5

[a]Data from ArcView Coverage 1992-1996.

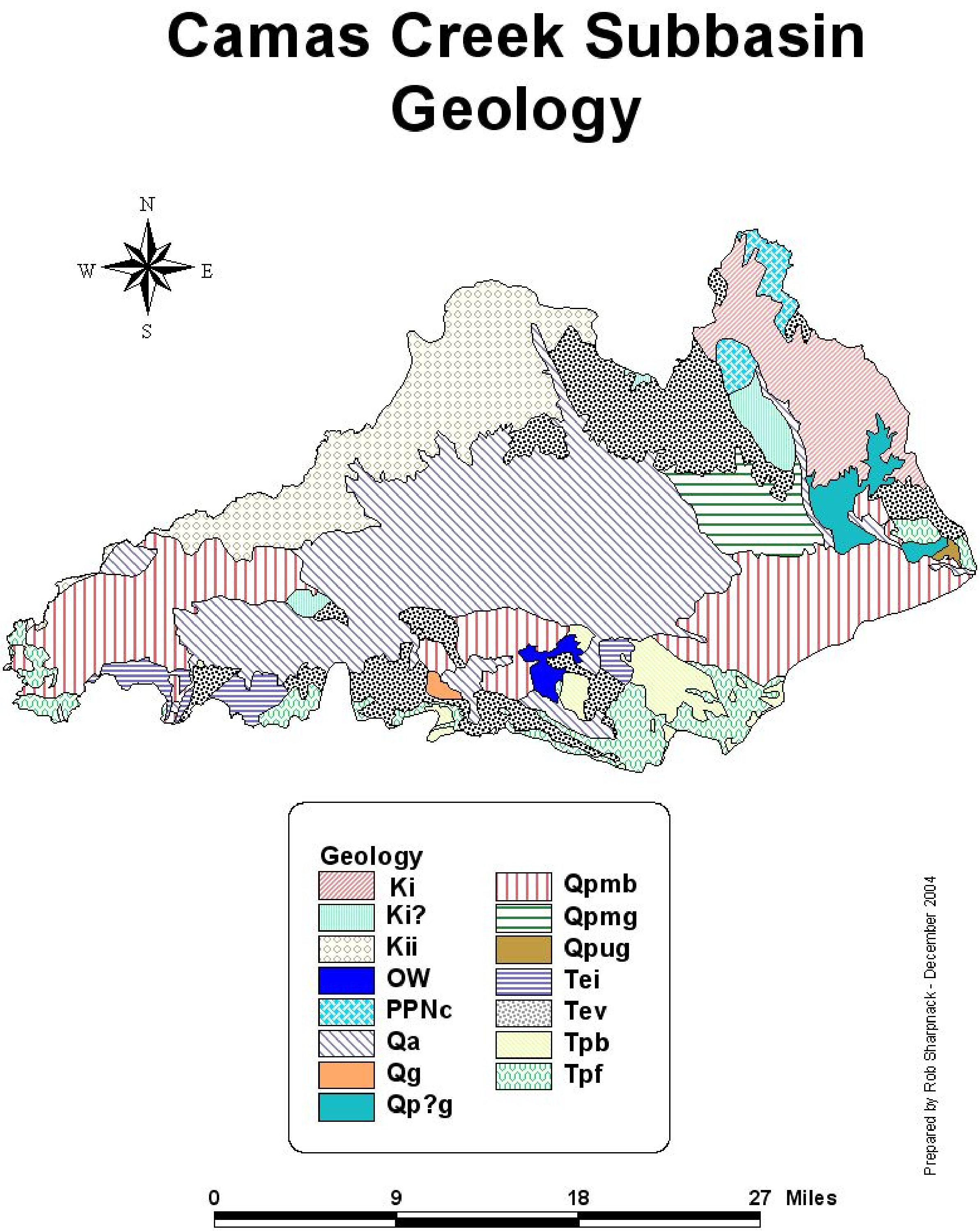


Figure 5. Geologic formations of the Camas Creek Subbasin.

K factor is a measure of the susceptibility of soil to erosion and runoff . Soils with K factor values of 0.05 to 0.15 are resistant to detachment; soils with K factor values of 0.05 to 0.2 tend to be easily detached but have low runoff. Soils with higher K factors of 0.25 to 0.4 are moderately susceptible to detachment and have moderate runoff. Soils with K factors of 0.4 or greater are easily detached and have high rates of runoff (MSU 2005).

The majority of the subbasin has soil K factors of 0.25 to 0.35 (Figure 6); these soils lie along the Camas Prairie and flood plains of many of the streams. Soils with K factors of 0.15 to 0.25 lie in the upper portions of the subbasin in the headwater stretches of many of the creeks in the subbasin. Finally, there are two smaller patches of soil in the headwater stretches of the Soldier and Willow Creek drainages that have K factors of 0-0.08 and 0.35 to 0.45 (ArcView Coverage 1992-1996).

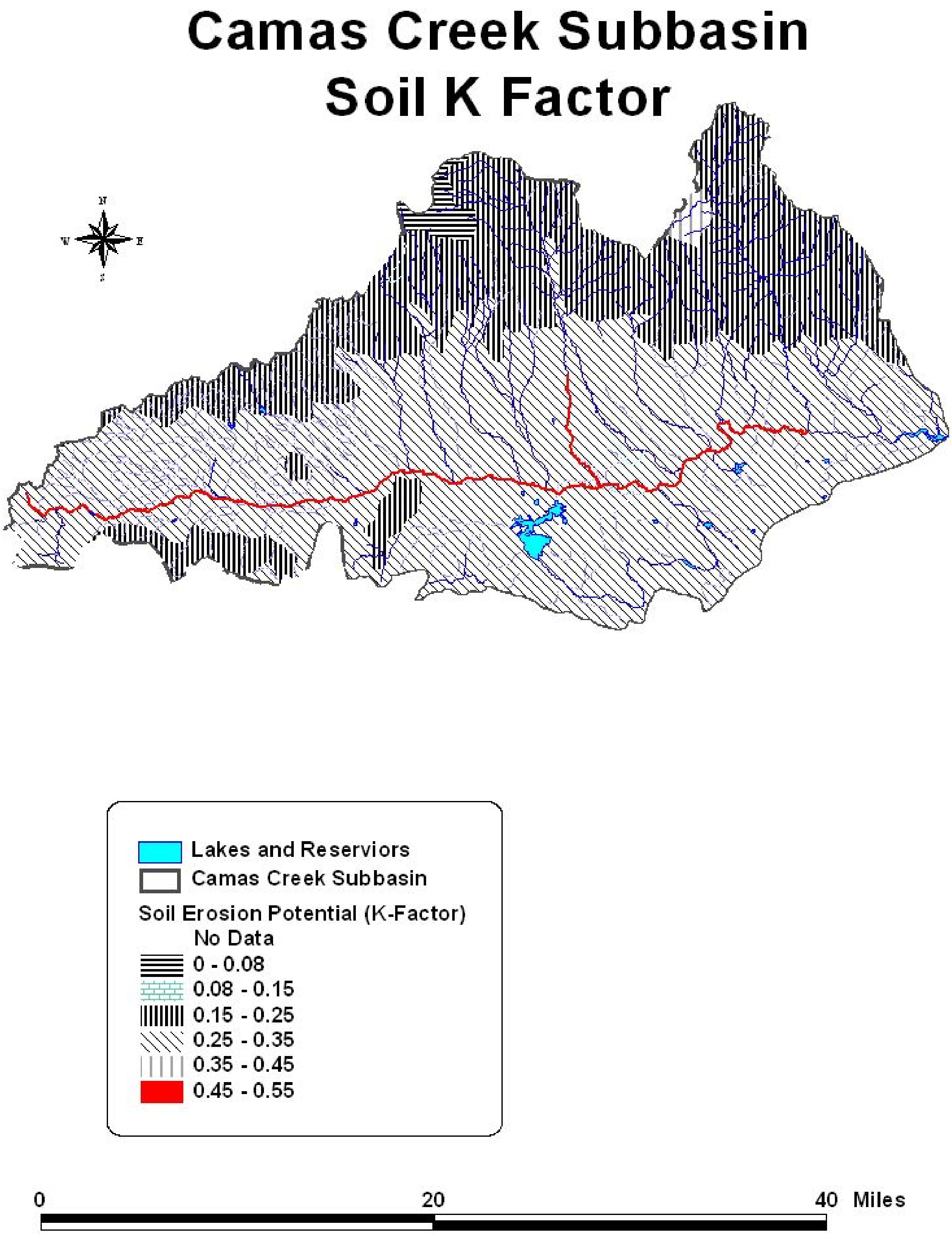


Figure 6. Soil erosivity (K factors) of the Camas Creek Subbasin.

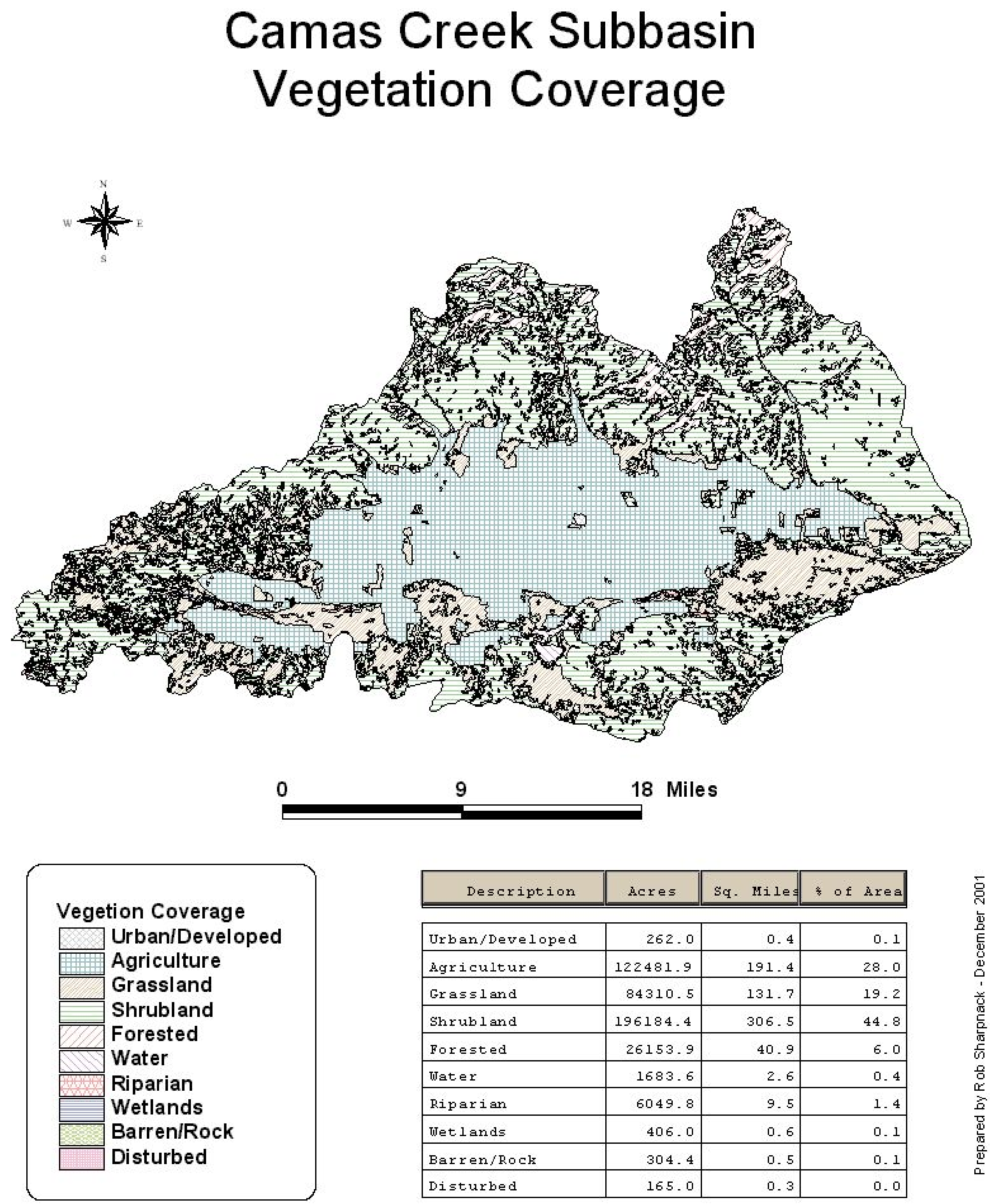
Topography

Two different elevation ranges characterize the Camas Creek Subbasin: the lower elevation range is less than or equal to 5,250 feet while the higher elevation is greater than 5,250 feet. Most of the mountains lie to the north, at elevations around 7,000 to 8,000 feet. Near the headwaters of Willow Creek and those of the Soldier Creek Forks are the highest elevations, ranging from 8,000 to 11,000 feet (ArcView Coverage, 1992-1996). The lowest elevation in the Camas Creek Subbasin is at the mouth of Camas Creek at 4,800 feet. Some of the peaks of the subbasin occur at Liberal and Cannonball Mountain (8,200 feet), Kelly Mountain (8,700 feet), and Smoky Dome (10,000 feet).

Camas Creek flows from west to east through the Camas Prairie. The Camas Creek Subbasin extends from the mouth, which empties into the Magic Reservoir to the basin divide line, which extends about a mile beyond the headwaters. The subbasin length is about 55 miles long and has an elevation difference of 945 feet. These characteristics yield a subbasin slope of about 0.33%.

Vegetation

The Camas Creek Subbasin vegetation consists mainly of agriculture, grassland, and shrubland (Figure 7). There is very little (2.1 % of the area) urban/developed, water, riparian, wetland, barren/rock, and disturbed vegetation in this subbasin. Agriculture vegetation accounts for 28% of the subbasin area and occurs in the center of the subbasin. Grassland occurs in 19.2% of the area and is found dispersed around the edges of the agriculture vegetation, but mostly to the south. Shrubland covers the remainder of the area at 44.8%, with a little bit of forested vegetation (6.0%) occurring in the north region (ArcView Coverage, 1992-1996).



Description	Acres	Sq. Miles	% of Area
Urban/Developed	262.0	0.4	0.1
Agriculture	122481.9	191.4	28.0
Grassland	84310.5	131.7	19.2
Shrubland	196184.4	306.5	44.8
Forested	26153.9	40.9	6.0
Water	1683.6	2.6	0.4
Riparian	6049.8	9.5	1.4
Wetlands	406.0	0.6	0.1
Barren/Rock	304.4	0.5	0.1
Disturbed	165.0	0.3	0.0

Figure 7. Vegetation coverage of the Camas Creek Subbasin.

Biological Communities

The presence of endangered, threatened, or sensitive species can impact the way in which the land of the subbasin is managed. There are a number of endangered, threatened, or sensitive species within the counties of the Camas Creek Subbasin (Appendix 2). These species are a concern within the counties but not necessarily found within the subbasin itself (USFWS 2001).

Some of these species are aquatic or depend upon the aquatic environment at some point in their life cycle. The bald eagle winters and nests in the area and feeds on fish within the streams. Some species of concern found within the subbasin are redband trout and Wood River sculpin. Bull trout are listed as a threatened species in Blaine, Camas, and Elmore Counties, but they do not occur within the Camas Creek Drainage (Warren 2001).

Fisheries can be a good indicator of the water quality status of a water body since the thermal requirements of fish have been fairly well studied (Grafe et al 2002). Fish in the northwest are identified as cold, cool, or warm water species and can be classified with overall pollution tolerance values of sensitive, tolerant, or intermediate (Zaroban et al 1999). There are many species of fish that are found within the waters of the Camas Creek Subbasin. The fish in the subbasin are identified, along with their temperature preference and tolerance values in Table 7.

Table 7. Fisheries of the Camas Creek Subbasin.

Family	Species	Temperature Preference	Tolerance value
Salmonidae	Rainbow trout	Cold water	S
	Brook trout	Cold water	I
Cottidae	Wood River sculpin	Cold water	S
	Sculpin sp		
Catostomidae	Sucker sp	Cool water	
	Mountain sucker	Cool water	I
Cyprinidae	Dace sp	Cool water	
	Speckled dace	Cool water	I
	Redside shiner	Cool water	I

[a]Species accumulated through various collection events.
[b]S-Sensitive, I-Intermediate, T-Tolerant.

The Wood River sculpin is a cold water species that is sensitive to pollution and endemic to the Wood River Drainage. The *Idaho Department of Fish and Game* (IDFG) consider it to be a species of special concern and the U.S. Forest Service (USFS) and U.S. Bureau of Land Management (BLM) consider it to be a sensitive species. These classifications are a result of the lack of knowledge about the range of the species, the land management impacts to the habitat of the Wood River sculpin, and the impacts to the species from competitive species (Zaroban 2003). These characteristics could make this species an excellent indicator of water quality trends within the subbasin if intensive surveys were completed in the Wood River Drainage.

Benthic macroinvertebrates have limited migration patterns, which makes them good indicators of environmental conditions (Grafe et al 2002). An analysis of the macroinvertebrates on the 303(d) listed streams was performed, yielding the following results:

- The Stream Macroinvertebrate Index (SMI), the average of nine metric indices, is an overall indicator of the health of a stream. A large group of sites rated good, however the majority of the sites rated as fair, poor and very poor.
- Taxa richness is a metric that measures the health of the community by a measure of the variety of taxa present. Generally, as habitat quality increases so too does taxa richness. Taxa richness of the listed streams in the Camas Creek Subbasin were low in comparison to other studies completed in southern Idaho.
- The pollution tolerance value indicates how tolerant a species is to pollution and ranges from 0 to 11. A lower number indicates intolerance. The majority of the sites rated as good, fair, and fairly poor for pollution tolerance values.
- The numbers of Ephemeroptera and Plecoptera taxa are metrics than can indicate temperature and fine sediment pollution. As the number of these taxa increase so too does water quality. This index score in the subbasin ranged from 0 to 77%.
- The percent scrapers metric decreases as fine sediment increases within a system. The percent clingers metric decreases as habitat disturbance increases. The number of scraper and clinger taxa within the subbasin was low.
- Low numbers of cold water taxa indicate that land use and pollutants are impacting a water body. The number of cold water taxa and their abundance were depressed in the subbasin.

Overall, the macroinvertebrate data in the Camas Creek Subbasin seem to indicate that the water bodies in the subbasin appear to be impacted by fine sediment and temperature (Clark 2003).

The following table also identifies the assessment units within the subbasin and their beneficial use support status.

Table 8. Assessment units of the subbasin and their beneficial use status.

Assessment unit	Assessment Name	Status	Creeks with data	Year of data	Notes
ID17040220SK001_02	Camas Creek-Elk Creek to Magic Reservoir	Not assessed	Poison	2001	Dry
ID17040220SK001_05	Camas Creek-Elk Creek to Magic Reservoir	Not supporting	Camas	1995	
ID17040220SK002_02	Camp Creek-source to mouth	Not supporting	Camp	1996, 2001	Dry (2001)

Assessment unit	Assessment Name	Status	Creeks with data	Year of data	Notes
ID17040220SK002_03	Camp Creek-source to mouth	Not supporting	No sites		
ID17040220SK003_02	Willow Creek-Beaver Creek to mouth	Not assessed	No sites		
ID17040220SK003_04	Willow Creek-Beaver Creek to mouth	Not supporting	Willow	1993, 1995	
ID17040220SK004_02	Beaver Creek-source to mouth	Full support	Beaver, Little Beaver	1993, 1995, 1997, 2001	
ID17040220SK004_03	Beaver Creek-source to mouth	Full support	Beaver Creek	1997	
ID17040220SK005_02	Willow Creek-source to Beaver Creek	Full support	West Fork Willow, Willow, Devils Dive, Buttercup, Cherry	1993, 1995, 2001	Devils Dive Dry (2001)
ID17040220SK005_03	Willow Creek-source to Beaver Creek	Not assessed	Willow	2001	
ID17040220SK006_02	Elk Creek-source to mouth	Not supporting	Elk	2001, 1993	Dry (2001)
ID17040220SK007_02	Camas Creek-Soldier Creek to Elk Creek	Not assessed	Knowlton	2001	Dry
ID17040220SK007_05	Camas Creek-Soldier Creek to Elk Creek	Not supporting	Camas	1995	
ID17040220SK008_02	Deer Creek-Big Deer Creek to mouth	Not assessed	Daugherty	2001	Dry
ID17040220SK008_03	Deer Creek-Big Deer Creek to mouth	Not assessed	Deer	1996	Dry
ID17040220SK008_04	Deer Creek-Big Deer Creek to mouth	Not assessed	No sites		
ID17040220SK009_02	Deer Creek-source to and including Big Deer Creek	Not assessed	Little Deer	2001	Dry
ID17040220SK010_02	Powell Creek-source to mouth	Not assessed	Powell	2001	Dry
ID17040220SK011_02	Soldier Creek-Wardrop Creek to mouth	Not supporting	No sites		
ID17040220SK011_03	Soldier Creek-Wardrop Creek to mouth	Full support	Soldier	1993, 1995	
ID17040220SK012_02	Soldier Creek-source to and including Wardrop Creek	Full support	North Fork Soldier, Reedy, Owens, Lawrence, Wardrop, Sampson	1995, 2001	Reedy, Owens, Lawrence Dry (2001)
ID17040220SK012_03	Soldier Creek-source to and including Wardrop Creek	Not assessed	South Fork Soldier	2001	
ID17040220SK013_02	Camas Creek-Corral Creek to Soldier Creek	Not assessed	McCan Gulch Creek	2001	Dry
ID17040220SK013_03	Camas Creek-Corral Creek to Soldier Creek	Not assessed	East Fork Threemile	1996	Dry
ID17040220SK013_05	Camas Creek-Corral Creek to Soldier Creek	Not supporting	Camas	1993, 1995, 2001	Dry (2001)

Assessment unit	Assessment Name	Status	Creeks with data	Year of data	Notes
ID17040220SK014_02	Threemile Creek-source to mouth	Not assessed	West Fork Threemile, McMahan, Threemile	1996, 2001	Threemile Dry (1996,2001)
ID17040220SK015_03	Corral Creek-confluence of East Fork and West Fork Corral	Not supporting	Corral	1993	
ID17040220SK016_02	East Fork Corral Creek-source to mouth	Full support	Rough, East Fork Corral	1993, 1994, 1996	
ID17040220SK016_03	East Fork Corral Creek-source to mouth	Not assessed	No sites		
ID17040220SK017_02	West Fork Corral Creek-source to mouth	Full support	West Fork Corral	1993	
ID17040220SK018_02	Camas Creek-source to Corral Creek	Not supporting	Cow	1993	
ID17040220SK018_03	Camas Creek-source to Corral Creek	Not supporting	Cow, Camas	1995, 1996, 2001	Cow Dry (1996, 2001)
ID17040220SK018_04	Camas Creek-source to Corral Creek	Not supporting	No sites		
ID17040220SK019_02	Chimney Creek-source to mouth	Full support	Sheep, Chimney	1996, 2001	Sheep Dry (2001)
ID17040220SK019_03	Chimney Creek-source to mouth	Not assessed	No sites		
ID17040220SK019_04	Chimney Creek-source to mouth	Not assessed	Chimney	1996, 2001	Dry (1996, 2001)
ID17040220SK020_02	Negro Creek-source to mouth	Not assessed	Negro	2001	Dry
ID17040220SK020_03	Negro Creek-source to mouth	Not assessed	No sites		
ID17040220SK021_02	Wild Horse Creek-source to mouth	Not assessed	No sites		
ID17040220SK021_03	Wild Horse Creek-source to mouth	Not supporting	Wild Horse	1993, 1996	Dry (1996)
ID17040220SK022_02	Malad River-source to mouth	Not assessed	No sites		
ID17040220SK022_03	Malad River-source to mouth	Not assessed	Malad	2001	Dry
ID17040220SK023_02	Mormon Reservoir	Not assessed	No sites		
ID17040220SK023_03	Mormon Reservoir	Not assessed	No sites		
ID17040220SK023L_0L	Mormon Reservoir	Not supporting	No sites		
ID17040220SK024_02	Dairy Creek-source to Mormon Reservoir	Not supporting	No sites		
ID17040220SK025_02	McKinney Creek-source to Mormon Reservoir	Not supporting	McKinney	1993	
ID17040220SK025_03	McKinney Creek-source to Mormon Reservoir	Not supporting	No sites		
ID17040220SK026_02	Spring Creek Complex	Not assessed	No sites		

Assessment unit	Assessment Name	Status	Creeks with data	Year of data	Notes
ID17040220SK026_03	Spring Creek Complex	Not assessed	Spring	1993	
ID17040220SK027_02	Kelly Reservoir	Not assessed	No sites		
ID17040220SK027L_0L	Kelly Reservoir	Not assessed	No sites		

[a]The above listed information has been accumulated through the IDASA program in May of 2005 and includes biological data collected up to 2001; some assessment statuses may not be reflected in the 1998 303(d) list, but in the more current lists of impaired waters.

Water Chemistry

Seasonal peaks for sediment, nutrients, and bacteria occur in the Camas Creek Subbasin. Historical and recent data were used to determine peak discharge of pollutants in the subbasin. Monthly data from all monitoring sites were averaged together to represent the annual graph for the subbasin.

Suspended load constitutes both washload and suspended bed-material load. Washload comes from the banks and upland areas and can remain in suspension during low velocities. Suspended bed-material load is transported with the washload by turbulent water and will drop out when velocities decrease (Gordon et al., 1992). Sediment in the subbasin was measured in the form of total suspended solids (TSS). Figure 8 depicts the average discharge of TSS in the Camas Creek Subbasin.

There are two peak discharges of TSS, the first peak occurs during the spring runoff months and the second peak occurs in the fall during base flow events. Higher concentration of TSS would be expected during spring runoff as the stream flows would likely be higher and more washload and suspended bed-material would be transported. A peak in the fall is less likely to be expected as velocities are low and are less likely to be carrying suspended bed-material loads. The peak is likely due to anthropogenic activities occurring in the subbasin, although late season precipitation events could also contribute to sediment loads during base flow events.

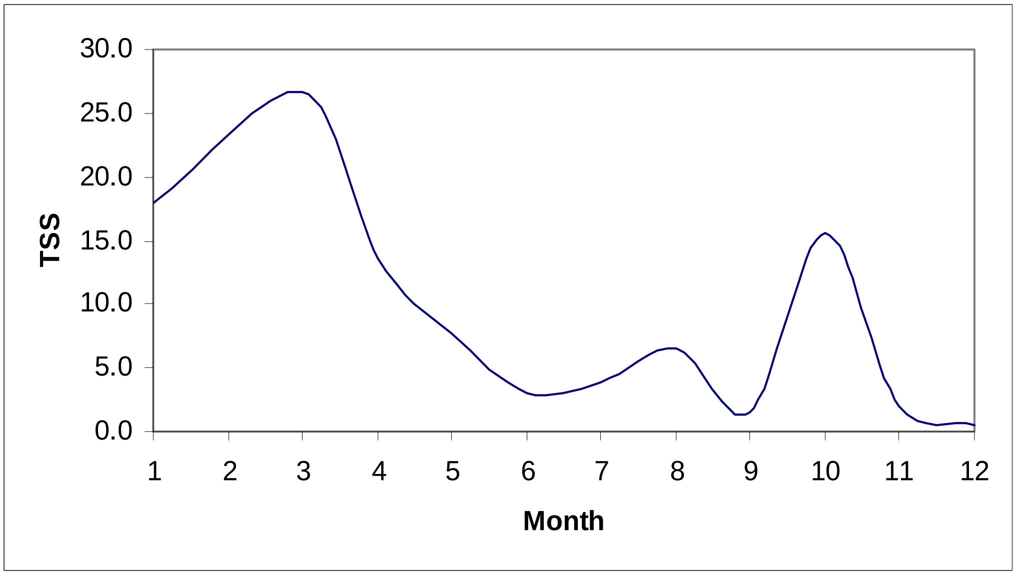


Figure 8. Average annual TSS (mg/L) in the subbasin.

Nitrogen and phosphorous are two components necessary for the growth of aquatic plants within a water body. In most freshwater systems phosphorous is the limiting factor because it has a tendency to bind with other elements or sediment and be taken out of the cycle (Federal Interagency Stream Restoration Working Group, 1998). Nutrients in the Camas Creek Subbasin were measured in the form of total phosphorous (TP).

Figure 9 depicts the average annual discharge of TP in the Camas Creek Subbasin. There is one peak discharge of TP; the event occurs during the spring runoff months and early summer months when flow in the subbasin is highest. Peak discharges of TP in the runoff period would be expected as sediments are generally transported during high flows. The TP quantity would be elevated because TP has a high tendency to bind with sediments, therefore as sediment is transported so too is TP. The TP values throughout the rest of the year are fairly stable.

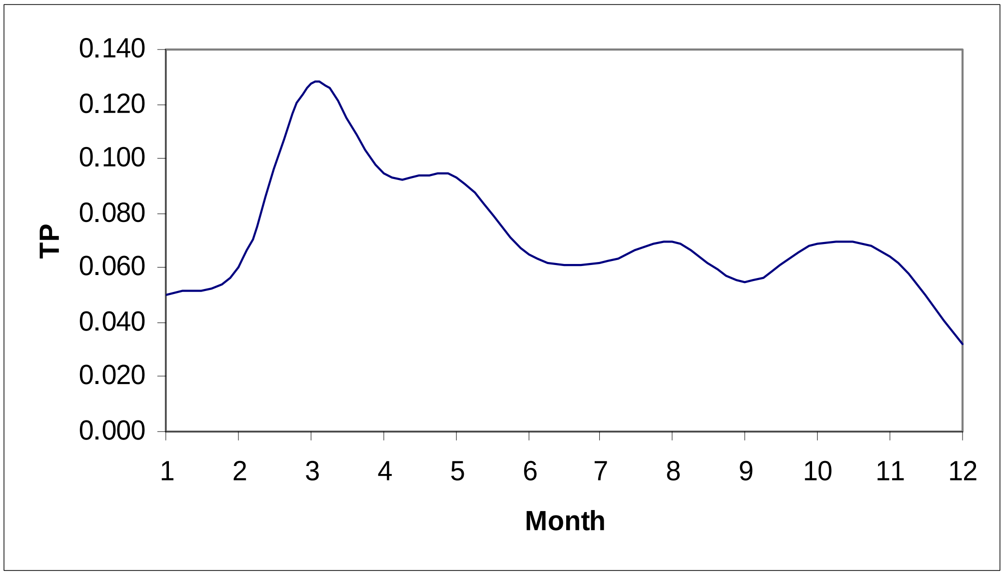


Figure 9. Average annual TP (mg/L) in the subbasin.

There are apt to be fluctuations in the bacteriological content of water in surface waters. These fluctuations tend to occur in the spring and fall when snow melt and rainfall introduce wash from the surrounding lands (Prescott 1931). Bacteria in the Camas Creek Subbasin were measured in the form of *Escherichia coli* (*E.coli*). Figure 10 depicts the average annual discharge of *E. coli* in the subbasin. *There are peaks in E. coli in the subbasin during the summer months.* These peaks are likely due to anthropogenic activities as there is less surface wash from precipitation events during the summer.

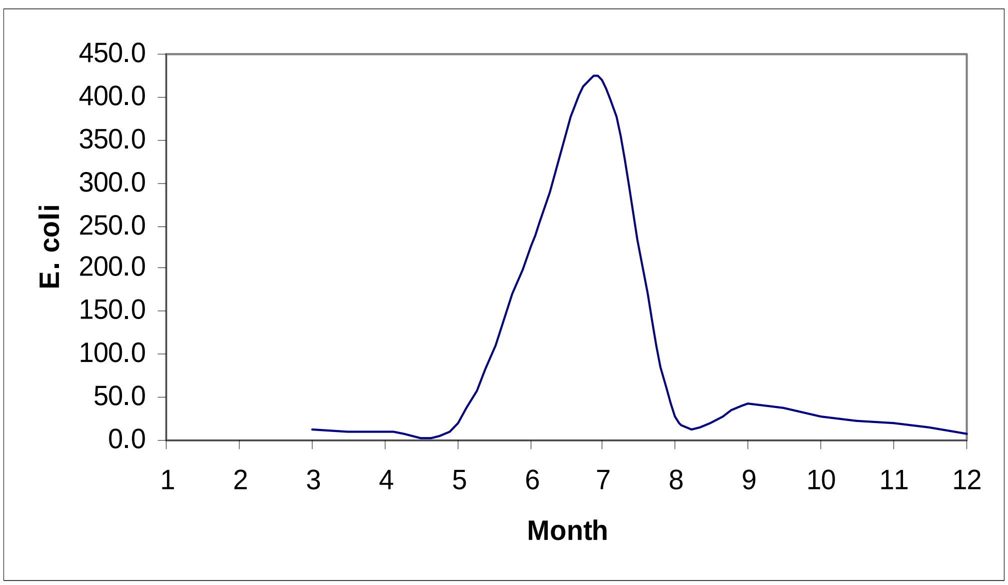


Figure 10. Average annual *E. coli* in the subbasin.

Subwatershed Characteristics

The Camas Creek Subbasin consists of nine watersheds of the 5th field *hydrological unit codes* (HUCs) referred to as *subwatersheds*. The subwatersheds of the subbasin and their attributes are described in the following sections.

5th field Hydrologic Unit Code (HUC)

The Camas Creek Subbasin consists of nine watersheds of the 5th field HUC category (ArcView Coverage 1992-1996). Each of these watersheds drains into the tributaries of Camas Creek or into Camas Creek itself. These watersheds will be the divisions used to aid in the implementation process to clean up the 303(d) listed streams.

Watershed Area

The watershed area is described in Table 9, which is organized by 5th field HUC. These HUCs are also shown in Figure 11.

Table 9. Camas Creek Subbasin 5th field HUC watershed areas.

5th Field HUC	Name	Associated 303(d) Creek	Area (km^2)	Acres	Percent of Area
17040220-01	Upper Magic Reservoir	Camp	147.9	36,546.4	8.3
17040220-02	Willow Creek	Willow, Beaver, and Little Beaver	162.7	40,181.8	9.2
17040220-03	Deer-Kelly-Elk	Elk and Camas	232.3	57,418.8	13.1
17040220-04	Soldier-Spring	Soldier and Camas	309.8	76,534.4	17.5
17040220-05	Corral Creek	Corral and Camas	89.9	22,179	5.1
17040220-06	Mormon Reservoir	Mckinney and Camas	177.9	43,944.5	10.0
17040220-07	Corral-Dairy	None	176.9	43,691.9	10.0
17040220-08	Chimney-Cow	Cow and Camas	180.3	44,538.8	10.2
17040220-09	Upper Camas Creek	Camas and Wild Horse	297.3	73,491.5	16.8

[a]Data from ArcView Coverage 1992-1996.

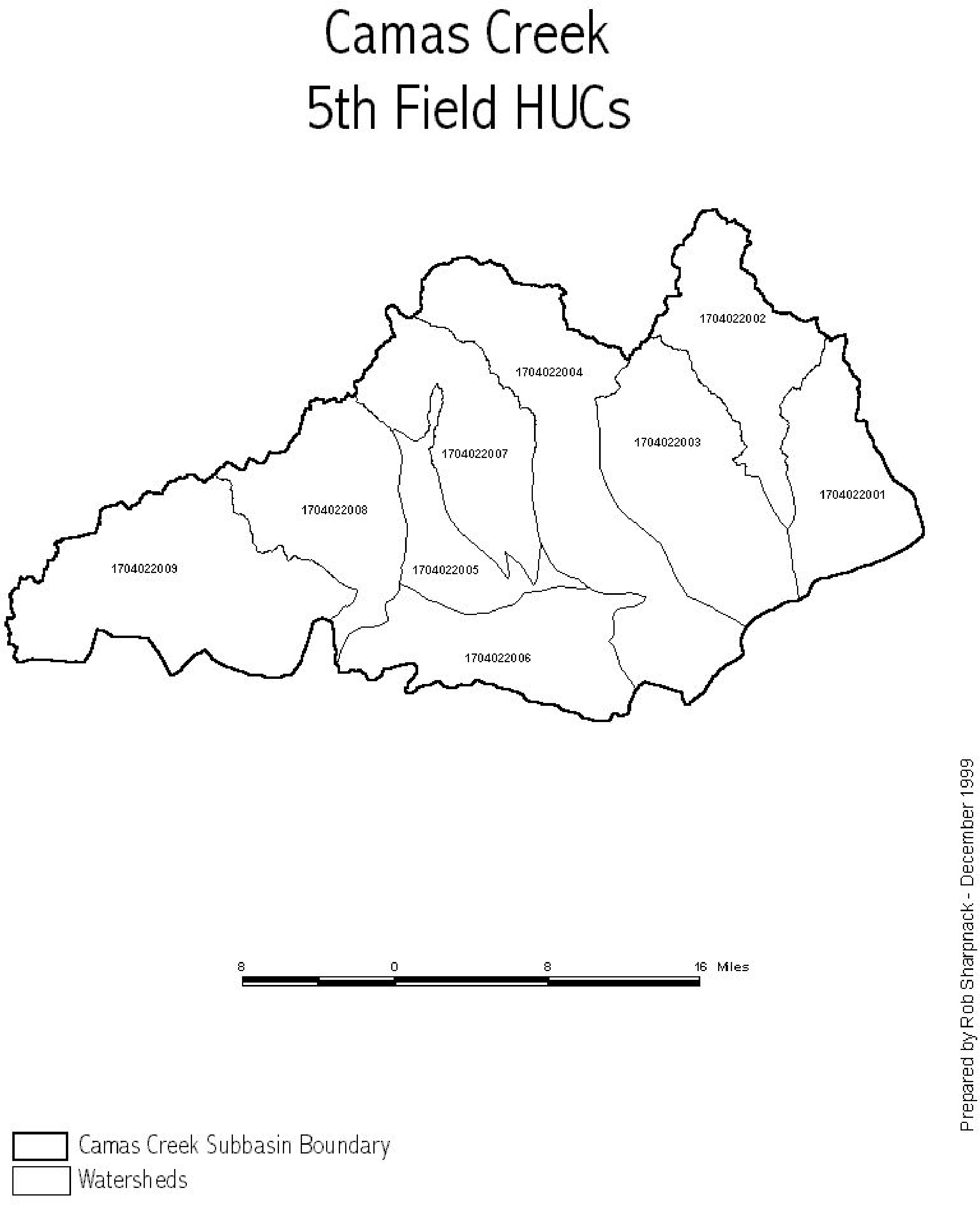


Figure 11. 5th field HUCs for Camas Creek Subbasin.

Watershed attributes can help indicate what factors may be influencing water quality in a given watershed. Table 10 provides information on watershed attributes for the various watersheds of the Camas Creek Subbasin.

Table 10. Camas Creek Subbasin watershed attributes.

5th Field HUC	Land Form	Dominant Aspect	Relief Ratio	Mean Elevation (meters)	Dominant Slope (%)	Hydrologic Regime	Unit Area Runoff (ton/acre/yr)
17040220-01	NR & SRB/HD	N to E	0.047	1713	9.1	REC	51.3
17040220-02	NR & SRB/HD	N to SE	0.045	2009	7.3	DEND	236.2
17040220-03	NR & SRB/HD	N to E	0.050	1716	8.6	REC	84.7
17040220-04	NR & SRB/HD	NW to E	0.047	1873	5.9	DEND + MB	386.7
17040220-05	NR & SRB/HD	N to E	0.019	1591	8.1	REC	20.4
17040220-06	SRB/HD	W to NE	0.029	1653	8.8	CONT	135
17040220-07	NR & SRB/HD	NW to SE	0.059	1846	7.4	PARA	256.5
17040220-08	NR & SRB/HD	N to SE	0.035	1702	9.7	DEND + PARA	152.2
17040220-09	SRB/HD	W to E	0.018	1680	5.7	CON	183.7

[a]Data from Buhidar 2002.
[b]SRB/HD-Snake River Basin/High Desert, NR- Northern Rockies, E-East, W-West, N-North, S-South, CON-contorted, ANN-annual, PARA-parallel, DEND-dendritic, MB-multi-basinal.

Landforms, which have been identified based on ecoregions, are recognizable formations or features of the land that have a characteristic shape and are produced by natural causes (NWOSSP 2004). In the case of watersheds of the Northern Rockies (NR), the landforms that are present are sharp-crested, steep sloped high mountains. For watersheds of the Snake River Basin High Desert (SRB/HD), characteristic landforms are tablelands with moderate to high relief plains (hills or low mountains). Both of these landforms are found throughout the watersheds of the Camas Creek Subbasin.

As can be seen, there are many traits that can characterize a region, and these traits are defined as follows:

- *Dominant aspect* of a watershed indicates the direction of the flow of the dominant stream of a watershed.
- *Relief ratio* of a watershed is a number that represents the difference in the elevations of the watershed divided by the watershed length.
- *Dominant slope* is a percentage that indicates the slope of the watershed by dividing the mean elevation by the watershed length.
- *Hydrologic regime* is a term that summarizes the drainage patterns of the watershed. In the case of the Camas Creek Subbasin, the patterns are contorted, annual, parallel, rectangular, and dendritic. Contorted drainages are found in coarsely layered metamorphic rocks and annual drainages are circular drainages that may form rings

around circular underground structures, such as domes and basins. *Parallel drainages* flow parallel to one another due to the terrain characteristics and usually indicate moderate to steep slopes, and *dendritic branches* are drainages with a branch like pattern that occurs in areas with uniform rock with little folding or faulting and gentle regional slopes. *Rectangular drainages* occur when joints or faults are at right angles, while *multibasinal drainages* have multiple-depression patterns (Ritter, 1978) (ISAS, 2004).

- *Unit area runoff* is an estimate based on the Revised Universal Soil Loss Equation, a sediment model of the amount of erosion that occurs within a watershed in a single year.

1.3 Cultural Characteristics

Human activity can affect the water quality of a water body, either by directly influencing the water or by degrading the land around the water body, which, in turn, can affect the water. The following section will describe some of the human activities that may be influencing the water quality in the Camas Creek Subbasin, including land use, land ownership, cultural features, population, history, and economics.

Land Use

Rangeland is the major land use in the Camas Creek Subbasin followed by dryland agriculture. Other land uses within the subbasin include forest, water, irrigated - gravity flow and sprinkler, and riparian (Table 11 and Figure 12) (ArcView Coverage 1992-1996).

Table 11. Land use of the Camas Creek Subbasin.

Land use	Area (km^2)	Percent of subbasin
Rangeland	1115.1	62.8
Dryland agriculture	534.5	30.1
Irrigated - sprinkler	56.8	3.2
Irrigated – gravity flow	39.1	2.2
Riparian	14.2	0.8
Forest	8.9	0.5
Water	5.3	0.3

[a]Data from ArcView Coverage 1992-1996.

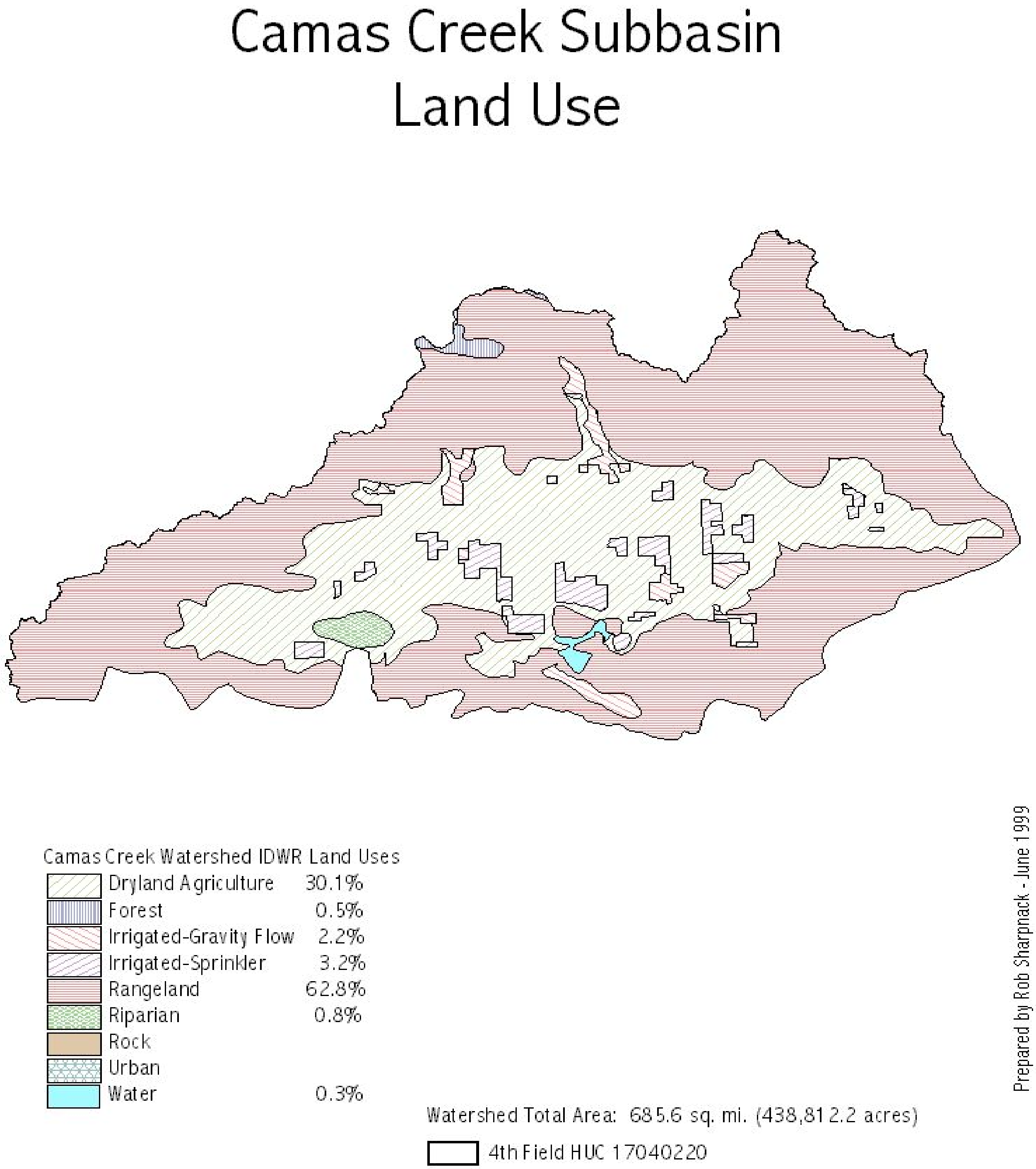


Figure 12. Land use of Camas Creek Subbasin.

Land Ownership, Cultural Features, and Population

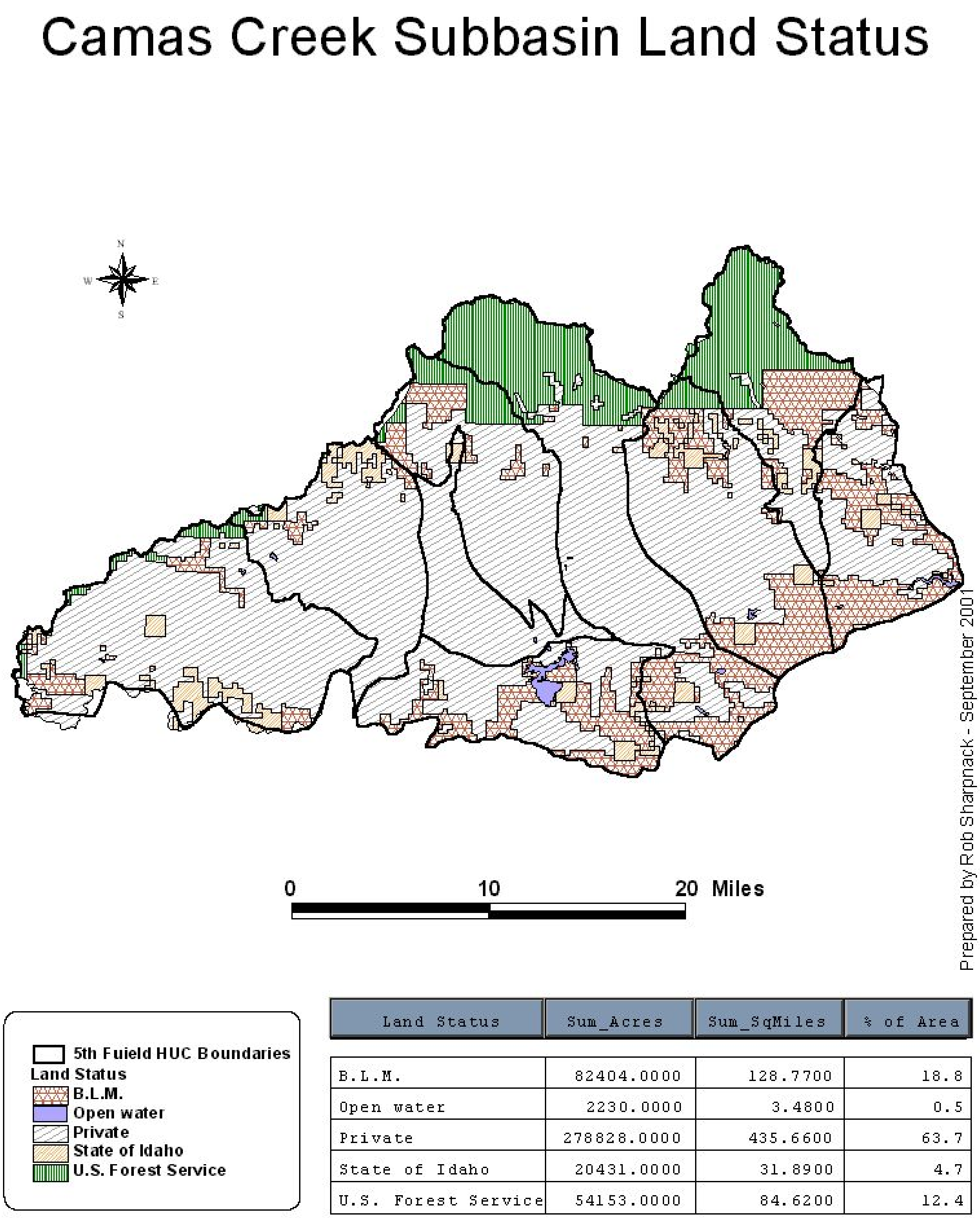
Most of the land ownership in the Camas Creek Subbasin is private, followed by public lands that are federally managed. The state also manages portions of the public land within the subbasin (Table 12 and Figure 13) (ArcView Coverage 1992-1996).

Table 12. Land ownership in the Camas Creek Subbasin.

Land use	Area (km^2)	Percent of subbasin
Private	1,128.5	63.7
BLM	333.6	18.8
USFS	219.1	12.4
State	82.6	4.7
Open water	9.1	0.5

[a]Data from ArcView Coverage 1992-1996.

There are four counties, two cities, and one historical city that exist in the Camas Creek Subbasin (Figure 14 and Figure 15). The majority of the Camas Creek Subbasin lies in Camas County (78.6% of the subbasin area); this county includes the three cities: Fairfield (19 miles west of the mouth of Camas Creek, on Highway 20, and is built up along Soldier Creek), Hill City (13 miles west of Fairfield and lies just west of Cow Creek on Highway 20), and Corral (a historical town that no longer exists). Smaller portions of the subbasin lay in Elmore County (15.1%), Blaine County (6%), and Gooding County (0.3%) (ArcView Coverage 1992-1996). The population for the Camas Creek Subbasin is estimated at 1,351 people. Seventy one percent of the total population is rural. In the last 10 years, the population of the Camas Creek Subbasin has increased 28% (IDOC 2001).



Land Status	Sum_Acres	Sum_SqMiles	% of Area
B.L.M.	82404.0000	128.7700	18.8
Open water	2230.0000	3.4800	0.5
Private	278828.0000	435.6600	63.7
State of Idaho	20431.0000	31.8900	4.7
U.S. Forest Service	54153.0000	84.6200	12.4

Figure 13. Land ownership of the Camas Creek Subbasin.

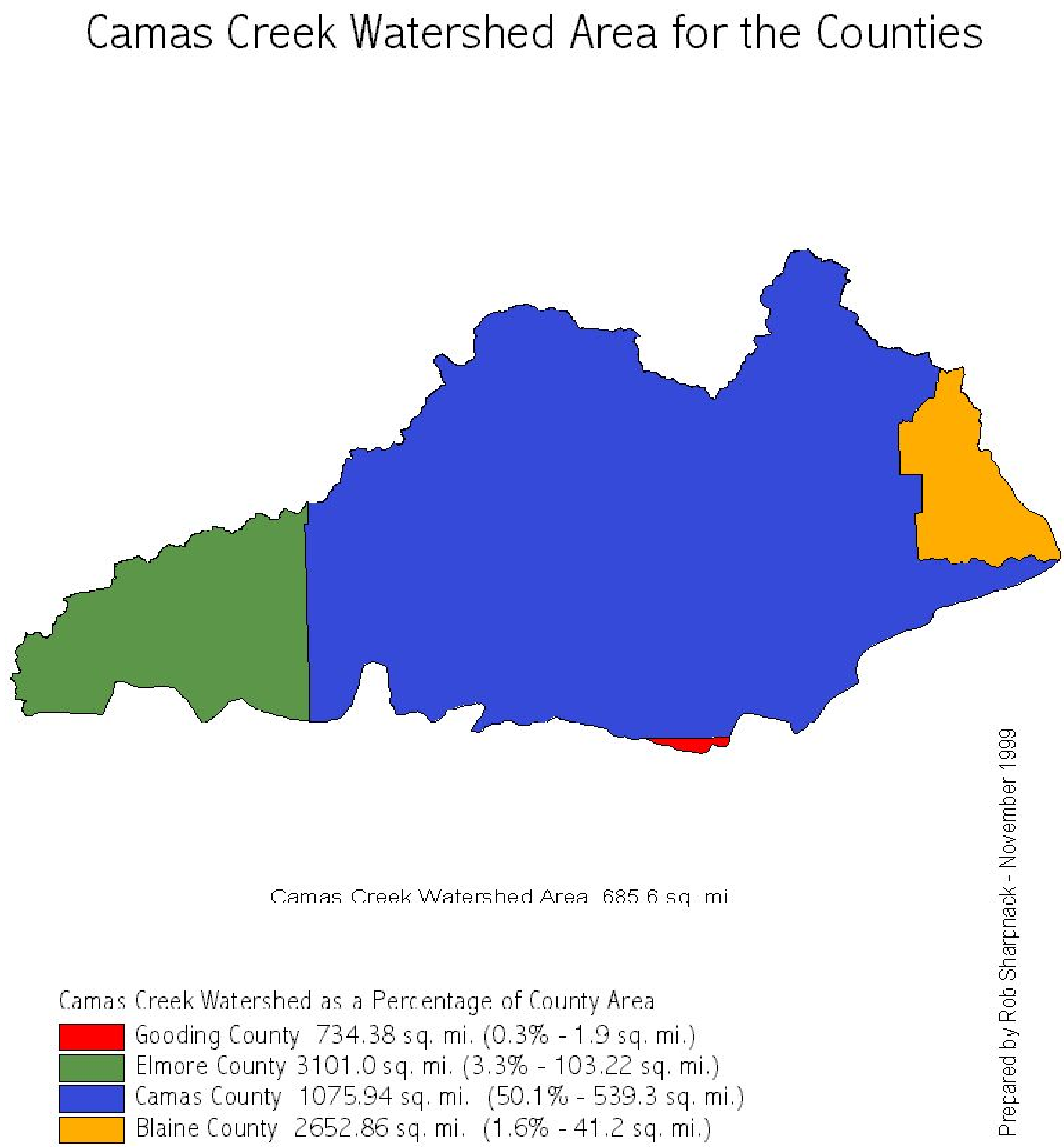


Figure 14. Counties of the Camas Creek Subbasin.

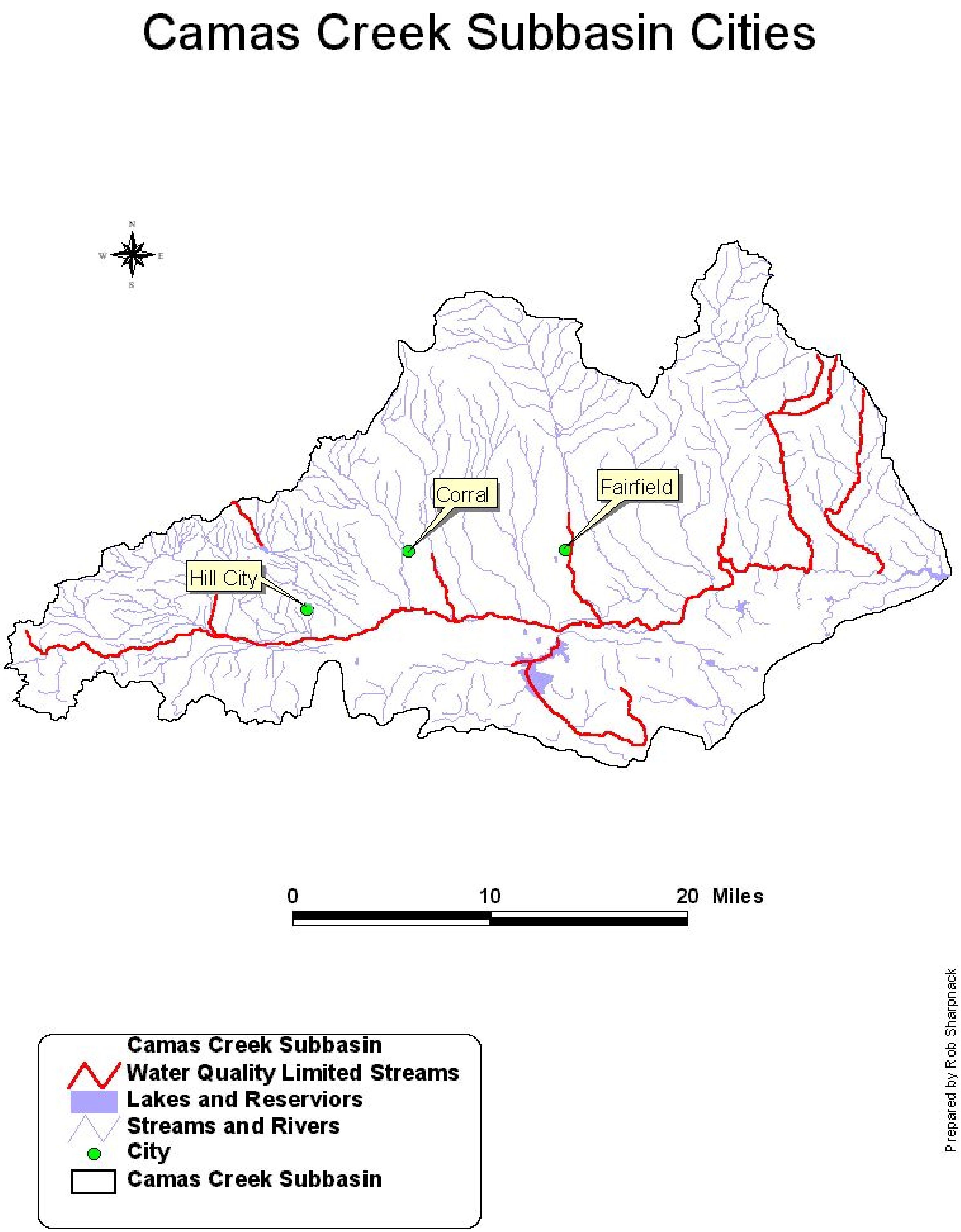


Figure 15. Cities of the Camas Creek Subbasin.

History and Economics

The Camas Creek Subbasin is predominately an agriculture region. Outside of the farming community the largest employers are Soldier Mountain Ski Area, Camas County School District, and Camas County Government. Wholesale and retail trades make up the third largest economic sector of the subbasin, led only by agriculture and government (IDOC 2001).

The majority of the subbasin lies in Camas County which has, over a 10 to 20-year span, shown a decrease in farming and cattle inventories, but an increase in retail trade and government. The other counties within this subbasin also show similar trends, however, there has been an increase in cattle inventories (Table 13).

Table 13. Agricultural statistics in the counties of Camas Creek Subbasin.

County & Year	Total number of Farms	Total Acres Farms	Average farm size (acres)	Total farms in crops	Total acres in crops	Cattle and calves in inventory	Number of irrigated farms	Number of irrigated acres
Blaine								
1987	221	246,774	1,117	193	75,191	27,474	173	54,441
1992	221	266,293	1,205	182	75,250	29,527	179	64,283
1997	195	214,985	1,102	163	70,233	26,849	160	56,909
Percent change	-11.8	-12.9	-1.3	-15.5	-6.6	-2.3	-7.5	4.5
Gooding								
1987	729	239,328	328	644	128,133	83,961	621	107,793
1992	683	227,114	333	585	139,228	113,347	581	115,398
1997	675	220,362	326	529		140,974	542	112,665
Percent change	-7.4	-7.9	-0.6	-17.9	8.7	67.9	-12.7	4.5
Camas								
1987	117	174,842	1,494	101	111,528	9,431	40	13,535
1992	93	129,490	1,392	80		7,878	28	7,486
1997	98	127,514	1,301	85	79,958	7,445	29	12,091
Percent change	-16.2	-27.1	-12.9	-15.8	-28.3	-21.1	-27.5	-10.7
Elmore								
1987	341	401,677	1,178	294		83,416	252	74,753
1992	285	353,528	1,240	237	111,390	94,298	202	75,108
1997	301	355,590	1,181	242	126,529	123,306	226	91,153
Percent change	-11.7	-11.5	0.3	-17.7		47.8	-10.3	21.9

[a]Data from Idaho Department of Commerce Website, 2001.

The City of Fairfield is the only *National Pollutant Discharge Elimination System* (NPDES) permitted facility in the Camas Creek Subbasin (Table 14 and Figure 16). Market Basket in Fairfield has had an NPDES permit, however, it is now on the city's system. The treatment train of the system is lagoons and rapid infiltration basins. The receiving water is an unnamed drainage ditch that drains into Soldier Creek and then eventually into Camas Creek. Prior to 1988 flow from the ditch reached Soldier Creek, but since this date the ditch has dried up. According to Discharge Monitoring Reports, the facility has discharged in the past very rarely. The facility has discharged from January to June of 1976, October to December of 1978, April to June of 1984, 1985, and 1988, and March of 1986 (DEQ 2004).

Table 14. Point source facilities of the Camas Creek Subbasin.

Facility	NPDES ID	Type	Design flow (mgd)	Discharge period
Fairfield	ID 002438-4	100% separated sanitary sewer	0.165	March - May

[a]Data from NPDES files at DEQ office in Twin Falls.

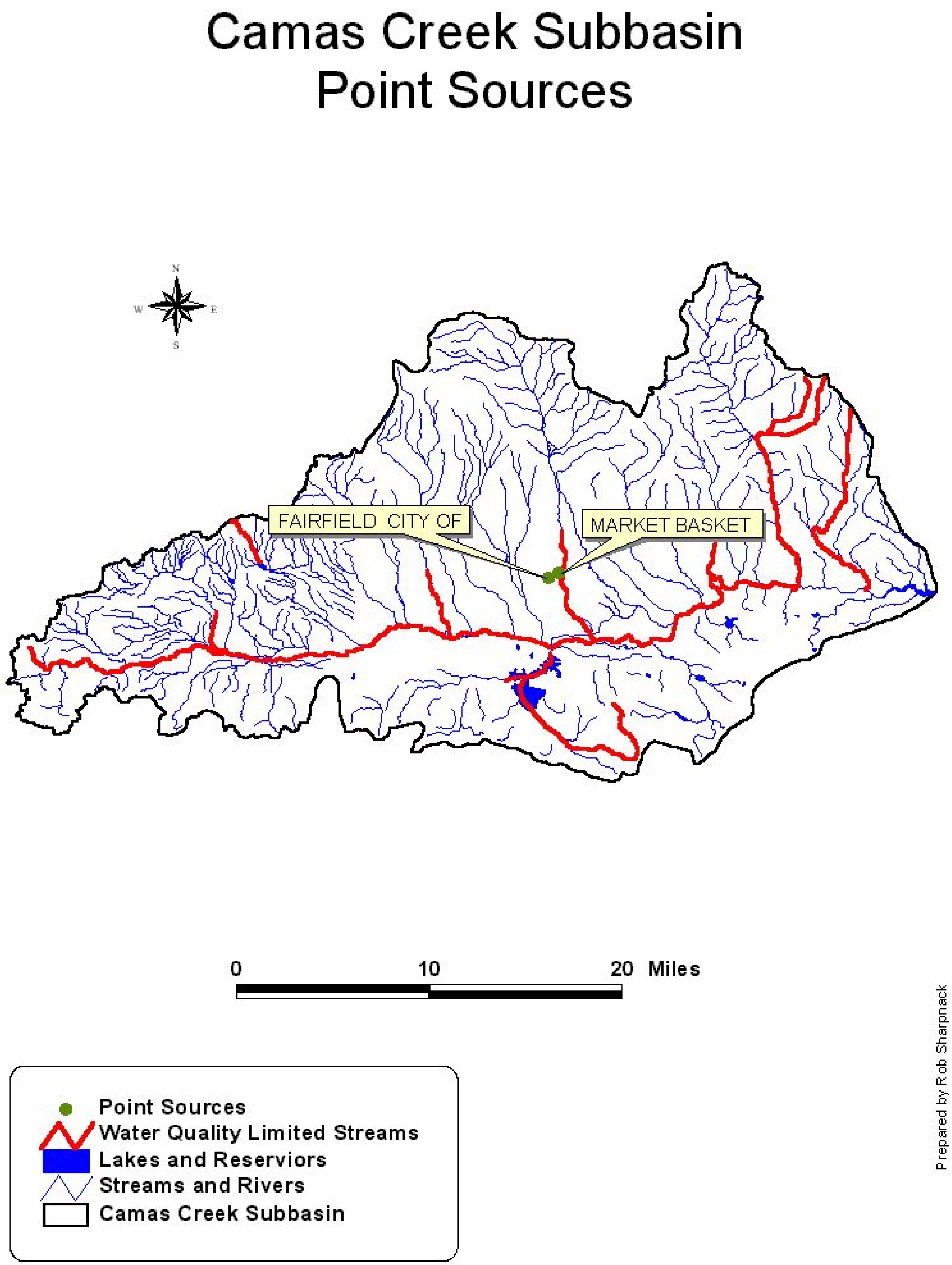


Figure 16. Point source facilities in the Camas Creek Subbasin.

2. Subbasin Assessment – Water Quality Concerns and Status

This section of the subbasin assessment identifies the water quality limited segments and the applicable water quality standards, and it summarizes the analyses of existing water quality data. Data gaps are also identified.

2.1 Water Quality Limited Segments Occurring in the Subbasin

About Assessment Units

Assessment units (AUs) now define all the waters of the state of Idaho. These units and the methodology used to describe them can be found in the *Water Body Assessment Guidance* (WBAG II) (Grafe et al 2002).

Assessment units are groups of similar streams that have similar land use practices, ownership, or land management. Stream order, however, is the main basis for determining AUs; although ownership and land use can change significantly, the AU remains the same. Using assessment units to describe water bodies offers many benefits, the primary benefit being that all the waters of the state are now defined consistently. In addition, using AUs fulfills the fundamental requirement of EPA's 305(b) report, a component of the Clean Water Act, wherein states report on the condition of all the waters of the state. Because AUs are a subset of water body identification numbers, there is now a direct tie to the water quality standards for each AU, so that beneficial uses defined in the water quality standards are clearly tied to streams on the landscape.

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

The boundaries from the 1998 303(d) listed segments have been transferred to the new AU framework, using an approach quite similar to how DEQ has been writing subbasin assessments (SBAs) and TMDLs. All AUs contained in the listed segment were carried forward to the 2002 303(d) listings in Section 5 of the Integrated Report. AUs not wholly contained within a previously listed segment, but partially contained (even minimally), were also included on the 303(d) list. This inclusion was necessary to maintain the integrity of the 1998 303(d) list and to maintain continuity with the TMDL program. These new AUs will lead to better assessment of water quality listing and de-listing.

When assessing new data that indicate full support, only the AU that the monitoring data represents will be removed (de-listed) from the 303(d) list (Section 5 of the Integrated Report.).

Listed Waters

There are twelve water quality limited segments in the 1998 303(d) list that occur in the Camas Creek Subbasin (Table 15, Figure 17). In general, the tributaries to Camas Creek are listed in the prairie region of the subbasin and in regions owned by private landowners; *however TMDLs completed will encompass the entire stretch of the water body.*

Table 15. §303(d) segments in the Camas Creek Subbasin.

Water body Name	Segment ID Number	Assessment Units	1998 §303(d) Boundaries	Pollutants
Camas Creek	2532	ID17040220SK013_05 ID17040220SK001_05 ID17040220SK007_05 ID17040220SK018_04 ID17040220SK018_03 ID17040220SK018_02	Headwaters to Macon Flat Bridge	SED
Soldier Creek	2537	ID17040220SK011_02	Baseline to Camas Creek	BAC, DO, NUT, QALT, SED
Mormon Reservoir	2539	ID17040220SK023L_0L		BAC, DO, NUT, QALT, SED
Little Beaver Creek	5301	ID17040220SK004_02	Headwaters to Beaver Creek	UNKN
Camp Creek	5302	ID17040220SK002_02 ID17040220SK002_03	Headwater to Camas Creek	UNKN
Willow Creek	5303	ID17040220SK003_04	Beaver Creek to Camas Creek	UNKN
Elk Creek	5304	ID17040220SK006_02	Baseline Road to Camas Creek	UNKN
McKinney Creek	5305	ID17040220SK025_02	Headwaters to Mormon Reservoir	UNKN
Corral Creek	5306	ID17040220SK015_03	Highway 20 to Camas Creek	UNKN
Cow Creek	5307	ID17040220SK018_02	Headwaters to Cow Creek Reservoir	UNKN
Wild Horse Creek	5308	ID17040220SK021_03	Highway 20 to Camas Creek	UNKN
Beaver Creek	5309	ID17040220SK004_02	Headwaters to Willow Creek	UNKN

[a]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.
[b]SED-sediment, BAC-bacteria, DO-dissolved oxygen, NUT-nutrients, QALT-flow alteration, UNKN-unknown.

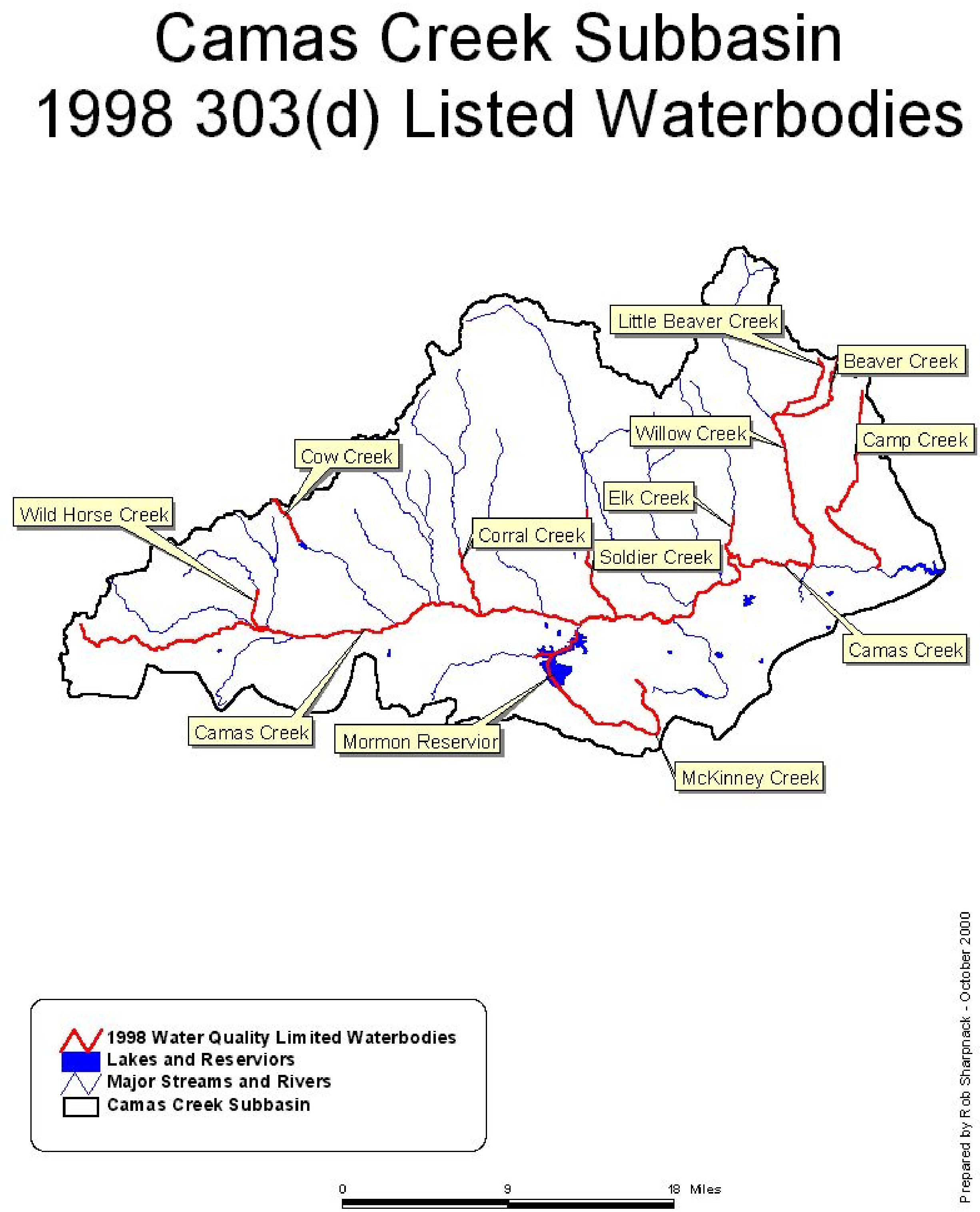


Figure 17. 303(d) listed streams in Camas Creek Subbasin.

2.2 Applicable Water Quality Standards

This section discusses the designated and existing beneficial uses for the listed water bodies of the Camas Creek Subbasin. Water quality criteria (narrative and numeric) are also discussed for each.

Beneficial Uses

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

Existing Uses

Existing uses under the CWA are "those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards." The existing in-stream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.003.35, .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 water 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 water body or segment, whether or not they are being attained." Designated uses are simply uses officially recognized by the state. In Idaho these include 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 water bodies 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.)

Presumed Uses

In Idaho, most water bodies listed in the tables of designated uses in the water quality standards do not yet have specific use designations. These undesignated uses are to be designated. In the interim, and absent information on existing uses, DEQ presumes that most waters in the state will support cold water aquatic life and either primary or secondary contact recreation (IDAPA 58.01.02.101.01). To protect these so-called "presumed uses," DEQ will apply the numeric 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 16 and Table 17 identify designated and existing uses of the 303(d) listed water bodies in the Camas Creek Subbasin. Following the tables is a description of how these existing uses were established.

Table 16. Camas Creek Subbasin designated beneficial uses.

Water body	Designated Uses	1998 §303(d) List
Camas Creek – Headwaters to R10E T2S NW/SE/NW	CW, SS, PCR	X
Camas Creek – R10E T2S NW/SE/NW to Hall Gulch Creek	CW, SS, PCR	X
Camas Creek – Hall Gulch Creek to Cow Creek	CW, SS, PCR	X
Camas Creek – Cow Creek to Soldier Creek	CW, SS, PCR	X
Camas Creek – Soldier Creek to Macon Flat Bridge	CW, SS, PCR	X
Camas Creek – Macon Flat Bridge to Magic Reservoir	CW, SS, PCR	

[a]CW – Cold Water, SS – Salmonid Spawning, PCR – Primary Contact Recreation, SCR – Secondary Contact Recreation, AWS – Agricultural Water Supply, DWS – Domestic Water Supply
[b]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 17. Camas Creek Subbasin existing/presumed beneficial uses.

Water body	Existing/Presumed Uses	1998 §303(d) List
Wild Horse Creek	CW, SCR	X
Cow Creek	CW, SCR	X
Corral Creek	CW, SS, SCR	X
McKinney Creek	CW, SCR	X
Soldier Creek	CW, SS, PCR	X
Elk Creek	CW, SCR	X
Willow Creek	CW, SS, PCR	X
Beaver Creek	CW, SS, SCR	X
Little Beaver Creek	CW, SS, SCR	X
Camp Creek	CW, SS, SCR	X
Dairy Creek	CW, SCR	
Mormon Reservoir	CW, PCR	X

[a]CW – Cold Water, SS – Salmonid Spawning, PCR – Primary Contact Recreation, SCR – Secondary Contact Recreation, AWS – Agricultural Water Supply, DWS – Domestic Water Supply
[b]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.

A number of factors were used to determine that cold-water aquatic life is an existing use for the 303(d) listed water bodies in the Camas Creek Subbasin. These factors included cold water macroinvertebrate indicators, cold water fish indicators, water chemistry data, and diel temperature data.

The Water Body Assessment Guidance (WBAG II) (Grafe et al 2002) states that cold water aquatic life uses can be determined by the macroinvertebrate and fish populations of the water body. When there are at least two cold water indicator macroinvertebrate species (identified in the empirically derived cold water taxon list) present in a water body, then the water body has cold water aquatic life as an existing use. For fish, if 50% of the total population or 50% of the total number of species are cold water adapted species, then the water body is considered to have cold water aquatic life use.

If diel water temperature is collected during the critical time period for cold water aquatic life (June 22 to September 21), temperature data can be used to determine cold water aquatic life use. If the percent of temperature exceedance is no greater than 10% for the maximum water temperature (22˚C) or the average water temperature (19˚C) then cold water aquatic life use is occurring.

There are also some water chemistry requirements in relation to aquatic life use designations that are found in IDAPA 58.01.02.250. The requirements for cold water aquatic life are that dissolved oxygen concentrations must be greater than six mg/l at all times, water temperature can not exceed a maximum instantaneous of 22˚C or a daily average of 19˚C, ammonia can not exceed calculated criterion more than once in a three year period, and turbidity can not exceed background by more than 50 *nephelometric turbidity units* (NTUs) for instantaneous measurements.

Because a water body may not be meeting beneficial uses due to impairment, all the above listed factors were considered when determining cold water aquatic life use. Based on these factors, cold water aquatic life was found to be an existing use on the following water bodies: Camp Creek, Willow Creek, Beaver Creek, Little Beaver Creek, Soldier Creek, and Corral Creek. The data available on Elk Creek, Cow Creek, Wild Horse Creek, McKinney Creek, and Dairy Creek do not strongly indicate that cold water aquatic life use is an existing use. However, since there are data gaps or minimal data pertaining to these streams, DEQ will assume that these streams do have cold water aquatic life as an existing use unless future data indicates otherwise.

According to the WBAG document, salmonid spawning occurs in a water body if, during the summertime, there are juvenile salmonids that are less than 100mm in overall length, as long as the water body is a first to fourth order stream. Salmonid spawning occurs in Camp Creek, Willow Creek, Beaver Creek, Little Beaver Creek, Soldier Creek, and Corral Creek. There were no salmonids present in Wild Horse and McKinney Creek, and there has been no fish data collected on Elk Creek or Cow Creek. *As a result, salmonid spawning is not identified as an existing use at this time.* It is unlikely that SS is occurring in Cow Creek as the 303(d) listed portion is a short first order segment and the remaining portions of Cow Creek are intermittent and has water during spring runoff. Elk Creek similarly has few tributaries and is intermittent. The water body in the Elk Creek drainage that provides limited perennial waters in the upper end of Elk Creek is a geothermically warm water body fed by hot springs. *Salmonid spawning is likely not to occur in these watersheds due to the lack of water or warm water influence. The SS criteria will not be assessed, but may need to be readdressed at a later date when data gaps are filled.*

The WBAG states that designated recreational facilities, water body size, and accessibility are factors used to determine if primary contact recreation is occurring on a water body rather than secondary contact recreation. In addition, if it was witnessed that swimming occurs in a water body, then it was automatically listed as primary contact recreation. *Based on these factors, primary recreation occurs on Camas Creek, Soldier Creek, and Willow Creek, while the remainder of the listed tributaries is secondary contact recreation.*

Domestic water supply is listed as a water use in most of the water rights that have been searched. However, in all domestic water right cases, both domestic water supply and irrigation were listed as water uses for that water right, therefore *domestic water supply is not considered an existing beneficial use for any of the water bodies that are 303(d) listed*, unless designated as such.

Surface Water Quality Criteria

There are general criteria that apply for all surface waters of the state, and there are other criteria that apply to the surface water based on designated or existing uses of the water body. Table 109, Appendix 3 (page 238) lists the general surface water criteria, surface water quality criteria for aquatic life use designation, surface water quality criteria for recreation use designations, surface water quality criteria for water supply use designation, and surface water quality criteria for wildlife and aesthetic use designations. Also incorporated into the table is natural background conditions language and wastewater treatment requirements as there are point sources in the subbasin.

Temperature elevations within the subbasin may or may not be naturally elevated in the subbasin. However, the influence of beaver dam complexes, geothermal springs, stream banks lined with basalt, and south facing slopes could be influencing water temperatures. As these are natural occurrences within a water body, there may be natural background conditions that may be contributing to elevated temperatures. Temperature TMDLs will be completed to restore potential natural vegetation to the riparian zones of the water body. If these conditions are restored and temperature is still elevated above standards then it is likely that natural background conditions are impacting water temperatures. Due to these influences natural background condition language may be applicable and can be further reviewed in Appendix 3.

2.3 Pollutant/Beneficial Use Support Status Relationships

Most of the pollutants that impair beneficial uses in streams are naturally occurring stream characteristics that have been altered by humans. That is, streams naturally have sediment, nutrients, and the like, but when anthropogenic sources cause these to reach unnatural levels, they are considered "pollutants" and can impair the beneficial uses of a stream.

Temperature

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

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

Dissolved Oxygen

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

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

Juvenile aquatic organisms are particularly susceptible to the effects of low DO due to their high metabolism and low mobility (they are unable to seek more oxygenated water). In addition, oxygen is necessary to help decompose organic matter in the water and bottom sediments. Dissolved oxygen reflects the health or the balance of the aquatic ecosystem. Oxygen is produced during photosynthesis and consumed during plant and animal respiration and decomposition. Oxygen enters water from photosynthesis and from the atmosphere. Where water is more turbulent (e.g., riffles, cascades), the oxygen exchange is greater due to the greater surface area of water coming into contact with air. The process of oxygen entering the water is called aeration.

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

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

Sediment

Both suspended (floating in the water column) and bedload (moves along the stream bottom) sediment can have negative effects on aquatic life communities. Many fish species can tolerate elevated suspended sediment levels for short periods of time, such as during natural spring runoff, but longer durations of exposure are detrimental. Elevated suspended sediment levels can interfere with feeding behavior (difficulty finding food due to visual impairment), damage gills, reduce growth rates, and in extreme cases eventually lead to death. Newcombe and Jensen (1996) reported the effects of suspended sediment on fish, summarizing 80 published reports on streams and estuaries. For rainbow trout, physiological stress, which includes reduced feeding rate, is evident at suspended sediment concentrations of 50 to 100 mg/L when those concentrations are maintained for 14 to 60 days. Similar effects are observed for other species, although the data sets are less reliable. Adverse effects on habitat, especially spawning and rearing habitat presumably from sediment deposition, were noted at similar concentrations of suspended sediment.

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

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

Settleable solids are defined as the volume (milliliters [ml]) or weight (mg) of material that settles out of a liter of water in one hour (Franson et al. 1998). Settleable solids may consist of large silt, sand, and organic matter. Total suspended solids (TSS) are defined as the material collected by filtration through a 0.45 µm (micrometer) filter (Standard Methods 1975, 1995). Settleable solids and TSS both contain nutrients that are essential for aquatic plant growth. Settleable solids are not as nutrient rich as the smaller TSS, but they do affect river depth and substrate nutrient availability for macrophytes. In low flow situations, settleable solids can accumulate on a stream bottom, thus decreasing water depth. This increases the area of substrate that is exposed to light, facilitating additional macrophyte growth.

Bacteria

Escherichia coli or E. coli, a species of fecal coliform bacteria, is used by the state of Idaho as the indicator for the presence of pathogenic microorganisms. Pathogens are a small subset of microorganisms (e.g., certain bacteria, viruses, and protozoa), which, if taken into the body through contaminated water or food, can cause sickness or even death. Some pathogens are also able to cause illness by entering the body through the skin or mucous membranes.

Direct measurement of pathogen levels in surface water is difficult because pathogens usually occur in very low numbers and analysis methods are unreliable and expensive. Consequently, indicator bacteria which are often associated with pathogens, but which generally occur in higher concentrations and are thus more easily measured, are assessed.

Coliform bacteria are unicellular organisms found in feces of warm-blooded animals such as humans, domestic pets, livestock, and wildlife. Coliform bacteria are commonly monitored as part of point source discharge permits (National Pollution Discharge Elimination System [NPDES] permits), but may also be monitored in nonpoint source arenas. The human health effects from pathogenic coliform bacteria range from nausea, vomiting, and diarrhea to acute respiratory illness, meningitis, ulceration of the intestines, and even death. Coliform bacteria do not have a known effect on aquatic life.

Coliform bacteria from both point and nonpoint sources impact water bodies, although point sources are typically permitted and offer some level of bacteria-reducing treatment prior to discharge. Nonpoint sources of bacteria are diffuse and difficult to characterize. Unfortunately, nonpoint sources often have the greatest impact on bacteria concentrations in water bodies. This is particularly the case in urban storm water and agricultural areas. *E. coli* is often measured in colony forming units (cfu) per 100 ml.

Nutrients

While nutrients are a natural component of the aquatic ecosystem, natural cycles can be disrupted by increased nutrient inputs from anthropogenic activities. The excess nutrients result in accelerated plant growth and can result in a eutrophic or enriched system.
The first step in identifying a water body's response to nutrient flux is to define which of the critical nutrients is limiting. A limiting nutrient is one that normally is in short supply relative to biological needs. The relative quantity affects the rate of production of aquatic biomass. Either phosphorus or nitrogen may be the limiting factor for algal growth, although phosphorous is most commonly the limiting nutrient in Idaho waters. Ecologically speaking, a resource is considered limiting if the addition of that resource increases growth.

Total phosphorus (TP) is the measurement of all forms of phosphorus in a water sample, including all inorganic and organic particulate and soluble forms. In freshwater systems, typically greater than 90% of the TP present occurs in organic forms as cellular constituents in the biota or adsorbed to particulate materials (Wetzel 1983). The remainder of phosphorus is mainly soluble orthophosphate, a more biologically available form of phosphorus than TP that consequently leads to a more rapid growth of algae. In impaired systems, a larger percentage of the TP fraction is comprised of orthophosphate. The relative amount of each form measured can provide information on the potential for algal growth within the system. Nitrogen may be a limiting factor at certain times if there is substantial depletion of nitrogen in sediments due to uptake by rooted macrophyte beds. In systems dominated by blue-green algae, nitrogen is not a limiting nutrient due to the algal ability to fix nitrogen at the water/air interface.

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

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

Sediment – Nutrient Relationship

The linkage between sediment and sediment-bound nutrients is important when dealing with nutrient enrichment problems in aquatic systems. Phosphorus is typically bound to particulate matter in aquatic systems and, thus, sediment can be a major source of phosphorus to rooted macrophytes and the water column. While most aquatic plants are able to absorb nutrients over the entire plant surface due to a thin cuticle (Denny 1980), bottom sediments serve as the primary nutrient source for most sub-stratum attached macrophytes. The USDA (1999) determined that other than harvesting and chemical treatment, the best and most efficient method of controlling growth is by reducing surface erosion and sedimentation.

Sediment acts as a nutrient sink under aerobic conditions. However, when conditions become anoxic sediments release phosphorous into the water column. Nitrogen can also be released, but the mechanism by which it happens is different. The exchange of nitrogen between sediment and the water column is for the most part a microbial process controlled by the amount of oxygen in the sediment. When conditions become anaerobic, the oxygenation of ammonia (nitrification) ceases and an abundance of ammonia is produced. This results in a reduction of nitrogen oxides (NO_x) being lost to the atmosphere.

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

Floating, Suspended, or Submerged Matter (Nuisance Algae)

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

Commonly, algae blooms appear as extensive layers or algal mats on the surface of the water. When present at excessive concentrations in the water column, blue-green algae often produce toxins that can result in skin irritation to swimmers and illness or even death in organisms ingesting the water. The toxic effect of blue-green algae is worse when an abundance of organisms die and accumulate in a central area.

Algal blooms also often create objectionable odors and coloration in water used for domestic drinking water and can produce intense coloration of both the water and shorelines as cells accumulate along the banks. In extreme cases, algal blooms can also result in impairment of agricultural water supplies due to toxicity. Water bodies with high nutrient concentrations that could potentially lead to a high level of algal growth are said to be eutrophic. The extent of the effect is dependent on both the type(s) of algae present and the size, extent, and timing of the bloom.

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

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

2.4 Summary and Analysis of Existing Water Quality Data

This section of the report describes the analysis process used for each water body as well as existing water quality data that was considered. For most of the water bodies, data collected by DEQ is the only available data; some data has been collected through the State Agricultural Water Quality Plan (SAWQP) program, and the USGS has collected indicator parameters on some of the water bodies but not consistently for analysis purpose.

Analysis Process

In analyzing the water quality data on the water bodies in this segment, the following steps were followed:

- The water body and the land surrounding the water body were described.
- Biological data were analyzed to determine if beneficial uses were fully supported.
- Hydrology was described, as this could be a major contributor of impairment to these water bodies.

- Water column data were analyzed and followed up with conclusions to be made about the water body.

Bioassessment Data

Biological data is used by the state of Idaho in determining if beneficial uses of wadeable perennial streams are fully supported. Biological and habitat data on water bodies are collected through the *Beneficial Use Reconnaissance Program* (BURP). The WBAG document is used as a tool to assess the biological data that has been collected.

The data collected through the BURP protocol includes macroinvertebrate, fish, and habitat data. Multimetric indices are used to determine the health of a water body. Each index has a number of characteristics that are rated and the sum of the ratings provides the stream index of that particular data type. If macroinvertebrate, fish, and habitat data are all collected at a site, the analysis of the data will provide a *stream macroinvertebrate index* (SMI), a *stream fish index* (SFI), and a *stream habitat index* (SHI). These indices are then given a condition rating score to determine if a water body is fully supporting its beneficial uses.

The index scores were broken down into three ranges of numbers. The number range varies between ecoregions. The range with the highest scores receives a condition rating of 3, the middle range of scores receives a condition rating of 2, and the next lower range of scores receives a condition rating of 1. For the SMI and SFI index there is a fourth lower range of scores; these scores are identified as minimum threshold.

At least two of the data groups must have been obtained at the collection event for a water body to be assessed. If the average condition rating scores for the indices that were collected is greater than or equal to 2 than the water body is considered *fully supporting*; if it is less than 2 the water body is considered *not fully supporting*. If either the SMI or SFI score indicates a minimum threshold, the water body is automatically considered *not fully supporting*. For more detail on how these index scores are developed see the WBAG and the *Idaho Small Stream Ecological Assessment Framework* (Grafe, ed 2000).

Biological data is used to indicate support status of beneficial uses, however the WBAG also identifies an exceedance policy for DO, pH, turbidity, and temperature in determining if water quality is capable of fully supporting beneficial uses. As these constituents are numerical criteria in the water quality standards, an elevation above the 10% exceedance policy indicates water quality is incapable of supporting beneficial uses and thus can supersede conclusions supported by biological data. These water chemistry data constituents are discussed in the subsection *Water Column Data.*

Hydrology

The hydrology sections of this report include a description of the water bodies' perennial/intermittent status (defined by ArcView coverage), the water bodies as observed by DEQ during drought years (2001-2003), predicted average stream flows, and water right diversions. When applicable, linear regression models were used to predict average stream flows.

There is one active stream flow station located within the Camas Creek Subbasin: USGS 13141500 Camas Creek near Blaine, Idaho. This gauging station was used to develop average stream flow models for the other water bodies in the Camas Creek Subbasin.

Flow alteration within a water body can impact beneficial uses, and it can be difficult to identify the degree of impact. In determining if there is an impact due to flow alteration, several things were examined: water rights, diversion maps, and changes in stream flow that did not appear to be due to precipitation events. Canal and ditch systems were identified using ArcView coverage as well as 1:25,000 topo quad maps. Changes in stream flow were identified based on observations and flows measured. Water right searches were performed from the Idaho Department of Water Resources Web site for each of the 303(d) listed water bodies. There are many water rights that list the source as multiple water bodies (usually a main stem and tributaries); therefore it is difficult to distinguish how much water is diverted from which water body. Due to these methods of record, the amount of water diverted from the 303(d) water body itself was a conservative estimate.

Water Chemistry

Water chemistry data is used in the subbasin assessment process to both identify if beneficial uses are fully supported and to identify the pollutants impacting the beneficial uses. The following sections describe the available data as well as standards or targets for the constituents.

Water chemistry data for the Camas Creek Subbasin is very limited. Water chemistry data that has been collected in the last five years (1998 – 2003) was used to assess the current status of the water bodies. Due to the lack of data within the subbasin, trend analysis cannot be performed. Recent data, as well as data that have been sporadically collected or is older than five years, was used to aid in determining the seasonal or monthly fluctuations that occur in the water body.

Recent and historical data in the subbasin has been collected by DEQ and by other agencies. Laboratory and field data were collected by DEQ at various locations during 2001-2003 . During this time, temperature loggers were also distributed throughout the subbasin. A private vendor was contracted by DEQ to perform monthly monitoring of the Camas Creek Subbasin from September 2001 to August 2002 for laboratory and field samples. (The data collected by other agencies varies from water body to water body and is extremely limited for most water bodies. In addition, EPA's Storage and Retrieval (STORET) database was used as a source of data but did not yield data that was not already obtained through the original sources.)

Numerical Criteria

There are numerical water quality standards that apply to surface waters of the state. These standards include bacteria, temperature, ammonia, pH, and turbidity. Ammonia, pH, DO, and turbidity data that is elevated beyond standards indicate that there is a pollutant that is impacting the water body, thus the pollutant needs to be identified. On the other hand, bacteria and temperature are pollutants; therefore if data for either of these constituents is elevated then they themselves are impacting the water body.

In addition to having numerical criteria in the water quality standards, temperature, pH, DO, and turbidity data is used, in addition to biological data, to indicate if water quality is capable of fully supporting beneficial uses. If the data set for any of these constituents is elevated beyond the water quality standards more than 10% of the time then the data indicate that water quality is not capable of fully supporting beneficial uses. As these constituents are numerical values in the water quality standards exceedance of the 10% policy supersede biological data in determining if water quality is capable of fully supporting beneficial uses.

Numerical standards for the above mentioned constituents are identified in Appendix 3, but a brief description of the numerical criteria will be discussed now.

- If NH3 standards were exceeded more than once in three years, as stated in water quality standards, then the NH3 data could be indicating that a pollutant is impacting water quality and thus beneficial uses. The pollutant would then need to be identified.
- If pH, DO, or turbidity were elevated more than 10% of the time then data indicated that a pollutant was impacting water quality and thus beneficial uses. The pollutant would then need to be identified. Standards for pH indicate that pH should not fall outside of the range of 6.5 to 9.0 standard units. Standards for DO indicate that DO should be greater than 6.0 mg/L. Standards for turbidity indicate that turbidity should not be elevated more than 50 NTUs above background levels.
- When bacteria values were elevated above the instantaneous criteria (576 or 406 cfu/100mL), then four additional samples collected within 30 days were used to calculate a geometric mean. If the geometric mean value was elevated above the criteria (126 cfu/100mL), then bacteria were impacting contact recreation beneficial uses. A TMDL for bacteria was then completed. If additional samples were not collected within 30 days, then the instantaneous data alone was used to determine if beneficial uses were impacted.
- If temperature data during either CWAL or SS critical periods was elevated more than 10% of the time, then water quality was identified as not being capable of supporting beneficial uses. In this case, canopy cover data were collected from aerial photos (Shumar 2004) as well as from field measurements (solar path finder) to develop loads for a temperature TMDL. The water body was characterized according to vegetation type, bankfull width, and elevation to identify the natural vegetation potential of the water body. The Alvord Lake Subbasin Total Maximum Daily Load and Water Quality Management Plan (Hammon, et al. 2003) was used to aid in determining the canopy cover surrogate targets based on these characteristics. The quantity of solar radiation for flat-plate collectors facing south at a fixed tilt was measured at a National Renewable

Energy Lab station in Boise, Idaho. These quantities were used to determine an existing and proposed solar radiation load based on the canopy cover of the water body.

Narrative Criteria

The narrative criteria of the water quality standards include nuisance aquatic vegetation and oxygen-demanding materials. These standards were measured with nutrient and sediment numerical surrogates that have been derived from various sources and used throughout many of the south central Idaho TMDLs. *The critical value for most of these narrative surrogates in determining if the beneficial uses were impacted by the pollutant is the annual average. However, due to monitoring designs and site inaccessibility the value was not a true annual average but an average of the period of record.*

Nutrient Criteria

Nutrient data used in the assessment of the water body includes total phosphorus (TP), total inorganic nitrogen (TIN), and chlorophyll. The surrogate targets for TP are those suggested in the EPA Quality Criteria for Water 1986 (EPA 1986). Surrogate targets for TIN were identified in the Idaho water quality status report 1980 (IDHW 1980) and the Salmonid-habitat relationships in the Western United States (USFS 1990). Nuisance levels of filamentous algae may be occurring when chlorophyll *a* levels are greater than 15 μg/L (Welch 1987). *The following values have been used in many TMDLs throughout the south central region of Idaho.*

- Chlorophyll values that are elevated above 15μg/L may be indicative of impacted beneficial uses. However, chlorophyll data were not collected simultaneously with TP and TIN data so a relationship between chlorophyll data and nutrient data can not be established in this subbasin.
- The recommended targets of TP to prevent eutrophication of a free flowing stream is 0.100 mg/L and for a stream delivering to a storage system is 0.050 mg/L for the delivering stream (EPA 1986). *For a free flowing water body*, the annual and monthly average target for TP is 0.100 mg/L. Monthly and annual averages elevated above this value may indicate impairment of the water body. Ideally, the monthly average would be used to determine if impairment was occurring. However, monitoring designs did not allow for a monthly average to be determined. As a result, the daily maximum value of 0.160 mg/L was used to determine if monthly averages were likely to be elevated, in combination with the annual average of 0.100 mg/L. *For a water body flowing into a storage system*, if the TP average for a water body flowing into a storage system was less than 0.100 mg/L but elevated above 0.050 mg/L, then it was concluded that TP was not impacting the beneficial uses of the water body but was likely impacting the water quality of the storage system. (The daily maximum value of 0.080 mg/L would be used in this case to indicate if monthly averages were likely to be elevated.) In a case such as this, a TMDL on the delivering stream was completed to limit the loading to the storage system.
- The Ambient Water Quality Criteria Recommendations for Rivers and Steams in Nutrient Ecoregion III, the Xeric West (EPA 2000) was not used to set nutrient targets for the

water bodies in this subbasin. The document identifies suggested targets for reference conditions and states that “reference conditions represent the natural, least impacted conditions or what is considered to be the most attainable conditions (28).” IDAPA states “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).” The goal is to protect the beneficial uses of the water body, not to restore the water body to reference conditions. As a result, these suggested ecoregional criteria will not be used as a target for TP in this subbasin.

- The limit for development of biological nuisances and eutrophication is considered to be 0.300 mg/L of TIN (IDHW 1980, USFS 1990). If TIN averages were elevated above 0.300 mg/L, it was concluded that nitrogen compounds might be impacting beneficial uses if TP values were also elevated in the system. Well data were then analyzed to determine if elevated TIN was due to groundwater influence.
- Instantaneous TP and TIN values were also examined to better characterize the water body and to identify periods of elevated influence. *Instantaneous data is being used to identify the seasonal fluctuations rather than monthly averages because the monitoring plan for the subbasin did not allow for monthly averages to be determined.* Instantaneous criteria for TIN were 0.480 mg/L while instantaneous criteria for TP were 0.160 mg/L for a free flowing water body and 0.080 mg/L TP for a storage system water body.
- For nutrients to be considered as an impact to a water body, there has to be either nuisance aquatic growth or an elevation of both phosphorous and nitrogen values. Total nitrogen to total phosphorous values was also calculated to find out what the limiting factor in the water body was. If TN/TP ratios were greater than 7, then the water body was phosphorous limited; if they were 7 or less, then the water body was nitrogen limited.

Sediment Criteria

Sediment data used in the assessment of the water body includes total suspended solids (TSS) and bedload sediment. The surrogate targets for TSS are those suggested by the European Inland Fisheries Advisory Commission (EIFAC 1964). The surrogate targets for bedload sediment (percent fines) are the upper values that are occurring in water bodies of the subbasin that are fully supporting their beneficial uses. Stream bank erosion targets are those that have been identified in numerous plans, the Salmon-Challis Forest Management Plan, the Salmon-Challis Annual Monitoring Plan, and an Inventory of Natural Conditions in the Salmon River Basin by Kerry Overton (Herron 2004). *These targets have been used in many TMDLs throughout the south central region of Idaho.*

- Water column data for sediment was measured in the form of TSS. The European Inland Fisheries Advisory Commission has suggested that targets of 25 mg/L would be highly protective, 80 mg/L would be moderately protective, and targets of 400 mg/L would be least protective. The program management team of DEQ has in the past proposed a target of 50 mg/L (Lay 2000). *The annual and monthly average target for TSS is 50 mg/L. Monthly and annual averages elevated above this value may indicate impairment of the* *water body. Ideally, the monthly average would be used to determine if impairment was occurring. However, monitoring designs did not allow for a monthly average to be determined. As a result, the daily maximum value of 80 mg/L was used to determine if monthly averages were likely to be elevated in combination with the annual average of 50 mg/L.*

- Instantaneous TSS values were also examined to better characterize the water body and to identify periods of elevated influence. *Instantaneous data is being used to identify the seasonal fluctuations rather than monthly averages because the monitoring plan for the subbasin did not allow for monthly averages to be determined*. An instantaneous criterion for TSS was 80 mg/L.
- Bedload sediment is measured as percent fines and a target of 35% or less fines indicates that bedload sediment is not impacting beneficial uses. A review of the percent fine data on water bodies that are fully supporting beneficial uses in the Little Wood River Subbasin indicate that beneficial uses are fully supported at percent fines that are 35% or less (Figure 18). When bedload sediment is elevated, a stream bank erosion inventory is completed to determine if stream bank erosion is the source of the elevated bedload sediment.
- The NRCS Stream Bank Erosion Inventory is used to estimate the amount of stream bank erosion occurring in a water body. Properly managed streams have stream bank stabilities of 80% or greater. This value has been identified in numerous plans that were identified above (Herron, 2004). *Therefore, 80% bank stability is the target for these assessments.* The water body was divided into segments based on numerous characteristics of the water body. The stream bank erosion inventories take into account bank stability, bank height, and recession rates of the water body. Stream bank erosion inventories were completed on each segment; this will aid in developing an overall allocation as well as identifying priority reaches of the water body.

Daily maximum assessment criteria for TP, TIN, and TSS were established by EPA NPDES permit procedures wherein daily maximum values are targeted at a 60% increase over monthly average criteria (monthly average criteria are the same as the annual criteria in this document). Seasonal and monthly fluctuations were described based on the daily maximum assessment criteria although they should really be described based on monthly average fluctuations. *The monitoring plan for the subbasin did not allow for monthly averages to be determined as there was only one sampling event or less per month. Throughout the document when historical data or sporadically taken data were available it was used to aid in determining monthly and seasonal fluctuations, however, this data would not necessarily be representative of the creek in current conditions or throughout the entire year.*

Some constituents, although they are not found within water quality standards either as numeric or narrative standards, were measured to aid in characterizing the water bodies . These additional constituents will aid in indicating if water quality is impacting beneficial uses. The assessment criteria for specific conductivity (SC) and *biochemical oxygen demand* (BOD) are 500 uhmos/cm and 10 mg/L, respectively (Buhidar 2001).

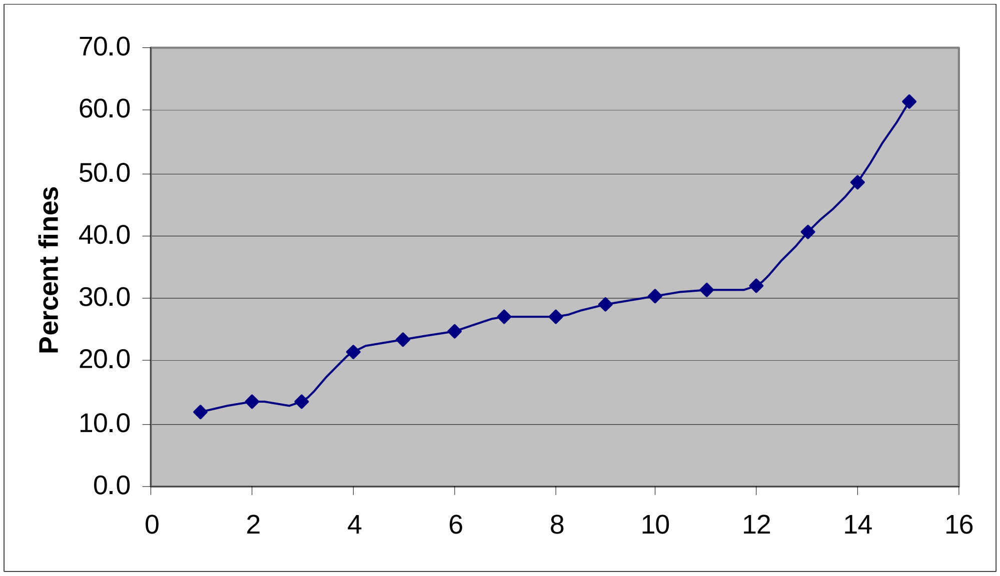


Figure 18. Bedload sediment in streams meeting beneficial uses.

Water Quality Assessments of Listed Water Bodies

Assessments for each of the water quality limited segments listed in Table 15 are provided in the following sections. Each assessment provides a general description of the segment along with discussions of biological and other data, hydrology, water column data, and conclusions drawn from the assessment.

Soldier Creek

Soldier Creek is a third order perennial stream that lies in the central part of the Camas Creek Subbasin (Figure 17, page 35). Its headwaters begin in the Soldier Mountains and flow south through Fairfield and into Camas Creek. Soldier Creek is 15.5 miles long, and the 303(d) listed segment is 6.2 miles long. The creek originates at an elevation of 5,905 feet and discharges at 4,954 feet. It has a bankfull width/depth ratio of 24.6, a sinuosity of 1.04, and a gradient of 1.16%, while the 303(d) listed segment has a gradient of 0.4%.

Land use, ownership, and vegetation of Soldier Creek were described based on a one mile wide stream corridor approach (one mile on each side of the creek, therefore two miles in all), as was done in the Big Wood River TMDL.

Although originating on USFS land, Soldier Creek passes mostly through private land with a couple of small portions of BLM land bordering the stream corridor. The 303(d) listed segment consists of private land (99.8% of the area) with BLM and open water making up the remainder (ArcView Coverage 1992-1996).

The land use for the upper part of the stream is rangeland with a thin stretch of irrigated gravity flow and dry land agriculture. Once into the 303(d) listed segment, the land use is predominately dry land agriculture (89.2% of the stream corridor), followed by small portions of irrigated-gravity flow (4.5%) and irrigated–sprinkler (6.3%).

The vegetation along the stream corridor of Soldier Creek changes as you move down the creek channel. Soldier Creek begins in shrubland areas with forested land distributed throughout it, and then flows down into agriculture land. The 303(d) listed segment consists mostly of agriculture vegetation (94.9% of the stream corridor); grassland makes up the next largest vegetation type (2.2%), followed by urban/developed (1.9%). Shrubland (0.1%), riparian (0.2%), wetland (0.2%), and disturbed vegetation (0.6%) make up the remainder of the stream corridor.

Soldier Creek stream corridor passes through three different geologic formations as well as six different soil types. This creek originates in intermediate plutons, and then it flows through alluvium, which is bordered by plutons and silicic and basaltic volcanic ejecta. At an elevation of about 5,300 feet the stream corridor consists entirely of alluvium.

The soils of the Soldier Creek drainage area have a soil erosion potential (K factor –the higher the number the more soil lost) that increases as you move down the watershed. The headwaters of the creek begin in soils with K factors of 0-0.08, but moves immediately into an area with soil K factors of 0.15-0.25. Soils with K factors of 0.25 to 0.35 are the predominate soils at about 5,300 feet; however, the soils with these K factors also occur above this elevation along the stream channel (ArcView Coverage 1992-1996).

Biological and Other Data

This section of the document discusses fisheries management by IDFG, biological data and information collected through the BURP protocol, and fishery data of the creek.

Idaho Fish and Game (IDFG) manages the fisheries of Soldier Creek in a manner consistent through the subbasin. Soldier Creek has been identified as a cold water fishery, with rainbow trout, brook trout, and brown trout as the species of desirable game fishes within the system. The creek is managed as a wild trout system with management goals that maintain or improve existing habitat for resident and migratory fisheries (IDFG 2001).

For a description of how biological data is assessed to determine beneficial use support status see the section entitled *Analysis Process* (page 45). Water chemistry data constituents that were used to determine if the water quality of this creek is capable of supporting beneficial uses are discussed in the subsection *Water Column Data*, page 57.

Very little biological or habitat data has been collected on Soldier Creek. Data were collected through the BURP protocol in 1993 and 1995. However, the data from these sites was collected more than five years ago and as a result this data is no longer Tier 1 data. (Under WBAG, data must have been collected within a period of five years from the current date in order to qualify as Tier I data, data having high scientific rigor). The 1993 and 1995 data is no longer representative of the present conditions of the creek, but could be used for trend analysis. The 1993 site was located approximately four miles upstream of Fairfield, and the 1995 site was located about a mile downstream of Fairfield. *Both of these sites are located on the segment of the creek that is impacted by lack of flows from the early summer months to the spring runoff months.*

Soldier Creek has had biological data collected on it; however the data should not be used to determine beneficial use support status. The WBAG process is to be used on perennial water bodies, therefore only consistently perennial segments of the water body should be assessed by the WBAG process. At this time biological data has not been collected on perennial segments of the creek. As a result water chemistry and habitat data was used to determine impairment to water quality.

The BURP files on Soldier Creek indicate a number of characteristics of the creek as well as a number of activities affecting the creek. The stream order, gradients, Rosgen stream channel types and activities affecting each reach are reported in Table 18. Additional information in the BURP files indicate that the middle reaches are heavily impacted by livestock, and that there are some heavily eroded stream banks that have been stabilized with non native materials. Riparian zone includes willows, cottonwood trees, and grasses. Lower reach information indicates that the banks are artificial dikes, and the channel is silty and covered in rocks (DEQ 1993-2001).

Table 18. Characteristics of Soldier Creek.

Reach	Stream order	Gradient (%)	Rosgen Stream Channel Type	Activities Affecting Reach
Middle	---	---	---	---
Lower	---	2.2	C	AG

[a]Data from BURP files.
[b]AG-agriculture

Fish data has been collected many times on Soldier Creek by a couple of agencies (Table 19). The USFS collected fish data in 2002 at various sites and DEQ collected fish data in 1993 and 1995.

Rainbow trout, brook trout, and sculpin have been found in Soldier Creek. As a whole, 100% of the fish species of Soldier Creek were cold water indicators, and 100% of all the fish collected were cold water indicators; 41.7% of the rainbow trout and 25.1% of the brook trout were young of the year.

Table 19. Soldier Creek fish data.

Site	Rainbow trout	Brook trout	Sculpin	Sucker	Dace	Redside shiner	Rainbow trout young of year	Brook trout young of year
S-Impact	0	1	0	0	0	0	0	0
S-reference	0	179	52	0	0	0	0	15
95SCIROA20	0	10	14	0	0	0	0	0
2002USFS01	11	47	60	0	0	0	4	27
2002USFS02	1	21	26	0	0	0	1	12
2002USFS03	0	26	6	0	0	0	0	10
2002USFS04	0	10	16	0	0	0	0	7

[a]Data collected by DEQ and USFS.

Hydrology

Soldier Creek is identified as a perennial creek; however, a large portion of the water body becomes intermittent early in the summer. Ten creeks flow into the upper third portion of Soldier Creek, but the lower two thirds of the creek does not receive water from any natural flow channels. Due to low gradients, snowmelt and precipitation events occurring within the prairie reaches of the creek are likely contribute to the ground water supply rather than to surface flows. As there are no tributaries in the lower two thirds of the creek, dewatering of Soldier Creek in the upper regions leaves the lower two thirds of the creek dry from June until spring runoff events in April.

The lower two thirds of Soldier Creek lie over the Camas Prairie aquifer, and this overlay corresponds with a number of characteristics of Soldier Creek and its tributaries:

- The last of the tributaries that feed into Soldier Creek occur at the upper borders of the aquifer. As there are no natural flow channels that occur downstream of these tributaries, the aquifer probably aids in maintaining perennial flows in Soldier Creek.
- The alluvium that lies along most of the Soldier Creek channel as well as throughout the Camas Prairie likely allows a great deal of ground water and surface water interaction.
- Surface flow is likely to dissipate through the alluvium into the ground water if water tables are lowered, whereas when ground water tables are high the alluvium allows waters to emerge and contribute to surface flows.
- Events that alter either surface water or ground water are likely to impact the other.

There is not a gauging station located on Soldier Creek, currently or historically, therefore flow data collected in 2001-2003 was used to predict an average stream flow. The site for stream flow measurements occurred at a road crossing approximately four miles upstream of the confluence with Camas Creek. Flows taken at this site are representative of the intermittent stretches of the creek.

The Camas Creek gauging station (13141500 – Camas Creek near Blaine, ID) is a functioning station that was used in predicting Soldier Creek flow. Soldier Creek and Camas Creek are in the same general areas, have similar ecoregions, and similar amounts of development. These similarities result in the assumption that precipitation and runoff in the Camas Creek and Soldier Creek watersheds was similar, as well as being similar throughout the period of record. Based on this assumption a linear regression model of Camas Creek flow versus Soldier Creek flow was performed using data collected on the same day (Figure 19. *The statistical values of the regression analysis ($p=0.000$, $r^2=0.843$) indicate that this model can be used to determine a predicted average flow for Soldier Creek* (Figure 20).

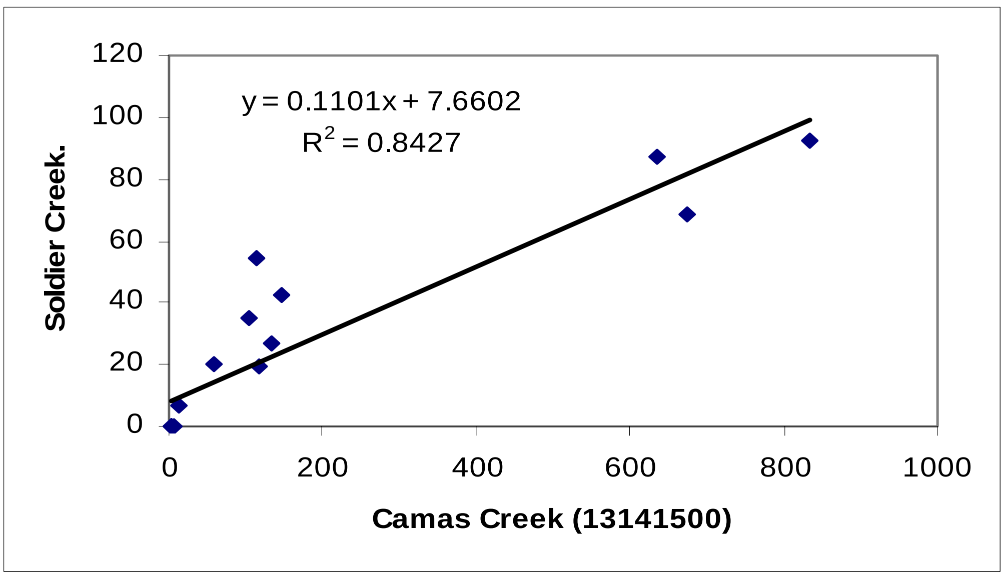


Figure 19. Soldier Creek flow (cfs) regression analysis.

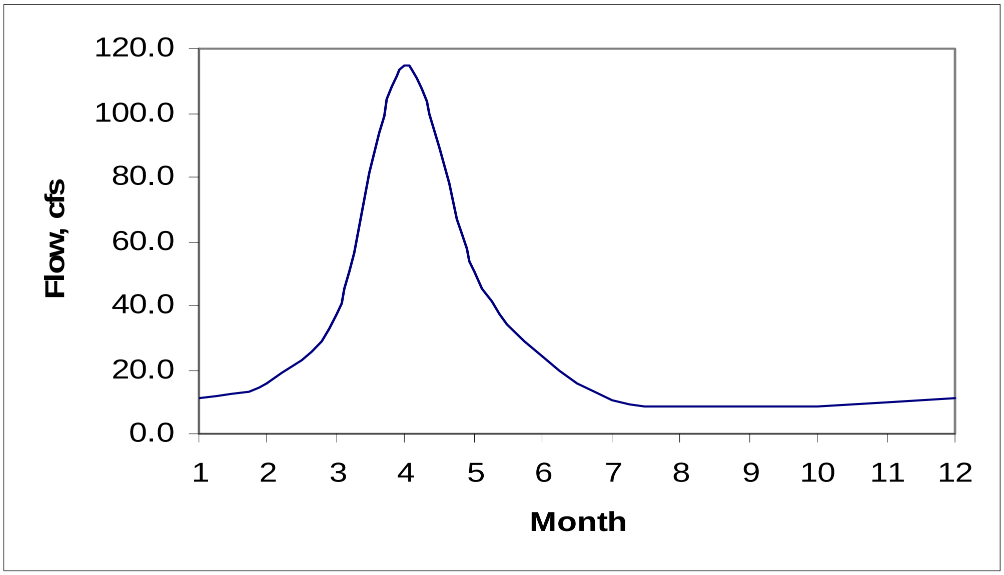


Figure 20. Soldier Creek predicted hydrograph.

Flows are the largest impact to beneficial uses within Soldier Creek. Predicted flows for Soldier Creek tend to peak rapidly in April. *This rapid peak is likely a result of south facing slopes as well as historic channel straightening.* High flow for Soldier Creek occurs in April and averages 114 cfs, with low flows occurring from June to March. The hydrograph predicts base flows, but does not show the *dry periods (July to March)* that have occurred likely due to drought, water diversions, and aquifer level fluctuations.

During the 2001 to 2003 period, water was not present in the lower 8.5 miles of the creek during the summer months until the next spring. Data collected monthly in 1977 indicate that the upper third of the creek retains perennial flows, and data collected in 1992-1993 and 2001-2003 indicate that the lower two thirds of the creek is dry during the summer months.

There are many water rights for the Soldier Creek drainage area. Diversions off of Soldier Creek itself account for 33 cfs of water, while diversions off of its tributaries account for 17 cfs. This water is used for various purposes: irrigation, stockwater, domestic water supply, commercial, and recreation (IDWR 2002). *During the fall, water begins to flow into the previously dried segment of Soldier Creek, yet not enough to create flows that run the entire length of the channel.*

Water Column Data

Water chemistry data for Soldier Creek is limited. The USGS collected specific conductivity data 32 times and pH data once on Soldier Creek. In the early 1990s data were collected for the State Agriculture Water Quality Plan (SAWQP) and included TSS, TP, DO, specific conductivity, and pH water column data. Monthly monitoring for water column data were completed throughout the 2001-2003 periods. Temperature loggers were also distributed at various locations.

Table 20 describes the number of samples, maximums, averages, minimums, and number of values elevated above assessment criteria. *For a description of how the assessment criteria were developed and analyzed, see Analysis Process, page 45.*

Table 20. Soldier Creek water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number of values elevated above instantaneous criteria	Instantaneous criteria	Average criteria (monthly and annual)
Indicators							
SC	9	96.1	78.0	52.6	0	< 500	---
PH	9	8.33	---	7.38	0	6.5 < x < 9.0	---
TNH3	6	0.273	0.070	0.012	0	Variable	---
Turb	9	18.2	8.9	0	0	BG + 50	---
DO	8	10.82	9.65	8.69	0	> 6	---
BOD	2	6.0	5.0	4.0	0	< 10	---
Chl a	2	5.0	2.5	0	0	< 15	---
Pollutants							
TSS	3	20.0	7.3	1.0	0	< 80	< 50
TP	3	0.060	0.026	0.005	0	< 0.16	< 0.10
TIN	2	1.214	0.662	0.110	1	< 0.48	< 0.3
E. coli	8	47.0	19.3	8.0	0	< 406	< 126

[a]SC-Specific Conductivity (uhmos/cm), pH-Hydrogen Ion Concentration (standard units), TNH3-Total Ammonia (mg/L), Turb-Turbidity (NTUs), DO-Dissolved oxygen (mg/L), BOD-Biological oxygen demand (mg/L), Chl a-chlorophyll a (ug/L), TSS-Total Suspended Solids (mg/L), TP-Total Phosphorous (mg/L), TIN-Total Inorganic Nitrogen (mg/L), *E. coli*-Escherichia coli (colony forming units/100ml).
[b]The average assessment criteria for *E. coli* is actually a geometric mean rather than an average.

The indicator constituents do not indicate that pollutants are impacting the water body. All indicators meet their criteria. *Historical data* also meets assessment criteria; there was only one elevation for dissolved oxygen (DO) and specific conductivity (SC) accounting for 2.1% and 1.3% of the samples collected.

The following parameters are used in the WBAG to indicate whether or not water quality is capable of supporting beneficial uses: pH, turbidity, and dissolved oxygen (DO). The 10% exceedance policies are applied to pH, turbidity, and DO. If these parameters are not elevated beyond standards more than 10% of the time than water quality is capable of fully supporting beneficial uses. In the case of Soldier Creek, neither pH, turbidity, nor DO is elevated. *Water quality (DO, pH, and turbidity) appears to be capable of fully supporting beneficial uses.*

The water column data (TSS) indicates that sediment is not impacting water quality, however bedload sediment data (percent fines) indicates that sediment is impairing water quality of Soldier Creek. The TSS average values (7.3 mg/L) averaged well below the average assessment criteria (50 mg/L) and there were never any values elevated above instantaneous criteria (80 mg/L). The percent fines data were slightly elevated above the assessment criteria (35%). There were four collection events in the water body and the value for percent fines ranged from 2.1% to 38.7%. *Bedload sediment indicates that sediment transport is occurring and may be impacting water quality of Soldier Creek.*

The critical period for sediment transport is typically during the spring and early summer, when flow is elevated due to runoff events. *Seasonally*, TSS values are elevated in April (15.5 mg/L). The TSS values were never elevated above monthly average criteria (50 mg/L) nor daily maximum values (80 mg/L). *Historically* (1993), TSS values averaged 16 mg/L and 15.3 mg/L in April and May.

Stream bank erosion inventories were completed to identify the source of the sediment and they indicate that the stream banks are contributing a larger load of sediment into the creek. Bank stability of upper, middle, and lower portions of the water body were calculated at 85.9%, 71.3%, and 56.5%. The target for stream bank stability is 80% or greater; these targets are not being met. *Sediment erosion from banks is impacting water quality, a sediment TMDL will be completed.*

The limited water column data (chlorophyll, TP, and TIN) indicate that nutrients are not impacting the water quality of Soldier Creek. Chlorophyll data is limited; however, values have remained below the assessment criteria (15 μg/L) indicating that nuisance aquatic vegetation is not occurring in the water body. The TP average values (0.026 mg/L) averaged well below the average assessment criteria (0.100 mg/L) and there were never any values elevated above instantaneous criteria (0.160 mg/L). The TIN average values (0.662 mg/L) averaged above the average assessment criteria (0.300 mg/L). The elevated TIN values at first appear to be a concern, however in relation to nuisance aquatic vegetation, TIN and TP values together are truly the important values. *If both TP and TIN values were elevated then there would likely be a nuisance aquatic plant problem, however TP levels near background levels are limiting the ability of nuisance aquatic plants to grow in the system. In addition, the majority of the creek is dry; therefore excessive growth of aquatic plants is not likely to occur in the absence of water. A nutrient TMDL will not be completed.*

The critical period for nuisance aquatic vegetation is typically during the late spring to early fall months, when primary production is elevated. *Seasonally*, TP levels are elevated in April (0.050 mg/L) and June (0.028 mg/L) during May they average 0.014 mg/L. The TP values were never elevated above monthly average criteria (0.100 mg/L) or above daily maximum values (0.160 mg/L). *Historically* (1993), TP levels in April were 0.200 mg/L and in May averaged 0.108 mg/L. *Seasonally*, TIN values are elevated in April (0.706 mg/L) in May and June they average 0.105 mg/L. The TIN values are elevated in April above monthly average criteria (0.300 mg/L) and above daily maximum values (0.480 mg/L). The TN/TP ratios for Soldier Creek average 34.4, indicating that *the water body is a phosphorous limited water body.*

Well data in the Camas Creek Subbasin indicates that TIN levels in the ground water are elevated above the surface water assessment criteria. Well data collected in the 1990s indicates that TIN values range from 0.035 mg/L to 6.058 mg/L and averages 1.855 mg/L. Of the 21 samples collected 81% of them are elevated above the daily maximum assessment criteria (0.480 mg/L).

Bacteria (*E. coli*) are not impacting the primary contact recreation beneficial uses of Soldier Creek. The maximum number of *E. coli* that occurred throughout the period of record was 47, a value that is well below the instantaneous standard (406 cfu/100ml). As there were never any instantaneous violations, it was not necessary to calculate geometric mean values for the system. *Seasonally*, *E. coli* values are slightly elevated in May (36.0 cfu/100ml) and June (20 cfu/100ml), but never above instantaneous water quality standards. *A bacteria TMDL will not be completed.*

The existing uses within Soldier Creek are cold water aquatic life (CWAL) and salmonid spawning (SS); as such maximum daily and average daily temperatures from 24-hour temperature data is analyzed based on critical time periods for these existing uses. The critical time periods for CWAL are June 22 through September 21. As brook trout and rainbow trout are both spawning in Soldier Creek, the critical time period for salmonid spawning is from October 1 through July 15. Temperature loggers were placed at various locations on Soldier Creek for the 2001-2003 periods.

In respect to water quality standards, temperature appears to indicate that water quality is not capable of fully supporting SS existing uses (Table 21 and Figure 21). For the period of record, the daily maximum temperatures (34.7% exceedance) and the daily average temperatures (33.7% exceedance) for SS were both elevated above the 10% exceedance policy. A temperature logger was also placed in the headwater stretches of the creek. *Data for SS indicate that there is no exceedance of the 10% exceedance policy. Upper stretches of the water body could act as a refuge for aquatic life.*

Table 21. Soldier Creek temperature elevations.

Year	Site	Days in critical period	Days measured	Elevated maximum temperatures (# / %)		Elevated average temperatures (# / %)	
CWAL							
2003	Upper	92	0	---	---	---	---
2003	Lower	92	0	---	---	---	---
SS							
2003	Upper	288	251	6	2.4	5	2.0
2003	Lower	288	95	33	34.7	32	33.7

[a] CWAL days missing in the 2003 data include June 22 through September 21, due to dry stream and misplacement of logger.
[b] SS days missing in the 2003 data include for the lower site October 1 through March 11, June 14 through July 15 due to dry water body, at upper site October 1 through October 13, June 22 through July 15, due to late placement and poor placement of logger.

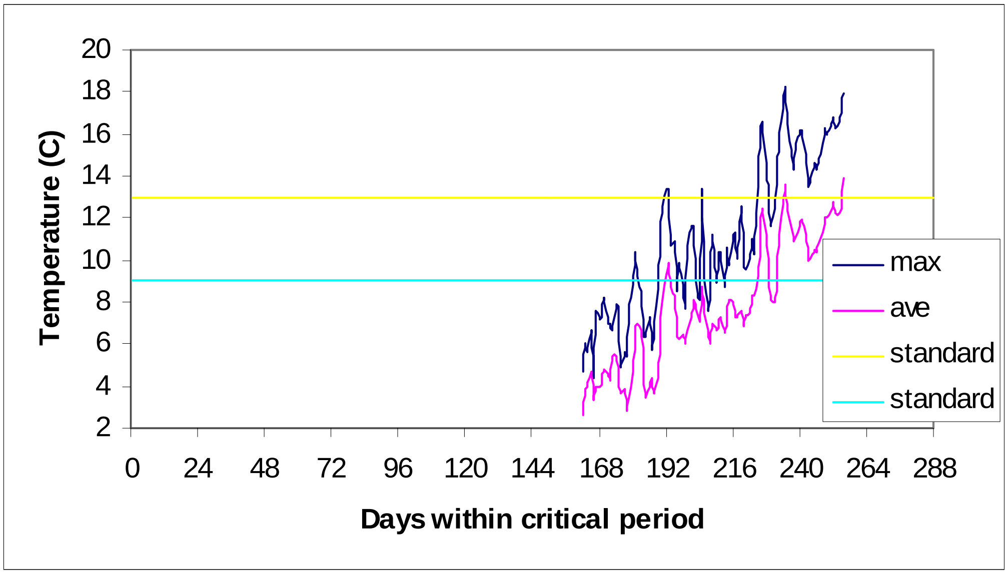


Figure 21. Soldier Creek SS temperatures (2003).

Temperature elevations may be being influenced by a number of activities, such as the following:

- Lack of canopy cover due to anthropogenic activities as well as due to some natural events could be a contributing factor to elevated temperatures.
- There are a number of beaver dams within the watershed that are likely contributing to elevated temperatures. Even as a beaver dam filters sediment out of the water column and redevelops flood plains, the width of the creek increases creating a wetland type area and exposing the water to more solar radiation.
- Removal of water for water use demands reduces the quantity of water and allows solar radiation to elevate temperatures more rapidly.
- Soldier Creek is located in southern Idaho, a desert region where air temperatures are typically hot during summer months.

Existing canopy cover was estimated from aerial photographs of the creek, canopy cover targets were developed for various segments of the creek based on bankfull width and vegetation type (Table 22). Soldier Creek was divided into 14 segment lengths for aerial photo interpretations, the canopy cover ranged from 0 to 60% (Appendix 5). The creek was divided into two representative segments to determine the canopy cover targets for each of the 14 segment lengths. Soldier Creek is dominated by willow and alders in the upper segment and willows in the lower segment; therefore the co-dominant willow-alder community shade curve and the willow community shade curve in the Alvord Lake TMDL on page 77 were the best matching shade curves for the two segments. Targets for canopy cover on the creek were as follows: upper portions (55%) and lower portions (30%). *As some of the existing canopy cover estimates fell outside of the canopy cover targets, a temperature TMDL will be completed. However, if at such future time, water quality* *standards are modified through the negotiated rule making process and it is found that the collected temperature data were meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.*

Table 22. Soldier Creek canopy cover.

Segment	Bankfull width (m)	Vegetation type	Existing CC ranges (%)	CC target (%)
Upper (headwaters to road crossing above baseline road)	22.6	Willow-alder-aspen	30-60	55
Lower (road crossing above baseline road to mouth)	27.9	willow	0-30	30

[a] Bankfull width was determined from BURP data or flow data measurements for each section.
[b] Existing CC (canopy cover) was measured by aerial photo interpretation completed by Mark Shumar (DEQ).
[c] The Alvord Lake TMDL was used to aid in selecting CC (canopy cover) targets that were based on similarities in bankfull width and vegetation type.

Conclusions

Through the subbasin assessment process, the following have been identified about Soldier Creek:

- Biological data should not be used to assess beneficial uses on the lower two thirds of the creek due to the creeks intermittent nature; there is a data gap for BURP data having been collected on perennial segments of the creek.
- The hydrology of the water body is likely the largest impairment to water quality; droughts, flow diversions, aquifer level fluctuations, and channel straightening all contribute to the intermittent status of the lower segments of the creek.
- Water chemistry data (turbidity, DO, and pH) indicate that water quality is sufficient to support beneficial uses.
- Sediment (bedload sediment from stream bank erosion) is impacting the water quality of the creek.
- Nutrients (TP and TIN) are not impacting water quality.
- Bacteria (*E. coli*) are not impacting primary contact recreation beneficial uses.
- Temperature is elevated, thus indicating that water quality is not sufficient to support beneficial uses, but there also lies a temperature data gap for this creek.

As a result of the subbasin assessment, a TMDL will be completed for sediment and temperature on Soldier Creek, and the creek will remain listed as impaired by flow alteration. In addition, nutrients, DO, and bacteria will be delisted as pollutants impairing Soldier Creek. If at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data were meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.

Willow Creek

Willow Creek is a fourth order perennial stream that lies in the eastern part of the Camas Creek Subbasin (Figure 17, page 35). Its headwaters begin to the east of the Smoky Mountains and flow south into Camas Creek. Willow Creek is 28.0 miles long and the 303(d) listed segment is 8.7 miles long. It originates at an elevation of 7,349 feet and discharges at 4,757 feet. Willow Creek has a bankfull width/depth ratio of 15.8, a sinuosity of 1.67, a gradient of 1.76%, while the 303(d) listed segment has a gradient of 0.72%.

Land use, ownership, and vegetation of Willow Creek are described based on a one mile stream corridor approach (one mile on each side of the creek, therefore two miles in all) as was done in the Big Wood River TMDL.

The upper portion of the creek passes through USFS land and then flows on to private land, although BLM land and small sections of state land border the stream corridor. The 303(d) listed segment consists of private land (67.7% of the area), BLM land (18.6%), and state land (13.8%).

The land use for the majority of the water body is rangeland. Once into the 303(d) listed segment, the land use is predominately rangeland (49.8% of the area) and dry land agriculture (44.3%) the remainder of the listed segment is irrigated-gravity flow (0.4%) and irrigated-sprinkler (5.5%).

The vegetation along Willow Creek's stream corridor changes as you move down the creek channel. Willow Creek begins in shrubland areas with forested land distributed throughout it. Further down the water body, shrubland becomes most prominent. The 303(d) listed segment begins in shrubland (53.8% of the area) with grassland (12.7%) and forested vegetation (1.4%) dispersed throughout it. Agriculture (30%) occurs in the lower stretches of the creek. The remainder of the area is made up of riparian vegetation (2.1%).

Willow Creek stream corridor passes through seven different geologic formations as well as three different soil types. The headwaters originate in thrusted marine detritus but pass quickly into plutons. The creek itself then passes through alluvium, which is bordered by plutons in the middle segment and by Pleistocene deposits and outwash fanglomerate flood and terrace gravels in the lower segment. The lowest most section of the creek flows through plateau and canyon filling basalts.

The soils of the Willow Creek drainage area have a soil erosion potential (K factor –the higher the number the more soil lost) that increases as you move down the watershed. There are two basic K factor ranges occurring in Willow Creek. The majority of the soil has a K factor value of 0.15 to 0.25. The lower section of Willow Creek has soils with a K factor value of 0.25 to 0.35. There is a small section of land in the Willow Creek drainage toward the headwaters that has a K factor of 0.35 to 0.45 (ArcView Coverage 1992-1996).

A fire occurred on Willow Creek in the late summer of 2001. This fire destroyed much of the riparian zone in the lower section of the water body. It also impacted some tributaries of Willow Creek including Beaver Creek and Little Beaver Creek, as well as some tributaries of Camp Creek.

Biological and Other Data

This section of the document discusses the fisheries management by IDFG, biological data and information collected through the BURP protocol, and fishery data of the creek.

IDFG manages the fisheries of Willow Creek in a manner consistent throughout the subbasin. Willow Creek has been identified as a cold water fishery with rainbow trout, brook trout, and brown trout as the species of desirable game fishes within the system. The creek is managed as a wild trout system with management goals that maintain or improve existing habitat for resident and migratory fisheries (IDFG 2001).

The IDFG has periodically collected fish data on several stretches of the Willow Creek drainage in the late 1980s and early 1990s. IDFG has identified that in summer of low water years the middle portion of Willow Creek lacks flow and water exists only in pools and beaver dam ponds (IDFG 1993). This lack of water in this segment likely indicates that the segment is used as early rearing habitat (IDFG 1994). This dry period and segment could be impacting the total number of resident fish (IDFG 1995). The lower portions of the creek in the prairie region have been identified as having dense riparian zones and plentiful fish habitat. Sedimentation could be impacting spawning success; however there are gravels present to support some reproduction. Irrigation diversions within the reach could be acting as a migration barrier for larger fish that are migrating from Magic Reservoir. The lower portions of the creek in the basalt canyon have dense riparian zones, however they are not consistent. Spawning habitat is limited due to sedimentation. The lack of instream cover as well as spawning area could be limiting fish production. However, it has been identified that this lower segment may not be receiving flushing spring flows, therefore the sediment does not get moved out of the system (IDFG 1987).

For a description of how biological data is assessed to determine beneficial use support status see the section entitled *Analysis Process* (page 45). Water chemistry data constituents that were used to determine if the water quality of this creek is capable of supporting beneficial uses are discussed in the subsection *Water Column Data*, page 69.

Very little biological and habitat data has been collected on Willow Creek. Data were collected on Willow Creek through the BURP protocol in 1993 and 1995, and more recently twice in 2001. The 1993 and 1995 data were collected more than 5 years ago; as a result they are no longer Tier 1 data. The 1993 and 1995 site were located upstream of the baseline road crossing (approximately 3 miles upstream of the mouth), the 2001 sites were located upstream of the USFS border (approximately 12 miles from the mouth) and upstream of the West Fork confluence (approximately 15 miles upstream of the mouth). *The lower site is in a segment of the water body that can be impacted by lack of flow during low water years.*

There has not been enough biological data collected to determine how low water years impact this water body in comparison with average water years.

The BURP files on Willow Creek indicate a number of characteristics of the creek as well as a number of activities affecting the creek. The stream order, gradients, Rosgen stream channel types, and activities affecting each reach are reported in Table 23. Additional information in the BURP files indicate that the upper reaches have camps along the streams, large animal access, lots of large roots providing bank stability, and lots of rocky point bars. The middle reaches have riparian zones consisting of willows, water birch, wild berry bushes, and grasses, there are signs of domestic and wildlife animals, and diversions are present (DEQ 1993-2001).

Table 23. Characteristics of Willow Creek.

Reach	Stream order	Gradient (%)	Rosgen Stream Channel Type	Activities Affecting Reach
Upper	2	2, 1	G, G	REC, RDS, GR
Middle	---	1.5	C	AG, DIV

[a]Data from BURP files.
[b]REC-recreation, RDS-roads, GR-grazing, AG-agriculture, DIV-diversion.

In three of the four collection events, biological rating scores indicate that Willow Creek is fully supporting its beneficial uses (Table 24). The 1993 site scored a minimum threshold in the SMI index, which automatically indicates impairment of the water body. *For the DEQ metrics to work effectively a minimum of 150 macroinvertebrates for total abundance is necessary. This site had less than the necessary number of macroinvertebrates* (Clark 2003). *However when data were recollected two years later at the same site, the SMI scores rated a two.* Data has been collected more recently and is more representative of current conditions of the creek. The SMI scores were a 2 for the 1995 event and a 3 for both 2001 events. The SFI scores for the 2001 events were a 2 and a 3. The SHI scores for the 1995 and 2001 events were 3. The average condition rating score for Willow Creek ranged from 2.5 to 3. (A condition rating score of 2 or greater indicates that beneficial uses are fully supported.) *The more recent biological data collected on Willow Creek indicate that beneficial uses are fully supported.*

Table 24. Condition rating scores for Willow Creek.

Site	SMI	SFI	SHI	Average
1993STWFA026	MT	ND	1	---
1995STWFA042	2	ND	3	2.5
2001STWFA010	3	3	3	3
2001STWFA013	3	2	3	2.7

[a]MT-minimum threshold (automatically indicates impairment), ND- no data.
[b]An average condition score of 2 or greater indicates that beneficial uses are fully supported.

A macroinvertebrate study was completed in 1994, in the middle stretches of Willow Creek. Macroinvertebrate data were the only biological constituent collected, therefore beneficial uses support status can not be determined through the WBAG process. *However, the individual SMI scores range from 2 to 3, supporting the conclusions made above.*

Fish data has been collected many times on Willow Creek by various agencies. The IDFG has collected fish data on the creek in 1992 and 1993. The BLM has collected fish data in 2000 along with macroinvertebrate data in 2001. The USFS has collected fish data twice in 2001 and once in 2002. Finally, DEQ has collected fish data twice in 1993, once in 1994, twice in 2001, and once in 2002.

Rainbow trout, sculpin, dace, and sucker have been found to occur in Willow Creek (Table 25). As a whole 50% of the fish species of Willow Creek were cold water indicators and 99.1% of all the fish collected were cold water indicators, 55.7% of the rainbow trout were young of the year. In 1990 IDFG collected one brown trout in their sample event, which was likely a result of a hatchery release (IDFG 1994).

Table 25. Willow Creek fish data.

Site	Rainbow trout	Brook trout	Brown trout	Sculpin	Sucker	Dace	Redside shiner	Rainbow trout young of year	Brook trout young of year
2002DEQWC01	96	0	0	0	0	20	0	68	0
2001STWFA010	21	0	0	24	0	0	0	15	0
2001STWFA013	29	0	0	0	0	0	0	24	0
2001USFS01	17	0	0	0	0	0	0	11	0
2001USFS05	81	0	0	31	0	0	0	55	0
2001USFS06	55	0	0	10	0	0	0	32	0
2000BLM01***	95	0	0	0	C	C	0	13	0
1994DEQ01	64	0	0	51	0	0	0	4	0
1993DEQ01	46	0	0	69	0	0	0	39	0
1993FGWC01	24	0	0	29	0	0	0	15	0
1992FGWC01	9	0	0	12	0	0	0	0	0
1990FGWC01	127	0	1	81	0	0	0	0	0

[a]Data collected by DEQ, BLM, USFS, and IDFG.
[b]***-species were probably targeted, C- common (no numerical values).

Hydrology

Willow Creek is a perennial creek; however, a small segment of the water body becomes intermittent in drought years. Twenty one creeks flow into Willow Creek until Willow Creek flows out of the foothills into the prairie. From the foothills it is a relatively short distance before Willow Creek provides a year round flow to Camas Creek. The middle portion of Willow Creek has been known to go dry during drought years, however during this time the lower portion of Willow Creek still provides a base flow to Camas Creek. The last mile of Willow Creek flows through a small basalt canyon, these porous basalt rocks likely allow the surface water to be fed by the ground water supply. A complex of beaver dams throughout the length of Willow Creek that could be raising water tables near the creek.

The lower third of Willow Creek lies over the Camas Prairie aquifer and this overlay corresponds with a number of characteristics of Willow Creek:

- The aquifer probably aids in maintaining perennial flows in this lower segment of Willow Creek, and thus a base flow that is contributed to Camas Creek.
- The alluvium that lies along most of the Willow Creek channel likely allows ground water and surface water interaction.
- Surface flow is likely to dissipate through the alluvium into the ground water if water tables are lowered, whereas the alluvium allows waters from high ground water tables to emerge and contribute to surface flows.
- Events that alter either surface water or ground water are likely to impact the other.

There is not a gauging station located on Willow Creek currently or historically, so flow data collected in 2001-2003 was used to predict an average stream flow. The site for stream flow measurements occurred at the Highway 20 road crossing.

The Camas Creek gauging station (13141500- Camas Creek near Blaine, ID) is a functioning station that was used in predicting Willow Creek flow. Willow Creek and Camas Creek are in the same general areas, have similar ecoregions, and similar amounts of development. These similarities result in the assumption that precipitation and runoff in the Camas Creek and Willow Creek watersheds was similar, as well as being similar throughout the period of record. Based on this assumption a linear regression model of Camas Creek flow versus Willow Creek flow was performed using data collected on the same day for both watersheds (Figure 22). *The statistical values of the regression analysis ($p=0.000$, and $r^2=0.784$) indicate that this model can be used to determine a predicted average flow for Willow Creek* (Figure 23).

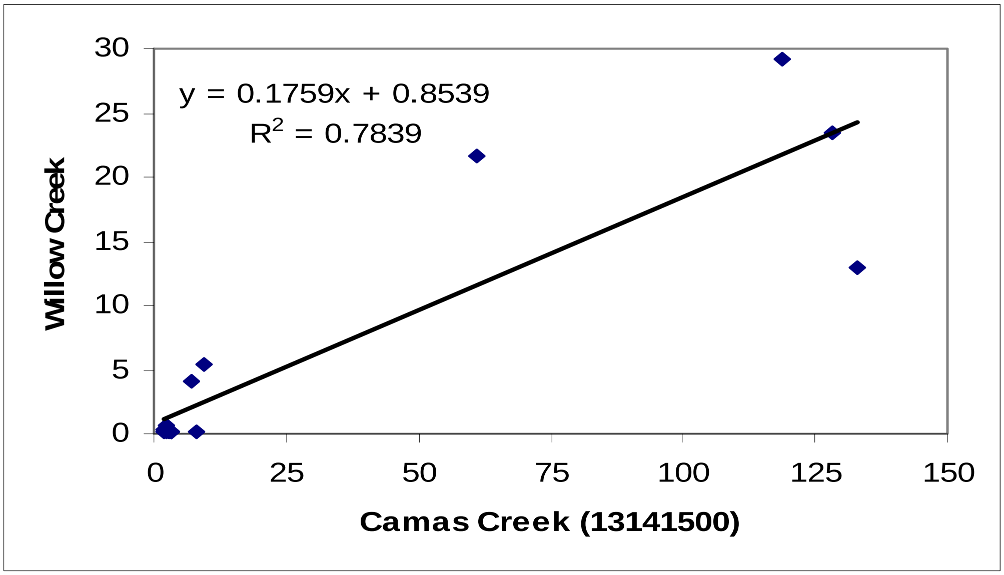


Figure 22. Willow Creek flow (cfs) regression analysis.

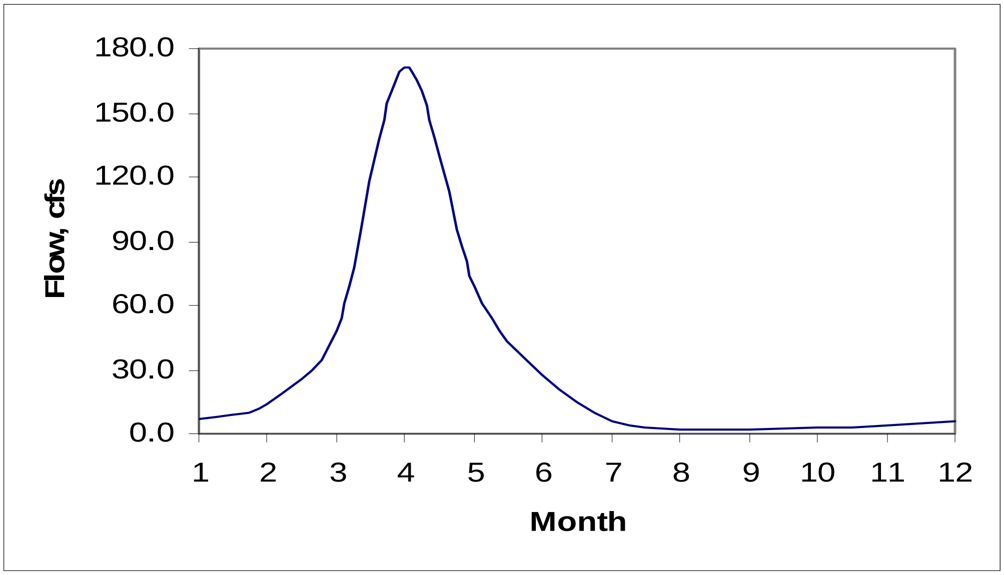


Figure 23. Willow Creek predicted hydrograph.

Flows do not appear to be impacting beneficial uses of Willow Creek. Predicted flows for Willow Creek tend to peak rapidly in April. This rapid peak is likely a result of south facing slopes. High flow for Willow Creek occurs in April and averages 171.5 cfs, with low flows occurring from June to March. The hydrograph predicts base flows, but does not show the dry periods that have been recorded as occurring in middle stretches of Willow Creek during drought years. *Willow Creek has perennial flows in the upper portion of the watershed and the lower portion of the watershed. Willow Creek contributes perennial flow to Camas*

Creek, this connection unlike many of the other creeks within the subbasin likely provides a refuge for aquatic life during drought conditions.

There are many water rights for the Willow Creek drainage area. Diversions off of Willow Creek itself account for 9.0 cfs of water while diversions off of its tributaries account for 15.1 cfs (IDWR 2002). This water is used for various purposes: irrigation, storage, wildlife storage, stockwater, industrial, and domestic water supply.

Water Column Data

Water chemistry data for Willow Creek is limited. The USGS collected specific conductivity data 12 times and pH and TP data once on Willow Creek in the 1970s. In the early 1990s data were collected for SAWQP and included TSS, TP, DO, specific conductivity, and pH water column data. Monthly monitoring for water column data were completed throughout the 2001-2003 periods. Temperature loggers were also distributed at various locations.

Table 26 describes the number of samples, maximums, averages, minimums, and number of values elevated above assessment criteria. *For a description of how the assessment criteria were developed and analyzed see Analysis Process, page 45.*

Table 26. Willow Creek water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number of values elevated above instantaneous criteria	Instantaneous criteria	Average criteria (monthly and annual)
Indicators							
SC	17	268.7	225.6	179.0	0	< 500	---
pH	17	8.55	---	6.89	0	6.5 < x < 9.0	---
TNH3	6	0.090	0.044	0.005	0	Variable	---
Turb	17	7.6	3.0	0	0	BG + 50	---
DO	17	14.13	10.08	7.39	0	> 6	---
BOD	5	10.0	6.6	4.0	0	< 10	---
Chl a	3	2.0	1.8	1.6	0	< 15	---
Pollutants							
TSS	9	3.0	1.2	0.5	0	< 80	< 50
TP	9	0.052	0.033	0.005	0	< 0.16	< 0.10
TIN	5	3.375	1.651	0.450	4	< 0.48	< 0.3
E. coli	13	110.0	35.4	2.0	0	< 406	< 126

[a]SC-Specific Conductivity (uhmos/cm), pH-Hydrogen Ion Concentration (standard units), TNH3-Total Ammonia (mg/L), Turb-Turbidity (NTUs), DO-Dissolved oxygen (mg/L), BOD-Biological oxygen demand (mg/L), Chl a-chlorophyll a (ug/L), TSS-Total Suspended Solids (mg/L), TP-Total Phosphorous (mg/L), TIN-Total Inorganic Nitrogen (mg/L), *E. coli*-Escherichia coli (colony forming units/100ml).
[b]The average assessment criteria for *E. coli* is actually a geometric mean rather than an average.

The indicator constituents do not indicate that pollutants are impacting the water body. All indicators meet their criteria. Historical data also meets assessment criteria; there was only one elevation in DO accounting for 2.0% of the samples collected.
The following parameters are used in the WBAG to indicate whether or not water quality is capable of supporting beneficial uses: pH, turbidity, and DO. The 10% exceedance policies are applied to pH, turbidity, and DO. If these parameters are not elevated beyond standards more than 10% of the time than water quality is capable of fully supporting beneficial uses. *In the case of Willow Creek, neither pH, turbidity, nor DO is elevated. Water quality (DO, pH, and turbidity) appears to be capable of fully supporting beneficial uses.*

The water column data (TSS) indicates that sediment is not impacting water quality, however bedload sediment data (percent fines) indicates that sediment is impairing beneficial uses of Willow Creek. The TSS average values (1.2 mg/L) averaged well below the average assessment criteria (50 mg/L) and values were never elevated above instantaneous criteria (80 mg/L). The percent fines data were elevated above the assessment criteria (35%). There were eight collection events in the water body and the value of percent fines ranged from 15.5% to 48.3%. Only one of these events was elevated above the criteria. *Bedload sediment indicates that sediment transport is occurring, but does not appear to be impacting beneficial uses of Willow Creek.*

The critical period for sediment transport is typically during the spring and early summer, when flow is elevated due to runoff events. *Seasonally*, TSS values are elevated in April (18.0 mg/L) and May (3.1 mg/L) during the remainder of the months they average 0.9 mg/L. The TSS values were never elevated above monthly average criteria (50 mg/L) or daily maximum criteria (80 mg/L). *Historically* (1993), TSS values in April were 14 mg/L and averaged 29.3 mg/L in May.

Stream bank erosion inventories were completed to identify the source of the sediment and they indicate that the stream banks are contributing a larger load of sediment into the creek. Bank stability of upper, middle, and lower portions of the water body were calculated at 70.7%, 70.7%, and 79.5%. The target for stream bank stability is 80% or greater; these targets are not being met.

Stream bank erosion inventories indicate sediment is impairing beneficial uses; however biological data does not support this conclusion. The data in the section Biological and Other Data indicate that beneficial uses are fully supported, although sediment erosion from banks is slightly elevated above the targets. It appears that in the Willow Creek drainage and possibly subbasin wide that beneficial uses are not impacted until stream bank stability is less than 70%. *A sediment TMDL will not be completed since the sediment erosion that is occurring is not impacting beneficial uses.*

The water column data (chlorophyll, TP, and TIN) indicate that nutrients are not impacting the beneficial uses of Willow Creek. Chlorophyll data is limited; however, values have remained below the assessment criteria (15 μg/L) indicating that nuisance aquatic vegetation is not occurring in the water body. The TP average values (0.033 mg/L) averaged well below the average assessment criteria (0.100 mg/L) and values were never elevated above instantaneous criteria (0.160 mg/L). The TIN average values (1.651 mg/L) averaged above the average assessment criteria (0.300 mg/L). The elevated TIN values at first appear to be a concern. However in relation to nuisance aquatic vegetation, TIN and TP values together are truly the important values. If both TP and TIN values were elevated then there would likely be a nuisance aquatic plant problem. The TP levels near background levels are limiting the ability of nuisance aquatic plants to grow in the system. *Currently, pollutants are not a concern as low TP levels are limiting the growth of aquatic plants, however an influx of TP in the future could lead to excessive and nuisance aquatic growth. A nutrient TMDL will not be completed.*

The critical period for nuisance aquatic vegetation is typically during the late spring to early fall months, when primary production is elevated. *Seasonally*, TP levels are elevated in April (0.048 mg/L), June (0.040 mg/L), September (0.035 mg/L), November (0.052 mg/L), and December (0.044 mg/L). The TP values were never elevated above monthly average criteria (0.100 mg/L) or above daily maximum values (0.160 mg/L). *Historically* (1993), TP levels in April were 0.220 mg/L and averaged 0.127 mg/L in May. *Seasonally*, TIN levels are elevated in April (0.493 mg/L), August (3.230 mg/L), and October (3.375 mg/L). The April averages are elevated above the average assessment criteria, the August and October values are elevated above daily maximum criteria. The TIN levels are elevated the most when base flow occurs and ground water influence is greatest. The TN/TP ratios for Willow Creek average 55.9 indicating that *the water body is a phosphorous limited water body*.

Well data in the Camas Creek Subbasin indicate that TIN levels in the ground water are elevated above the surface water assessment criteria. Well data collected in the 1990s indicates that TIN values range from 0.035 mg/L to 6.058 mg/L and averages 1.855 mg/L. Of the 21 samples collected 81% of them are elevated above the daily maximum assessment criteria (0.480 mg/L).

Bacteria (*E. coli*) are not impacting the primary contact recreation beneficial uses of Willow Creek. The maximum number of *E. coli* that occurred throughout the period of record was 110, a value that is well below the instantaneous standard (406 cfu/100ml). As there were never any instantaneous violations, it was not necessary to calculate geometric mean values for the system. *Seasonally*, *E. coli* values are elevated in June (57 cfu/100ml), July (52 cfu/100ml), September (50 cfu/100ml), October (80 cfu/100ml), and November (110 cfu/100ml), but never above instantaneous water quality standards. *A bacteria TMDL will not be completed.*

The existing uses within Willow Creek are CWAL and SS; as such, maximum daily and average daily temperatures from 24-hour temperature data is analyzed based on critical periods for these existing uses. The critical periods for CWAL are June 22 through September 21. As rainbow trout are spawning in Willow Creek, the critical periods for salmonid spawning is from March 15 through July 15. Temperature loggers were placed at various locations on Willow Creek for the 2001-2003 periods.

In respect to water quality standards, temperature appears to indicate that water quality is not capable of fully supporting CWAL and SS existing uses (Table 27 and Figure 24), although the biological data and water chemistry data discussed previously indicate otherwise. For the period of record, the daily average temperatures for CWAL (6.5% exceedance) do not exceed the 10% exceedance policy, however, the daily maximum temperatures (24.5% exceedance) do exceed the exceedance policy. The daily average temperatures (50% exceedance) and the daily maximum temperatures (52.8% exceedance) for SS were both elevated above the 10% exceedance policy. *A temperature logger was also placed in the headwater stretches of the creek. Data for CWAL temperatures indicates that there is no temperature exceedance in the headwater stretches, however SS temperatures indicate that the headwaters are exceeding temperature standards.*

Table 27. Willow Creek temperature elevations.

Year	Site	Days in critical period	Days measured	Elevated maximum temperatures (# / %)		Elevated average temperatures (# / %)	
CWAL							
2002	Upper	92	83	0	0	0	0
2003	Upper	92	68	0	0	0	0
2002	Lower	92	83	45	54.2	12	0
2003	Lower	92	68	0	0	0	0
SS							
2002	Upper	123	123	37	30.1	45	36.6
2003	Upper	123	123	24	22.0	22	17.9
2002	Lower	123	123	60	48.8	63	51.2
2003	Lower	123	123	63	51.2	67	54.5

[a] CWAL days missing in the 2002 data include September 13 through September 21, 2003 data include August 29 through September 21.

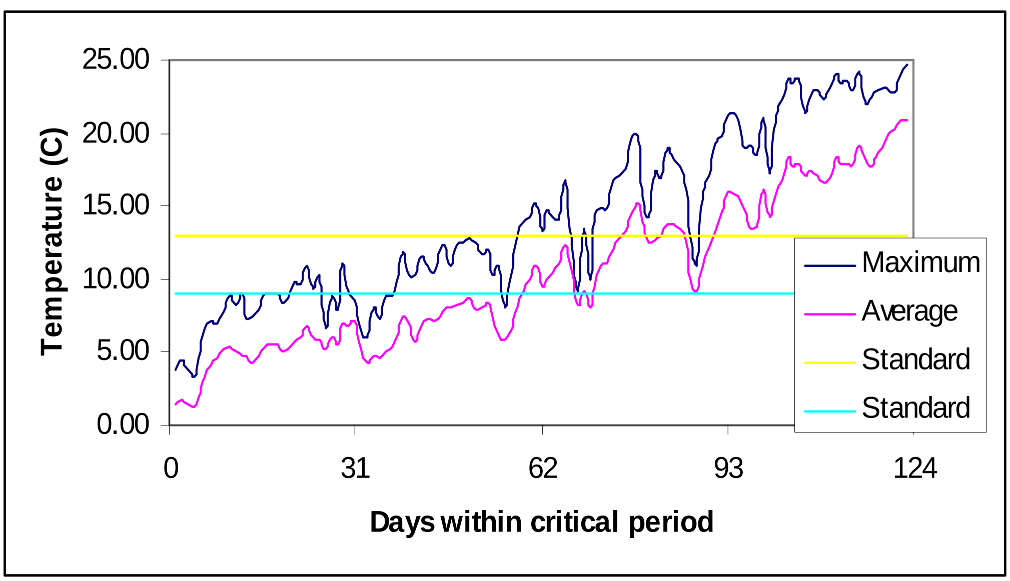


Figure 24. Willow Creek SS temperatures (2002).

Temperature elevations may be being influenced by a number of activities, such as the following:

- Lack of canopy cover due to anthropogenic activities as well as due to some natural events could be a contributing factor to elevated temperatures.
- A number of large beaver dam complexes within the watershed are likely contributing to elevated temperatures. Even as a beaver dam filters sediment out of the water column and redevelops flood plains, the width of the creek increases, creating a wetland type area and exposing the water to more solar radiation.
- Geologic formations are likely contributing to the temperature elevations as the creek runs through basalt lined box canyons. These geologic formations could be contributing to the solar radiation exposure due to the inability of the creek, in some areas, to develop some larger riparian plants as a result of restricted growth area. The basalt rocks are likely conducting a certain amount of heat that contributes to the increased temperatures of the water body.
- Removal of water for water use demands reduces the quantity of water and allows solar radiation to elevate temperatures more rapidly.
- Willow Creek is located in southern Idaho, a desert region where air temperatures are typically hot during summer months.

Existing canopy cover was estimated from aerial photographs of the creek, canopy cover targets were developed for various segments of the creek based on bankfull width and vegetation type (Table 28). Willow Creek was divided into 20 segment lengths for aerial photo interpretations, the canopy cover ranged from 10% to 60% (Appendix 5). The creek was divided into three representative segments to determine the canopy cover targets for each of the 20 segments. Willow Creek is dominated by willows and alders in the upper portions and willows in the lower portions; therefore the co-dominant willow alder community and willow community shade curve in the Alvord Lake TMDL on page 77 were the best matching shade curve for the segments. Targets for canopy cover on the creek were as follows: upper portions (55%), middle portions (35%), and lower portions (50%). *As some of the existing canopy cover estimates fell outside of the canopy cover targets, a temperature TMDL will be completed. However, if at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data were meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at this time.*

Table 28. Willow Creek canopy cover.

Segment	Bankfull Width (m)	Vegetation Type	Existing CC ranges (%)	CC Target (%)
Upper	5.9	Willows	20-60	55
Middle	8.0	Willows	10-50	35
Lower	5.3	willows	30-50	50

[a] Bankfull width was determined from BURP data or flow data measurements for each section.
[b] Existing CC (canopy cover) was measured by aerial photo interpretation completed by Mark Shumar (DEQ).
[c] The Alvord Lake TMDL was used to aid in selecting CC (canopy cover) targets that were based on similarities in bankfull width and vegetation type.

Conclusions

Through the subbasin assessment process, the following have been identified about Willow Creek:

- Biological data indicates that beneficial uses are fully supported.
- Flow is sufficient to support beneficial uses although middle portions of the creek appear to go dry during drought situations.
- Water chemistry data (turbidity, DO, and pH) indicate that water quality is sufficient to support beneficial uses.
- Sediment (stream bank erosion) is slightly elevated but is not impacting beneficial uses of the water body.
- Nutrients (TP and TIN) are not impacting beneficial uses.
- Bacteria (*E. coli*) are not impacting primary contact recreation beneficial uses.
- Temperature is elevated, thus indicating that water quality is not capable of supporting beneficial uses.

As a result of the subbasin assessment, a TMDL will be completed for temperature on Willow Creek. However, if at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data were meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.

Beaver Creek

Beaver Creek is a third order perennial stream that lies in the eastern part of the Camas Creek Subbasin (Figure 17). Its headwaters begin southeast of the Little Smoky Mountains and flows southwest to Willow Creek. Beaver Creek is 5.6 miles long and is listed from headwaters to mouth. It originates at an elevation of 7,709 feet and discharges at 5,249 feet. Beaver Creek has a bankfull width/depth ratio of 8.9, a sinuosity of 1.50, and a gradient of 8.34%.

Land use, ownership, and vegetation of Beaver Creek was described based on a 1mile-stream corridor approach (one mile on each side of the creek, therefore two miles in all), as was done in the Big Wood River TMDL.

Beaver Creek occurs mostly on BLM land (65.8%) and the land use for the entire stretch of the stream is rangeland. There is a small portion of private land near the mouth and near the middle stretches of the water body that accounts for 26.6% of the area. The remainder of the land is USFS land (4.2%) and state land (3.5%).

The vegetation along the stream corridor of Beaver Creek is predominately shrubland (86.9% of the area). Agriculture (1.1%), grassland (1.5%), forested (7.7%), riparian (2.0%), and disturbed (0.7%) are distributed throughout the shrubland.

Beaver Creek stream corridor passes through two different geologic formations and one soil type. This creek lies within Cretaceous plutons with a small amount of alluviums right at the mouth. The soils of the Beaver Creek drainage area have a soil erosion potential (K factor – the higher the number the more soil lost) of 0.15 to 0.25 (ArcView Coverage 1992-1996).

In 2001 two range fires burned through or near the Beaver Creek drainage. These fires greatly impacted Beaver Creek and destroyed most of the riparian zone in the lower half of the creek.

Biological and Other Data

This section of the document will discuss the fisheries management by IDFG, biological data and information collected through the BURP protocol, and fishery data of the creek.

The IDFG manages the fisheries of Beaver Creek in a manner consistent throughout the subbasin. Beaver Creek has been identified as a cold water fishery with rainbow trout, brook trout, and brown trout as the species of desirable game fishes within the system. The creek is managed as a wild trout system with management goals that maintain or improve existing habitat for resident and migratory fisheries (IDFG 2001).

For a description of how biological data is assessed to determine beneficial use support status see the section entitled *Analysis Process* (page 45). Water chemistry data constituents that were used to determine if the water quality of this creek is capable of supporting beneficial uses are discussed in the subsection *Water Column Data* (page 79).

Biological data were collected on Beaver Creek through the Beneficial Use Reconnaissance Program (BURP) process historically in 1993, 1995, twice in 1997, and more recently in 2001. The1993 and 1995 data were collected more than 5 years ago; as a result they are no longer Tier 1 data. All of the burp sites were located near the confluence of Little Beaver Creek with Beaver Creek (about half a mile upstream of the mouth). Macroinvertebrate and habitat data were collected at all sites, however fish data were collected during two of the collection events, the 1995 and 2001 collection events.

The BURP files on Beaver Creek indicate a number of characteristics of the creek as well as a number of activities affecting the creek. The stream order, gradients, Rosgen stream channel type, and activities affecting each reach are reported in Table 29. Additional information in the BURP files indicate that the lower reaches have been used for sheep grazing and camping areas, the riparian zone consists of willows, aspen, thistles, grasses, and sagebrush, trash has been dumped on the bank, and beaver dams exist (DEQ 1993-2001).

Table 29. Characteristics of Beaver Creek.

Reach	Stream order	Gradient (%)	Rosgen Stream Channel Type	Activities Affecting Reach
Lower	---,3, 2, 2	0.9, 3.9, 3.9, 0.5	B, B, B, G	GR, MIN, RDS, REC

[a]Data from BURP files.
[b]REC-recreation, RDS-roads, GR-grazing, MIN-mining.

In three of the five collection events, biological rating scores indicate that Beaver Creek is fully supporting its beneficial uses (Table 30). The 1993 and 1995 site scored a minimum threshold in the SMI index, which automatically indicates impairment of the water body. *For the DEQ metrics to work effectively a minimum of 150 macroinvertebrates for total abundance is necessary* (Clark 2003). *The 1993 and 1995 sites had less than the necessary number of macroinvertebrates.* However as data has been collected more recently in similar areas the more recent data was used to represent the creek. The SMI scores for both the 1997 sites and the 2001 site were three. The SFI score for the 2001 site was 2. The SHI score for all collection events was 1. The scores for both 1997 events and the 2001 event averaged 2. (A condition rating score of 2 or greater indicates that beneficial uses are fully supported.) *The more recent biological data collected on Beaver Creek indicate that beneficial uses are fully supported.*

Table 30. Condition rating scores for Beaver Creek.

Site	SMI	SFI	SHI	Average
1993STWFA001	MT	ND	1	---
1995STWFB011	MT	ND	1	---
1997STWFA077	3	ND	1	2
1997STWFA078	3	ND	1	2
2001STWFA020	3	2	1	2

[a]MT-minimum threshold (automatically indicates impairment), ND- no data.
[b]An average condition score of 2 or greater indicates that beneficial uses are fully supported.

Fish data has been collected occasionally on Beaver Creek by various agencies (Table 31). The IDFG has collected fish data on the creek in 1995. The BLM has collected fish data on the creek in 1998. Finally, DEQ has collected fish data twice, in 1995 and 2001.

Rainbow trout have been found to occur in Beaver Creek. As a whole ,100% of the fish species of Beaver Creek were cold water indicators and 100% of all the fish collected were cold water indicators, 84.7% of the rainbow trout were young of the year.

Table 31. Beaver Creek fish data.

Site	Rainbow trout	Brook trout	Sculpin	Sucker	Dace	Redside shiner	Rainbow trout young of year	Brook trout young of year
2001STWFA020	10	0	0	0	0	0	7	0
1995SCIROB11	0	0	0	0	0	0	0	0
1995FGBB01	69	0	0	0	0	0	59	0
1998BLMBC01***	71+	---	---	---	---	---	61+	---

[a]Data collected by DEQ, IDFG, and BLM.
[b]--- = no data species probably targeted, + = more fish (not recorded).

Hydrology

Beaver Creek is a perennial creek that is fed by two other water bodies and provides a year round flow to Willow Creek. Beaver Creek is a drainage source for the narrow valley foothills to the east of Willow Creek. There lies a complex of beaver dams in the lower portions of the water body that could be raising water tables near the creek.

There is not a gauging station located on Beaver Creek, currently or historically, therefore flow data collected in 2001-2003 was used to predict an average stream flow. The site for stream flow measurement occurred at the road crossing near the mouth of Beaver Creek.

The Camas Creek gauging station (13141500-Camas Creek near Blaine, ID) is a functioning station that was used in predicting Beaver Creek flow. Beaver Creek and Camas Creek are in the same general areas, have similar ecoregions, and similar amounts of development. These similarities result in the assumption that precipitation and runoff in the Camas Creek and Beaver Creek watersheds was similar, as well as being similar throughout the period of record. Based on this assumption, a linear regression model of Camas Creek flow versus Beaver Creek flow was performed using data collected on the same day (Figure 25*). The statistical values of the regression analysis (p=0.000,* r^2*=0.942) indicate that this model can be used to determine a predicted average flow for Beaver Creek* (Figure 26).

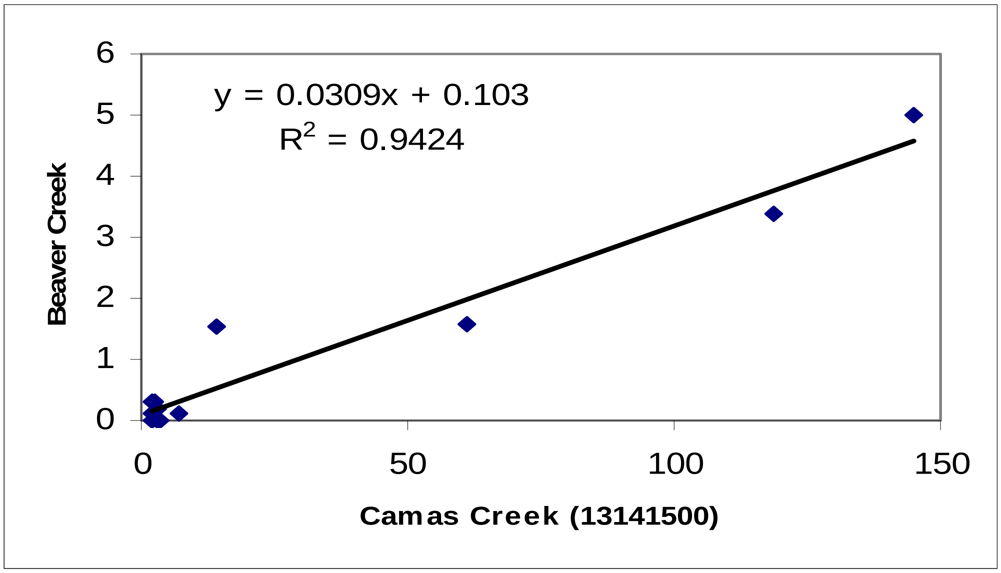


Figure 25. Beaver Creek flow (cfs) regression analysis.

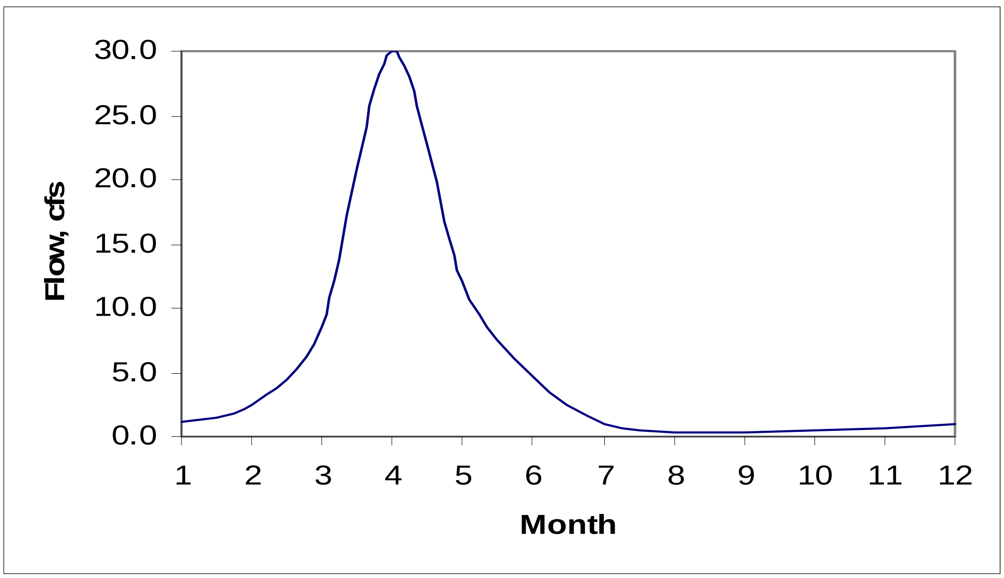


Figure 26. Beaver Creek predicted hydrograph.

Flows are not likely impacting the beneficial uses of Beaver Creek as year round flows occur even during drought conditions except in the lower most 200 meters. Predicted flows for Beaver Creek tend to peak rapidly in April. High flow for Beaver Creek occurs in April and averages at 30.1 cfs with low flows occurring from June to March.

There are few water rights for the Beaver Creek drainage area. Diversions off of Beaver Creek itself account for 1.5 cfs of water while diversions off of its tributaries account for 2.4

cfs. This water is used for various purposes: stockwater, wildlife, mining, and industrial (IDWR 2002).

Water Column Data

Water chemistry data for Beaver Creek is very limited. Monthly monitoring for water chemistry data were completed throughout the 2001-2003 periods. Temperature loggers were also distributed at various locations.

Table 32 describes the number of samples, maximums, averages, minimums, and number of values elevated above assessment criteria. *For a description of how the assessment criteria were developed and analyzed, see Analysis Process, page 45.*

Table 32. Beaver Creek water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number of values elevated above instantaneous criteria	Instantaneous Criteria	Average Criteria (monthly and annual)
Indicators							
SC	9	277.0	245.1	215.0	0	< 500	---
PH	9	8.39	---	7.65	0	6.5 < x < 9.0	---
TNH3	3	0.050	0.022	<0.005	0	Variable	---
Turb	9	13.7	3.8	0	0	BG + 50	---
DO	9	10.81	8.41	7.35	0	> 6	---
BOD	2	7.0	5.5	4.0	0	< 10	---
Chl a	1	1.6	---	---	0	< 15	---
Pollutants							
TSS	5	10.0	4.6	1.0	0	< 80	< 50
TP	5	0.046	0.022	<0.005	0	< 0.16	< 0.10
TIN	3	0.250	0.133	0.005	0	< 0.48	< 0.3
E. coli	8	96.0	22.7	0.5	0	< 576	< 126

[a]SC-Specific Conductivity (uhmos/cm), pH-Hydrogen Ion Concentration (standard units), TNH3-Total Ammonia (mg/L), Turb-Turbidity (NTUs), DO-Dissolved oxygen (mg/L), BOD-Biological oxygen demand (mg/L), Chl a-chlorophyll a (ug/L), TSS-Total Suspended Solids (mg/L), TP-Total Phosphorous (mg/L), TIN-Total Inorganic Nitrogen (mg/L), *E. coli*-Escherichia coli (colony forming units/100ml).
[b]The average assessment criteria for *E. coli* is actually a geometric mean rather than an average.

The indicator constituents do not indicate that pollutants are impacting the water body. All indicators meet their criteria.

The following parameters are used in the WBAG to indicate whether or not water quality is capable of supporting beneficial uses: pH, turbidity, and DO. The 10% exceedance policy is applied to pH, turbidity, and DO. If these parameters are not elevated beyond standards more than 10% of the time than water quality is capable of fully supporting beneficial uses. In the case of Beaver Creek, neither pH, turbidity, nor DO is elevated more than 10% of the time. *Water quality (DO, pH, and turbidity) appears to support the conclusion made under the biological data assessment, beneficial uses are fully supported.*

The water column data (TSS) indicates that sediment is not impacting beneficial uses, however bedload sediment data (percent fines) indicate that sediment may be impacting beneficial uses of Beaver Creek. The TSS average values (4.6 mg/L) averaged well below the average assessment criteria (50 mg/L) and values were never elevated above instantaneous criteria (80 mg/L). The percent fines data were elevated above the assessment criteria (35%). There were nine collection events in the water body and the values for percent fines ranged from 18.7% to 53.4%. *Bedload sediment appears to be impacting beneficial uses, however it may be a result of historical events and flows that have not been sufficient to move the sediment out of the system.*

The critical period for sediment transport is typically during the spring and early summer, when flow is elevated due to runoff events. *Seasonally*, TSS values are elevated in June (6.6 mg/L) and November (8.0 mg/L). The TSS values are not elevated above monthly assessment criteria (50 mg/L) in June or above daily maximum values (80 mg/L).

Stream bank erosion inventories were completed to identify the source of the sediment and they indicate that the stream banks are not contributing an excessive load of sediment to the water body. Bank stability of upper and lower portions of the water body was calculated at 83.2% and 80.0%. The target for stream bank stability is 80%, these values are being met, and therefore the *elevated bedload is not currently being delivered from the stream banks*.

Bedload sediment is elevated in the system; however it is likely due to historical events and biological data indicates that beneficial uses are not impacted. Currently there is very little sediment being transported in the water column and very little erosion occurring from the banks. *The bedload sediments are likely to remain until a large flushing event moves them out of the system. A sediment TMDL will not be completed.*

The water column data (chlorophyll, TP, and TIN) indicate that nutrients are not impacting the beneficial uses of Beaver Creek. Chlorophyll data is limited; however it was not elevated above the 15 μg/L criteria. The TP average values (0.022 mg/L) averaged well below the average assessment criteria (0.100 mg/L) and values were never elevated above instantaneous criteria (0.160 mg/L). The TIN average values (0.133 mg/L) averaged well below the average assessment criteria (0.300 mg/L). Neither TP nor TIN values are elevated; *a nutrient TMDL will not be completed.*

The critical period for nuisance aquatic vegetation is typically during the late spring to early fall months when primary production is elevated. *Seasonally*, TP values are slightly elevated in June (0.033 mg/L), August (0.023 mg/L), and November (0.046 mg/L). The TP values for June were not elevated above monthly average assessment criteria (0.100 mg/L) nor were any of the months elevated above daily maximum criteria. *Seasonally*, TIN values are elevated in June (0.347 mg/L) and November (0.143 mg/L). The TIN values in April are elevated above monthly average assessment values (0.300 mg/L), however neither month was elevated above daily maximum values. The TN/TP ratios for Beaver Creek average at 10.9 indicating that *the creek is a phosphorous limited water body, however late in the season it is a nitrogen limited water body.*

Bacteria (*E. coli*) are not impacting the secondary contact recreation beneficial uses of Beaver Creek. The maximum number of *E. coli* that occurred throughout the period of record was 96, a value that is well below the 576 cfu/100ml instantaneous standard. As there were never any instantaneous exceedance, it was not necessary to calculate geometric mean values for the system. *Seasonally, E. coli* values are slightly elevated in June (56.5 cfu/100ml) and August (43 cfu/100ml), but never above the instantaneous water quality standards. *A bacteria TMDL will not be completed*.

The existing uses within Beaver Creek are CWAL and SS; as such maximum daily and average daily temperatures from 24 hour temperature data is analyzed based on critical time periods for these existing uses. The critical periods for CWAL are June 22 through September 21. As rainbow trout are spawning in Beaver Creek, the critical periods for salmonid spawning is from March 15 through July 15. Temperature loggers were placed at various locations on Beaver Creek for the 2001-2003 periods.

In respect to water quality standards, temperature appears to indicate that water quality is not capable of fully supporting CWAL and SS existing uses (Table 33 and Figure 27), although biological data and water chemistry data discussed previously indicate otherwise. For the period of record, the daily average temperatures for CWAL (0.5% exceedance) do not exceed the 10% exceedance policy, however, the daily maximum temperatures (23.9% exceedance) do exceed the policy. The daily average temperatures (45.3% exceedance) and daily maximum temperatures (45.9% exceedance) for SS were both elevated above the 10% exceedance policy. *A temperature logger was also placed in the headwater stretches of the creek. Data for CWAL met the exceedance policy, however SS temperatures did not.*

Table 33. Beaver Creek temperature elevations.

Year	Site	Days in critical period	Days measured	Elevated maximum temperatures (# / %)		Elevated average temperatures (# / %)	
CWAL							
2002	Lower	92	83	44	53.0	1	1.2
2003	Lower	92	68	0	0	0	0
2003	Upper	92	80	0	0	0	0
SS							
2002	Lower	123	60	57	46.3	55	44.7
2003	Lower	123	123	56	45.5	57	46.3
2003	Upper	123	123	54	43.9	54	43.9

[a] CWAL days missing in the 2002 data include September 13 through September 21, 2003 lower site data were missing August 29 through September 21, 2003 upper site was missing September 10 through September 21.
[b] SS days missing in the 2002 data include March 15 through May17

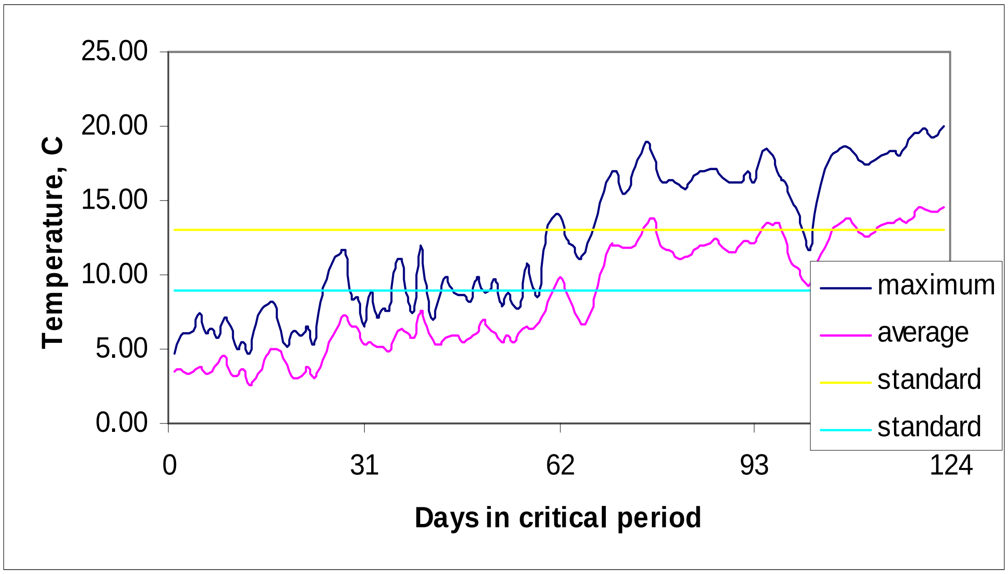


Figure 27. Beaver Creek SS temperatures (2003).

Temperature elevations may be influenced by a number of activities, such as the following:

- Lack of canopy cover due to anthropogenic activities as well as due to some natural events could be a contributing factor to elevated temperatures.
- There are a number of large beaver dam complexes within the watershed that are likely contributing to elevated temperatures. Even as a beaver dam filters sediment out of the water column and redevelops flood plains, the width of the creek increases creating a wetland type area and exposing the water to more solar radiation.
- Removal of water for water use demands reduces the quantity of water and allows solar radiation to elevate temperatures more rapidly.
- Beaver Creek is located in southern Idaho, a desert region where air temperatures are typically hot during summer months.

Existing canopy cover was estimated from aerial photographs of the creek, canopy cover targets were developed for various segments of the creek based on bankfull width and vegetation type (Table 34). Beaver Creek was divided into 10 segment lengths for aerial photo interpretations, the canopy cover ranged from 30% to 60% (Appendix 5). The creek was divided into two representative segments to determine the canopy cover targets for each of the 10 segment lengths. Beaver Creek in the upper portions are dominated by aspens and willows and the lower portions are dominated by willows; therefore the co-dominant Aspen Willow Community and the Willow Mix Community shade curves in the Alvord Lake TMDL on page 75 and 77 were the best matching shade curve for the segments. Targets for canopy cover on the creek were as follows: upper portions (85%) and lower portions (60%). *As some of the existing canopy cover estimates fell outside of the canopy cover targets, a temperature TMDL will be completed. However, if at such future time, water quality standards are modified through the negotiated rule making process and it is found that the* *collected temperature data were meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.*

Table 34. Beaver Creek canopy cover.

Segment	Bankfull Width (m)	Vegetation Type	Existing CC ranges (%)	CC Target (%)
Upper	2.3	Willow-aspen-alder	30-60	85
Lower	2.9	willow	40-50	60

[a] Bankfull width was determined from BURP data or flow data measurements for each section.
[b] Existing CC (canopy cover) was measured by aerial photo interpretation completed by Mark Shumar (DEQ).
[c] The Alvord Lake TMDL was used to aid in selecting CC (canopy cover) targets that were based on similarities in bankfull width and vegetation type.

Conclusions

Through the subbasin assessment process, the following have been identified about Beaver Creek:

- Biological data indicates that beneficial uses are fully supported.
- Flow is sufficient to support beneficial uses although there may be some areas that dry up during years of continual drought.
- Water chemistry data (turbidity, DO, and pH) indicate that water quality is sufficient to support beneficial uses.
- Sediment (bedload sediment) is elevated; however sediment (TSS) is not being carried in the water column and is not being contributed from stream banks at this time. Bedload sediment is likely from historical events and will not be cleaned out until flushing events are sufficient to move them out of the system.
- Nutrients (TP and TIN) are not impacting beneficial uses.
- Bacteria (*E. coli*) are not impacting secondary contact recreation beneficial uses.
- Temperature is elevated, thus indicating that water quality is not sufficient to support beneficial uses.

As a result of the subbasin assessment, a TMDL will be completed for temperature on Beaver Creek. However, if at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data were meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.

Little Beaver Creek

Little Beaver Creek is a second order perennial stream that lies in the eastern part of the Camas Creek Subbasin (Figure 17, page 35). Its headwaters begin southeast of the Little Smoky Mountains and flows southwest to Beaver Creek. Little Beaver Creek is 3.7 miles long and the entire stretch is 303(d) listed. It originates at an elevation of 7,545 feet and discharges at 5,413 feet. Little Beaver Creek has a bankfull width/depth ratio of 6.8, a sinuosity of 1.20, and a gradient of 10.8%.

Land use, ownership, and vegetation of Little Beaver Creek was described based on a 1mile-stream corridor approach (one mile on each side of the creek, therefore two miles in all) as was done in the Big Wood River TMDL.

The majority of Little Beaver Creek occurs on BLM land at 75.4% of the stream corridor area and the land use for the whole stretch of the creek is rangeland. The remainder of the one mile stream corridor is made up by private land (12.9%), state land (0.2%), and USFS land (11.5%).

The vegetation along Little Beaver Creeks stream corridor is predominately shrubland at 87.1% of the corridor area. Agriculture (1.3%), grassland (1.8%), forested (7.3%), riparian (1.6%), and disturbed (0.9%) land is distributed throughout the shrubland.

Little Beaver Creeks stream corridor passes through 2 different geologic formations and one soil type. This creek lies in Cretaceous plutons there is a small portion of alluvium but this occurs in the stream corridor but is not actually in the watershed. The soil of the Little Beaver Creek drainage area has a soil erosion potential (K factor – the higher the number the more soil lost) of 0.15 to 0.25 (ArcView Coverage 1992-1996).

In 2001 two range fires burned through or near the Beaver Creek drainage. The first fire missed Little Beaver Creek but burned the vegetation on the hills to the north. The second fire greatly impacted Little Beaver Creek and destroyed much of its riparian zone along the lower half of the stream.

Biological and Other Data

The IDFG manages the fisheries of Little Beaver Creek in a manner consistent throughout the subbasin. Little Beaver Creek has been identified as a cold water fishery with rainbow trout, brook trout, and brown trout as the species of desirable game fishes within the system. The creek is managed as a wild trout system with management goals that maintain or improve existing habitat for resident and migratory fisheries (IDFG 2001).

For a description of how biological data is assessed to determine beneficial use support status see the section entitled *Analysis Process* (page 45). Water chemistry data constituents that were used to determine if the water quality of this creek is capable of supporting beneficial uses are discussed in the subsection Water Column Data, page 88.

Biological data were collected on Little Beaver Creek through the BURP process in 1993, 1995, 1997, and more recently in 2001. The 1993 and 1995 data were collected more than 5 years ago; as a result they are no longer Tier 1 data. The 1995 data were collected in the middle of June, which falls out of the range of the July 1 to October 1 data collection range established by the WBAG. The 1993 and 1995 sites were located near the middle stretches of the creek, whereas the 1997 and 2001 sites were located near the mouth. Macroinvertebrate and habitat data were collected at all sites, however fish data were collected during two of the collection events, the 1995 and 2001 collection events.

The BURP files on Little Beaver Creek indicate a number of characteristics of the creek as well as a number of activities affecting the creek. The stream order, gradients, Rosgen stream channel type, and activities affecting each reach are reported in Table 35. Additional information in the BURP files indicate that the upper reaches have riparian zones that consist of willows, aspens, alder, sagebrush, and grasses, the stream is clear and is fed by many small springs, there is mining activity upstream and an artificial dike that has been busted through. Lower reaches of the creek have cut banks and riparian zones that consist of willows, grasses, hemlock, birch, nettle, and sagebrush. There is evidence of sheep and cattle in the area, and there is very little water in the creek (DEQ 1993-2001).

Table 35. Characteristics of Little Beaver Creek.

Reach	Stream order	Gradient (%)	Rosgen Stream Channel Type	Activities Affecting Reach
Upper	---	6.0	A	GR, MIN, RDS
Lower	2, 2	4.2, 2	A, G	REC, MIN, RDS, GR

[a]Data from BURP files.
[b]REC-recreation, RDS-roads, GR-grazing, MIN-mining.

In two of the four collection events biological rating scores indicate that Little Beaver Creek is fully supporting its beneficial uses (Table 36). The 1993 site scored a minimum threshold in the SMI index, which automatically indicates impairment of the water body; however the data is no longer Tier 1 data. The 1995 collection event was collected outside of the collection time frame and had less than the necessary number of macroinvertebrates. *For the DEQ metrics to work effectively a minimum of 150 macroinvertebrates for total abundance is necessary* (Clark 2003). The data that was collected more recently was used to represent current conditions of the creek. The SMI scores for both the 1997 and the 2001 events were 3. The SFI score of the 2001 event was 2. The SHI score of the 1997 and 2001 collection events was 3 and 2. The average condition rating scores for the 1997 and 2001 collection events were 2 and 3. (A condition rating score of 2 or greater indicates that beneficial uses are fully supported.) *The more recent biological data collected on Little Beaver Creek indicate that beneficial uses are fully supported.*

Table 36. Condition rating scores for Little Beaver Creek.

Site	SMI	SFI	SHI	Average
1993STWFA011	MT	ND	1	---
1995STWFB012	1	1	1	1
1997STWFA079	3	ND	3	3
2001STWFA027	3	2	1	2

[a]MT-minimum threshold (automatically indicates impairment), ND- no data.
[b]An average condition score of 2 or greater indicates that beneficial uses are fully supported.

Fish data has been collected sporadically on Little Beaver Creek (Table 37). The IDFG collected fish data in 1998 while DEQ collected fish data twice in 1995 and 2001.

Rainbow trout have been found to occur in Little Beaver Creek. As a whole 100% of the fish species of Little Beaver Creek were cold water indicators and 100% of all the fish collected were cold water indicators, 66.1% of the rainbow trout were young of the year.

Table 37. Little Beaver Creek fish data.

Site	Rainbow trout	Brook trout	Sculpin	Sucker	Dace	Redside shiner	Rainbow trout young of year	Brook trout young of year
2001STWFA027	12	0	0	0	0	0	11	0
1998FGBL01	43	0	0	0	0	0	26	0
1995SCIROB12	1	0	0	0	0	0	0	0

[a]Data collected by DEQ and IDFG.

Hydrology

Little Beaver Creek is a perennial creek that has been known to go dry during drought conditions. Little Beaver Creek is fed by two other water bodies and typically provides a year round flow to Beaver Creek. During the 2001-2003 drought periods when data were collected the last mile of the creek provided a small, yet year round flow to Beaver Creek. Upstream the creek however was dry; flows began to return to the water body later in the fall season when precipitation events were more likely to occur in the subbasin. The riparian zone along the creek is high and thick indicating that there is either typically enough flow in Little Beaver Creek or enough ground water influence to support such a well-developed riparian zone.

There is not a gauging station located on Little Beaver Creek currently or historically, so flow data collected in 2001-2003 was used to predict an average stream flow. The sites for stream flow measurements occurred near the confluence with Beaver Creek.

The Camas Creek gauging station (13141500-Camas Creek near Blaine, ID) is a current station that was used in predicting Little Beaver Creek flow. Little Beaver Creek and Camas Creek are in the same general areas, have similar ecoregions, and similar amounts of development. These similarities result in the assumption that precipitation and runoff in the Camas Creek and Little Beaver Creek watersheds was similar as well as being similar throughout the period of record. Based on this assumption a linear regression model of Camas Creek flow versus Little Beaver Creek flow was performed using data collected on the same day (Figure 28). *The statistical values of the regression analysis ($p=0.002$, $r^2=0.809$) indicate that this model can be used to determine a predicted average flow for Little Beaver Creek* (Figure 29).

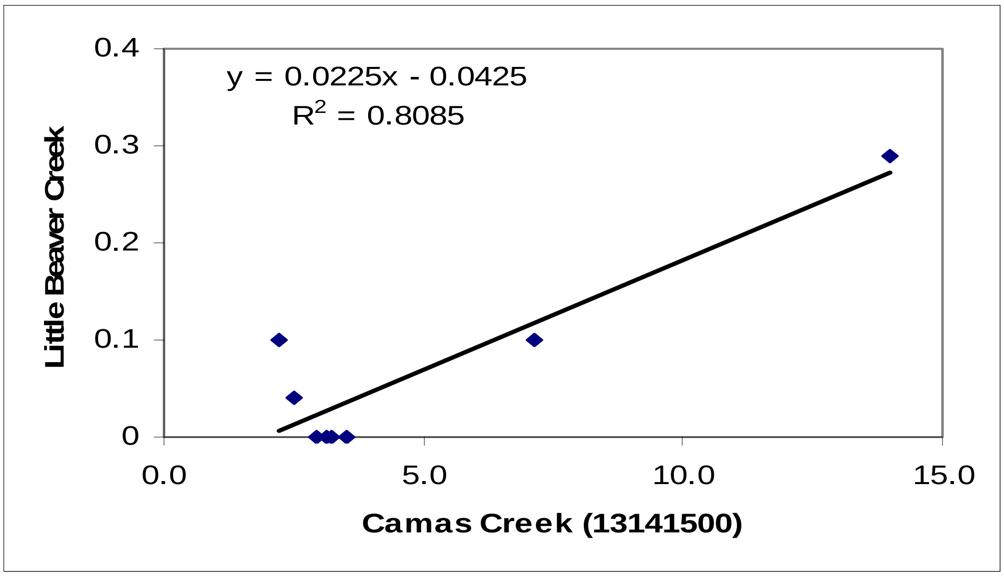


Figure 28. Little Beaver Creek flow (cfs) regression analysis.

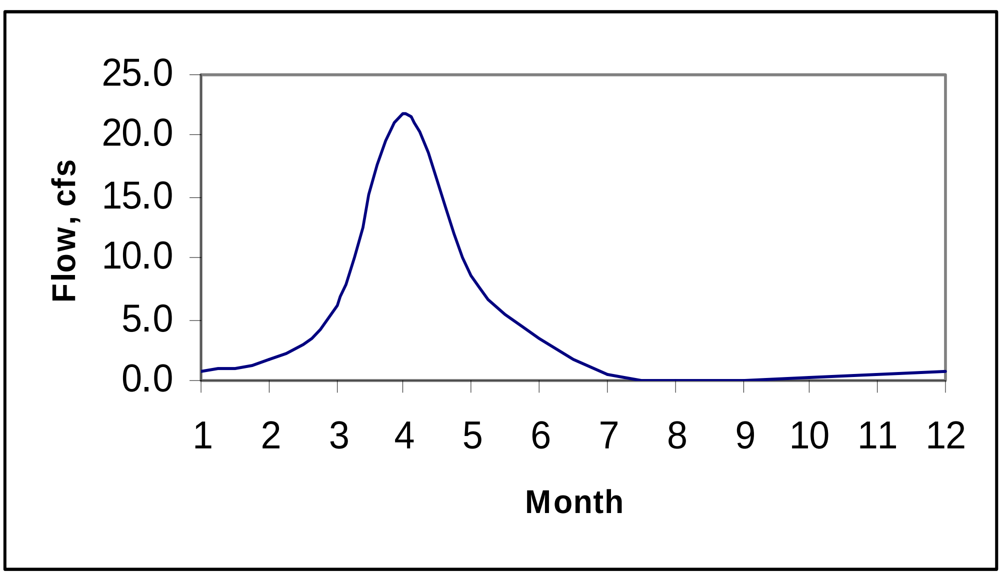


Figure 29. Little Beaver Creek predicted hydrograph.

Flows are not likely impacting the beneficial uses of Little Beaver Creek despite the lack of water in the system during drought years. Beaver Creek likely acts as a refuge for aquatic life during drought years when Little Beaver Creek goes dry. Predicted flows for Little Beaver Creek tend to peak rapidly in April. High flow for Little Beaver Creek occurs in April and averages at 21.8 cfs with low flows occurring from June to March. *There needs to be more flow data that spans across low, average, and high flow years collected on Little Beaver Creek, this is definitely a huge data gap that is necessary to characterize the creek.*

There are few water rights for the Little Beaver Creek drainage area. Diversions off of Little Beaver Creek itself account for 0.6 cfs of water while diversions off of its tributaries account for 0.5 cfs. This water is used for various purposes: stockwater, mining, and wildlife.

Water Column Data

Water chemistry data for Little Beaver is very limited. Monthly monitoring for water chemistry data were completed throughout the 2001-2003 periods. Temperature loggers were also distributed at various locations.

Table 38 describes the number of samples, maximums, averages, minimums, and number of values elevated above assessment criteria. *For a description of how the assessment criteria were developed and analyzed, see Analysis Process, page 45.*

Table 38. Little Beaver Creek water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number of values elevated above instantaneous criteria	Instantaneous Criteria	Average Criteria (monthly and average)
Indicators							
SC	2	244.0	229.0	214.0	0	< 500	---
PH	2	8.18	---	8.11	0	6.5 < x < 9.0	---
TNH3	1	0.005	---	---	0	Variable	---
Turb	2	5.1	4.6	4.0	0	BG + 50	---
DO	2	7.5	6.5	5.4	1	> 6	---
BOD	0	---	---	---	---	< 10	---
Chl a	0	---	---	---	---	< 15	---
Pollutants							
TSS	3	9.2	4.1	1.0	0	< 80	< 50
TP	3	0.063	0.031	<0.005	0	< 0.16	< 0.10
TIN	1	0.082	---	---	0	< 0.48	< 0.3
E. coli	4	53.0	29.5	2.0	0	< 576	< 126

[a]SC-Specific Conductivity (uhmos/cm), pH-Hydrogen Ion Concentration (standard units), TNH3-Total Ammonia (mg/L), Turb-Turbidity (NTUs), DO-Dissolved oxygen (mg/L), BOD-Biological oxygen demand (mg/L), Chl a-chlorophyll a (ug/L), TSS-Total Suspended Solids (mg/L), TP-Total Phosphorous (mg/L), TIN-Total Inorganic Nitrogen (mg/L), *E. coli*-Escherichia coli (colony forming units/100ml).
[b]The average assessment criteria for *E. coli* is actually a geometric mean rather than an average.

Due to inaccessibility and dry locations very little data has been collected on Little Beaver Creek. Water chemistry data and flow data are considered to be data gaps for Little Beaver Creek and will not be assessed during the TMDL phase. *As biological data indicates that beneficial uses are fully supported, water chemistry constituents are not impacting beneficial uses. However, bacteria, 24-hour temperature data, and bedload sediment data have been collected and can be assessed.*

Bedload sediment data (percent fines) indicates that sediment may be impacting beneficial uses; however beneficial uses in the creek are not impacted according to biological data. The percent fines data were elevated above the assessment criteria (35%). There were six collection events in the water body and the values for percent fines ranged from 23.1% to 72.6%.

Stream bank erosion inventories were completed to identify the source of the sediment and they indicate that the stream banks are contributing an excessive load of sediment in the lower portions, but not the upper portions. Bank stability of upper and lower portions of the water body was calculated at 79% and 53%. *The target for stream bank stability is 80% or greater, the lower portion values are not meeting the target, yet biological data indicates beneficial uses are fully supported. A sediment TMDL will not be completed.*

Bacteria (*E. coli*) are not impacting the secondary contact recreation beneficial use of Little Beaver Creek. The maximum number of *E. coli* that occurred throughout the period of record was 53, a value that is well below the 576 cfu/100ml instantaneous standard. As there were never any instantaneous exceedance, it was not necessary to calculate geometric mean values for the system. *A bacteria TMDL will not be completed.*

The existing uses within Little Beaver Creek are CWAL and SS; as such maximum daily and average daily temperatures from 24 hour temperature data is analyzed based on critical time periods for these existing uses. The critical time periods for CWAL are June 22 through September 21. As rainbow trout are spawning in Little Beaver Creek, the critical periods for salmonid spawning is from March 15 through July 15. Temperature loggers were placed at various locations on Little Beaver Creek for the 2001-2003 periods.

In respect to water quality standards, temperature appears to be impacting CWAL and SS existing uses (Table 39 and Figure 30), although biological data discussed previously indicate otherwise. For the period of record, the daily average temperatures (0% exceedance) do not exceed the 10% exceedance policy; however, the daily maximum temperatures (35.9% exceedance) do exceed the exceedance policy. The daily average temperatures (43.1% exceedance) and daily maximum temperatures (45.5% exceedance) for SS were both elevated above the 10% exceedance policy. A temperature logger was also placed in the headwater stretches of the creek. *Data indicates that temperature standards for SS are not being met.*

Table 39. Little Beaver Creek temperature elevations.

Year	Site	Days in critical period	Days measured	Elevated maximum temperatures (# / %)		Elevated average temperatures (# / %)	
CWAL							
2002	Lower	92	83	34	41.0	0	0
2003	Lower	92	68	32	47.1	0	0
2003	Upper	92	59	0	0	0	0
SS							
2002	Lower	123	60	55	91.7	51	85.0
2003	Lower	123	123	57	46.3	55	44.7
2003	Upper	123	123	30	24.4	42	34.1

[a] CWAL days missing in the 2002 data include September 13 through September 21, 2003 lower site data were missing August 29 through September 21, 2003 upper site was missing August 20 through September 21.
[b] SS days missing in the 2002 data include March 15 through May17.

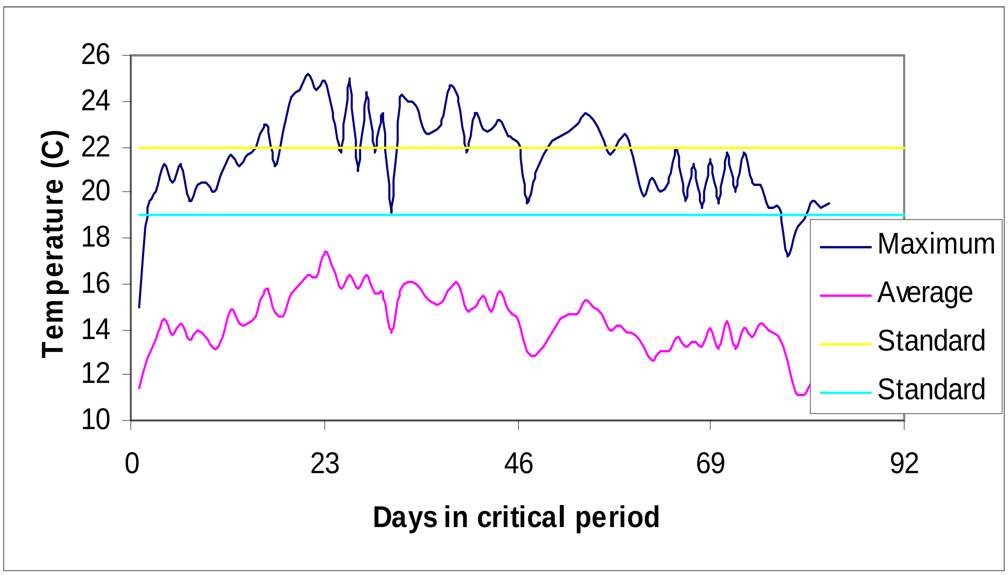


Figure 30. Little Beaver Creek CWAL temperatures (2002).

Temperature elevations may be being influenced by a number of activities, such as the following:

- Lack of canopy cover due to anthropogenic activities as well as due to some natural events could be a contributing factor to elevated temperatures.
- There are some large beaver dams within the watershed that are likely contributing to elevated temperatures. Even as a beaver dam filters sediment out of the water column and redevelops flood plains, the width of the creek increases creating a wetland type area and exposing the water to more solar radiation.
- Removal of water for water use demands reduces the quantity of water and allows solar radiation to elevate temperatures more rapidly.

- Little Beaver Creek is located in southern Idaho, a desert region where air temperatures are typically hot during summer months.

Existing canopy cover was estimated from aerial photographs of the creek, canopy cover targets were developed for various segments of the creek based on bankfull width and vegetation type (Table 40). Little Beaver Creek was divided into 9 segment lengths for aerial photo interpretations, the canopy cover ranged from 20% to 50% (Appendix 5). The creek was divided into two representative segments to determine the canopy cover targets for each of the 9 segment lengths. Little Beaver Creek is dominated in the upper portions by willows, and alder and in the lower portions by willow; therefore the co-dominant willow-alder community and willow mix community shade curve in the Alvord Lake TMDL on page 75 and 77 were the best matching shade curves for the segments. Targets for canopy cover on the creek were as follows: upper portions (85%) and lower portions (75%). *As some of the existing canopy cover estimates fell outside of the canopy cover targets, a temperature TMDL will be completed. However, if at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data were meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.*

Table 40. Little Beaver Creek canopy cover.

Segment	Bankfull Width (m)	Vegetation Type	Existing CC ranges (%)	CC Target (%)
Upper	1.3	Willow-alder	20-50	85
Lower	1.5	willow	30-50	75

[a] Bankfull width was determined from BURP data or flow data measurements for each section.
[b] Existing CC (canopy cover) was measured by aerial photo interpretation completed by Mark Shumar (DEQ).
[c] The Alvord Lake TMDL was used to aid in selecting CC (canopy cover) targets that were based on similarities in bankfull width and vegetation type.

Conclusions

Through the subbasin assessment process, the following have been identified about Little Beaver Creek:

- Biological data indicates that beneficial uses are fully supported.
- Lack of flow in sequential drought years does not appear to impact beneficial uses.
- Water chemistry data is a data gap do to inaccessibility and dry segments.
- Sediment (bedload sediment) is elevated however it is not impacting the beneficial uses.
- Bacteria (*E. coli*) are not impacting secondary contact recreation beneficial uses.
- Temperature is elevated, thus indicating that water quality is not sufficient to support beneficial uses.

As a result of the subbasin assessment, a TMDL will be completed for temperature on Little Beaver Creek. However, if at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data were meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.

Camp Creek

Camp Creek is a third order perennial stream that lies in the eastern part of the Camas Creek Subbasin (Figure 17, page 35). Its headwaters begin southwest of the Kelly Mountain and flows south to Camas Creek. Soldier Creek is 12.4 miles long and the whole stretch is 303(d) listed. It originates at an elevation of 7,217 feet and discharges at 4,888 feet. Camp Creek has a bankfull width/depth ratio of 13.9, a sinuosity of 1.25, and a gradient of 3.55%.

Land use, ownership, and vegetation of Camp Creek was described based on a 1mile-stream corridor approach (one mile on each side of the creek, therefore two miles in all), as was done in the Big Wood River TMDL.

Camp Creek weaves in and out of BLM (32.6%) and private land (63.6%). The stream corridor also encompasses state land (3.7%) and open water (0.1%).

The land use along Camp Creek is predominately rangeland (66.2% of the stream corridor). Dryland agriculture (33.2%) also occurs along with irrigated sprinkler (0.6%).

The vegetation along the stream corridor of Camp Creek changes as you move down the creek channel. Camp Creek begins in shrubland (70.9%) and moves through grassland (15.5%) and agriculture vegetation (12.3%). Forested, water, and riparian vegetation together make up the remaining 1.3% of the area.

Camp Creek stream corridor passes through six different geologic formations as well as four different soil types. The upper half of the creek originates in plutons and passes through outwash fanglomerate flood and terrace gravels. The bottom half passes through more outwashed fanglomerate flood and terrace gravels, through some alluvium, and then through plateau and canyon-filling basalt. There is a small portion of mixed silicic and basaltic volcanic ejecta and silicic welded tuff ash and flow rocks within the stream corridor.

The soils of the Camp Creek drainage area have a soil erosion potential (K factor-the higher the number the more soil lost) that increases as you move down the watershed. The K factor begins in the upper half at 0.15 to 0.25, with the lower half at 0.25-0.35 (ArcView Coverage 1992-1996).

Biological and Other Data

The IDFG manages the fisheries of Camp Creek in a manner consistent throughout the subbasin. Camp Creek has been identified as a cold water fishery with rainbow trout, brook trout, and brown trout as the species of desirable game fishes within the system. The creek is managed as a wild trout system with management goals that maintain or improve existing habitat for resident and migratory fisheries (IDFG 2001).

For a description of how biological data is assessed to determine beneficial use support status see the section entitled *Analysis Process* (page 45). Water chemistry data constituents that were used to determine if the water quality of this creek is capable of supporting beneficial uses are discussed in the subsection Water Column Data, page 96.

Very little biological or habitat data has been collected on Camp Creek. Data were collected through the BURP protocol twice in 1996 and more recently in 2001. The 1996 sites were located in the headwater stretches and the middle portions of the creek. The 2001 data collection event occurred in the middle portion of the creek near one of the previous sites. Macroinvertebrate and habitat data were collected at both 1996 collection events; however fish data were collected at only one of the sites. *There was no data collected at the 2001 site as the water body was dry. All sites were located above the spring that influences perennial flow in the lower segment of Camp Creek.*

Camp Creek has had biological data collected on it; however the data should not be used to determine beneficial use support status. The WBAG process is to be used on perennial water bodies therefore only consistently perennial segments of the water body should be assessed by the WBAG process. *At this time biological data has not been collected on perennial segments of the creek. As a result water chemistry and habitat data was used to determine impairment to water quality.*

The BURP files on Camp Creek indicate a number of characteristics of the creek as well as a number of activities affecting the creek. The stream order, gradients, Rosgen stream channel types, and activities affecting each reach are reported in Table 41. Additional information in the BURP files indicates that upper reaches are slightly braided and somewhat marshy. Middle reaches have young willows along the creek, large basalt rocks in the creek, and has been dry with some standing water throughout the creek (DEQ 1993-2001).

Table 41. Characteristics of Camp Creek.

Reach	Stream order	Gradient (%)	Rosgen Stream Channel Type	Activities Affecting Reach
Upper		1.1	C	GR, RDS, REC
Middle	3	4.0,2.0	B, G	GR, RDS, REC,

[a]Data from BURP files.
[b]REC-recreation, RDS-roads, GR-grazing.

Rainbow trout have been found to occur in Camp Creek (Table 42). As a whole 100% of the fish species of Camp Creek and 100% of all the fish collected were cold water indicators. Also, 100.0% of the rainbow trout were young of the year.

Table 42. Camp Creek fish data.

Site	Rainbow trout	Brook trout	Sculpin	Sucker	Dace	Redside shiner	Rainbow trout young of year	Brook trout young of year
1996SCIROB47	14	0	0	0	0	0	14	0

[a]Data collected by DEQ.

Hydrology

Camp Creek is a perennial creek with intermittent tendencies. Upper headwater reaches where the riparian zone consists of willows and is thicker tend to have minimal perennial flows. However, the creek then moves through a slightly wider valley where grasses dominate the riparian zone rather than willows, perennial flows are lost. As the creek travels through the foothills, cottonwoods and willows contribute to the riparian zone despite the dry nature of the creek, beaver dams in these areas allow sporadic perennial pools to exist. Prior to leaving the foothills willows are found to be growing within the channel rather than along the channel banks. This would seem to indicate that there is a subsurface flow that contributes enough water in the channel to allow willows to develop.

The majority of Camp Creek is dry, however the lower portion of Camp Creek is perennial as it is fed by a perennial spring. In channel stock ponds that are found downstream of this spring influence limit the influence that the spring runoff would have to the creek. However, perennial flow from Camp Creek still contributes to the perennial flow of Camas Creek.

The lower two thirds of Camp Creek lie over the Camas Prairie aquifer. This overlay corresponds with a number of characteristics of Camp Creek.

- There are a number of springs within this overlay that contribute to the perennial flows of the lower portion of Camp Creek.
- The aquifer overlays an area of Camp Creek where there are cottonwoods located along the creek and where some willows are growing within the dry channel.
- The aquifer probably aids in maintaining perennial flows in Camp Creek.
- The geology of the Camp Creek channel likely allows a great deal of ground water and surface water interaction. Surface flow is likely to dissipate into the ground water if water tables are lowered, whereas the waters when ground water tables are high emerge and contribute to surface flows.
- Events that alter either surface water or ground water are likely to impact the other.

There is not a gauging station located on Camp Creek currently or historically, so flow data collected in 2001-2003 was used to predict an average stream flow. The sites for stream flow measurements occurred at the Highway 20-road crossing.

The Camas Creek gauging station (13141500) near Blaine, Idaho is a current station that was used in predicting Camp Creek flow. Camas Creek and Camp Creek are in the same general areas, have similar ecoregions, and similar amounts of development. These similarities result in the assumption that precipitation and runoff in the Camas Creek and Camp Creek watersheds was similar as well as being similar throughout the period of record. Based on this assumption a linear regression model of Camas Creek flow versus Camp Creek flow was performed using data collected on the same day. *The statistical values of the regression analysis ($p=0.002$, $r^2=0.582$) indicate that this model is not the best predictor of average flow for Camp Creek, as a result historical and current actual data was used to show the flow conditions of Camp Creek during drought years (*Figure 31*).*

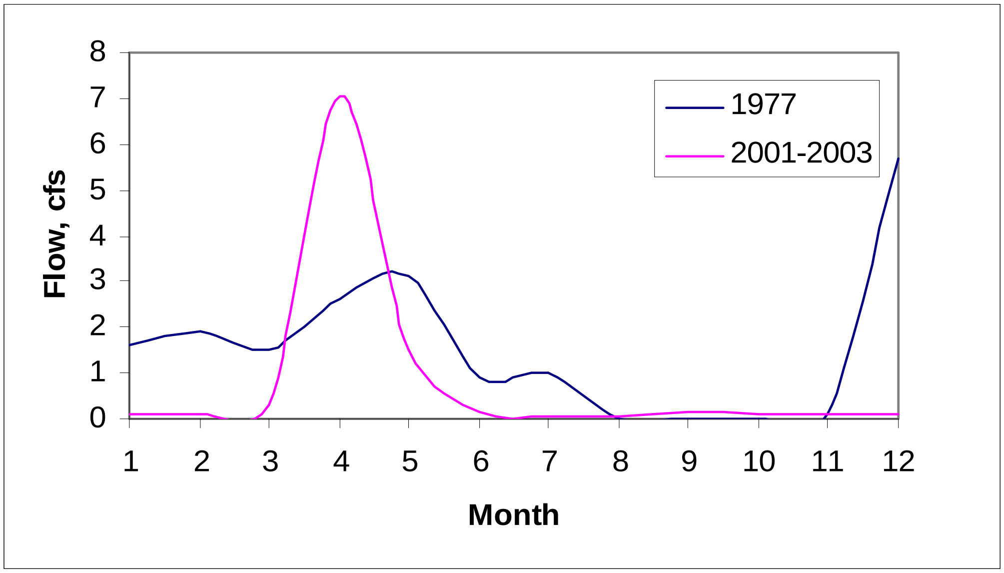


Figure 31. Camp Creek actual hydrograph in drought years (1977, 2001-2003).

Flows are likely impacting the water quality and beneficial uses of Camp Creek. Actual flows during drought years on Camp Creek indicate that flow peaks in April (7.0 cfs) with low flow occurring from June to March. *Little flow data has been collected on Camp Creek; there is a large data gap for flow data on this water body.*

The hydrograph does not indicate the lack of flow that has occurred in segments of the creek in the 2001-2003 periods. The headwaters of Camp Creek have at least a small amount of water year round. The middle segment has gone dry in the 2001-2003 drought years. There are several springs that feed the lower segment of Camp Creek. These springs maintain a low flow in about a mile and a half of the creek before it discharges into Camas Creek. *The 1977 data collected by the USGS appears to indicate that there should be even a minimal amount of flow in the middle portions of the creek during drought years.*

There are many water rights for the Camp Creek drainage area. Diversions off of Camp Creek itself account for 14.5 cfs of water while diversions off of its tributaries account for 9.0 cfs. This water is used for various purposes: irrigation, stockwater, domestic water supply, wildlife, and mining (IDWR 2002).

Water Column Data

Water chemistry for Camp Creek is limited. There were 12 points of sampling performed by the USGS in 1977-78 for flow, temperature, and specific conductivity. Monthly monitoring for water chemistry data were completed throughout the 2001-2003 periods. Temperature loggers were also distributed at various locations.

Table 43 describes the number of samples, maximums, averages, minimums, and number of values elevated above assessment criteria. *For a description of how the assessment criteria were developed and analyzed, see Analysis Process, page 45.*

Table 43. Camp Creek water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number of values elevated above instantaneous criteria	Instantaneous Criteria	Average Criteria (monthly and annual)
Indicators							
SC	11	213.0	164.2	125.1	0	< 500	---
PH	11	8.72	---	6.89	0	6.5 < x < 9.0	---
TNH3	5	0.342	0.126	0.011	0	Variable	---
Turb	11	104.7	17.1	1.8	1	BG + 50	---
DO	11	11.03	9.27	7.60	0	> 6	---
BOD	3	22.0	12.3	4.0	2	< 10	---
Chl a	3	5.8	4.0	3.0	0	< 15	---
Pollutants							
TSS	6	30.0	5.9	0.5	0	< 80	< 50
TP	6	0.112	0.090	0.069	0	< 0.16	< 0.10
TIN	3	1.187	0.503	0.055	1	< 0.48	< 0.3
E. coli	8	378.0	103.5	1.0	0	< 576	< 126

[a]SC-Specific Conductivity (uhmos/cm), pH-Hydrogen Ion Concentration (standard units), TNH3-Total Ammonia (mg/L), Turb-Turbidity (NTUs), DO-Dissolved oxygen (mg/L), BOD-Biological oxygen demand (mg/L), Chl a-chlorophyll a (ug/L), TSS-Total Suspended Solids (mg/L), TP-Total Phosphorous (mg/L), TIN-Total Inorganic Nitrogen (mg/L), *E. coli*-Escherichia coli (colony forming units/100ml).
[b]The average assessment criteria for *E. coli* is actually a geometric mean rather than an average.

The indicator constituents do not indicate that pollutants are impacting the water body. All indicators meet their criteria, except turbidity and BOD. Turbidity was elevated once, at this time the turbidity readings fluctuated greatly and would not stabilize as a result the average measurement was recorded. Fluctuations were likely a result of influences of the flow on the turbidity probe. Spring flows were likely affecting the turbidity reading; at any rate this elevation accounts for only 9% of the measurements within the period of record. During times in which flows were less than 0.2 cfs, BOD levels were elevated, however DO levels at the time were capable of supporting the higher BOD levels. Historical indicators also were meeting criteria.

The following parameters are used in the WBAG to indicate whether or not water quality is capable of supporting beneficial uses: pH, turbidity, and DO. The 10% exceedance policies are applied to pH, turbidity, and DO. If these parameters are not elevated beyond standards more than 10% of the time than water quality is capable of fully supporting beneficial uses. In the case of Camp Creek, neither pH, turbidity, nor DO is elevated more than 10% of the time. *Water quality (DO, pH, and turbidity) appears to indicate that water quality is capable of fully supporting beneficial uses.*

The water column data (TSS) indicates that sediment is not impacting water quality, however bedload sediment data (percent fines) indicates that sediment may be impacting water quality. The TSS average values (5.9 mg/L) averaged well below the average assessment criteria (50 mg/L) and values were never elevated above instantaneous criteria (80 mg/L). The percent fines data were elevated above the assessment criteria (35%). There were six collection events in the water body and the values for percent fines ranged from 31.9% to 65.3%. *Bedload sediment appears to be impacting water quality.*

The critical period for sediment transport is typically during the spring and early summer, when flow is elevated due to runoff events. *Seasonally,* TSS values are elevated in October (30 mg/L), but never above the daily maximum value (80 mg/L). This elevation occurred when flow was less than 0.2 cfs; the event was likely a result of fall precipitation events or anthropogenic activities.

Stream bank erosion inventories were completed to identify the source of the sediment and they indicate that the stream banks are contributing a larger load of sediment into the creek. Bank stability of upper (63.6%), lower upper (50%), middle (74.3%), lower middle (63.8%), and lower (59.7%) portions are not meeting the bank stability target (80% or greater). *Sediment erosion from banks is impacting water quality, a sediment TMDL will be completed.*

The water column data (chlorophyll, TP, and TIN) indicate that nutrients are not impacting the water quality of Camp Creek. Chlorophyll data is limited; however, values remain below 15 µg/L indicating that nuisance aquatic vegetation is not occurring in the water body. The TP average values (0.090 mg/L) averaged below the average assessment criteria (0.100 mg/L) and values were never elevated above the instantaneous criteria (0.160 mg/L). The TIN average values (0.503 mg/L) averaged above the assessment criteria (0.300 mg/L). The elevated TIN values at first appear to be a concern, however, in relation to nuisance aquatic vegetation, TIN and TP values together are truly the important values. *Nutrients are not a concern at this time; however an influx of TP could lead to some nuisance aquatic growth problems.*

The critical period for nuisance aquatic vegetation is typically during the late spring to early fall months when primary production is elevated. *Seasonally*, TP values are slightly elevated in June (0.103 mg/L), October (0.112 mg/L), and November (0.092 mg/L). April and June were not elevated above the monthly average assessment criteria (0.100 mg/L), all months were never elevated above the daily assessment value (0.160 mg/L). *Seasonally*, TIN values are elevated in April (0.546 mg/L) and October (1.187 mg/L). April was elevated above monthly average assessment criteria (0.300 mg/L) and was the only month elevated above daily maximum values (0.480 mg/L). *The TIN and TP values were never elevated at the same time, but once in October, outside of the growing period.* The TN/TP ratios for Camp Creek average at 12.4 indicating that *the water body is a phosphorous limited water body*.

Well data in the Camas Creek Subbasin indicates that TIN levels in the ground water are elevated above the surface water assessment criteria. Well data collected in the 1990s indicates that TIN values range from 0.035 mg/L to 6.058 mg/L and averages 1.855 mg/L. Of the 21 samples collected 81% of them are elevated above the daily maximum assessment criteria (0.480 mg/L).

Bacteria (*E. coli*) are not impacting the secondary contact recreation beneficial uses of Camp Creek. The maximum number of *E. coli* that occurred throughout the period of record was 378, a value below the 576 cfu/100ml instantaneous standard. As there were never any instantaneous exceedance, it was not necessary to calculate geometric mean values for the system. *Seasonally*, *E. coli* values are slightly elevated in June (378 cfu/100ml) and September (240 cfu/100ml), but never above the instantaneous water quality standards. The remainder of the months average 43 cfu/100ml.

The existing uses within Camp Creek are CWAL and SS; as such maximum daily and average daily temperatures from 24 hour temperature data is analyzed based on critical time periods for these existing uses. The critical time periods for CWAL are June 22 through September 21. As rainbow trout are spawning in Camp Creek, the critical time periods for salmonid spawning is from March 15 through July 15. Temperature loggers were placed at various locations on Camp Creek for the 2001-2003 periods.

In respect to water quality standards, temperature appears to indicate that water quality is not capable of fully supporting CWAL and SS existing uses (Table 44 and Figure 32). For the period of record, the daily average CWAL temperatures (23.9% exceedance) and daily maximum CWAL temperatures (38.0% exceedance) exceeded the 10% exceedance policy. The daily average temperatures (74.8% exceedance) and daily maximum temperatures (63.4% exceedance) for SS were both elevated above the 10% exceedance policy. A temperature logger was also placed in the headwater stretches of the creek. *Headwater reaches are meeting CWAL temperature standards but not SS temperature standards.*

Table 44. Camp Creek temperature elevations.

Year	Site	Days in critical period	Days measured	Elevated maximum temperatures (# / %)		Elevated average temperatures (# / %)	
CWAL							
2003	Upper	92	80	5	5.4	1	1.1
2003	Lower	92	80	35	38.0	22	23.9
SS							
2003	Upper	123	123	58	47.2	53	43.1
2003	Lower	123	123	78	63.4	92	74.8

[a] CWAL days missing in the 2003 data include September 10 through September 21, 2003.

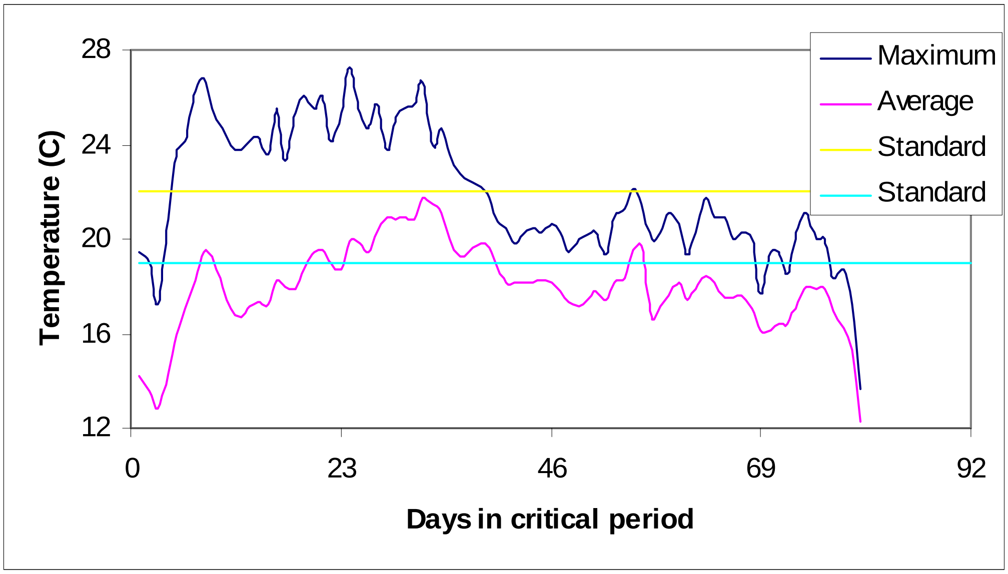


Figure 32. Camp Creek CWAL temperatures (2003).

Temperature elevations may be being influenced by a number of activities, such as the following:

- Lack of canopy cover due to anthropogenic activities as well as due to some natural events could be a contributing factor to elevated temperatures.
- Stock ponds within the creek could be increase surface area exposure to solar radiation and thus elevating water temperatures.
- There are a number of beaver dam complexes within the watershed that are likely contributing to elevated temperatures. Even as a beaver dam filters sediment out of the water column and redevelops flood plains, the width of the creek increases creating a wetland type area and exposing the water to more solar radiation.
- Removal of water for water use demands reduces the quantity of water and allows solar radiation to elevate temperatures more rapidly.

- Camp Creek is located in southern Idaho, a desert region where air temperatures are typically hot during summer months.

Existing canopy cover was estimated from aerial photographs of the creek, canopy cover targets were developed for various segments of the creek based on bankfull width and vegetation type (Table 45). Camp Creek was divided into 21 segment lengths for aerial photo interpretations, the canopy cover ranged from 10% to 60% (Appendix 5). The creek was divided into four representative segments to determine the canopy cover targets for each of the 21 segment lengths. Camp Creek is dominated by willows with grasses, alders, and cottonwood occurring occasionally; therefore the willow mix community shade curve in the Alvord Lake TMDL on page 75 was the best matching shade curve for all four segments. Targets for canopy cover on the creek were as follows: upper portions (75%), upper middle portions (35%), lower middle portions (65%), and lower portions (50%). *As some of the existing canopy cover estimates fell outside of the canopy cover targets, a temperature TMDL will be completed. However, if at such future times, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data were meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.*

Table 45. Camp Creek canopy cover.

Segment	Bankfull Width (m)	Vegetation Type	Existing CC ranges (%)	CC Target (%)
Upper (headwaters to main road crossing)	1.6	Willows	20-60	75
Upper Middle (main road crossing to Spare Creek)	5.3	Willows, cottonwoods	10-40	35
Lower Middle (Spare Creek to spring)	2.6	Willows, grasses	10-50	65
Lower (spring to mouth)	3.8	Grass, willow, alders	20-30	50

[a] Bankfull width was determined from BURP data or flow data measurements for each section.
[b] Existing CC (canopy cover) was measured by aerial photo interpretation completed by Mark Shumar (DEQ).
[c] The Alvord Lake TMDL was used to aid in selecting CC (canopy cover) targets that were based on similarities in bankfull width and vegetation type.

Conclusions

Through the subbasin assessment process, the following have been identified about Camp Creek:

- Biological data should not be used to assess this water body due to intermittent tendencies except in the lower mile.
- Flow is not sufficient in the majority of the water body to support beneficial uses.

- Water chemistry data (turbidity, DO, and pH) indicate that water quality is sufficient to support beneficial uses.
- Sediment (bedload sediment) is impacting water quality.
- Nutrients (TP and TIN) are not impacting water quality.
- Bacteria (*E. coli*) are not impacting secondary contact recreation beneficial uses.
- Temperature is elevated, thus indicating that water quality is not sufficient to support beneficial uses.

As a result of the subbasin assessment, a TMDL will be completed for sediment and temperature on Camp Creek and the creek will be listed as impaired by flow alteration. However, if at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data were meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.

Elk Creek

Elk Creek is a second order perennial stream that lies in the eastern part of the Camas Creek Subbasin (Figure 17, page 35). Its headwaters begin east of the Cannonball Mountain and flows south into Camas Creek. Elk Creek is 9.9 miles long and the 303(d) listed segment is 3.5 miles long. It originates at an elevation of 7,709 feet and discharges at 4,954 feet. Elk Creek has a bankfull width/depth ratio of 13.3, a sinuosity of 1.1, and a gradient of 5.25%, while the 303(d) listed segment has a gradient of 0.71%.

Land use, ownership, and vegetation of Elk Creek was described based on a 1mile-stream corridor approach (one mile on each side of the creek, therefore two miles in all), as was done in the Big Wood River TMDL.

Elk Creek passes through patches of USFS, BLM and state land near the headwaters but quickly passes into private land. The 303(d) listed segment of the creek is 100% private land within the stream corridor.

The land use for the upper half of the water body is rangeland with dry land agriculture making up the majority of the land use for the lower half. The 303(d) listed segment consists of rangeland (3.0%), dry land agriculture (93.0%), and irrigated-sprinkler (4.1%).

The vegetation along the stream corridor of Elk Creek changes as you move down the creek channel. The upper half of Elk Creek consists of shrubland with forested and grassland vegetation distributed throughout it. It then moves down into agriculture land in the lower half. The 303(d) listed segment consists of agriculture vegetation (81.0%), shrubland (9.7%), grassland (8.6%) and riparian (0.7%).

The stream corridor of Elk Creek passes through seven different geologic formations as well as five different soil types. The upper half of this creek lies in mixed silicic and basaltic volcanic ejecta flows with plutons and thrusted marine detritus bordering the stream corridor. The lower half of the creek lies in Pleistocene deposits with the mouth located in plateau and canyon-filling basalt but bordered by alluvium.

The soils of the Elk Creek drainage area have a soil erosion potential (K factor-the higher the number the more soil lost) that increases as you move down the watershed. The soils in the headwaters have K factors of 0.35 to 0.45, but the creek moves rapidly into areas with soils that have a K factor of 0.15 to 0.25. The lower half of the stream corridor has soils with K values of 0.25 to 0.35 (ArcView Coverage 1992-1996).

Biological and Other Data

The IDFG manages the fisheries of Elk Creek in a manner consistent throughout the subbasin. Elk Creek has been identified as a cold water fishery with rainbow trout, brook trout, and brown trout as the species of desirable game fishes within the system. The creek is managed as a wild trout system with management goals that maintain or improve existing habitat for resident and migratory fisheries (IDFG 2001).

For a description of how biological data is assessed to determine beneficial use support status see the section entitled *Analysis Process* (page 45). Water chemistry data constituents that were used to determine if the water quality of this creek is capable of supporting beneficial uses are discussed in the subsection Water Column Data, page 105.

Very little biological or habitat data has been collected on Elk Creek. Data were collected on Elk Creek through the BURP protocol in 1993 and more recently in 2001. The1993 data were collected more than 5 years ago; as a result they are no longer Tier 1 data. The data were also collected in June, which is outside of the collection period of July to September established by the WBAG. The site was located about two miles upstream of the mouth. Macroinvertebrate and habitat data were collected at the site. The 2001 site was located about 2.5 miles upstream of the mouth; however data were not collected, as the water body was dry. *Both of these sites are located on the segment of the creek that is impacted by lack of flows from the early summer months to the spring runoff months.*

Elk Creek has had biological data collected on it; however the data should not be used to determine beneficial use support status. The WBAG process is to be used on perennial water bodies therefore only consistently perennial segments of the water body should be assessed by the WBAG process. *At this time biological data has not been collected on perennial segments of the creek. As a result water chemistry and habitat data was used to determine impairment to water quality*.

The BURP files on Elk Creek indicate a number of characteristics of the creek as well as a number of activities affecting the creek. The stream order, gradients, Rosgen stream channel types, and activities affecting each reach are reported in Table 46. Additional information in the BURP files indicate that the lower reaches have a broken cottonwood canopy, pasture grass surrounds the creek and the creek is known to go dry (DEQ 1993-2001).

Table 46. Characteristics of Elk Creek.

Reach	Stream order	Gradient (%)	Rosgen Stream Channel Type	Activities Affecting Reach
Lower	2	1	G	AG, RDS, GR

[a]Data from BURP files.
[b]AG-agriculture, RDS-roads, GR-grazing.

Fish data have never been collected on this water body.

Hydrology

Elk Creek is a perennial creek; however, the majority of the water body becomes intermittent early in the summer. Four tributaries drain the hillsides of the watershed and feed the headwater reaches of Elk Creek. Once Elk Creek travels out of the foothills onto the prairie there are no longer any natural flow channels that contribute to surface flow of the creek. Snowmelt and precipitation events in the prairie reaches probably contribute to ground water supplies rather than surface flow. A small segment of the middle reaches of the water body maintain year round flows that are a result of flows from a geothermic warmer creek. The remainder of the creek is dry from the summer period to the next spring runoff event except the lower half-mile of the creek. There are several beaver dams within this area that likely aid in maintaining perennial waters by raising water tables.

The lower half of Elk Creek lies over the Camas Prairie aquifer. This overlay corresponds with a number of characteristics of Elk Creek.

- The last of the tributaries that feed into Elk Creek occur at the upper borders of the aquifer. As there are no natural flow channels that occur downstream of these tributaries, the aquifer probably aids in maintaining perennial flows in Elk Creek.
- The geology of the Elk Creek channel likely allows a great deal of ground water and surface water interaction.
- Surface flow is likely to dissipate into the ground water if water tables are lowered, whereas the groundwater when water tables are high, emerge and contribute to surface flows.
- Events that alter either surface water or ground water are likely to impact the other.

There is not a gauging station located on Elk Creek currently or historically, so flow data collected in 2001-2003, 1977, and 1992 was used to predict an average stream flow. The sites for stream flow measurements occurred at the highway 20-road crossing and baseline road crossing.

The Camas Creek gauging station (13141500) near Blaine, Idaho is a current station that was used in predicting Elk Creek flow. Camas Creek and Elk Creek are in the same general areas, have similar ecoregions, and similar amounts of development. These similarities result in the assumption that precipitation and runoff in the Camas Creek and Elk Creek watersheds was similar as well as being similar throughout the period of record. Based on this assumption a linear regression model of Camas Creek flow versus Elk Creek flow was performed using data collected on the same day (Figure 33). *The statistical values of the regression analysis (p=0.000,* r^2*=0.757) indicate that this model can be used to determine a predicted average flow for Elk Creek* (Figure 34).

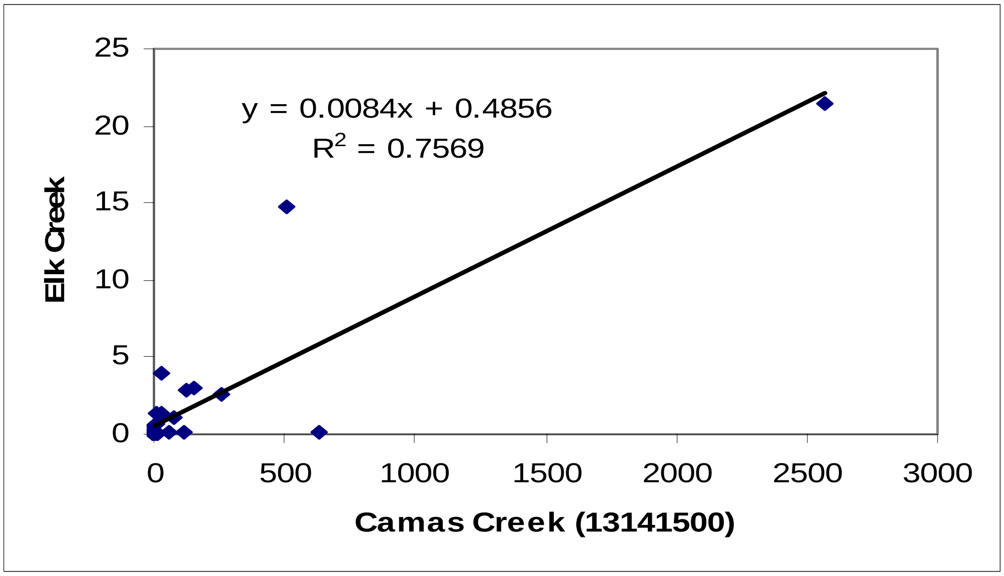


Figure 33. Elk Creek flow (cfs) regression analysis.

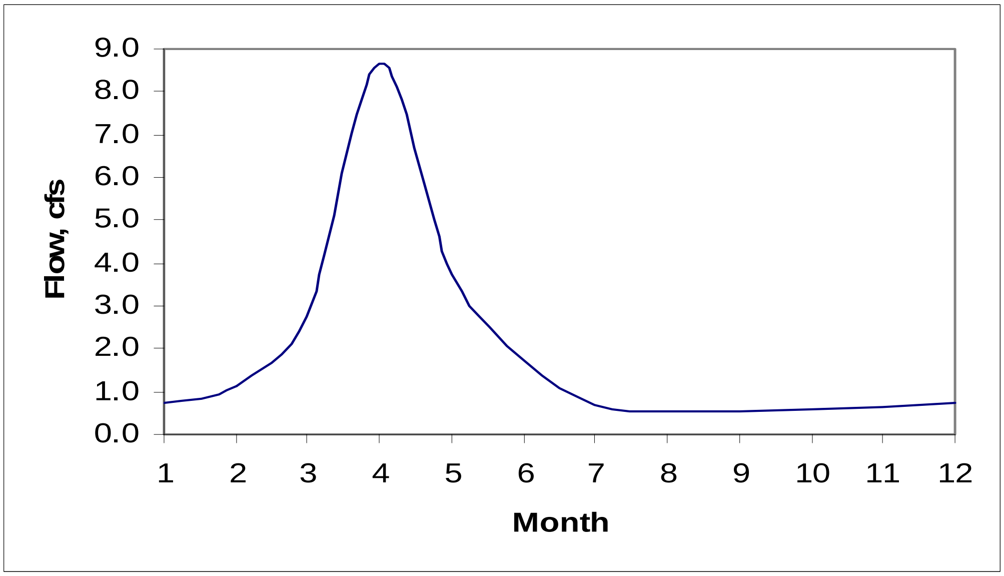


Figure 34. Elk Creek predicted hydrograph.

Flows are the largest impact to beneficial uses within Elk Creek. Predicted flows for Elk Creek tend to peak rapidly in April. *This rapid peak is likely a result of south facing slopes* *as well as historic channel straightening.* High flow for Elk Creek occurs in April and averages at 8.6 cfs with low flows occurring from June to March.

The majority of Elk Creek frequently goes dry; however, there are lower and upper segments that do have perennial waters. There is a creek called Hot Spring Creek that feeds Elk Creek in the headwaters. This allows there to be water during drought years for about half a mile up in the headwaters. The lower portion (about half a mile) also has water year round (although little or no flow) as a result of the high water table and beaver dams. The remainder of the creek goes dry in drought years.

There are many water rights for the Elk Creek drainage area. Diversions off of Elk Creek itself account for 8.2 cfs of water while diversions off of its tributaries account for 7.7 cfs. This water is used for various purposes: irrigation, stockwater, and wildlife (IDWR 2002).

Water Column Data

Water chemistry data for Elk Creek is very limited. There were 13 points of sampling for flow, temperature, and specific conductivity done in 1977 by the USGS, along with one point of sampling for pH, TP, and *E. coli*. There was 13 points of sampling for flow, seven points of sampling for temperature, DO, specific conductivity, and pH, three points of sampling for TSS, and two points of sampling for TP in 1993 completed for the SAWQP program. Monthly monitoring for water chemistry data were completed throughout the 2001-2003 periods. Temperature loggers were also distributed at various locations.

Table 47 describes the number of samples, maximums, averages, minimums, and number of values elevated above assessment criteria. *For a description of how the assessment criteria were developed and analyzed, see Analysis Process, page 45.*

Table 47. Elk Creek water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number of values elevated above instantaneous criteria	Instantaneous Criteria	Average Criteria (monthly and annual)
Indicators							
SC	8	241.0	182.7	147.7	0	< 500	---
PH	8	8.64	---	7.63	0	6.5 < x < 9.0	---
TNH3	3	0.111	0.059	0.005	0	Variable	---
Turb	8	13.3	6.4	2.6	0	BG + 50	---
DO	8	13.94	8.95	7.38	0	> 6	---
BOD	3	31.0	14.7	4.0	1	< 10	---
Chl a	2	2.7	2.3	1.8	0	< 15	---
Pollutants							
TSS	6	45.0	8.7	1.0	0	< 80	< 50
TP	6	0.210	0.090	0.025	1	< 0.16	< 0.10
TIN	3	2.488	1.096	0.065	2	< 0.48	< 0.3
E. coli	7	11.0	5.1	0.5	0	< 576	< 126

[a]SC-Specific Conductivity (uhmos/cm), pH-Hydrogen Ion Concentration (standard units), TNH3-Total Ammonia (mg/L), Turb-Turbidity (NTUs), DO-Dissolved oxygen (mg/L), BOD-Biological oxygen demand (mg/L), Chl a-chlorophyll a (ug/L), TSS-Total Suspended Solids (mg/L), TP-Total Phosphorous (mg/L), TIN-Total Inorganic Nitrogen (mg/L), *E. coli*-Escherichia coli (colony forming units/100ml).
[b]The average assessment criteria for *E. coli* is actually a geometric mean rather than an average.

The indicator constituents do not indicate that pollutants are impacting the water body. All indicators meet their criteria, except BOD. The BOD levels were elevated in October when plant material is decomposing, however the BOD levels did not impact DO levels. Historical indicators also meet assessment criteria.

The following parameters are used in the WBAG to indicate whether or not water quality is capable of supporting beneficial uses: pH, turbidity, and DO. The 10% exceedance policy is applied to pH, turbidity, and DO. If these parameters are not elevated beyond standards more than 10% of the time than water quality is capable of fully supporting beneficial uses. In the case of Elk Creek, neither pH, turbidity, nor DO is elevated more than 10% of the time. *Water quality (DO, pH, and turbidity) appears to indicate that water quality is capable of fully supporting beneficial uses.*

The water column data (TSS) indicates that sediment is not impacting beneficial uses, however bedload sediment data (percent fines) is elevated in the system. The TSS average values (8.7 mg/L) averaged well below the average assessment criteria (50 mg/L) and values were never elevated above instantaneous criteria (80 mg/L). The percent fine data were elevated above the assessment criteria (35%). There were four collection events in the water body and the values for percent fines ranged from 14.1% to 67.1%. *Bedload sediment appears to be impacting water quality.*

The critical period for sediment transport is typically during the spring and early summer when flow is elevated due to runoff events. *Seasonally*, TSS is elevated in October (45.0 mg/L), but never above daily maximum values (80 mg/L). *Historically* (1993), TSS values were 4, 94, and 23 mg/L in March, April, and May.

Stream bank erosion inventories were completed to identify the source of the bedload sediment and they indicate that the stream banks are contributing an excessive load of sediment to the water body. Bank stability of upper and lower portions of the water body was calculated at 76.0% and 72.5%. The target for stream bank stability is 80% or greater; these values are less than the target. *A sediment TMDL will be completed.*

The water column data (chlorophyll, TP, and TIN) indicate that nutrients are not impacting the water quality of Elk Creek. Chlorophyll data is limited; however, values remain below 15µg/L indicating that nuisance aquatic vegetation is not occurring in the water body. The TP average values (0.090 mg/L) averaged below the average assessment criteria (0.100 mg/L) and values were elevated once above the instantaneous criteria (0.160 mg/L) when flow was minimal in the water body. The TIN average values (1.096 mg/L) averaged above the average assessment criteria (0.300 mg/L).

The elevated TIN values at first appear to be a concern, however, in relation to nuisance aquatic vegetation, TIN and TP values together are truly the important values. If both TP and TIN values were elevated then there would likely be a nuisance aquatic plant problem. *A comparison of TP and TIN values indicates that when TP levels are higher TIN levels are lower and when TIN levels are higher TP levels are lower (Figure 35). Aquatic nuisance vegetation is not a problem in this water body as there is only about a mile of the stream (half a mile in the headwaters and half a mile at the mouth) that has flow during the growing period. However, it appears that if perennial flows are returned to the creek, nutrient levels may need to be further studied.*

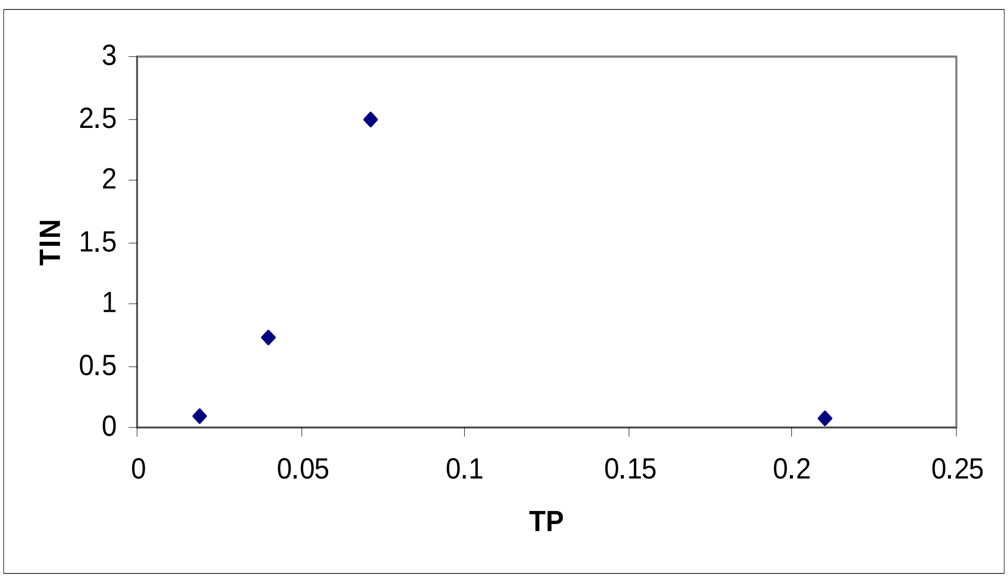


Figure 35. Comparison of TP (mg/L) and TIN (mg/L) values.

The critical period for nuisance aquatic vegetation is typically during the late spring to early fall months, when primary production is elevated. *Seasonally*, TP values are elevated in June (0.210 mg/L), and November (0.120 mg/L). The TP levels in June were elevated above daily maximum values (0.160 mg/L), but all other months remained below daily maximum values. *Historically* (1993), TP values in April, May, and August were 0.300, 0.160, and 0.080 mg/L. *Seasonally*, TIN values are elevated in April (0.734 mg/L) and October (2.488 mg/L). At both sampling events flows were 0.2 cfs and influenced by ground water. *The TN/TP ratios for Elk Creek average at 21.1 indicating that the water body is a phosphorous limited water body. During the period of record the water body was nitrogen limited in June, the month in which flow, if it occurs is a result of strictly ground water.*

Well data in the Camas Creek Subbasin indicates that TIN levels in the ground water are elevated above the surface water assessment criteria. Well data collected in the 1990s indicates that TIN values range from 0.035 mg/L to 6.058 mg/L and averages 1.855 mg/L. Of the 21 samples collected 81% of them are elevated above the daily maximum assessment criteria (0.480 mg/L).

Bacteria (*E. coli*) are not impacting the secondary contact recreation beneficial use of Elk Creek. The maximum number of *E. coli* that occurred throughout the period of record was 11, a value well below the 376 cfu/100ml instantaneous standard. As there were never any instantaneous exceedance, it was not necessary to calculate geometric mean values for the system. *Seasonally*, *E. coli* values are slightly elevated in April (11 cfu/100ml), May (5.5 cfu/100ml), and October (11 cfu/100ml), but never above instantaneous standards. The remainder of the months average 0.9 cfu/100 ml.

Cold water aquatic life (CWAL) is an existing use within Elk Creek. The CWAL beneficial uses are not impacted by temperature rather they are impacted by lack of flow in the water body during the critical periods for CWAL. The water body is dry from July until spring runoff months. Flows are affecting CWAL rather than temperature, therefore a temperature TMDL will not be completed. Temperature issues in the water body will be evaluated when perennial flows return regularly to the entire length of Elk Creek.

Conclusions

Through the subbasin assessment process, the following have been identified about Elk Creek:

- Biological data should not be used to assess this water body due to intermittent tendencies.
- Flow is not sufficient to support beneficial uses.
- Water chemistry data (turbidity, DO, and pH) indicate that water quality is sufficient to support beneficial uses.
- Sediment (bedload sediment) is impacting water quality.

- Nutrients (TP and TIN) are not impacting water quality, but may need to be observed if perennial flows are returned to the creek.
- Bacteria (*E. coli*) are not impacting secondary contact recreation beneficial uses.
- Temperature data is unavailable during CWAL time periods as flow does not exist during those times.

As a result of the subbasin assessment, a TMDL will be completed for sediment on Elk Creek and the creek will be listed as impacted by flow alteration and channelization.

Corral Creek

Corral Creek is a third order perennial stream that lies in the central part of the Camas Creek Subbasin (Figure 17, page 35). Its headwaters begin south of the Soldier Mountains and flows south into Camas Creek. Corral Creek is 7.46 miles long and the 303(d) listed segment is 3.73 miles long. It originates at an elevation of 5,216 feet and discharges at 5,019 feet. Corral Creek has a bankfull width/depth ratio of 19.2, a sinuosity of 1.09, a gradient of 0.5%, while the 303(d) listed segment has a gradient of 0.33%.

Land use, ownership, and vegetation of Corral Creek was described based on a 1mile-stream corridor approach (one mile on each side of the creek, therefore two miles in all) as was done in the Big Wood River TMDL.

Although the forks of Corral Creek originate on USFS and BLM land Corral Creek passes mostly through private land with a couple of small portions of BLM and state land bordering the stream corridor. The 303(d) listed segment consists entirely of private land.

The land use for the forks of Corral Creek is rangeland but Corral Creek itself is predominately dry land agriculture, with irrigated-gravity flow and irrigated sprinkler occurring within the stream corridor. The 303(d) listed segment consists of dryland agriculture (62.3%), irrigated-sprinkler (27.0%), rangeland (8.2%), and irrigated-gravity flow (2.5%).

The vegetation along the stream corridor of Corral Creek changes as you move down the creek channel. The forks of Corral Creek are predominately shrubland with forest and agriculture vegetation distributed throughout it. The main fork is predominately agriculture vegetation with grasslands bordering the stream corridor. The land use for the 303(d) listed segment is agriculture (58.9%) with grassland (12.8%), shrubland (0.6%), riparian (0.6%), wetland (0.1%), and urban/developed (0.1%).

Corral Creek stream corridor passes through three different geologic formations as well as three different soil types. The forks of this water body originate in intermediate plutons while the main body is surrounded by alluvium. The mouth of the creek can be found in plateau and canyon-filling basalt.

The soils of the Corral Creek drainage area have a soil erosion potential (K factor – the higher the number the more soil lost) that increases as you move down the watershed. The soils in the region have K factors of 0.15 to 0.25 in the headwater region; however, K factors increase to 0.25 to 0.35 for most of the main stem (ArcView Coverage 1992-1996).

Biological and Other Data

The IDFG manages the fisheries of Corral Creek in a manner consistent throughout the subbasin. Corral Creek has been identified as a cold water fishery with rainbow trout, brook trout, and brown trout as the species of desirable game fishes within the system. The creek is managed as a wild trout system with management goals that maintain or improve existing habitat for resident and migratory fisheries (IDFG 2001).

For a description of how biological data is assessed to determine beneficial use support status see the section entitled *Analysis Process* (page 45). Water chemistry data constituents that were used to determine if the water quality of this creek is capable of supporting beneficial uses are discussed in the subsection Water Column Data, page 113.

Very little biological or habitat data has been collected on Corral Creek. Data were collected on Corral Creek through the BURP protocol in 1993. The1993 data were collected more than 5 years ago; as a result they are no longer Tier 1 data. The site was located about one mile upstream of the mouth. *This site is located on the segment of the creek that is impacted by lack of flows from the early summer months to the spring runoff months.*

Corral Creek has had biological data collected on it; however the data should not be used to determine beneficial use support status. The WBAG process is to be used on perennial water bodies therefore only consistently perennial segments of the water body should be assessed by the WBAG process. *At this time biological data has not been collected on perennial segments of the creek. As a result water chemistry and habitat data was used to determine impairment to water quality.*

Brook trout and sculpin have been found to occur in Corral Creek (Table 48). As a whole 100% of the fish species of Corral Creek were cold water indicators. Thirty three percent of the brook trout were young of the year.

Table 48. Corral Creek fish data.

Site	Rainbow trout	Brook trout	Sculpin	Sucker	Dace	Redside shiner	Rainbow trout young of year	Brook trout young of year
1993SCIRO05	0	3	24	0	0	0	0	1

[a]Data collected by DEQ.

Hydrology

Corral Creek is a perennial creek; however, a large portion of the water body becomes intermittent early in the summer. Corral Creek in the upper portion of the watershed retains a perennial flow throughout the year. However, as the channel moves downstream flow within the water body is lost during the summer months. Three tributaries drain the foothills in the watershed in the headwaters; however as Corral Creek travels from the foothills to the prairie there are no natural channels contributing to Corral Creek flows. Due to low gradients, snowmelt and precipitation events in the prairie reaches likely contribute to ground water supply rather than to surface flow. There are three braided segments and one wetland area in the short length of Corral Creek.

The entire length of Corral Creek lies over the Camas Prairie aquifer. This overlay corresponds with a number of characteristics of Corral Creek:

- The last of the tributaries that feed into Corral Creek occur at the upper borders of the aquifer. As there are no natural flow channels that occur downstream of these tributaries, the aquifer probably aids in maintaining perennial flows in Corral Creek.
- A wide wetland is located in the middle stretches of the creek. The wetland dries up in the summer, however the ground water probably aids in the riparian development and sustainability of the plants.
- The alluvium along the channel of Corral Creek that is found along the length of the prairie likely allows a great deal of ground water and surface water interaction.
- Surface flow is likely to dissipate into the groundwater if water tables are lowered, whereas the groundwater when water tables are high, emerge and contribute to surface flows.
- Events that alter either surface water or ground water are likely to impact the other.

There is not a gauging station located on Corral Creek currently or historically, so flow data collected in 2001-2002 and 1993 was used to predict an average stream flow. The sites for stream flow measurements occurred at the road crossing about a mile upstream of the confluence and at a site a mile below baseline road.

The Camas Creek gauging station (13141500) near Blaine, Idaho is a current station that was used in predicting Corral Creek flow. Corral Creek and Camas Creek are in the same general areas, have similar ecoregions, and similar amounts of development. These similarities result in the assumption that precipitation and runoff in the Camas Creek and Corral Creek watersheds was similar as well as being similar throughout the period of record. Based on this assumption a linear regression model of Camas Creek flow versus Corral Creek flow was performed using data collected on the same day (Figure 36). *The statistical values of the regression analysis ($p=0.000$, $r^2=0.817$) indicate that this model can be used to determine a predicted average flow for Corral Creek* (Figure 37).

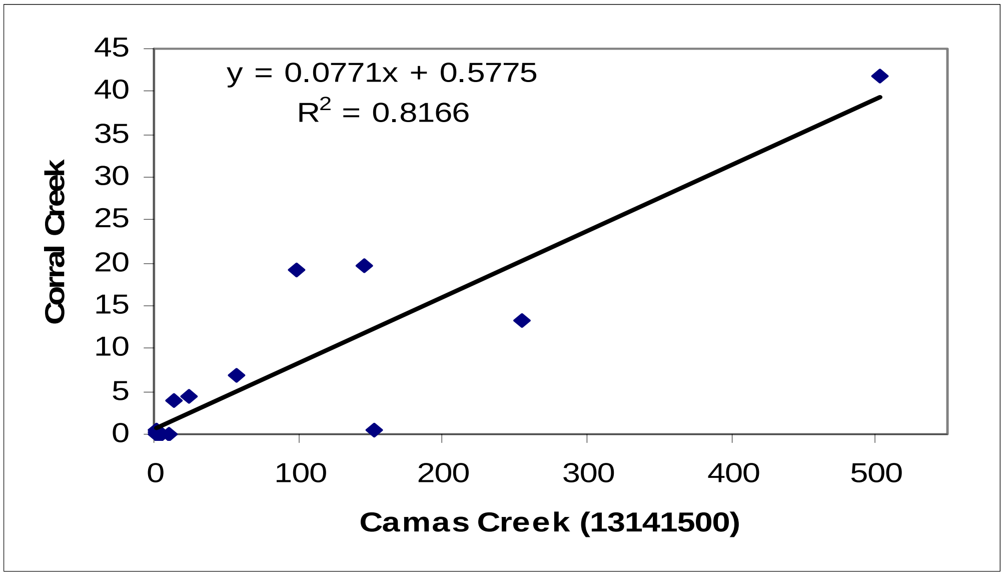


Figure 36. Corral Creek flow (cfs) regression analysis.

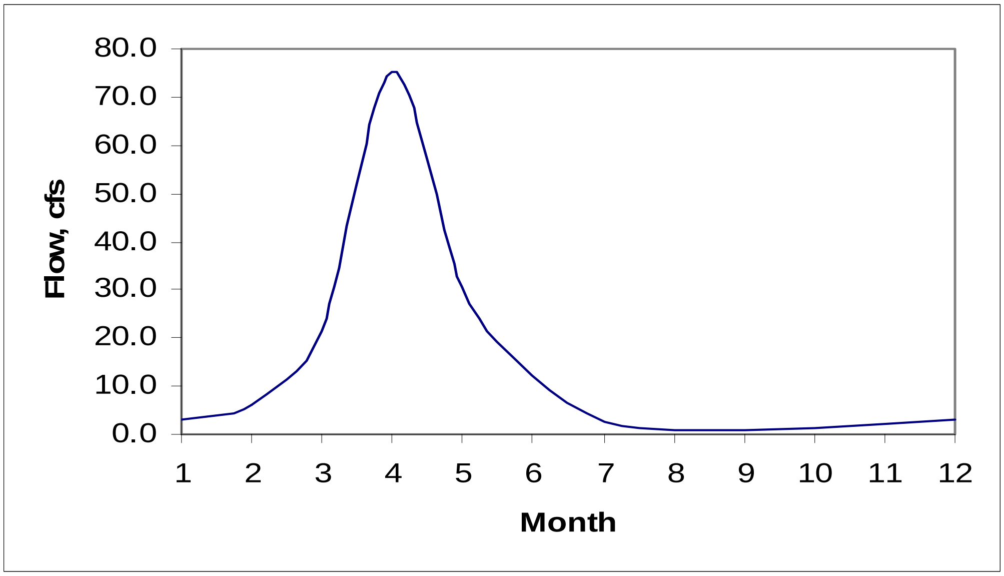


Figure 37. Corral Creek predicted hydrograph.

Flows are the largest impact to beneficial uses within Corral Creek. Predicted flows for Corral Creek tend to peak rapidly in April. *This rapid peak is likely a result of south facing slopes as well as historic channel straightening.* High flow for Corral Creek occurs in April and averages at 75.4 cfs with low flows occurring from June to March. *The hydrograph predicts base flows, but does not show the dry periods (July to March) that have occurred likely due to drought, water diversions, and aquifer level fluctuations.*

There are many water rights for the Corral Creek drainage area. Diversions off of Corral Creek itself account for 67 cfs of water while diversions off of its tributaries account for 35 cfs. This water is used for various purposes: irrigation, stockwater, domestic water supply, heating, and wildlife (IDWR 2002). *During the fall, water begins to flow into the previously dried segment of Corral Creek, yet not enough to create flows that run the entire length of the channel.*

Water Column Data

Water chemistry data for Corral Creek is very limited. There were 43 points of sampling for DO, specific conductivity, and pH at three locations in 1993 through the SAWQP program, and four points of sampling for TSS and TP at three locations. Monthly monitoring for water chemistry data were completed throughout the 2001-2003 periods. Temperature loggers were also distributed at various locations.

Table 49 describes the number of samples, maximums, averages, minimums, and number of values elevated above assessment criteria. *For a description of how the assessment criteria were developed and analyzed, see Analysis Process, page 45.*

Table 49. Corral Creek water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number of values elevated above instantaneous criteria	Instantaneous Criteria	Average Criteria (monthly and annual)
Indicators							
SC	8	110.2	96.0	86.4	0	< 500	---
PH	8	8.20	---	6.66	0	6.5 < x < 9.0	---
TNH3	2	0.050	0.034	0.018	0	Variable	---
Turb	8	23.0	6.5	0	0	BG + 50	---
DO	8	11.09	9.93	8.60	0	> 6	---
BOD	1	4	---	---	0	< 10	---
Chl a	5	87.7	20.5	2.2	1	< 15	---
Pollutants							
TSS	3	8.0	3.3	1.0	0	< 80	< 50
TP	3	0.123	0.087	0.061	0	< 0.16	< 0.10
TIN	3	0.098	0.073	0.055	0	< 0.48	< 0.3
E. coli	4	56.0	38.0	29.0	0	< 576	< 126

[a]SC-Specific Conductivity (uhmos/cm), pH-Hydrogen Ion Concentration (standard units), TNH3-Total Ammonia (mg/L), Turb-Turbidity (NTUs), DO-Dissolved oxygen (mg/L), BOD-Biological oxygen demand (mg/L), Chl a-chlorophyll a (ug/L), TSS-Total Suspended Solids (mg/L), TP-Total Phosphorous (mg/L), TIN-Total Inorganic Nitrogen (mg/L), *E. coli*-Escherichia coli (colony forming units/100ml).
[b]The average assessment criteria for *E. coli* is actually a geometric mean rather than an average.

The indicator constituents do not indicate that pollutants are impacting the water body. Chlorophyll was elevated once during high flows, at this time much of the riparian community of Corral Creek is within bankfull as point bars are revegetating. Also the next day data were taken again but placed away from point bars and read as 5.4 ug/L. Historical data also meets assessment criteria, DO was depressed four times and pH depressed once both accounting for less than 10% of the samples.

The water column data (TSS) indicates that sediment is not impacting water quality; however bedload sediment data (percent fines) indicates that sediment is likely impacting the water quality of Corral Creek. The TSS average values (3.3 mg/L) averaged well below the average assessment criteria (50 mg/L) and values are never elevated above instantaneous criteria (80 mg/L). The percent fines data were elevated above the assessment criteria (35%).There were three collection events in the water body and the values for percent fines ranged from 34.7% to 76.4%.

The critical period for sediment transport is typically during the spring and early summer when flow is elevated due to runoff events. *Seasonally*, TSS values are elevated in March (8 mg/L), but never above the daily maximum criteria (80 mg/L). *Historically*, TSS values were 13 mg/L in April and 12, 16, and 21 mg/L in May.

Stream bank inventories were completed on Corral Creek to identify the source of the bedload sediment and they indicate that the stream banks are contributing an excessive load of sediment into the creek. Bank stability of upper and lower portions of the water body were calculated to be 74.8% and 60.7%. The target for stream bank stability is 80% or greater; these targets are not being met. *Sediment erosion from banks is impacting water quality, a sediment TMDL will be completed.*

The water column data (chlorophyll, TP, and TIN) indicate that nutrients are not impacting the water quality of Corral Creek. Chlorophyll data is limited, but is indicating that nuisance aquatic vegetation is not occurring in the water body. The TP average values (0.087 mg/L) averaged below the average assessment criteria (0.100 mg/L) and values were never elevated above instantaneous criteria (0.160 mg/L). The TIN average values (0.073 mg/L) averaged well below the average assessment criteria (0.300 mg/L). Neither TIN nor TP components are elevated. In addition, flow is lacking in the lower portions of the creek in the summer months, this restricts the growth of nuisance aquatic plants, a *nutrient TMDL will not be completed.*

The critical period for nuisance aquatic vegetation is typically during the late spring to the early fall months when primary production is elevated. *Seasonally*, TP values are elevated in March (0.123 mg/L), but never above the daily maximum values (0.160 mg/L). *Historically*, they have been elevated in April (0.280 mg/L) and May (0.150 mg/L, 0.160 mg/L, and 0.190 mg/L). *Seasonally*, TIN values are elevated in May (0.098 mg/L), but never above the daily maximum values (0.480 mg/L). The TN/TP ratios for Corral Creek average 7.2 indicating that *the water body is phosphorous limited*.

Bacteria (*E. coli*) are not impacting the secondary contact recreation beneficial uses of Corral Creek. The maximum number of *E. coli* that occurred throughout the period of record was 56, a value that is well below the 576 cfu/100 ml instantaneous standard. As there were never any instantaneous exceedance, it was not necessary to calculate geometric mean values for the system. *Seasonally, E. coli* values are slightly elevated in May (45.5 cfu/100ml), however they are not elevated above the instantaneous water quality standards. *A bacteria TMDL will not be completed.*

The existing uses within Corral Creek are CWAL and SS, as such maximum daily and average daily temperatures from 24-hour temperature data is analyzed based on critical time periods for these existing uses. The critical time periods for CWAL are June 22 through September 21. As brook trout are spawning in Corral Creek, the critical time period for salmonid spawning is from October 1 through June 1. Temperature loggers were placed at various locations on Corral Creek for the 2001-2003 periods.

In respect to water quality standards, temperature appears to indicate that water quality is not capable of fully supporting CWAL and SS existing uses (Table 50 and Figure 38). For the period of record, the creek is dry during CWAL critical time periods therefore can not be assessed. However, during the SS critical time periods, the daily maximum temperatures (46.3% exceedance) and daily average temperatures (46.3% exceedance) exceed the 10% exceedance policy. A temperature logger was also placed in the headwater stretches of the creek. *The SS temperature criteria were met, but not the daily maximum CWAL temperature criteria.*

Table 50. Corral Creek temperature elevations.

Year	Site	Days in critical period	Days measured	Elevated maximum temperatures (# / %)		Elevated average temperatures (# / %)	
CWAL							
2003	Upper	92	80	17	21.3	4	5.0
2003	Lower	92	0	---	---	---	---
SS							
2003	Upper	244	231	21	9.1	15	6.5
2003	Lower	244	80	37	46.3	37	46.3

[a] CWAL days missing in the 2003 data for the upper site include September 10 through September 21, for the lower site all days were missing due to the creek drying up.
[b] SS days missing in the 2003 data include for the upper site include October 1 through October 13 and for the lower site October 1 through March 14.

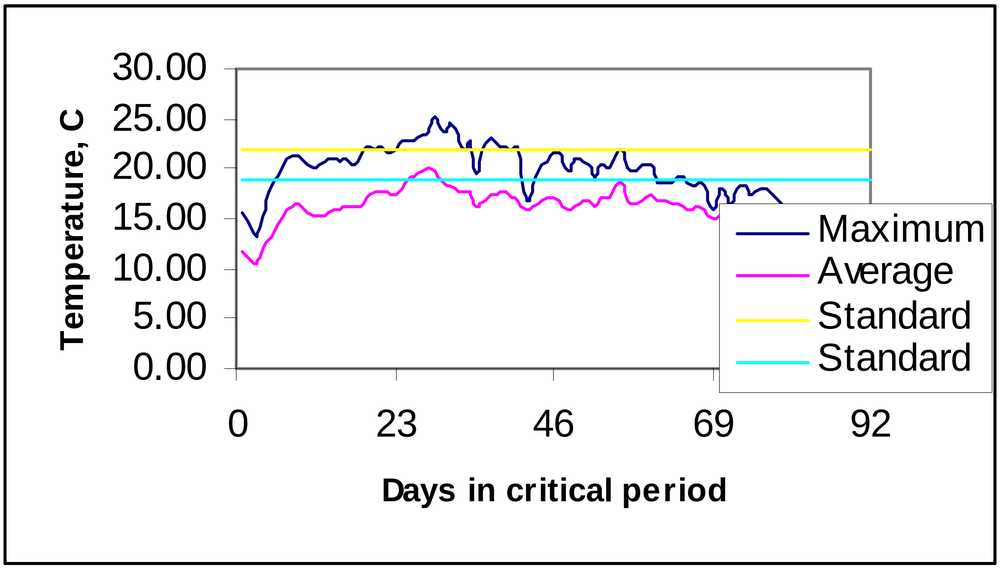


Figure 38. Corral Creek (upper) CWAL temperatures (2003).

Temperature elevations may be being influence by a number of activities, such as the following:

- Lack of canopy cover due to anthropogenic activities as well as due to some natural events could be a contributing factor to elevated temperatures.
- There is a wetland about 3.5 miles upstream of the mouth. A wetland widens the creek channel and may expose the water to more solar radiation.
- Removal of water for water use demands reduces the quantity of water and allows solar radiation to elevate temperatures more rapidly.
- Corral Creek is located in southern Idaho, a desert region where air temperatures are typically hot during summer months.

Existing canopy cover was estimated from aerial photographs of the creek, canopy cover targets were developed for various segments of the creek based on bankfull width and vegetation type (Table 51). Corral Creek was divided into 11 segment lengths for aerial photo interpretations, the canopy cover ranged from 0% to 40% (Appendix 5). The creek consists of only one segment that was used to determine canopy cover targets for each of the 11 segment lengths. Corral Creek is dominated by willows and grasses therefore the willow community shade curve in the Alvord Lake TMDL on page 77 was the best matching shade curve for the segment. The target for canopy cover on the creek was 50%. *As some of the existing canopy cover estimates fell outside of the canopy cover targets, a temperature TMDL will be completed. However, if at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data were meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.*

Table 51. Corral Creek canopy cover.

Segment	Bankfull Width (m)	Vegetation Type	Existing CC ranges (%)	CC Target (%)
Forks to the mouth	4.9	Willows, grasses	0-40	50

[a] Bankfull width was determined from BURP data or flow data measurements for each section.
[b] Existing CC (canopy cover) was measured by aerial photo interpretation completed by Mark Shumar (DEQ).
[c] The Alvord Lake TMDL was used to aid in selecting CC (canopy cover) targets that were based on similarities in bankfull width and vegetation type.

Conclusions

Through the subbasin assessment process, the following have been identified about Corral Creek:

- Biological data should not be used to assess the beneficial uses of this water body except on perennial segments.
- Flow is not sufficient on the majority of the water body to support beneficial uses.
- Water chemistry data (turbidity, DO, and pH) indicates that water quality is sufficient to support beneficial uses.
- Sediment (bedload sediment) is impacting water quality of the creek.
- Nutrients (TP and TIN) are not impacting the water quality of the creek.
- Bacteria (*E. coli*) are not impacting secondary contact recreation beneficial uses.
- Temperature is elevated, thus indicating that water quality is not sufficient to support beneficial uses.

As a result of the subbasin assessment, a TMDL will be completed for sediment and temperature on Corral Creek and the creek will be listed for flow alteration. However, if at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data were meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.

Cow Creek

Cow Creek is a third order perennial stream that lies in the western part of the Camas Creek Subbasin (Figure 17, page 35). Its headwaters begin south of the Soldier Mountains and flows southeast into Camas Creek. Cow Creek is 9.9 miles long and the 303(d) listed segment is 2.5 miles long. It originates at an elevation of 6,609 feet and discharges at 5,052 feet. Cow Creek has a bankfull width/depth ratio of 10.5, a sinuosity of 1.07, and a gradient of 1.94%, while the 303(d) listed segment has a gradient of 7.52%.

Land use, ownership, and vegetation of Cow Creek was described based on a 1mile-stream corridor approach (one mile on each side of the creek, therefore two miles in all) as was done in the Big Wood River TMDL.

Although Cow Creek originates on USFS land and passes through BLM land it passes mostly through private land. The 303(d) listed segment consists of private land (67.8%), USFS land (19.8%), BLM land (7.1%), state land (4.3%), and open water (1.1%).

The land use for the entire stretch of Cow Creek include, from headwaters to mouth, rangeland, dry land agriculture, irrigated-sprinkler, and riparian. The 303(d) listed segment is composed entirely of rangeland.

The vegetation along the stream corridor of Cow Creek corridor changes as you move down the creek channel. The 303(d) listed segment is primarily shrubland (69.1%) with grassland (27.5%) dispersed throughout it. The remainder of the stream corridor consists of forested (1.7%), water (1.1%), and riparian (0.7%). The unlisted segment is composed mainly of agriculture with grassland dispersed throughout it.

The stream corridor of Cow Creek passes through five different geologic formations as well as five different soil types. This creek originates and has its 303(d) listed segment lying in intermediate plutons. The unlisted segment lies in plateau and canyon –filling basalt, then through a small quantity of plutons bordered by mixed silicic and basaltic volcanic ejecta flows and then finally into alluvium.

The soils of the Cow Creek drainage area have a soil erosion potential (K factor) that increases as you move down the watershed. The K factor for the listed segment is 0.15 to 0.25. The remainder of the creek lies in soils with a K factor of 0.25 to 0.35 (ArcView Coverage 1992-1996).

Biological and Other Data

The IDFG manages the fisheries of Cow Creek in a manner consistent throughout the subbasin. Cow Creek has been identified as a cold water fishery with rainbow trout, brook trout, and brown trout as the species of desirable game fishes within the system. The creek is managed as a wild trout system with management goals that maintain or improve existing habitat for resident and migratory fisheries (IDFG 2001).

For a description of how biological data is assessed to determine beneficial use support status see the section entitled *Analysis Process* (page 45). Water chemistry data constituents that were used to determine if the water quality of this creek is capable of supporting beneficial uses are discussed in the subsection Water Column Data, page 121.

Very little biological or habitat data has been collected on Cow Creek. Data were collected on Cow Creek through the BURP protocol in 1993 and 1996. The 1993 data were collected more than five years ago; as a result it is no longer Tier 1 data. The 1993 site was located about 1.5 miles upstream of the reservoir. The 1996 site was located about three miles upstream of the mouth. *The entire length of Cow Creek is impacted by lack of flows from the early summer to the spring runoff months.*

Cow Creek has had biological data collected on it; however the data should not be used to determine beneficial use support status. The WBAG process is to be used on perennial water bodies therefore only consistently perennial segments of the water body should be assessed by the WBAG process. *As a result water chemistry and habitat data was used to determine impairment to water quality.*

Fish data has not been collected on Cow Creek.

Hydrology

Above Cow Creek Reservoir, Cow Creek is a perennial first order stream with intermittent tendencies during drought conditions. There are no tributaries that contribute to the flow of Cow Creek. Cow Creek drains the foothills of the upper portion of the watershed into Cow Creek Reservoir. Springs do contribute flow to the water body during the summer months however during the period of sampling drought conditions likely impacted the ability of the spring to contribute perennial flows throughout the creek.

The lower third of this segment of Cow Creek lies over the Camas Prairie aquifer. The aquifer probably aids in maintaining perennial flows in Cow Creek. The geology of Cow Creek likely allows a great deal of ground water and surface water interaction. Surface flow is likely to dissipate into the groundwater if water tables are lowered, whereas the groundwater when water tables are high emerge and contribute to surface flows. Events that alter either surface water or ground water are likely to impact the other.

There is not a gauging station located on Cow Creek currently or historically, so flow data collected in 2001-2002 and 1977 was used to predict an average stream flow for Cow Creek (above the reservoir). The sites for stream flow measurements occurred at the road crossing upstream of Cow Creek Reservoir.

The Camas Creek gauging station (13141500) near Blaine, Idaho is a current station that was used to predict Cow Creek flow. Cow Creek and Camas Creek are in the same general areas, have similar ecoregions, and similar amounts of development. These similarities result in the assumption that precipitation and runoff in the Camas Creek and Cow Creek watersheds was similar as well as being similar throughout the period of record. Based on this assumption a linear regression model of Camas Creek flow versus Cow Creek flow was performed using data collected on the same day (Figure 39). *The statistical values of the regression analysis ($p=0.000$, $r^2=0.981$) indicates that this model can be used to determine a predicted average flow for Cow Creek (above the reservoir) (Figure 40)*.

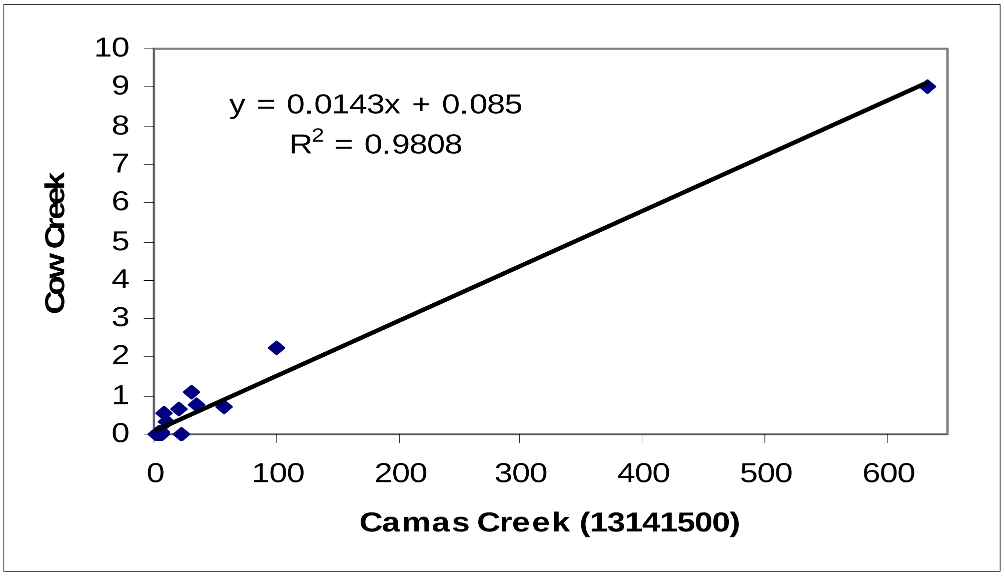


Figure 39. Cow Creek (above the reservoir) flow (cfs) regression analysis.

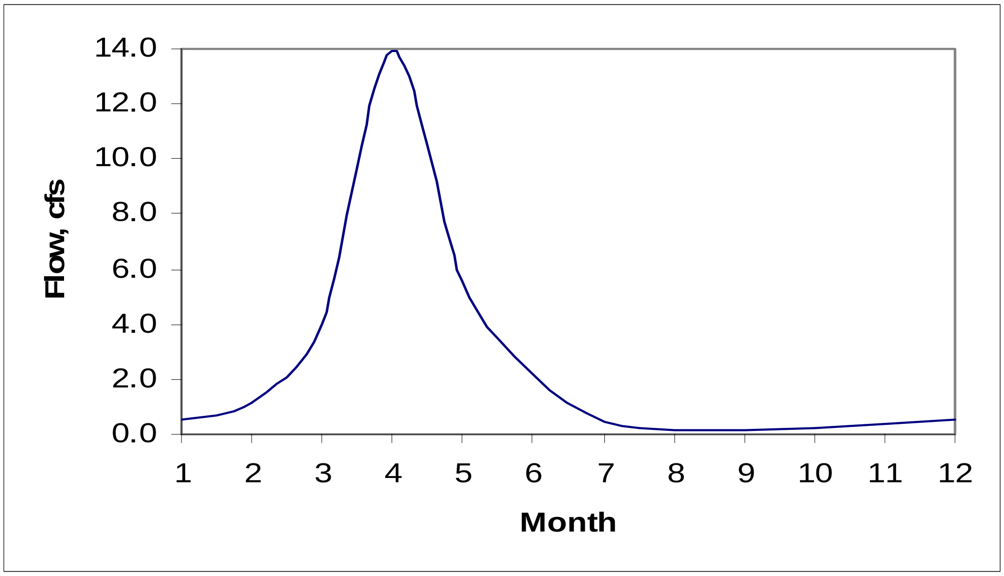


Figure 40. Cow Creek (above the reservoir) predicted hydrograph.

Flows are not likely impacting water quality or beneficial uses of Cow Creek (above the reservoir). Predicted flows for Cow Creek tend to peak rapidly in April. *This rapid peak is likely a result of south facing slopes*. High flow for Cow Creek occurs in April and averages at 14.0 cfs with low flows occurring from June to March. The hydrograph predicts base flows, but does not show the dry periods (July to March) that have occurred likely due to drought and aquifer level fluctuations.

There are a few water rights for the Cow Creek drainage area. Diversions off of Cow Creek (above the reservoir) account for 9.8 cfs of water. Diversions off of its tributaries account for

0.74 cfs. This water is used for various purposes: irrigation, stockwater, storage, and wildlife (IDWR 2002).

Water Column Data

Water chemistry data for Cow Creek is very limited. There were 12 points of sampling performed by the USGS in 1977 for flow, temperature, and specific conductivity. Monthly monitoring for water chemistry data were completed throughout the 2001-2003 periods. Temperature loggers were also distributed at various locations.

Table 52 describes the number of samples, maximums, averages, minimums, and number of values elevated above assessment criteria. *For a description of how the assessment criteria were developed and analyzed, see Analysis Process, page 45.*

Table 52. Cow Creek water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number of values elevated above instantaneous criteria	Instantaneous criteria	Average criteria (monthly and annual)
Indicators							
SC	5	113.5	92.3	74.2	0	< 500	---
PH	5	7.86	---	7.16	0	6.5 < x < 9.0	---
TNH3	2	0.050	0.038	0.025	0	Variable	---
Turb	5	2.1	0.8	0	0	BG + 50	---
DO	5	9.26	8.96	8.22	0	> 6	---
BOD	1	1.5	---	---	0	< 10	---
Chl a	0	---	---	---	---	< 15	---
Pollutants							
TSS	3	6.0	3.7	1.0	0	< 80	< 50
TP	4	0.131	0.115	0.094	0 / 3	< 0.16 / 0.08	< 0.10 / 0.05
TIN	3	0.055	0.045	0.038	0	< 0.48	< 0.3
E. coli	6	33.0	9.5	1.0	0	< 576	< 126

[a]SC-Specific Conductivity (uhmos/cm), pH-Hydrogen Ion Concentration (standard units), TNH3-Total Ammonia (mg/L), Turb-Turbidity (NTUs), DO-Dissolved oxygen (mg/L), BOD-Biological oxygen demand (mg/L), Chl a-chlorophyll a (ug/L), TSS-Total Suspended Solids (mg/L), TP-Total Phosphorous (mg/L), TIN-Total Inorganic Nitrogen (mg/L), *E. coli*-Escherichia coli (colony forming units/100ml).
[b]The average assessment criteria for *E. coli* is actually a geometric mean rather than an average.

The indicator constituents do not indicate that pollutants are impacting the water body. All indicators meet their criteria. Historical data also meets assessment criteria.

The following parameters are used in the WBAG to indicate whether or not water quality is capable of supporting beneficial uses: pH, turbidity, and DO. The 10% exceedance policy is applied to pH, turbidity, and DO. If these parameters are not elevated beyond standards more than 10% of the time than water quality is capable of fully supporting beneficial uses. In the case of Cow Creek, neither pH, turbidity, nor DO is elevated more than 10% of the time. *Water quality (DO, pH, and turbidity) appears to be capable of fully supporting beneficial uses.*

The water column data (TSS) indicates that sediment is not impacting water quality; however bedload sediment data (percent fines) indicate that sediment is impacting water quality. The TSS average values (3.7 mg/L) averaged well below the average assessment criteria (50 mg/L) and values were never elevated above instantaneous criteria (80 mg/L). The percent fines data were elevated above the assessment criteria (35%). There were four collection events in the water body and the values for percent fines ranged from 50.7% to 84.1%.

The critical period for sediment transport is typically during the spring and early summer when flow is elevated due to runoff events. *Seasonally*, TSS values are elevated in April (4 mg/L) and June (6 mg/L), but never above daily maximum criteria (80 mg/L).

Stream bank inventories were completed on Cow Creek to identify the source of the sediment and they indicate that the stream banks are contributing an excessive load of sediment into the creek. Bank stability of upper, middle, and lower portions of the water body were calculated to be 71.3%, 59.6%, and 72.3%. The target for stream bank stability is 80% or greater; these targets are not being met. *Sediment erosion from banks is likely impacting the water quality of Cow Creek, a sediment TMDL will be completed*.

The water column data (chlorophyll, TP, and TIN) indicate that nutrients are not likely impacting the water quality of Cow Creek. The TP average values (0.115 mg/L) averaged above the average assessment criteria (0.100 mg/L), but there were never any values elevated above instantaneous criteria (0.160 mg/L). The TIN average values (0.045 mg/L) averaged well below the average assessment criteria. It would appear that nutrients are impacting Cow Creek as a result of elevated TP levels, however in relation to nuisance aquatic vegetation TIN and TP values together are truly the important values. *If TP and TIN values were both elevated there would likely be a nuisance aquatic vegetation problem. In addition, Cow Creek does not maintain a flow during the summer which is also limiting the growth of aquatic plants.*

The critical period for nuisance aquatic vegetation is typically during the late spring to the early fall months, when primary production is elevated. *Seasonally*, TP values are elevated in April (0.131 mg/L), May (0.093 mg/L), and June (0.094 mg/L). *Seasonally*, TIN values are elevated in June (0.055 mg/L), but never above daily maximum values. The TN/TP ratios for Cow Creek average 4.1, indicating that *the water body is a nitrogen limited water body*.

The receiving water for the upper portions of Cow Creek is Cow Creek Reservoir; an elevated source of TP is being delivered to the reservoir. The TP average values (0.115 mg/L) averaged well above the average assessment criteria (0.05 mg/L) for a water body delivering to a storage system. *As a result, a nutrient TMDL will be completed on Cow Creek to limit the delivery of TP to the reservoir.*

Bacteria (*E. coli*) are not impacting the secondary contact recreation beneficial use of Cow Creek. The maximum number of *E. coli* that occurred throughout the period of record was 33, a value that is well below the 576 cfu/100ml instantaneous standard. As there were never any exceedance, it was not necessary to calculate geometric mean values for the system. *Seasonally*, *E. coli* values are slightly elevated in May (10.5 cfu/100ml) and June (33 cfu/100 ml); however they are not elevated above the instantaneous water quality standards.

The existing use of Cow Creek is CWAL; as such maximum daily and average daily temperatures from 24 hour temperature data is analyzed based on critical time periods for this existing use. The critical time periods for CWAL are June 22 through September 21. *The CWAL beneficial uses are not impacted by temperature rather they are impacted by lack of flow in the water body during the critical periods for CWAL.* The water body is dry from July until spring runoff months. Flows are affecting CWAL rather than temperature, *therefore a temperature TMDL will not be completed*. Temperature issues in the water body will be evaluated when perennial flows return regularly to this segment of Cow Creek.

Conclusions

Through the subbasin assessment process, the following have been identified about Cow Creek:

- Biological data should not be used to determine beneficial use support status until perennial flows are returned to the creek.
- Flow is likely sufficient to support beneficial uses in non drought years.
- Water chemistry data (turbidity, DO, and pH) indicate that water quality is sufficient to support beneficial uses.
- Sediment (bedload sediment) is impacting the water quality of the creek.
- Nutrients (TP and TIN) are not impacting the water quality of the creek, but are likely impacting the water quality of the receiving waters, Cow Creek Reservoir.
- Bacteria (*E. coli*) are not impacting secondary contact recreation beneficial uses.
- Temperature can not be evaluated at this time due to the lack of flow occurring during CWAL critical time periods.

As a result of the subbasin assessment, a TMDL will be completed for sediment and nutrients on Cow Creek (above the reservoir).

Wild Horse Creek

Wild Horse Creek is a third order perennial stream that lies in the eastern part of the Camas Creek Subbasin (Figure 17, page 35). Its headwaters begin east of the Little Camas

Reservoir and flows southeast into Camas Creek. Wild Horse Creek is 8.1 miles long and the 303(d) listed segment is 2.5 miles long. It originates at an elevation of 5,413 feet and discharges at 5,052 feet. Wild Horse Creek has a bankfull width/depth ratio of 11.0, a sinuosity of 1.44, and a gradient of 0.85%, while the 303(d) listed segment has a gradient of 0.25%.

Land use, ownership, and vegetation of Wild Horse Creek was described based on a one mile-stream corridor approach (one mile on each side of the creek, therefore two miles in all) as was done in the Big Wood River TMDL.

Wild Horse originates on and is composed mostly of private land but passes through portions of BLM land and USFS land. The 303(d) listed segment is mostly private land (94.2% of the area) with a small portion of BLM land (5.8%).

The land use for the non-listed segment is rangeland, while the listed segment is made up of rangeland (15.0%) and dry land agriculture (85.0%).

The vegetation along the stream corridor of Wild Horse Creek changes as you move down the creek channel. The non-listed segment is shrubland and grassland. The listed segment is composed of agriculture vegetation (58.6%), grassland (17.4%), shrubland (15.3%), riparian (5.2%), and wetland (3.4%).

Wild Horse Creek stream corridor passes through three different geologic formations as well as three different soil types. This creek originates in intermediate plutons and plateau and canyon-filling basalt and then flows into alluvium. The 303(d) listed segment is predominately alluvium.

The soils of the Wild Horse Creek drainage area have a soil erosion potential (K factor – the higher the number the more soil lost) that increases as you move down the watershed. The soils in the headwaters have a K factor of 0.15 to 0.25, but the creek moves immediately into an area with soils that have K factors of 0.25-0.35 (ArcView Coverage 1992-1996).

Biological and Other Data

The IDFG manages the fisheries of Wild Horse Creek in a manner consistent throughout the subbasin. Wild Horse Creek has been identified as a cold water fishery with rainbow trout, brook trout, and brown trout as the species of desirable game fishes within the system. The creek is managed as a wild trout system with management goals that maintain or improve existing habitat for resident and migratory fisheries (IDFG 2001).

For a description of how biological data is assessed to determine beneficial use support status see the section entitled *Analysis Process* (page 45). Water chemistry data constituents that were used to determine if the water quality of this creek is capable of supporting beneficial uses are discussed in the subsection Water Column Data, page 123.

Very little biological or habitat data has been collected on Wild Horse Creek. Data were collected on Wild Horse Creek through the BURP process historically in 1993 and in 1996. The 1993 data were collected more than 5 years ago; as a result it is no longer Tier 1 data. The 1993 site was located about one mile upstream of the mouth and the 1996 site was located about six miles upstream of the mouth. *The upper site is located on a segment of the creek that is impacted by lack of flows from the early summer to the spring runoff months. The lower site is on a segment of the creek that is perennial only due to high ground water tables and beaver dam complexes.*

Wild Horse Creek has had biological data collected on it; however the data should not be used to determine beneficial use support status. The WBAG process is to be used on perennial water bodies therefore only consistently perennial segments of the water body should be assessed by the WBAG process. Macroinvertebrate, fish, and habitat indexes developed on typical streams are probably not suitable for intermittent stream beaver complexes (Mebane 2002). *As a result water chemistry and habitat data was used to determine impairment to water quality*.

The BURP files on Wild Horse Creek indicate a number of activities affecting the creek. Activities affecting the creek include grazing, roads, agriculture, and recreation. Additional information in the BURP files indicates that in the upper reaches the stream has no flow; it is a series of ponds with stagnant water. The lower reach information indicates that the flow of the creek dissipates into the ground and resurfaces and the banks consist of willows, grasses, and rocks (DEQ 1993-2001).

Suckers and redside shiners have been found to occur in Wild Horse Creek (Table 53). As a whole 100% of the fish species of Wild Horse Creek were cool water indicators. There were no salmonids present.

Table 53. Wild Horse Creek fish data.

Site	Rainbow trout	Brook trout	Sculpin	Sucker	Dace	Redside shiner	Rainbow trout young of year	Brook trout young of year
2001DEQWHC01	0	0	0	18+	0	18+	0	0

[a]Data collected by DEQ.
[b]+ = 100's of visuals.

Hydrology

Wild Horse Creek is an intermittent water body; however there are perennial segments to this creek. Three tributaries contribute to the flow of Wild Horse Creek. Two of these tributaries drain the prairie in which Wild Horse Creek lies and the other tributary drains the base of the foothills that lie to the north of Wild Horse Creek. As a result there is likely little flow in this watershed during spring runoff. Due to low gradients, snowmelt and precipitation events in this watershed likely contribute to the ground water system rather than to surface flows. As a result the upper portion of Wild Horse Creek goes dry early in the summer. The middle section of Wild Horse Creek does not contribute flow to the downstream portion during the summer, yet water is retained within the creek as a series of perennial pools. The lower segment of Wild Horse Creek has been straightened in the past and also retains water within the creek as a series of perennial pools. The high water table found in the region and series of beaver dams aids in maintaining these perennial pools. Wild Horse Creek as a result, likely acts more as a wetland than a creek.

The entire length of Wild Horse Creek and most of its tributaries lie over the Camas Prairie aquifer, and this overlay corresponds with a number of characteristics of Wild Horse Creek:

- The aquifer probably aids in maintaining perennial pools throughout the length of Wild Horse Creek.
- The alluvium that is found along the length of the lower portion of Wild Horse Creek likely allows a great deal of ground water and surface water interaction.
- Surface flow is likely to dissipate into the groundwater if water tables are lowered, whereas the groundwater when water tables are high, emerge and contribute to surface flows.
- Events that alter either surface water or ground water are likely to impact the other.

There is not a gauging station located on Wild Horse Creek currently or historically, so flow data collected in 2001-2003 was used to create an average stream flow. The sites for stream flow measurements occurred about a mile upstream of the Camas Creek confluence.

The Camas Creek gauging station (13141500) near Blaine, Idaho is a current station that was used in predicting Wild Horse Creek flow. Wild Horse Creek and Camas Creek are in the same general area, have similar ecoregions, and similar amounts of development. These similarities result in the assumption that precipitation and runoff in the Camas Creek and Wild Horse Creek watersheds was similar as well as being similar throughout the period of record. Based on this assumption a linear regression model of Camas Creek flow versus Wild Horse Creek flow was performed using data collected on the same day (Figure 41). *The statistical values of the regression analysis ($p=0.003$ and $r^2=0.738$) indicate that this model can be used to determine a predicted average flow for Wild Horse Creek (Figure 42).*

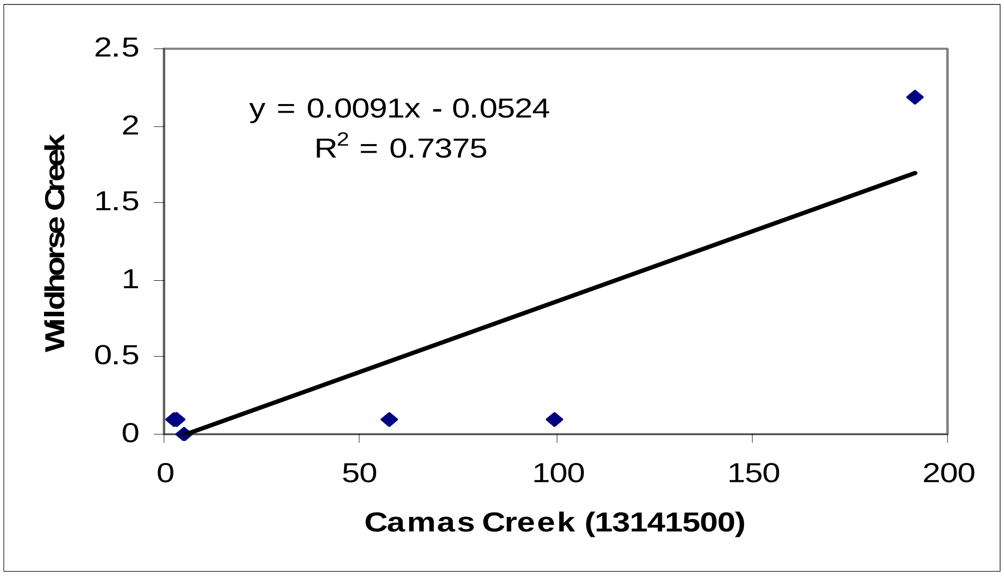


Figure 41. Wild Horse Creek flow (cfs) regression analysis.

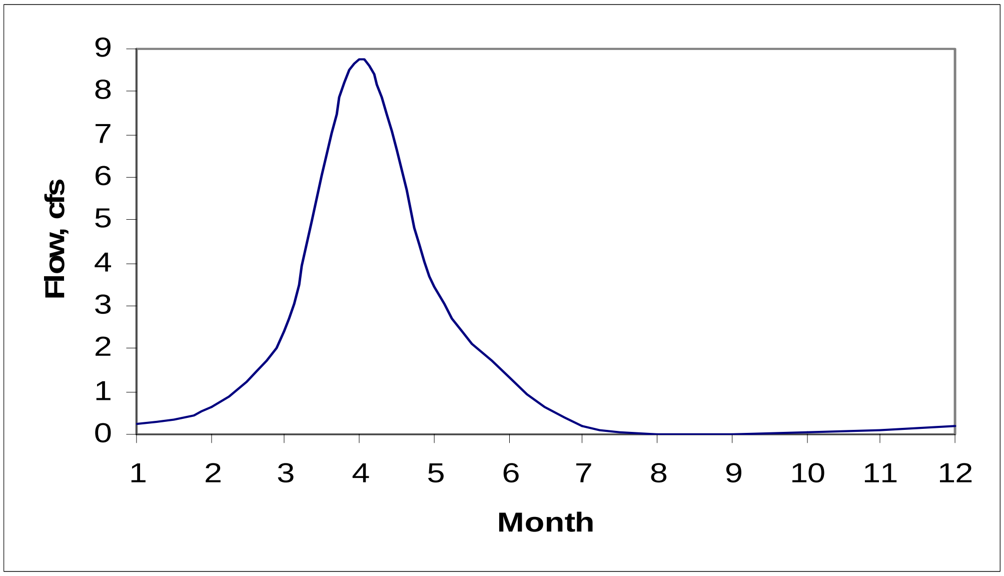


Figure 42. Wild Horse Creek predicted hydrograph.

Flows are impacting water quality and beneficial uses of Wild Horse Creek. Predicted flows for Wild Horse Creek tend to peak rapidly in April. *This rapid peak is likely a result of south facing slopes as well as historic channel straightening*. High flow for Wild Horse Creek occurs in April and averages at 8.8 cfs with low flows occurring from June to March.

The hydrograph does not depict the wetland characteristics of Wild Horse Creek. It is a series of perennial pools, so although there is a larger quantity of water there is little or no flow occurring in the lower segment; as a result there is probably little delivery to Camas Creek downstream.

There were no water rights found for the Wild Horse Creek drainage area (IDWR 2002).

Water Column Data

Water chemistry data for Wild Horse Creek is limited. Monthly monitoring for water chemistry data were completed throughout the 2001-2003 periods. Temperature loggers were also distributed at various locations.

Table 54 describes the number of samples, maximums, averages, and number of values elevated above assessment criteria. *For a description of how the assessment criteria were developed and analyzed, see Analysis Process, page 45.*

Table 54. Wild Horse Creek water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number of values elevated above instantaneous criteria	Instantaneous Criteria	Average Criteria (monthly and annual)
Indicators							
SC	13	202.0	114.7	40.7	0	< 500	---
PH	13	8.11	---	7.00	0	6.5 < x < 9.0	---
TNH3	5	0.050	0.030	0.005	0	Variable	---
Turb	13	27.5	9.5	2.9	0	BG + 50	---
DO	13	11.17	8.61	7.34	0	> 6	---
BOD	3	15.0	7.3	3.0	1	< 10	---
Chl a	2	4.0	3.4	2.7	0	< 15	---
Pollutants							
TSS	7	4.0	1.4	0.5	0	< 80	< 50
TP	7	0.064	0.036	0.005	0	< 0.16	< 0.10
TIN	4	0.164	0.097	0.055	0	< 0.48	< 0.3
E. coli	19	2500.0	391.8	1.0	4	< 576	< 126

[a]SC-Specific Conductivity (uhmos/cm), pH-Hydrogen Ion Concentration (standard units), TNH3-Total Ammonia (mg/L), Turb-Turbidity (NTUs), DO-Dissolved oxygen (mg/L), BOD-Biological oxygen demand (mg/L), Chl a-chlorophyll a (ug/L), TSS-Total Suspended Solids (mg/L), TP-Total Phosphorous (mg/L), TIN-Total Inorganic Nitrogen (mg/L), *E. coli*-Escherichia coli (colony forming units/100ml).
[b]The average assessment criteria for *E. coli* is actually a geometric mean rather than an average.

The indicator constituents do not indicate that pollutants are impacting the water body. All indicators meet their criteria, except BOD. The BOD levels were slightly elevated in October and at this time DO levels were capable of supporting the higher demand.

The following parameters are used in the WBAG to indicate whether or not water quality is capable of supporting beneficial uses: pH, turbidity, and DO. The 10% exceedance policy is applied to pH, turbidity, and DO. If these parameters are not elevated beyond standards more than 10% of the time than water quality is capable of fully supporting beneficial uses. In the case of Wild Horse Creek, neither pH, turbidity, or DO is elevated more than 10% of the time. *Water quality (DO, pH, and turbidity) is capable of fully supporting beneficial uses.*

The water column data (TSS) indicates that sediment is not impacting water quality; however, bedload sediment data (percent fines) indicates that sediment is impacting water quality of Wild Horse Creek. The TSS average values (1.4 mg/L) averaged well below the average assessment criteria (50 mg/L) and values were never elevated above instantaneous criteria (80 mg/L). The percent fines data were elevated above the assessment criteria (35%). There were three collection events in the water body and the values for percent fines ranged from 27.2% to 85.1%. *Bedload sediment appears to be impacting water quality.*

The critical period for sediment transport is typically during the spring and early summer months when flow is elevated due to runoff events. *Seasonally*, TSS is elevated in April (4 mg/L), May (1.7 mg/L), and June (1.9 mg/L), but never above daily maximum criteria (80 mg/L) or monthly average criteria (50 mg/L).

Stream bank erosion inventories were completed to identify the source of the sediment and they indicate that the stream banks are contributing an excessive load of sediment to the creek. Bank stability of upper, middle, and lower portions of the water body were calculated to be 97.5%, 82.2%, and 67.4%. The target for stream bank stability is 80%, these values are not being met in upper portions of the water body. *Sediment erosion from banks is impacting water quality, a sediment TMDL will be completed.*

The water column data (chlorophyll, TP, and TIN) indicate that nutrients are not impacting the water quality of Wild Horse Creek. Chlorophyll data is limited; however, values remain below 15μg/L, indicating that nuisance aquatic vegetation is not occurring in the water body. The TP average values (0.036 mg/L) averaged well below the average assessment criteria (0.100 mg/L) and values were never elevated above the instantaneous criteria (0.160 mg/L). The TIN average values (0.097 mg/L) averaged well below the average assessment criteria (0.300 mg/L). *Neither TIN nor TP components are elevated, a nutrient TMDL will not be completed.*

The critical period for nuisance aquatic vegetation is typically during the late spring to early fall months when primary production is elevated. *Seasonally*, TP values are slightly elevated in April (0.064 mg/L), September (0.049 mg/L), and October (0.044 mg/L), but never above the daily maximum value assessment criteria (0.160 mg/L). The remaining months have TP values averaging 0.028 mg/L. *Seasonally*, TIN values are slightly elevated in April (0.164 mg/L) and June (0.147 mg/L), but never exceed the daily maximum value criteria (0.480 mg/L) or the monthly average criteria (0.300 mg/L). The TN/TP ratios for Wild Horse Creek average 20.4 indicating that *the water body is a phosphorous limited water body.*

Bacteria (*E. coli*) are impacting the secondary contact recreation beneficial use of Wild Horse Creek. The maximum number of *E. coli* that occurred throughout the period of record was *2,500, a value that exceeds the 576 cfu/100ml instantaneous standard.* The first elevation in bacteria occurred in June and four additional samples were collected within 30 days of the original exceedance. *The geometric mean of this five samples was 363.2, a value exceeding the 126 cfu/100ml geometric mean standard for bacteria. A bacteria TMDL will be completed. Seasonally*, *E. coli* values were elevated in June (1,020 cfu/100ml) and July (1,063 cfu/100ml). The remaining months averaged *E. coli* values of 20.8 cfu/100ml.

The existing use within Wild Horse Creek is CWAL; as such maximum daily and average daily temperatures from 24 hour temperature data is analyzed based on critical time periods for this existing use. The critical time period for CWAL is from June 22 through September 21. Temperature loggers were placed at various locations during the 2001-2003 periods.

In respect to water quality standards, temperature appears to indicate that water quality is not capable of fully supporting CWAL existing uses (Table 55 and Figure 43). For the period of record, the daily average temperatures for CWAL (41.3% exceedance) and daily maximum temperatures (18.8% exceedance) do exceed the 10% exceedance policy.

Table 55. Wild Horse Creek temperature elevations.

Year	Site	Days in critical period	Days measured	Elevated maximum temperatures (# / %)		Elevated average temperatures (# / %)	
CWAL							
2003	Upper	92	0	---	---	---	---
2003	Lower	92	80	15	18.8	33	41.3

[a] CWAL days missing in the 2003 data for the upper site include June 22 through September 21, a result of logger malfunction, for the lower site include September 10 through September 21.

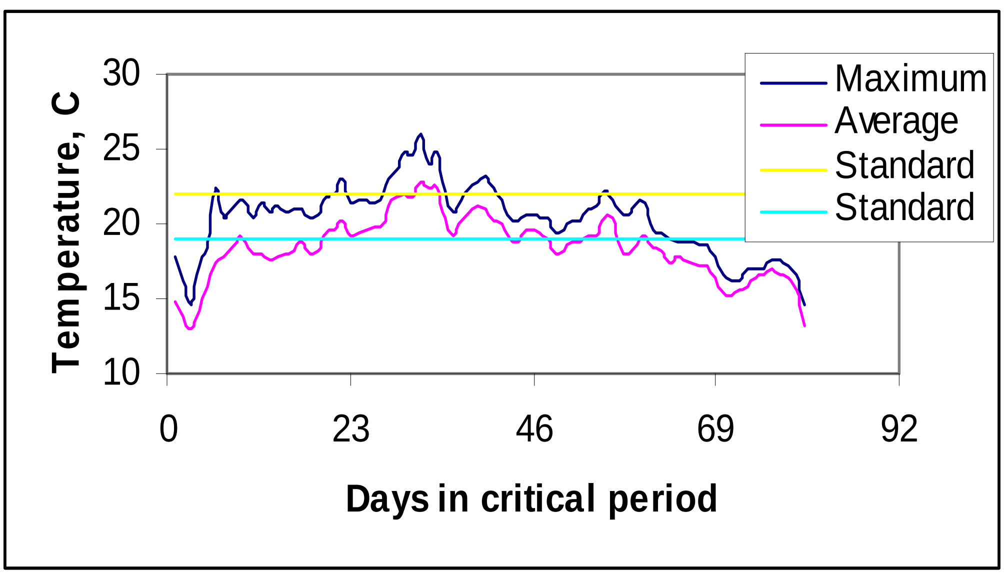


Figure 43. Wild Horse Creek CWAL temperatures (2003).

Temperature elevations may be being influenced by a number of activities, such as the following:

- Lack of canopy cover due to anthropogenic activities as well as due to some natural events could be a contributing factor to elevated temperatures.
- There are a number of large beaver dam complexes within the watershed that are likely contributing to elevated temperatures. Even as a beaver dam filters sediment out of the water column and redevelops flood plains, the width of the creek increases creating a wetland type area and exposing the water to more solar radiation.
- Water that provides perennial waters to the water body is contributed by ground water during the CWAL critical time periods rather than surface flow.
- Wild Horse Creek is located in southern Idaho, a desert region where air temperatures are typically hot during summer months.

Existing canopy cover was estimated from aerial photographs of the creek, canopy cover targets were developed for various segments of the creek based on bankfull width and vegetation type (Table 56). Wild Horse Creek was divided into 12 segment lengths for aerial photo interpretations, the canopy cover ranged from 0% to 40% (Appendix 5). Wild Horse Creek is dominated by willows and grasses therefore the willow mix community shade curve in the Alvord Lake TMDL on page 75 was the best matching shade curve for the water body. The target for canopy cover on the creek was 50%. *As the existing canopy cover estimates fell outside of the canopy cover targets, a temperature TMDL will be completed. However, if at such future time, water quality standards are modified through the negotiated rulemaking process and it is found that the collected temperature data were meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.*

Table 56. Wild Horse Creek canopy cover.

Segment	Bankfull Width (m)	Vegetation Type	Existing CC ranges (%)	CC Target (%)
Headwaters to the mouth	3.6	Willows, grasses	0-40	50

[a] Bankfull width was determined from BURP data or flow data measurements for each section.
[b] Existing CC (canopy cover) was measured by aerial photo interpretation completed by Mark Shumar (DEQ).
[c] The Alvord Lake TMDL was used to aid in selecting CC (canopy cover) targets that were based on similarities in bankfull width and vegetation type.

Conclusions

Through the subbasin assessment process, the following have been identified about Wild Horse Creek:

- Biological data should not be used to assess the beneficial uses of this water body.
- Flow is not sufficient to support beneficial uses.
- Water chemistry data (turbidity, DO, and pH) indicates that water quality is sufficient to support beneficial uses.

- Sediment (bedload sediment) is impacting water quality of the creek.
- Nutrients (TP and TIN) are not impacting the water quality of the creek.
- Bacteria (*E. coli*) are impacting the secondary contact recreation beneficial uses of the creek.
- Temperature is elevated, thus indicating that the water quality is not sufficient to support beneficial uses.

As a result of the subbasin assessment, a TMDL will be completed for sediment, bacteria, and temperature on Wild Horse Creek and the creek will be listed as impaired by flow alteration. However, if at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data were meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.

McKinney Creek

McKinney Creek is a third order perennial stream that lies in the south-central part of the Camas Creek Subbasin (Figure 17, page 35). Its headwaters begin north of Fir Grove Mountain and flows southeast then northwest into Mormon Reservoir. McKinney Creek is 9.9 miles long. It originates at an elevation of 5,577 feet and discharges at 5,019 feet. McKinney Creek has a bankfull width/depth ratio of 9.9, a sinuosity of 2.66, and a gradient of 1.06%.

Land use, ownership, and vegetation of McKinney Creek was described based on a 1mile-stream corridor approach (one mile on each side of the creek, therefore two miles in all) as was done in the Big Wood River TMDL.

The stream corridor consists of BLM land (46.5%), private land (37.0%), state land (13.2%), and open water (3.3%). The majority of the lower part of the creek passes through private land while the majority of the upper portion of the creek passes through state land. The creek itself passes through only a tiny portion of BLM land although BLM land surrounds the creek.

The land use for the stream is predominately rangeland (81.7%) with a thin stretch of irrigated gravity flow (15.5%) and water (2.8%).

The vegetation along McKinney Creek's stream corridor changes as you move down the creek channel. The upper portion is predominately shrubland (65.1%) with grassland dispersed throughout it while the lower half is predominately grassland (30.6%) with portions of shrubland. The remainder of the vegetation consists of riparian (2.0%) and water (2.3%).

McKinney Creek stream corridor passes through six different geologic formations as well as four different soil types. This creek originates and flows through silicic welded tuff ash and flow rocks while being bordered by olivine basalt flows, silicic welded tuff ash and flow rocks, and mixed silicic and basaltic volcanic ejecta flows. The lower half of the water body flows through alluvium and is bordered by silicic and basaltic volcanic ejecta flows, olivine basalt flows, intrusions, and open water. The soils of the McKinney Creek drainage area have a soil erosion potential (K factor – the higher the number the more soil lost) that is the same throughout the watershed. The K factor of the soils is 0.25 to 0.35.

Biological and Other Data

The IDFG manages the fisheries of McKinney Creek in a manner consistent throughout the subbasin. McKinney Creek has been identified as a cold water fishery with rainbow trout, brook trout, and brown trout as the species of desirable game fishes within the system. The creek is managed as a wild trout system with management goals that maintain or improve existing habitat for resident and migratory fisheries (IDFG 2001).

For a description of how biological data is assessed to determine beneficial use support status see the section entitled *Analysis Process* (page 45). Water chemistry data constituents that were used to determine if the water quality of this creek is capable of supporting beneficial uses are discussed in the subsection Water Column Data, page 136.

Very little biological data or habitat data has been collected on McKinney Creek. Data were collected through the BURP protocol in 1993. The data were collected more than 5 years ago; as a result it is no longer Tier 1 data. The site was located about four miles upstream of the mouth *in the perennial segment of the creek*. Macroinvertebrate and habitat data were collected at the site. Fish data were collected in 2001.

The BURP files on McKinney Creek indicate that the upper stretches of the creek have man made dirt dams as well as beaver dams, riparian zone consists of grasses, sagebrush, and some willows, and there has been livestock grazing (DEQ 1993-2001).

In the collection event biological rating scores indicate that McKinney Creek was not meeting its beneficial uses (Table 57). The SMI scores received a minimum threshold score, which automatically lists the water body as impaired. McKinney Creek is not fully supporting its beneficial uses.

Table 57. Condition rating scores for McKinney Creek.

Site	SMI	SFI	SHI	Average
1993STWFA013	MT	ND	1	---

[a]MT-minimum threshold (automatically indicates impairment), ND- no data.
[b]An average condition score of 2 or greater indicates that beneficial uses are fully supported.

Mountain sucker and speckled dace have been found to occur in McKinney Creek (Table 58). As a whole 100% of the fish species of McKinney Creek were cool water indicators. There were no salmonids present at the time of sampling.

Table 58. McKinney Creek fish data.

Site	Salmonids	Mountain sucker	Speckled dace	Sculpin	Salmonid young of years
2001DEQF001	0	9	82	0	0

[a]Data collected by DEQ.

Hydrology

McKinney Creek is a perennial water body; however, a large portion of the water body becomes intermittent early in the summer. Two tributaries to McKinney Creek drain the low-lying foothills. Both tributaries contribute spring runoff flows into McKinney Creek, while only the one may contribute a small (less than 0.5 cfs) flow to McKinney Creek the remainder of the year. McKinney Creek delivers water into Mormon Reservoir until the beginning of summer, at which time the lower half of the creek goes dry. The upper portions of the creek aid in draining the foothills of the region, but also provide a drainage area for several springs. These springs feed two stock ponds in the upper reaches and support the perennial status of McKinney Creek. Once the creek travels out of the foothills into the flat land stretches the spring influence dissipates and the water body becomes intermittent.

The lower half of McKinney Creek lies over the Camas Prairie aquifer, and this overlay corresponds with a number of characteristics of McKinney Creek:

- The geologic formations along McKinney Creek likely allow a great deal of ground water and surface water interaction.
- Surface flow is likely to dissipate into the groundwater if water tables are lowered, whereas the groundwater when water tables are high, emerge and contribute to surface flows.
- Events that alter either surface water or ground water are likely to impact the other.

There is not a gauging station located on McKinney Creek currently or historically, so flow data collected in 1977 and 2001 through 2003 was used to predict an average stream flow. The sites for stream flow measurements occurred at the first and second road crossing near the confluence.

The Camas Creek gauging station (13141500) near Blaine, Idaho is a current station that was used in predicting McKinney Creek flow. McKinney Creek and Camas Creek are in the same general areas, have similar ecoregions, and similar amounts of development. These similarities result in the assumption that precipitation and runoff in the Camas Creek and McKinney Creek watersheds was similar as well as being similar throughout the period of record. Based on this assumption a linear regression model of Camas Creek flow versus McKinney Creek flow was performed using data collected on the same day (Figure 44). The statistical values of the regression analysis (p=0.000, r^2=0.738) indicates that this model can be used to determine a predicted average flow for McKinney Creek (Figure 45).

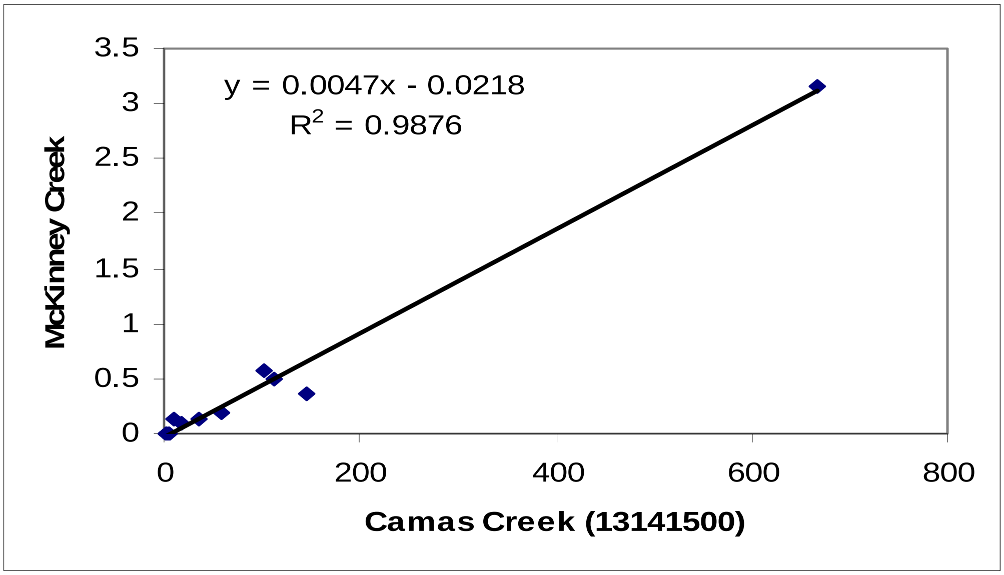


Figure 44. McKinney Creek flow (cfs) regression analysis.

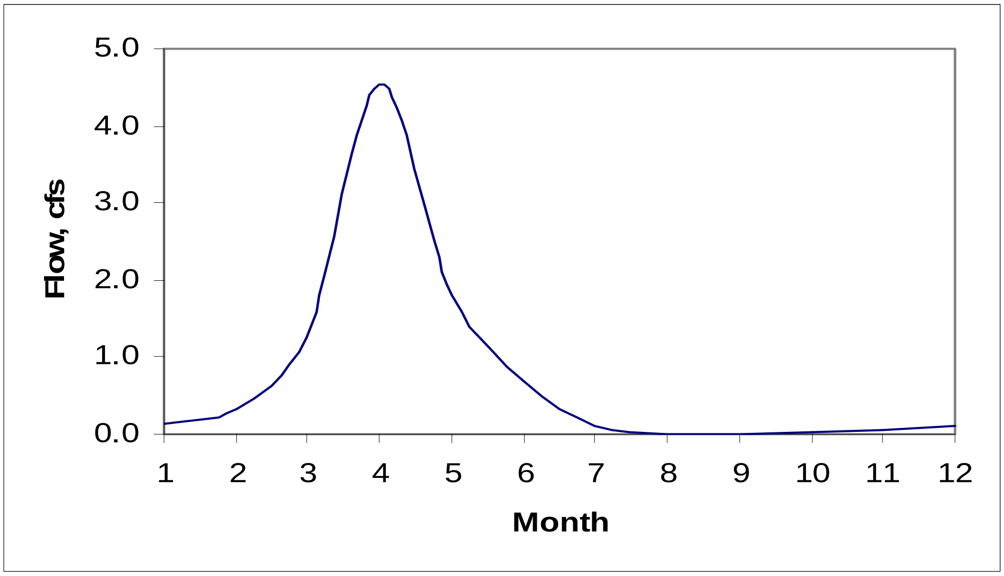


Figure 45. McKinney Creek predicted hydrograph.

Flows are impacting the water quality and beneficial uses of McKinney Creek. Predicted flows for McKinney Creek tend to peak rapidly in April. High flow for McKinney Creek occurs in April and averages at 4.5 cfs with low flows occurring from June to March. McKinney Creek predominately has water during the spring runoff months. A spring feeds McKinney Creek thus allowing there to be a small amount of water year round for about 3.5 miles. The lower portion of McKinney Creek is dry from July until the spring runoff. The hydrograph predicts base flows, but does not show the dry periods (July to March) that have occurred likely due to drought, water storage, and aquifer level fluctuations.

There were no water rights found for the McKinney Creek drainage area (IDWR 2002).

Water Column Data

Water chemistry data is very limited for McKinney Creek. There were seven points of sampling for flow, and three points of sampling for specific conductivity and temperature performed by the USGS in 1977. Monthly monitoring data for water chemistry data were completed throughout the 2001-2003 periods. Temperature loggers were also distributed at various locations.

Table 59 describes the number of samples, maximums, averages, minimums, and number of values elevated above daily maximum assessment criteria. *For a description of how the assessment criteria were developed and analyzed, see Analysis Process, page 45.*

Table 59. McKinney Creek water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number of values elevated above instantaneous criteria	Instantaneous Criteria	Average Criteria (monthly and annual)
Indicators							
SC	5	124.4	87.5	57.8	0	< 500	---
PH	5	8.30	---	7.38	0	6.5 < x < 9.0	---
TNH3	4	0.060	0.029	0.008	0	Variable	---
Turb	5	39.1	10.0	0	0	BG + 50	---
DO	5	10.30	9.96	9.48	0	> 6	---
BOD	1	4	---	---	0	< 10	---
Chl a	1	0	---	---	0	< 15	---
Pollutants							
TSS	3	5.0	3.1	2.0	0	< 80	< 50
TP	3	0.057	0.034	<0.005	0 / 0	< 0.16 / 0.08	< 0.10 / 0.05
TIN	3	0.071	0.050	0.013	0	< 0.48	< 0.3
E. coli	4	148.0	76.3	1.0	0	< 576	< 126

[a]SC-Specific Conductivity (uhmos/cm), pH-Hydrogen Ion Concentration (standard units), TNH3-Total Ammonia (mg/L), Turb-Turbidity (NTUs), DO-Dissolved oxygen (mg/L), BOD-Biological oxygen demand (mg/L), Chl a-chlorophyll a (ug/L), TSS-Total Suspended Solids (mg/L), TP-Total Phosphorous (mg/L), TIN-Total Inorganic Nitrogen (mg/L), *E. coli*-Escherichia coli (colony forming units/100ml).
[b]The average assessment criteria for *E. coli* is actually a geometric mean rather than an average.

The indicator constituents do not indicate that pollutants are impacting the water body. All indicators meet their criteria. Historical data also meets assessment criteria.

The following parameters are used in the WBAG to indicate whether or not water quality is capable of supporting beneficial uses: pH, turbidity, and DO. The 10% exceedance policy is applied to pH, turbidity, and DO. If these parameters are not elevated beyond standards more than 10% of the time than water quality is capable of fully supporting beneficial uses. In the case of McKinney Creek, neither pH, turbidity, nor DO is elevated more than 10% of the time. *Water quality (DO, pH, and turbidity) appears to indicate that water quality is capable of supporting beneficial uses.*

The water column data (TSS) indicates sediment is not impacting the beneficial uses of McKinney Creek; however, bedload sediment (percent fines) indicates sediment is impacting beneficial uses. The TSS average values (3.1 mg/L) averaged well below the average assessment criteria (50 mg/L) and values were never elevated above instantaneous criteria (80 mg/L). The percent fines data were elevated above the assessment criteria (35%). There were two collection events in the water body and the values for percent fines ranged from 55.5% to 97.1%. Bedload sediment appears to be impacting water quality of McKinney Creek.

The critical period for sediment transport is typically during the spring and early summer months when flow is elevated due to runoff events. *Seasonally,* TSS values are elevated in April (5 mg/L) but never above the daily maximum assessment criteria (80 mg/L). The TSS values for the remaining months average 2.1 mg/L.

Stream bank inventories were completed on McKinney Creek to identify the source of the sediment and they indicate that the stream banks are contributing an excessive load of sediment into the creek. Bank stability of upper (57.3%), lower upper (56.4%), upper middle (59.8%), lower middle (70.7%), upper lower (4.8%), and lower portions (28.0%) do not meet the target for stream bank stability. The target for stream bank stability is 80% or greater. *Sediment erosion from banks is impacting beneficial uses of McKinney Creek, a sediment TMDL will be completed.*

The water column data (TP and TIN) indicate that nutrients are not impacting the beneficial uses of McKinney Creek. The TP average values (0.034 mg/L) averaged well below the average assessment criteria (0.100 mg/L) and values were never elevated above instantaneous criteria (0.160 mg/L). The TIN average values (0.050 mg/L) averaged well below the average assessment criteria (0.480 mg/L). *Nutrients are not impacting the beneficial uses of the water body.*

The receiving water for McKinney Creek is Mormon Reservoir; McKinney Creek is not delivering an elevated source of TP to the reservoir. The TP average values (0.034 mg/L) averaged below the average assessment criteria (0.050 mg/L) for a water body delivering into a storage system. *As a result, a nutrient TMDL will not be completed on McKinney Creek to aid in nutrient transport to Mormon Reservoir. However, if perennial flows are reestablished in the lower portion of McKinney Creek so that delivery transport of water encompasses more than spring runoff flows, nutrient delivery to the reservoir may need to be reassessed.*

The critical periods for nuisance aquatic vegetation are typically during the spring and into the summer months, when primary production is elevated. *Seasonally*, TP values are slightly elevated in April (0.057 mg/L) and May (0.042 mg/L), but never above daily maximum assessment criteria (0.160 mg/L or 0.80 mg/L). *Seasonally*, TIN values are elevated in April (0.071 mg/L), but never above daily maximum assessment criteria (0.480 mg/L).

Bacteria (*E. coli*) are not impacting the secondary contact recreation beneficial uses of McKinney Creek. The maximum number of *E. coli* that occurred throughout the period of record was 148, a value well below the 576 cfu/100ml instantaneous standard. As there were never any instantaneous violations, it was not necessary to calculate geometric mean values for the system. *Seasonally*, *E. coli* values are slightly elevated in April (144 cfu/100ml), but never above the instantaneous standard. *Bacteria are not a concern at this time, a bacteria TMDL will not be completed.*

The existing use within McKinney Creek is CWAL; as such maximum daily and average daily temperatures from 24-hour temperature data is analyzed based on critical time periods for this existing use. The critical time periods for CWAL are June 22 through September 21. Temperature loggers were placed at various locations on McKinney Creek for the 2001-2003 periods.

Temperature data is a data gap within McKinney Creek. Temperature loggers were placed in the lower portions of the creek in 2002 and 2003. The creek goes dry prior to the CWAL critical time periods.

Conclusions

Through the subbasin assessment process, the following have been identified for McKinney Creek:

- Biological data indicates that beneficial uses are not fully supported.
- Flow is not sufficient to support beneficial uses in certain areas of the creek and flow alteration may be impacting beneficial uses in segments where flow is sufficient.
- Water chemistry data (turbidity, DO, and pH) indicates that water quality is sufficient to support beneficial uses.
- Sediment (bedload sediment from stream bank erosion) is impacting beneficial uses of the creek.
- Nutrients (TP and TIN) are not impacting the beneficial uses of the creek and the creek is not delivering an excessive load of nutrients to Mormon Reservoir.
- Bacteria (*E. coli*) are not impacting the secondary contact recreation beneficial uses of the creek.
- Temperature at this time is a data gap.

As a result of the subbasin assessment, a TMDL will be completed for sediment on McKinney Creek. In addition, the creek will be listed as impacted by flow alteration.

Dairy Creek

Dairy Creek is a second order ephemeral stream that lies in the south-central part of the Camas Creek Subbasin (Figure 17, page 35). Its headwaters begin south of the Bennett Mountains and flow east into Mormon Reservoir. Dairy Creek is 4.5 miles long. It originates at an elevation of 5,085 feet and discharges at 5,052 feet. Dairy Creek has an average bankfull width/depth ratio of 22.9, a sinuosity of 1.13, and a gradient of 0.13%.

Land use, ownership, and vegetation of Dairy Creek are described based on a one mile stream corridor approach (one mile on each side of the creek, therefore two miles in all) as was done in the Big Wood River TMDL.

Dairy Creek passes through predominately private land with a small segment of BLM land near the headwaters and at the mouth.

The land use for the stream corridor is rangeland and dry land agriculture.

The vegetation along the stream corridor of Dairy Creek changes as you move down the creek channel. Dairy Creek runs through grassland, agriculture, and shrubland vegetation.

The Dairy Creek stream corridor passes through four different geologic formations as well as three different soil types. This creek originates in mixed silicic and basaltic volcanic ejecta flows, and flows through colluvium fanglomerate and talus, alluvium, and then plateau and canyon-filling basalt.

The soils of the Dairy Creek drainage have a soil erosion potential (K factor) that remains consistent (0.25 to 0.35) throughout the drainage (ArcView Coverage 1992-1996).

Biological and Other Data

IDFG manages the fisheries of Dairy Creek in a manner similar to many of the other water bodies in the subbasin. Dairy Creek has been identified as a cold water fishery, with rainbow trout, brook trout, and brown trout as the species of desirable game fishes within the system. The creek is managed as a wild trout system with management goals that maintain or improve existing habitat for resident and migratory fisheries (IDFG 2001).

For a description of how biological data is assessed to determine beneficial use support status see the section entitled *Analysis Process* (page 45). Water chemistry data constituents that were used to determine if the water quality of this creek is capable of supporting beneficial uses are discussed in the subsection Water Column Data, page 141.

Dairy Creek is an intermittent water body, and, as such, biological data has never been collected on it. Dairy Creek is a creek of interest at this time due to the influence it has on Mormon Reservoir.

Hydrology

Dairy Creek is an intermittent water body that contributes spring runoff flow to Mormon Reservoir. There are seven water bodies that drain the foothills or springs of the Dairy Creek watershed, however only one of these tributaries actually contributes flows to Dairy Creek. The remaining water bodies do not connect with Dairy Creek. Dairy Creek historically delivered its waters to Camas Creek; however, channelization projects in the past have altered the delivery system to Mormon Reservoir.

There is not a gauging station located on Dairy Creek, currently or historically, so flow data collected in 2001-2003 and 1977 was used to predict an average stream flow. The site for stream flow measurements was located near the confluence with Mormon Reservoir.

The Camas Creek gauging station (13141500), near Blaine, Idaho, is a current station that was used in predicting Dairy Creek flow. Dairy Creek and Camas Creek are in the same general areas, have similar ecoregions, and similar amounts of development. These similarities result in the assumption that precipitation and runoff in the Camas Creek and Dairy Creek watersheds was similar as well as being similar throughout the period of record. Based on this assumption a linear regression model of Camas Creek flow versus Dairy Creek flow was performed using data collected on the same day (Figure 46*). The statistical values of the regression analysis (p=0.000 and r^2=0.845) indicate that this model can be used to determine a predicted average flow for Dairy Creek (Figure 47).*

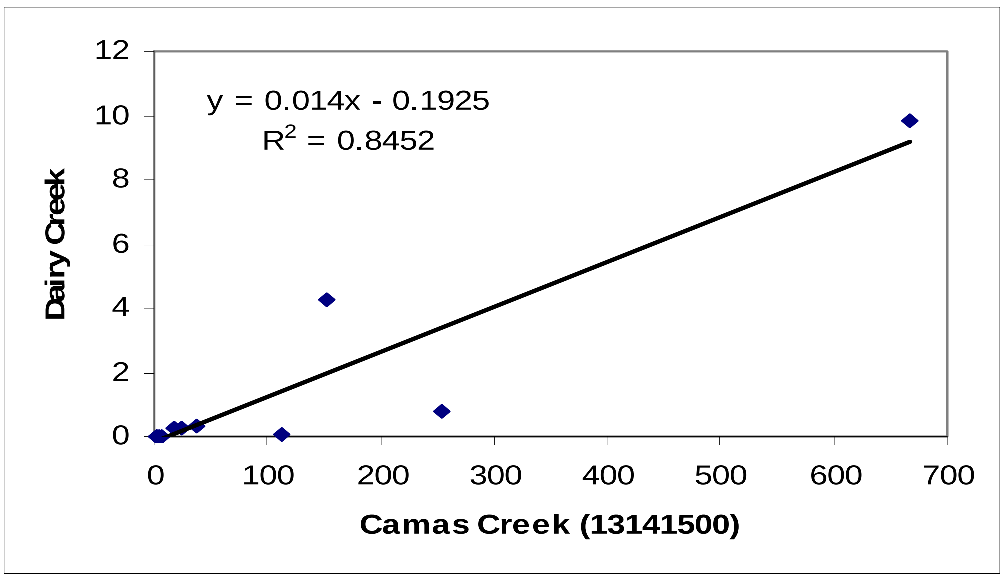


Figure 46. Dairy Creek flow (cfs) regression analysis.

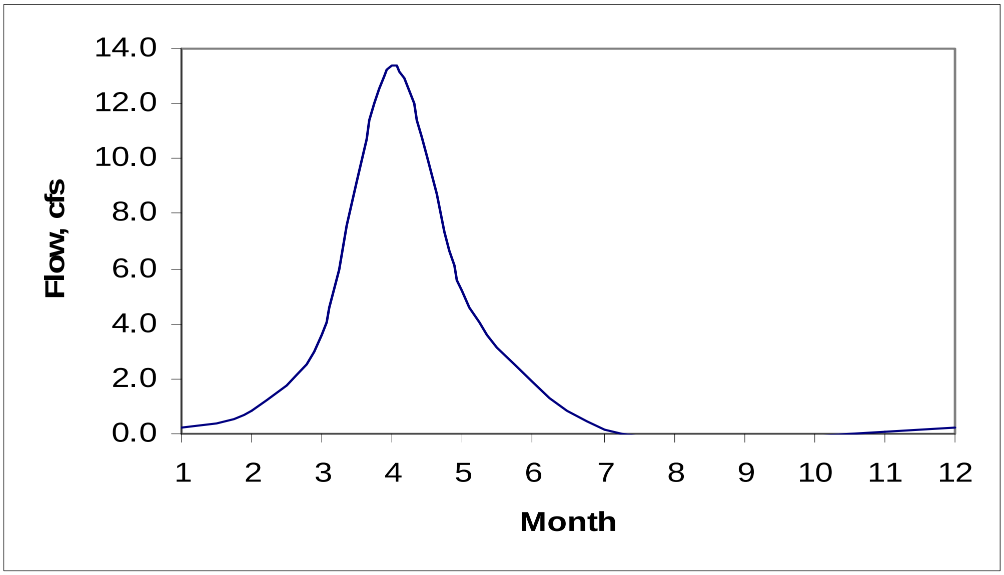


Figure 47. Dairy Creek predicted hydrograph.

Flows are not likely impacting the water quality of Dairy Creek. Predicted flows for Dairy Creek tend to peak rapidly in April. High flow for Dairy Creek occurs in April and averages 13.4 cfs, with no flow occurring from June to March. Dairy Creek is an ephemeral stream that feeds Mormon Reservoir.

There are many water rights for the Dairy Creek drainage area. Diversions off of Dairy Creek itself account for 3.7 cfs of water while diversions off of its tributaries account for 0.7 cfs. This water is used for various purposes: irrigation, stockwater, and wildlife (IDWR 2002).

Water Column Data

Water chemistry data for Dairy Creek is very limited. There were seven points of sampling for flow and three points of sampling for temperature and specific conductivity performed by the USGS in 1977. Monthly monitoring for water chemistry data were completed throughout the 2001-2003 periods.

Table 60 describes the number of samples, maximums, averages, minimums, and number of values elevated above assessment criteria. *For a description of how the assessment criteria were developed and analyzed see Analysis Process, page 45.*

Table 60. Dairy Creek water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number of values elevated above instantaneous criteria	Instantaneous Criteria	Average Criteria (monthly and annual)
Indicators							
SC	4	98.5	79.2	62.0	0	< 500	---
PH	4	8.00	---	7.61	0	6.5 < x < 9.0	---
TNH3	3	0.032	0.021	0.014	0	Variable	---
Turb	4	37.9	10.2	0	0	BG + 50	---
DO	4	10.46	8.75	6.65	0	> 6	---
BOD	0	---	---	---	---	< 10	---
Chl a	1	0.9	---	---	0	< 15	---
Pollutants							
TSS	3	8.4	6.5	3.2	0	< 80	< 50
TP	3	0.091	0.085	0.073	0 / 2	< 0.16 / 0.08	< 0.10 / 0.05
TIN	3	0.377	0.140	0.017	0	< 0.48	< 0.3
E. coli	4	8.0	4.0	1.0	0	< 576	< 126

[a]SC-Specific Conductivity (uhmos/cm), pH-Hydrogen Ion Concentration (standard units), TNH3-Total Ammonia (mg/L), Turb-Turbidity (NTUs), DO-Dissolved oxygen (mg/L), BOD-Biological oxygen demand (mg/L), Chl a-chlorophyll a (ug/L), TSS-Total Suspended Solids (mg/L), TP-Total Phosphorous (mg/L), TIN-Total Inorganic Nitrogen (mg/L), *E. coli*-Escherichia coli (colony forming units/100ml).
[b]The average assessment criteria for *E. coli* is actually a geometric mean rather than an average.

The indicator constituents do not indicate that pollutants are impacting the water body. All indicators meet their criteria with no elevations above the criteria or any policy exceedance. Historical indicators also met the assessment criteria.

The following parameters are used in the WBAG to indicate whether or not water quality is capable of supporting beneficial uses: pH, turbidity, and DO. The 10% exceedance policy is applied to pH, turbidity, and DO; if these parameters are not elevated beyond standards more than 10% of the time than water quality appears to be capable of supporting beneficial uses. In the case of Dairy Creek, neither pH, turbidity, nor DO are elevated during the period of record. *Water quality (DO, pH, and turbidity) appears to be capable of supporting beneficial uses of Dairy Creek.*

The water column data (TSS) indicates that sediment is not impacting water quality, however bedload sediment (percent fines) indicates that sediment is impacting water quality of Dairy Creek. The TSS average values (6.5 mg/L) averaged well below the average assessment criteria (50 mg/L) and values were never elevated above instantaneous criteria (80 mg/L). The percent fine data were elevated above the assessment criteria (35%). There were two collection events in the water body, and the values for percent fines were 38.2% and 51.5%.

The critical period for sediment transport is typically during the spring and early summer when flow is elevated due to runoff events. *Seasonally*, TSS values are slightly elevated in April (8.0 mg/L) and May (8.4 mg/L), but never above daily maximum assessment criteria (80 mg/L).

Stream bank inventories were completed on Dairy Creek to identify the source of the sediment and they indicate that the stream banks are contributing an excessive load of sediment into the creek. Bank stability of upper and lower portions was calculated to be 53.9% and 22.2%. The target for stream bank stability is 80% or greater; these targets are not being met. *Sediment erosion from banks is impacting water quality, a sediment TMDL will be completed.*

The water column data (chlorophyll, TP, and TIN) indicate that nutrients are not impacting the water quality of Dairy Creek. Chlorophyll data is very limited; however, values remain below 15 µg/L indicating that nuisance aquatic vegetation is not occurring in the water body. The TP average values (0.085 mg/L) averaged well below the average assessment criteria (0.100 mg/L) and values were never elevated above instantaneous criteria (0.160 mg/L). The TIN average values (0.140 mg/L) averaged well below the average assessment criteria (0.300 mg/L). The TIN and TP values are both low and the creek is dry the majority of the year. *Nutrients are not impacting the water quality of Dairy Creek; a nutrient TMDL will not be completed to improve conditions of Dairy Creek.*

The critical period for nuisance aquatic vegetation is typically during the late spring to the early fall months, when primary production is elevated. *Seasonally*, average monthly TP values are slightly elevated in April (0.090 mg/L) and June (0.091 mg/L), but never above daily maximum assessment criteria (0.160 mg/L).

The receiving water for Dairy Creek is Mormon Reservoir; Dairy Creek is delivering an excessive amount of TP to the reservoir. The TP average values (0.085 mg/L) averaged above the average assessment criteria (0.050 mg/L) for a water body delivering into a storage system. *As a result, a nutrient TMDL will be completed on Dairy Creek to aid in limiting nutrient transport to Mormon Reservoir*.

Bacteria (*E. coli*) are not impacting the secondary contact recreation beneficial use of Dairy Creek. The maximum number of *E. coli* that occurred throughout the period of record was 8, a value well below the 576 cfu/100ml instantaneous standard. As there were never any instantaneous violations, it was not necessary to calculate geometric mean values for the system. *Bacteria are not a concern at this time in this water body, a bacteria TMDL will not be completed*.

Conclusions

Through the subbasin assessment process, the following have been identified for Dairy Creek:

- Biological data has never been collected on this water body and should not be used to determine beneficial use support status as the creek is intermittent.
- Flow is not sufficient to support beneficial uses as it is an intermittent water body that has been channelized.
- Water chemistry data (turbidity, DO, and pH) indicates that water quality is sufficient to support beneficial uses.
- Sediment (bedload sediment from stream bank erosion) is impacting water quality of the creek.
- Nutrients (TP) are not impacting the water quality of the creek; however the creek is contributing an excessive load of TP to Mormon Reservoir.
- Bacteria (*E. coli*) are not impacting the secondary contact recreation beneficial uses of the creek.

As a result of the subbasin assessment, a TMDL will be completed for sediment and nutrients on Dairy Creek. Dairy Creek will also be listed as impaired by flow alteration.

Camas Creek

Camas Creek is a 5th order perennial stream that lies along the length of the Camas Creek Subbasin (Figure 17, page 35). Its headwaters begin north of the Bennett Mountains and south of Anderson Ranch Reservoir and flow east into Magic Reservoir. Camas Creek is 54.1 miles long, and the 303(d) listed segment is 43.5 miles long. It originates at an elevation of 5,413 feet and discharges at 4,796 feet. Camas Creek has a bankfull width/depth ratio of 27.7, a sinuosity of 1.13, and a gradient of 0.22%.

Land use, ownership, and vegetation of Camas Creek was described based on a one mile-stream corridor approach (one mile on each side of the creek, therefore two miles in all) as was done in the Big Wood River TMDL.

Camas Creek flows through private land and small areas of public land. The 303(d) listed segment consists of private land (90.4%), BLM land (6.3%), state land (2.5%), USFS land (0.4%), and open water (0.4%).

The land use for the upper part of the stream is rangeland then dry land agriculture with riparian, irrigated sprinkler, and irrigated gravity flow occurring in small quantities. The 303(d) listed segment consists of dry land agriculture (55.5%), rangeland (29.7%), irrigated sprinkler (6.0%), riparian (5.3%), irrigated-gravity flow (3.2%), and water (0.3%).

The vegetation along the stream corridor of Camas Creek changes as you move down the creek channel. The 303(d) listed segment consists of agriculture (49.3%), grassland (27.5%), shrubland (19.2%), riparian (3.0%), wetland (0.6%), water (0.3%), and forested land (0.1%).

Camas Creek stream corridor passes through ten different geologic formations, as well as eight different soil types. This creek originates in plateau and canyon-filling basalt, silicic welded tuff ash and flow rocks, and intrusions. The geology along the remainder of Camas Creek is mostly alluvium, bordered to the south by mixed silicic and basaltic volcanic ejecta, plateau and canyon-filling basalt, and outwash fanglomerate flood and terrace gravels. The lower portion of the listed segment passes through plateau and canyon filling basalt, which is bordered to the north by Middle Pleistocene deposits.

The soils of the Camas Creek drainage area have a soil erosion potential (K factor – the higher the number the more soil lost) that does not vary the length of the creek. The K factor of the soils is 0.25 to 0.35 (ArcView Coverage 1992-1996).

Biological and Other Data

The IDFG manages the fisheries of Camas Creek differently than it does the rest of the creeks in the subbasin. Camas Creek has been identified as a cold water fishery, with rainbow trout and brown trout as the species of desirable game fishes within the system. The creek is managed as a wild trout system, with management goals to investigate the potential for fishery development and improve habitat, where feasible (IDFG 2001).

For a description of how biological data is assessed to determine beneficial use support status see the section entitled *Analysis Process* (page 45). Water chemistry data constituents that were used to determine if the water quality of this creek is capable of supporting beneficial uses are discussed in the subsection Water Column Data, page 149.

Very little biological or habitat data has been collected on Camas Creek. Data were collected through the BURP protocol in 1993, five times in 1995, and more recently in 2001.The site for data collection in 1993, one of the 1995 collection events, and the 2001 data collection, was approximately 24 miles upstream of the mouth of Camas Creek. The remaining 1995 sites were located approximately 4.5, 13.5, and 28.5 miles above the mouth and 4.5 miles from the headwaters of Camas Creek.

Much of the biological data collected on Camas Creek is not representative of the creek at this time for a number of reasons. The 1993 and 1995 data were collected more than 5 years ago; as a result this data is no longer Tier 1 data, and no longer representative of current conditions of the creek. Four of the five 1995 data collection events were collected in June, outside of the July to October time frame established in the WBAG document and thus stream index values may not apply. Finally the 1993 event and two of the 1995 events were collected on intermittent segments of the creek. *The WBAG process is to be used on perennial waters.*

The BURP files on Camas Creek indicate a number of characteristics of the creek as well as a number of activities affecting the creek. The stream order, gradients, Rosgen stream channel types, and activities affecting each reach are reported in Table 61. Additional information in the BURP files indicate that upper reaches are braided and marshy, water is similar to small reservoirs with slow moving or stagnant water. Middle reaches appear to have cut banks, channelization is evident, there are many sand bars within the creek, there are marshy areas, and the riparian zone consists of willows, grasses, and sagebrush, this segment has also been reported as being dry. The lower reaches indicate that the creek bed is rocky and flows through a rock canyon; the riparian zone consists of willows and thorn bush (DEQ 1993-2001).

Table 61. Characteristics of Camas Creek.

Reach	Stream order	Gradient (%)	Rosgen Stream Channel Type	Activities Affecting Reach
Upper		0.5	C	GR
Middle	5	1.0, 0.9,0.15	C, C, F	GR, RDS, AG, DIV, REC
Lower		0.3, 0.9	C, C	GR, AG, RDS

[a]Data from BURP files.
[b]REC-recreation, RDS-roads, GR-grazing, MIN-mining.

Three of six of the collection events were completed in reaches that had some amount of perennial flow and data indicates that beneficial uses are not fully supported. All three of the sites yielded SMI scores that indicate minimum threshold and automatically indicate impairment of the water body.

Table 62. Condition rating scores for Camas Creek.

Site	SMI	SFI	SHI	Average
1995STWFAA14	MT	ND	1	---
1995STWFA016	MT	ND	1	---
1995STWFA040	MT	ND	1	---

[a]MT-minimum threshold (automatically indicates impairment), ND- no data.
[b]An average condition score of 2 or greater indicates that beneficial uses are fully supported.

Rainbow trout, brook trout, sculpin, sucker, redside shiner, and dace have been found to occur in Camas Creek (Table 63). In the 2002 data collection event, 33.3% of the species were cold water indicators and 34.8% of the fish population was cold water indicators and 93.5% of the rainbow trout were young of the year. In the 1993 data collection event, 20% of the brook trout present were young of the year.

Table 63. Camas Creek fish data.

Site	Rainbow trout	Brook trout	Sculpin	Sucker	Dace	Redside shiner	Rainbow trout young of year	Brook trout young of year
1993STWFA02	2	10	4	P	P	0	0	2
2000BLMCC01	18	---	---	C	VA	VA	3	---
2002SDEQF02	46	0	0	5	76	0	43	0

[a]Data collected by DEQ and BLM.
[b]C = common, VA = very abundant, --- = no data (species probably targeted), P = present.

Hydrology

Camas Creek is a perennial water body; however, a large portion of the water body becomes intermittent early in the summer. Twenty-nine water bodies drain the surrounding hillsides of the subbasin into Camas Creek. Fifteen of these water bodies are perennial in nature, while the remaining water bodies are intermittent water bodies. Unlike many of the tributaries that feed it, Camas Creek does not drain any foothills directly. Rather, Camas Creek lies in the flat prairies of the subbasin and acts as a channel for its tributaries to drain the foothills. Due to low gradients, snowmelt and precipitation events that occur on the prairie of Camas Creek likely contribute to the ground water system rather than to surface flows. As a result, ground water becomes an important factor in maintaining surface flows of Camas Creek and its tributaries.

Camas Creek receives a large amount of water from its tributaries during spring runoff events. These spring runoff events occur quickly, as the majority of the tributaries of Camas Creek drain foothills that have south facing slopes. Much of Camas Creek goes dry during the summer months, likely because of the lack of flow occurring in these same tributaries.

However, ground water plays an important role in the water that remains throughout the year. A complex of springs supply headwater stretches of Camas Creek with water year round. Downstream segments of the creek are dry; however, in the fall water slowly flows back down the channel. The lower section of Camas Creek is fed by ground water as well as some surface flow during the summer; therefore it maintains perennial waters throughout the year. The amount of flow occurring is minimal; however, the waters to support aquatic life are present.

The entire length of Camas Creek lies over the Camas Prairie aquifer, and this overlay corresponds with a number of characteristics of Camas Creek:

- The aquifer probably aids in maintaining perennial flows in Camas Creek.
- Groundwater definitely plays a large role in maintaining perennial flows in approximately 17 miles of the Camas Creek.

- The geology of Camas Creek likely allows a great deal of ground water and surface water interaction.
- Surface flow is likely to dissipate into the groundwater if water tables are lowered, whereas the groundwater, when water tables are high, emerges and contributes to surface flows.
- Events that alter either surface water or ground water are likely to impact the other.

As a result of the gauge located about four miles upstream of the mouth, much more is known about the hydrology of Camas Creek. During the 2001 to 2003 periods, water was present in the creek at the gauge year round, however, there was approximately 37.1 miles of the creek that went dry during the summer months until the next spring. The gauge data represents the creek well during spring runoff events; however, later in the year groundwater plays a larger role in the perennial status of these lower reaches of Camas Creek. As a result, gauge data is not representative of what is occurring in the remaining 43.1 miles of the creek.

Flows are impacting the water quality and beneficial uses of Camas Creek. Camas Creek has a gauging station that has been in place near the confluence with Magic Reservoir since 1912. This gauging station (13141500) data were used to create the hydrograph of Camas Creek (Figure 48). Flows for Camas Creek tend to increase in late March and decrease in early May. High flow for Camas Creek occurs in April and averages 970.2 cfs, with low flows occurring from June to March.

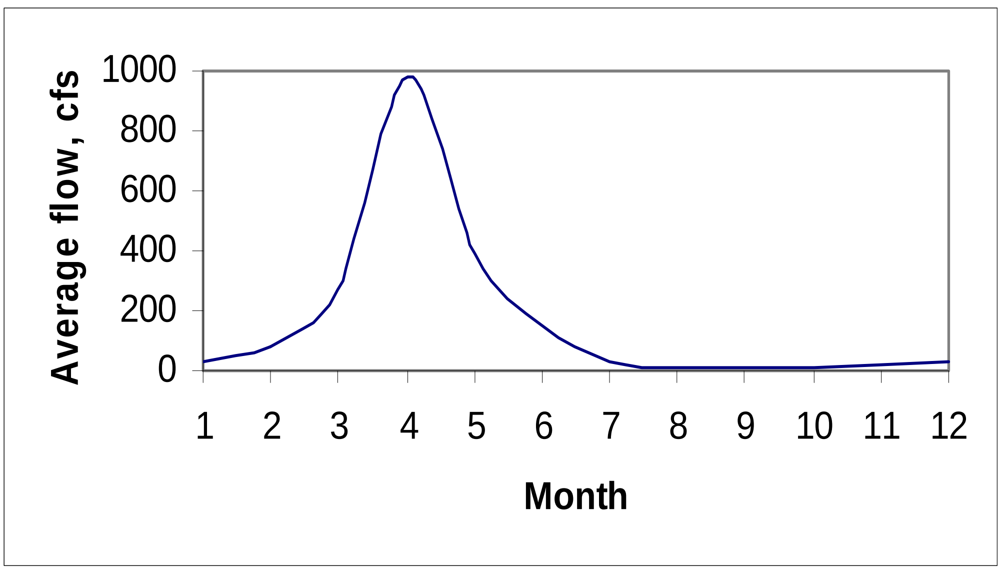


Figure 48. Camas Creek annual hydrograph.

In 2001-2003 (drought years) Camas Creek was identified as having no flow from July until November, whereupon access to the creek is minimal. The lower portion of Camas Creek does not typically go dry because of groundwater influence. The upper portion of the water body goes dry during the summer; however, during spring runoff the valley bottom is covered in water (Figure 49).

Figure 49. Camas Creek in spring runoff.

There are many water rights for the Camas Creek drainage area. Diversions off of Camas Creek itself account for 97.1 cfs of water while diversions off of its tributaries account for 379.1 cfs. This water is used for various purposes: irrigation, stockwater, domestic water supply, wildlife, aesthetic, and recreation (IDWR 2002).

Water Column Data

Water chemistry data for Camas Creek is limited. Historical data includes data from the 1970s to the 1990s collected by USGS. This data includes 200 samples of flow, temperature, and specific conductivity, as well as 24 samples of pH and TP and one sample of DO. Monthly monitoring for water chemistry data were completed throughout the 2001-2003 periods at four sites. The lower site was used to identify pollutants impacting water quality and thus beneficial uses. Temperature loggers were also distributed at various locations.

Table 64 describes the number of samples, maximums, averages, minimums, and number of values elevated above assessment criteria. *For a description of how the assessment criteria were developed and analyzed see Analysis Process, page 45.*

Table 64. Camas Creek water chemistry data.

Parameter	Count	Maximum	Average	Minimum	Number of values elevated above instantaneous criteria	Instantaneous criteria	Average criteria (monthly and annual)
Indicators							
SC	32	433.0	139.0	58.8	0	< 500	---
PH	32	10.10	---	6.44	2	6.5 < x < 9.0	---
TNH3	6	1.170	0.251	0.005	0	Variable	---
Turb	31	152.7	25.4	0.9	4	BG + 50	---
DO	32	11.87	7.81	4.00	8	> 6	---
BOD	6	22.0	8.8	1.5	1	< 10	---
Chl a	20	24.0	9.2	1.6	3	< 15	---
Pollutants							
TSS	8	34.0	10.2	0.5	0	< 80	< 50
TP	8	0.190	0.106	0.053	2 / 4	< 0.16 / 0.08	< 0.10 / 0.08
TIN	4	0.306	0.164	0.053	0	< 0.48	< 0.3
E. coli	24	70.0	19.0	0.5	0	< 406	< 126

[a]SC-Specific Conductivity (uhmos/cm), pH-Hydrogen Ion Concentration (standard units), TNH3-Total Ammonia (mg/L), Turb-Turbidity (NTUs), DO-Dissolved oxygen (mg/L), BOD-Biological oxygen demand (mg/L), Chl a-chlorophyll a (ug/L), TSS-Total Suspended Solids (mg/L), TP-Total Phosphorous (mg/L), TIN-Total Inorganic Nitrogen (mg/L), *E. coli*-Escherichia coli (colony forming units/100ml).
[b]The average assessment criteria for *E. coli* is actually a geometric mean rather than an average.

The indicator constituents indicate that pollutants may be impacting the water body. Less than 10% of the samples are elevated for turbidity and pH. Turbidity was elevated at two lower sites on two sequential days in March during spring runoff. At the lower site pH was elevated in August and slightly depressed at an upper site in April. Less than 20% of the samples were elevated for chlorophyll and BOD. When BOD was elevated (October) DO levels were capable of supporting the oxygen demand. Chlorophyll levels were elevated three times, twice at an upper site in May and once at a lower site in March. The DO measurements at the upper site was depressed in March, April, May, and June and at the lower site was depressed in April and September. *Depressed DO levels and elevated chlorophyll values indicate that nutrients and sediment are likely impacting water quality.* The historical indicators met assessment criteria.

The following parameters are used in the WBAG to indicate whether or not water quality is capable of supporting beneficial uses: pH, turbidity, and DO. The 10% exceedance policy is applied to pH, turbidity, and DO; if these parameters are not elevated beyond standards more than 10% of the time than water quality appears to be capable of supporting beneficial uses. In the case of Camas Creek, neither pH nor turbidity is elevated more than 10% of the time, but DO is elevated 25% of the time. *Water quality (DO) appears to not be capable of fully supporting beneficial uses.*

The water column data (TSS) indicates that sediment is not impacting beneficial uses, however bedload sediment (percent fines) indicates that sediment is impacting beneficial uses of Camas Creek. The TSS average (10.2 mg/L) averaged well below the average assessment criteria (50 mg/L) and values were never elevated above instantaneous criteria (80 mg/L). The percent fine data were elevated above the assessment criteria (35%). There were 11 collection events in the water body and the values for percent fines ranged from 31.8% to 100.0%. Bedload sediment appears to be impacting beneficial uses of Camas Creek.

The critical period for sediment transport is typically during the spring and early summer when flow is elevated due to runoff events. *Seasonally*, TSS values are elevated in March (40.4 mg/L), April (21.1 mg/L), July (14.0 mg/L) and August (29.0 mg/L), these values remain below average monthly assessment criteria and daily maximum criteria. The remaining months have TSS values that average 1.2 mg/L.

Stream bank inventories were completed on Camas Creek to identify the source of the sediment and they indicate that the stream banks are contributing an excessive load of sediment into the creek. Bank stability of upper (65.0%), lower upper (66.7%), upper middle (70.9%), lower middle (73.6%), upper lower (48.1%), and lower (60.3%) portions do not meet stream bank targets. The target for stream bank stability is 80%. *Sediment erosion from banks is impacting beneficial uses of Camas Creek, a sediment TMDL will be completed.*

The water column data (chlorophyll, TP, and TIN) indicate that nutrients are impacting the beneficial uses of Camas Creek. Chlorophyll data is limited; however, values periodically are elevated above the 15 μg/L indicating that nuisance aquatic vegetation may be occurring in the water body. The TP average values (0.106 mg/L) averaged slightly above the average assessment criteria (0.100 mg/L) and two values were elevated above instantaneous criteria (0.160 mg/L). The TIN average values (0.164 mg/L) average well below the average assessment criteria (0.300 mg/L). *For nuisance aquatic vegetation TP and TIN values together need to be elevated, however as chlorophyll data is occasionally high and TP levels are elevated, a nutrient TMDL will be completed.*

The critical period for nuisance aquatic vegetation is typically during the spring and into the summer months, when primary production is elevated. *Seasonally*, average monthly TP values are slightly elevated in March (0.131 mg/L), June (0.132 mg/L), July (0.173 mg/L), August (0.190 mg/L), and October (0.135 mg/L). March and June are elevated above monthly average assessment criteria (0.100 mg/L), while July and August are elevated above daily maximum assessment criteria (0.160 mg/L). *Seasonally*, TIN average values are elevated in April (0.419 mg/L) and October (0.306 mg/L). The April values are elevated above monthly average criteria (0.300 mg/L). The October values are not elevated above daily maximum assessment criteria (0.480mg/L). The TN/TP values for Camas Creek average 10.24 *indicating that the water body is phosphorous limited.*

The receiving water for Camas Creek is Magic Reservoir; Camas Creek is delivering an excessive load of TP to the reservoir. The TP average values (0.106 mg/L) averaged well above the average assessment criteria (0.050 mg/L) for a water body delivering into a storage system. *As a result, a nutrient TMDL will be completed on Camas Creek to aid in nutrient transport to Magic Reservoir.*

Bacteria (*E. coli*) are not impacting the primary contact recreation beneficial uses of Camas Creek. The maximum number of *E. coli* that occurred throughout the period of record was 70, a value well below the 576 cfu/100ml instantaneous standard. As there were never any instantaneous violations, it was not necessary to calculate geometric mean values for the system. *Seasonally*, *E. coli* values are slightly elevated in April (23.3 cfu/100ml), May (23.4 cfu/100ml), and July (37.5 cfu/100ml), but never above instantaneous standards. The remaining months averaged 6.2 cfu/100ml. *A bacteria TMDL will not be completed.*

The designated uses of Camas Creek are CWAL and SS; as such maximum daily and average daily temperatures from 24 hour temperature data is analyzed based on critical time periods for these existing uses. The critical time periods for CWAL are June 22 through September 21. As brook trout and rainbow trout are both spawning in Camas Creek, the critical time periods for salmonid spawning is from October 1 through July 15. Temperature loggers were placed at various locations on Camas Creek for the 2001-2003 periods.

In respect to water quality standards, temperature appears to be impacting CWAL and SS designated uses (Table 65 and Figure 50). The daily average temperatures (3.3% exceedance) for CWAL do not exceed the 10% exceedance policy; however, the daily maximum temperatures (54.3% exceedance) for CWAL do exceed the exceedance policy. The daily average temperatures (36.0% exceedance) and daily maximum temperatures (27.9% exceedance) for SS are elevated above the 10% exceedance policy.

Table 65. Camas Creek elevated temperatures.

Year	Site	Days in critical period	Days measured	Elevated maximum temperatures (# / %)		Elevated average temperatures (# / %)	
CWAL							
2002	Lower	92	83	30	32.6	5	5.4
2003	Lower	92	68	52	56.5	0	0
2003	Upper	92	80	47	51.1	46	50.0
SS							
2002	Lower	288	272	72	26.5	55	20.2
2003	Lower	288	287	84	29.3	59	20.6
2003	Upper	288	275	74	26.9	60	21.8

[a] CWAL days missing in the lower site for 2002 include September 13 through September 21, for the 2003 data include August 29 through September 21. For the upper site days missing were September 10 through September 21.
[b] SS days missing for the lower site in 2002 data include October 1 through October 16, for the 2003 data include October 1 and for the upper site include October 1 through October 14.

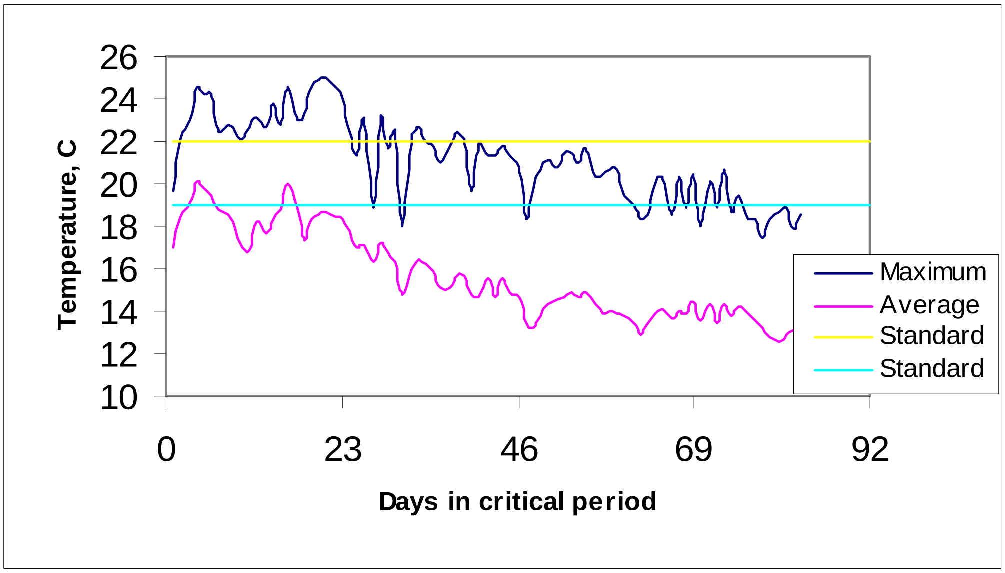


Figure 50. Camas Creek CWAL temperatures (Lower-2002).

Temperature elevations may be being influenced by a number of activities, such as the following:

- Lack of canopy cover due to anthropogenic activities as well as due to some natural events could be a contributing factor to elevated temperatures.
- There are a number of beaver dam complexes within the watershed that are likely contributing to elevated temperatures. Even as a beaver dam filters sediment out of the water column and redevelops flood plains, the width of the creek increases creating a wetland type area and exposing the water to more solar radiation.
- Camas Creek has a lot of overland flow that occurs in the upper portions of the watershed during spring runoff. The creek resembles a marsh, surface area is increased along with solar radiation exposure.
- Removal of water for water use demands reduces the quantity of water and allows solar radiation to elevate temperatures more rapidly.
- Camas Creek is located in southern Idaho, a desert region where air temperatures are typically hot during summer months.

Existing canopy cover was estimated from aerial photographs of the creek, canopy cover targets were developed for various segments of the creek based on bankfull width and vegetation type (Table 66). Camas Creek was divided into 47 segment lengths for aerial photo interpretations, the canopy cover ranged from 0% to 50% (Appendix 5). The creek was divided into five representative segments to determine the canopy cover targets for each of the 47 segment lengths. Camas Creek is dominated by grasses and willows therefore the Co-dominant Mesic Graminoid-Willow community, willow community, and willow mix community shade curves in the Alvord Lake TMDL on page 75, 76, and 77 were the best matching shade curves for the segments. Targets for canopy cover on the creek were as follows: upper (30%), lower upper (30%), upper middle (18%), lower middle (15%), and lower (15%). *As some of the existing canopy cover estimates fell outside of the canopy cover targets, a temperature TMDL will be completed. However, if at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data were meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at this time.*

Table 66. Camas Creek canopy cover.

Segment	Bankfull Width (m)	Vegetation Type	Existing CC ranges (%)	CC Target (%)
Upper	1.5	Grasses, willow	10-50	30
Lower upper	9.2	Willow, grasses	10-50	30
Upper middle	15.6	Willow, grasses	0-10	18
Lower middle	16.5	Willow, grasses	0-20	15
Lower	12.6	Grasses, willow	0-40	15

[a] Bankfull width was determined from BURP data or flow data measurements for each section.
[b] Existing CC (canopy cover) was measured by aerial photo interpretation completed by Mark Shumar (DEQ).
[c] The Alvord Lake TMDL was used to aid in selecting CC (canopy cover) targets that were based on similarities in bankfull width and vegetation type.

Conclusions

Through the subbasin assessment process, the following have been identified for Camas Creek:

- Biological data should not be used to determine beneficial use support status except in the perennial segments, data indicates in these segments that beneficial uses are not fully supported.
- Flow is not sufficient to support beneficial uses.
- Water chemistry data (DO) indicate that water quality is not sufficient to support beneficial uses.
- Sediment (bedload sediment from stream bank erosion) is impacting beneficial uses.
- Nutrients (TP) are impacting beneficial uses of Camas Creek and there is an excessive load of TP being delivered to Magic Reservoir.
- Bacteria (*E. coli*) are not impacting the primary contact recreational uses of the creek.
- Temperature is elevated, thus indicating water quality is not sufficient to support beneficial uses.

As a result of the subbasin assessment, a TMDL will be completed for sediment, nutrients, and temperature on Camas Creek; in addition the creek will be listed as impacted by flow alteration. If at such future time, water quality standards are modified through the negotiated rule making process and it is found that the collected temperature data were meeting the newer standards, then the temperature TMDL will be reopened and reconsidered. It is possible that a delisting of temperature may be considered at that time.

Mormon Reservoir

Land use, ownership, and vegetation of Mormon Reservoir is described based on a 1mile-wide corridor approach (one mile on each side of the reservoir) as was done in the Big Wood River TMDL.

The majority of the land surrounding the reservoir is private (56.0%) with open water making up 15.2% of the area. The remainder of the land is managed by BLM (23.4%) and the state (5.4%).

The land use for the reservoir is predominately rangeland (46.8%) with dry land agriculture making up 23.1% of the area, irrigated gravity flow and sprinkler each making up 7.9% of the area.

The vegetation along the reservoir corridor is predominately shrubland (33.8%) and grassland (32.1%) followed by agriculture (20.0%). Riparian (2.4%) and wetland (0.1%) make up the rest of that which is not water.

The Mormon Reservoir corridor passes through seven different geologic formations. Open water, alluvium basalt, intrusions, basaltic volcanic ejecta flows, and basalt flows and tuff make up the intermingled geologic formations of Mormon Reservoir.

The soils of the reservoir corridor that include the reservoir and land to the east of the reservoir have soil erosion potentials (K factors) of 0.25 to 0.35 (ArcView Coverage 1992-1996).

Biological and Other Data

IDFG manages the fisheries of Mormon Reservoir as a general system. This reservoir has been identified as a cold water fishery with rainbow trout and yellow perch as the species of desirable game fishes within the system. Management directions are to work to acquire minimum pool and to consider brown trout if forage fish become excessive. (IDFG 2001). IDFG stocking records indicate that stocking has occurred frequently in Mormon Reservoir. Several species have been stocked historically in the reservoir.

Hydrology

McKinney Creek and Dairy Creek are the main water bodies that contribute waters to Mormon Reservoir. Dairy Creek used to deliver to Camas Creek but channelization occurred to increase the delivery to Mormon Reservoir. A spring located within the reservoir contributes a continuous supply of water (1.8 cfs) to the reservoir throughout the year. The predicted hydrographs for McKinney Creek (Figure 45) and Dairy Creek (Figure 47) were described previously.

Mormon Reservoir (also known as Twin Lakes Reservoir) has a storage capacity of 33,000 acre-feet. It has filled only three times in 40 years. Mormon reservoir irrigates about 9,700 acres of cropland (USDA 1981). The surface of the water body covers 2,000 acres (IDPR 2005).

During the 2004 drought year, maximum depth near the dam was seven feet in the middle of May and near the inlets maximum depth was two feet. By the time of the next sampling event (early in June) boat access to the reservoir was not possible and samples were collected from the boat docks.

By nature Mormon Reservoir is a flow altered water body. The water of the reservoir is used for irrigation purposes as well as for recreational purposes.

Water Column Data

Water chemistry data for Mormon Reservoir is very limited. Nutrients, temperature, DO, chlorophyll, sediment, and bacteria data were collected irregularly throughout the data collection period. Data were collected at two sites on the reservoir. However, due to lack of water volume inaccessibility by boat was a problem. Most of the data collected was collected near the dam off of the boat ramp.

The Carlson Trophic State Index (TSI) was used to determine the trophic nature of Mormon Reservoir. This metric can be used to determine if phosphorous is in excess in the system. A TSI score of 50 or more indicates that a lake/reservoir is eutrophic and thus has high productivity (EPA 2004). This value has been used in various other south central TMDLs including the Goose Creek and Raft River Subbasin TMDLs. The TSI values for chlorophyll, secchi depth, TP, and total nitrogen were averaged together for an overall TSI score, however each will also be looked at individually. When looking at individual TSI scores the measured constituents can not exceed the following values for TSI scores to remain below the TSI threshold value: secchi depth (2m), chlorophyll at 1 meter (7.2ug/L), phosphorous (0.24 mg/L), and nitrogen (0.7 mg/L).

The overall average TSI score for Mormon Reservoir is 71.8, indicating that the trophic nature of the reservoir is mesotrophic. The average TSI for each site visit ranges from 60.0 to 86.6. TSI values tend to increase as the season progresses and the water volume decreases due to reservoir draw down. The TSI scores for phosphorous ranged from 95.1 to 111.4 and the TSI scores for nitrogen ranged from 33.3 to 70.5. Average TSI scores ranged from 12.62 to 85.56.

Nutrient and sediment TMDLs completed on McKinney Creek and Dairy Creek will aid in decreasing storage and delivery to the reservoir. The wind in the prairie aids in mixing the soil with the water so that phosphorous stored in the soils becomes suspended in the water column. Restricting pollutant input will aid Mormon Reservoir, but there is also a great deal of internal loading. It will take some time for the stored nutrients and sediment to be exported out of the reservoir out onto farmland.

Temperature and DO are data gaps and can not be assessed at this time. However, enough temperature data were collected to indicate that Mormon Reservoir does not have a large enough pool volume to stratify.

Bacteria are not threatening the primary contact beneficial uses of Mormon Reservoir. Bacteria data were collected throughout the summer, the highest value (140 cfu/100ml) was well below primary contact recreation beneficial use water quality standards.

Conclusions

Through the subbasin assessment process, the following have been identified about Mormon Reservoir:

- Mormon Reservoir does not have enough pool volume to stratify.
- Bacteria (*E. coli*) are not impacting the primary contact beneficial uses of the reservoir.
- Sediment (TSS and secchi depth) is impacting water quality.
- Nutrients (TP and TIN) are impacting water quality.
- Temperature and DO are data gaps.

As a result of the subbasin assessment, Mormon Reservoir will remain listed as impaired by flow alteration, sediment, nutrients, DO, and temperature. A TMDL for sediment is being completed on McKinney Creek and Dairy Creek to limit the delivery of this pollutant to the reservoir. A TMDL for nutrients is being completed on Dairy Creek to limit the delivery of this pollutant to the reservoir. The reservoir is also being delisted as being impacted by bacteria.

2.5 Data Gaps

Hydrology and geology play one of the biggest roles in this subbasin in relation to beneficial uses and water quality. As very little data has been collected in the past or recently, flow data is minimal. Flow data also needs to be taken across varying flow years, including drought years, average flow years, and high flow years. It also needs to be taken at various locations throughout the lengths of the water bodies. Flow is a large data gap in the Camas Creek Subbasin for all of the water bodies and the biggest contributor to impairment.

There is very little bioassessment data on any of the water bodies in this subbasin; because of flow alteration or natural hydrology, most of the streams have a dry period that makes it inappropriate to assess the condition of the water body through the biological data portion of the WBAG assessment processes. However, the data is still appropriate to collect for purposes other than beneficial use assessment. Willow Creek and the upper reaches of

Soldier Creek are the only water bodies that are 303(d) listed that have had fish data collected on them *sufficiently*. So a large data gap in the Camas Creek Subbasin is fishery data.

As it is difficult to assess beneficial uses on these water bodies, water chemistry data becomes more important in determining if beneficial uses are being met. There is very little data that has been collected historically or recently on the water bodies in this subbasin. Thus, water chemistry is a data gap for all of the water bodies.

Temperature data were collected during drought years under low flow conditions. This data is also not representative of activities occurring in situations that are not the worst case scenarios. It would be beneficial to determine the temperature cycle of the water body in normal years. It would also be beneficial to identify what influences the beaver dams within a watershed have on water temperatures.

The salmonid spawning periods in the subbasin for each creek are unknown. As a result salmonid spawning default time periods have been used in this document. The actual spawning periods within this subbasin need to be identified.

3. Subbasin Assessment – Pollutant Source Inventory

This section of the subbasin assessment provides an inventory of known or suspected sources of pollutants, including both point sources and nonpoint sources. Any relations between different pollutants and what is known about the delivery potential to impaired segments of water bodies is discussed.

3.1 Point Sources

There is one point source in the Camas Creek Subbasin. The City of Fairfield (Table 67) discharges their effluent to a ditch that drains into Soldier Creek.

Table 67. Point sources in the Camas Creek Subbasin.

	City of Fairfield
NPDES permit no.	ID 002438-4
First discharge	Jan. 1, 1976
Receiving water	Camas Creek through unnamed ditch to Soldier Creek
Discharge period	March 1 to June 30
Facility type	Lagoons and rapid infiltration basin
Discharge restrictions	Inflow must be ten times greater than the discharge
Design Flow	0.165 mgd

[a] Data collected from NPDES files in DEQ Twin Falls office.

3.2 Nonpoint Sources

Most of the 303(d) listed water bodies have similar nonpoint sources that could be contributing to the pollutant loads, however, intensity of the contribution varies. The exact amount of contribution is unknown, but load allocations have been designed on a one mile stream corridor land use approach.

Nonpoint source activities impacting the subbasin are identified in Table 68.

Table 68. Nonpoint sources of Camas Creek Subbasin.

Creek	Roads	Grazing	Stream crossings	Mining	Fires	Septic Systems	Agriculture	Forestry	Urban Runoff	Rural Runoff
Camas Creek	X	X				X	X		X	X
Camp Creek	X	X			X	X	X			X
Willow Creek	X	X			X	X	X			X
Beaver Creek	X	X		X	X					X
Little Beaver Creek	X	X	X	X	X					X
Elk Creek	X	X				X	X	X		X
Soldier Creek	X	X				X	X		X	X
Corral Creek	X	X				X	X			X
Cow Creek	X	X	X							X
Wild Horse Creek	X	X	X			X	X			X
McKinney Creek	X	X	X			X	X			X
Dairy Creek	X	X	X			X	X			X
Mormon Reservoir		X				X	X			X

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

A number of groups are working on, or have worked on, water quality projects in the Camas Creek Subbasin. It is unknown if these activities have enhanced water quality because there has been little data collected in this subbasin. These groups or activities are identified in Table 69.

Table 69. Camas Creek subbasin pollution control efforts.

Group/Program	Activity
Beaver Management Committee	Removal and relocation of beavers.
Willow Creek Project	Riparian areas fenced off from grazing, planting of some native species, stream bank stabilization, and water quality monitoring.
Camas Soil Conservation District	55 Conservation Reserve Program contracts on 7,509.7 acres.
Individuals	Stream Channel Alteration Permits – Soldier Creek has had four stream bank stabilization projects, Willow Creek has had one stabilization projects as well as two culvert/bridge projects, Camas Creek has had two stream bank stabilization projects and one bridge replacement project.
Elmore County Soil Conservation District	Conservation Reserve Program contracts, bank stabilization, and riparian plantings.

[a] Data collected from Stream Channel Alteration Permit Application files in Twin Falls DEQ office, (Boettger 1998), (Camas SCD 2001), (Elmore SCD 2002).

5. Total Maximum Daily Loads

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

Practically, the MOS 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 is completed 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.

5.1 TMDL Components

In the subbasin assessment it was identified which water bodies were impaired by a pollutant and will have a TMDL completed, the following describes the design conditions, target selection, and monitoring points for instream water quality targets, along with load capacity, estimates of existing pollutant loads, load allocation, and implementation strategies.

The goal of the TMDL and implementation process is to restore "full support of designated beneficial uses" (Idaho Code 39.3611, 3615) by determining load allocations for the pollutants impacting a water body. Through the subbasin assessment process, it has been identified what pollutants or pollution are impacting the impaired water body. In the case where pollutants are impacting a water body, a TMDL will be completed to determine necessary load allocations for point source and nonpoint source activities occurring in the water body. In the case of pollution (lack of flow or habitat alteration) impacting a water body, a TMDL will not be completed for the pollution.

Design conditions, target selections, and monitoring points become critical issues in developing a TMDL and tracking improvement in a water body and will be discussed for each water body and pollutant impaired.

The load capacity is a value that estimates the quantity of pollutant the water body can assimilate and still meet water quality standards. The load capacity is determined by various calculations depending on the pollutant. The load capacity must be a level to meet "...water quality standards with season variations and a margin of safety which takes into account any lack of knowledge..." (Clean Water Act § 303(d)(C)). In developing a load capacity for the water body, the likely sources of uncertainty include lack of knowledge of assimilative capacity, uncertain relation of selected targets to beneficial uses, and variability in target measurement.

Existing loads are estimates of the quantity of pollutant occurring in a water body. Data that is used to determine existing loads is typically very limited and not necessarily very representative of the average condition. However due to court appointed timelines, it is the best available data. Regulations allow that loadings "...may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading," (Water quality planning and management, 40 CFR § 130.2(I)). An estimate must be made for each point source. Nonpoint sources are typically estimated based on the type of sources (land use) and area (such as a subwatershed), but may be aggregated by type of source or land area. To the extent possible, background loads should be distinguished from human-caused increases in nonpoint loads.

Load allocation represents the portion of the load capacity of the stream that is allocated to existing nonpoint source activities, nonpoint source future growth, and background loads occurring within the watershed. Wasteload allocations are the allocations given to the point sources within the watershed, these allocations are calculated based on discharge monitoring report data and design flows. When data from the point source is not available, estimates are calculated. The following formula represents allocation division in a TMDL: LC=LA+WLA+BG+MOS+FG.

The margin of safety (MOS) represents 10% of the load capacity of the water body. This value provides an allocation that is not given to a pollutant source to provide for uncertainty in load capacity.

The future growth (FG) component takes into account a portion of the loading capacity that is reserved for future development within the watershed. At the request of the Wood River Watershed Advisory Group an allocation of 5% has been set aside for future growth.

Seasonal variation occurs within a pollutant and within a water body. The hydrologic regime of the water body as well as land-use management practices influences the seasonal variation in the water body. Seasonal variation within each 303(d) listed water body was discussed in the subbasin assessment portion of this document.

The TMDLs that were completed in this subbasin were on the following water bodies: Soldier Creek, Willow Creek, Beaver Creek, Little Beaver Creek, Camp Creek, Elk Creek, Corral Creek, Cow Creek, Wild Horse Creek, McKinney Creek, Dairy Creek, and Camas Creek. The TMDLs completed on Dairy Creek and McKinney Creek will aid in improving the water quality of Mormon Reservoir.

Soldier Creek

Through the subbasin assessment process, it has been identified that the water quality of Soldier Creek is being impacted by pollutants. The pollutants of concern in the water body have been found to be sediment and temperature. For a summary of load reductions for this water body see Table 70, for load allocations see Table 71, and for segmental breakdown of stream bank erosion values see Table 72.

Lack of flow is the largest impact to beneficial uses of Soldier Creek. Soldier Creek is impaired due to a lack of flow; however, EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for water bodies impaired by pollution, a TMDL has not been established for Soldier Creek for flow.

Design Conditions

Sediment impacts a water body during higher flow events, when the carrying capacity of the stream is greater and erosion is more likely to occur. Typically the higher flow events occur during spring runoff or periodically during storm situations; as a result the critical period for sediment on Soldier Creek has been identified as occurring from March to May. During this period the critical flow for the water body based on the predicted hydrograph is 67.4 cfs. As sediment has been found to be occurring as a result of stream bank erosion the critical flow period is less important in the development of stream bank stability TMDLs.

Solar radiation impacts the temperature of a water body during the late spring and summer months, when canopy cover is the major component that maintains cooler water temperatures. As a result the critical period for temperature on Soldier Creek has been identified as occurring from April to September. During this time, the critical flow for the water body, based on the predicted hydrograph, is 36.0 cfs. As a temperature TMDL targets canopy cover of a creek, the critical flow is less important in the development of a temperature TMDL.

Target Selection

Target selections are discussed in more complete detail in the subbasin assessment (SBA) portion of this document under the section *Analysis Process* (page 45). The water quality standards for the various pollutants can also be viewed in Appendix 3.

Sediment is impacting water quality of Soldier Creek in the form of bedload sediment. Suspended sediment measured during drought years is not impacting water quality of the stream, however bedload sediment measured in the form of percent fines indicates that sediment is impacting water quality. A value greater than 35% for percent fines was used to indicate that sediment was impacting the water body. If this was the case then stream bank erosion inventories were completed to determine if stream bank erosion was a contributor of sediment impact. The target for stream bank erosion is 80% bank stability.

Temperature is impacting the water quality of Soldier Creek and canopy cover is the method used to determine the amount of solar radiation the creek is receiving. Vegetation type and bankfull width were used to characterize the creek, then the Alvord Lake TMDL was used to aid in target selection based on these values (Table 22). The targets for the sections of the water bodies are as follows: upper (55%) and lower (30%). If the aerial photo estimates are less than the appropriate canopy cover target, canopy cover needs to be improved within the segment. Aerial photo estimations likely underestimate segments that have higher cover and overestimate segments that have lower cover, however in terms of the creek as a whole, these balance themselves out. This should be taken into account however during the implementation phase; the more critical areas are likely to be the areas with the least amount of canopy cover.

Monitoring Points

Because a stream bank erosion TMDL is site specific and cannot be measured by a pour point value, as some of the other constituents can, there is no monitoring point to be measured for identification. One possible way of tracking changes within the system would be various Wohlman pebble counts in locations that have been used in the past. For the stream bank erosion TMDL, the water body has been divided into three segments. These segments are as follows: upper, middle, and lower.

The monitoring point for temperature collection for TMDL development occurred about 2.5 miles upstream of the mouth and just downstream of the North and South Forks. Both sites can be used to identify further trends within the system, however the site upstream of the mouth should be used to determine if water quality standards on Soldier Creek are being met.

Load Capacity

The load capacities of the two TMDLs to be completed on Soldier Creek have been determined in different ways.

- The load capacity (99.2 tons per year [t/yr]) for stream bank erosion TMDLs was set using calculations that took into account erosion rates, bank height, and quantity of stream bank stability.
- The load capacity (702,970.0 kilowatt hours/day [kWh/day]) for the temperature TMDL was determined by converting canopy cover targets to solar radiation.

These values represent the estimated quantity of pollutant the water bodies are believed to be able to assimilate and still maintain beneficial uses full support status and meet water quality standards.

Estimates of Existing Pollutant Loads

The estimated existing loads for the two TMDLs to be completed on Soldier Creek are elevated above the load capacity of the water body:

- The existing load (772.2 t/yr) for stream bank erosion TMDLs was set using calculations that took into account erosion rates, bank height, and quantity of stream bank stability.
- The existing load (866,896.9 kWh/day) for temperature TMDLs was calculated as the sum of the amount of solar radiation for the segments of the creek.

These values represent the estimated existing load of pollutant occurring in the water body.

Load Allocation

The wasteload allocation for Soldier Creek incorporates construction storm water wasteload allocations, as well as wasteload allocations for the City of Fairfield. The wasteload allocation for construction storm water was determined by allocating 2% of the load capacity to construction storm water. *The wasteload allocation for construction storm water is 1.7 t/yr. The wasteload allocation for the City of Fairfield is 7.5 t/yr. The intent of this sediment TMDL is not to make the City of Fairfield's discharge permit any more restrictive than it already is. The combined sediment wasteload allocation for Soldier Creek is 9.2 t/yr.*

Construction storm water is not likely to impact the canopy cover; therefore a waste load allocation is not made for construction storm water in this watershed. However, there is a point source facility that does discharge to the creek.

This temperature TMDL is based on meeting potential natural riparian vegetation conditions in the watershed. Shade targets were developed with the idea that once shade levels are met, streams will achieve temperatures consistent with those achievable under natural conditions. Once natural conditions are known, point source discharges must not cumulatively increase receiving water temperature more than 0.3ºC above the natural stream temperature as stated in Idaho water quality standards (IDAPA 58.01.02.200.09 and IDAPA 58.01.02.401.03.v).

Prior to determining the natural temperature condition in a stream, point source discharges should not contribute water that will elevate the temperature of the receiving water above a 0.3 degree increase above average salmonid spawning temperatures (9 degrees Celsius), during the period of elevated temperatures (March 15 through July 15). The temperature of the effluent the point source will be capable of discharging will vary according to effluent flows and creek flows (Table 73). Additionally, point source dischargers should collect monitoring data on the temperature of their discharge and their receiving stream immediately above and below the discharge point. These data can be used in the future to ascertain applicability of the above referenced natural background provisions.

Background, MOS, and FG are values attributed to the watershed that are beyond human control, provide some flexibility within the watershed, and allow for future growth within the watershed. Calculations for each of these components were determined in various ways:

- The BG loads are not determined for a stream bank erosion TMDL because it is implied that background loads occur within the target.
- The BG loads, MOS, and FG are not determined for a temperature TMDL because the canopy cover targets are set for natural potential vegetation.
- The MOS for the sediment TMDL of Soldier Creek is 10% of the load capacity (9.9 t/yr).
- The FG for the sediment TMDL of Soldier Creek is 5% of the load capacity (5.0 t/yr).

The final load allocations for nonpoint source activity are determined by reducing the load capacity of the water body by the wasteload allocations, background, MOS, and FG values. Therefore, the load allocation for sediment is 75.1 t/yr and for temperature is 702,970.0 kWh/day.

Table 70. Soldier Creek load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
Sediment	67.4	80	99.2	772.2	87.2
temperature	36.0	55-30	702,970.0	866,896.9	18.9

[a]Sediment- target measured in percent bank stability, load capacity and existing load measured in t/yrr.
[b]Temperature – target measured in percent canopy cover, load capacity and existing load measured in kWh/day.

Table 71. Soldier Creek load allocations.

Pollutant	MOS	BG	FG	Available Load	Wasteload allocation	Load Allocation
Sediment (t/yr)	9.9	implicit	5.0	84.3	9.2	75.1
Temperature (kWh/day)	n.a.	n.a.	n.a.	702,970.0	0.0	702,970.0

[a]Implicit- Background (BG) is implied within the target.
[b]Margin of safety (MOS) and Future growth (FG), n.a.-not applicable.

Table 72. Soldier Creek stream bank erosion values.

Reach	Existing Erosion rate	Proposed Erosion rate	Existing Total Erosion	Proposed Total Erosion	Erosion Rate Percent Reduction	Percent of Existing Total Load
Upper	2.4	3.5	12.6	17.9	0	1.63
Middle	11.2	5.2	70.1	32.5	54	9
Lower	157.2	11.1	689.5	48.8	93	89
Total			772.2	99.2		

[a]See Appendix 4 for site descriptions
[b]Erosion rates measured in tons/mile/year. Total erosion measured in tons/year.

Table 73. City of Fairfield allowable effluent temperatures.

Soldier Creek flow (cfs)	Fairfield Effluent Discharge (cfs)				
	0.05	0.1	0.15	0.2	0.225
5	16.8	13.1	11.8	11.2	11.0
10	24.3	16.8	14.3	13.1	12.6
20	39.3	24.3	19.3	16.8	16.0
30	54.3	31.8	24.3	20.6	19.3
40	69.3	39.3	29.3	24.3	22.6
50	84.3	46.8	34.3	28.1	26.0
60	99.3	54.3	39.3	31.8	29.3
70	114.3	61.8	44.3	35.6	32.6

[a]The calculation used to determine the effluent temperatures (degrees Celsius) is {[(effluent flow + (0.25 x creek flow)) x (9 +0.3)] – [(0.25 x creek flow) x 9]} / effluent flow.

Reasonable Assurance

There is reasonable assurance that implementation, as the next step of the water body management process, will occur. First this document includes implementation strategies as described in subsequent pages; Idaho's water quality standards identify designated agencies that are responsible for evaluating and modifying best management practices to protect impaired water bodies. The state has committed itself to having implementation plans developed within 18 months of approval of the TMDL document. DEQ, the *Watershed Advisory Group* (WAG), and the designated agencies will develop implementation plans, and

DEQ will incorporate them into the state's water quality management plan. Also, in measuring the effectiveness of an implementation activity, DEQ will reassess the support status of the water body to determine if the water body has reached full support status. If full support status has not been obtained then further implementation will be necessary and further reassessment completed until full support status is completed. If full support status is completed then the requirements of the TMDL will be considered completed.

Willow Creek

Through the subbasin assessment process, it has been identified that the water quality of Willow Creek is being impacted by a pollutant. The pollutant of concern in the water body has been found to be temperature. For a summary of load reductions for this water body see Table 74 and for load allocations see Table 75.

Design Conditions

Solar radiation impacts the temperature of a water body during the late spring and summer months, when canopy cover is the major component that maintains cooler water temperatures. As a result, the critical period for temperature on Willow Creek has been identified as occurring from April to September. During this time, the critical flow for the water body, based on the predicted hydrograph, is 46.1 cfs. As a temperature TMDL targets canopy cover of a creek, the critical flow is less important in the development of a temperature TMDL.

Target Selection

Target selections are discussed in more complete detail in the subbasin assessment (SBA) portion of this document under the section *Analysis Process* (page 45). The water quality standards for the various pollutants can also be viewed in Appendix 3.

Temperature is impacting the water quality of Willow Creek, and canopy cover is the method used to determine the amount of solar radiation the creek is receiving. Vegetation type and bankfull width were used to characterize the creek, then the Alvord Lake TMDL was used to aid in target selection based on these values (Table 28; page 74). The targets for the sections of the water bodies are as follows: upper (55%), middle (35%) and lower (50%). If the aerial photo estimates are less than the appropriate canopy cover target, canopy cover needs to be improved within the segment. Aerial photo estimations likely underestimate segments that have higher cover and overestimate segments that have lower cover; however, in terms of the creek as a whole, these balance themselves out. This should be taken into account ,however, during the implementation phase; the more critical areas are likely to be the areas with the least amount of canopy cover.

Monitoring Points

The monitoring point for temperature collection for TMDL development occurred near the mouth, about 6 miles upstream of the mouth, about 12 miles upstream of the mouth, and about 0.5 miles upstream of the West Fork. All sites can be used to identify further trends within the system; however, the lower site near the mouth should be used to determine if water quality standards on Willow Creek are being met.

Load Capacity

The load capacity estimates the quantity of pollutant the water body is believed to be able to assimilate and still maintain beneficial uses full support status and meet water quality standards. The load capacity (520,835.7 kWh/day) for the temperature TMDL was determined by converting canopy cover targets to solar radiation.

Estimates of Existing Pollutant Loads

The estimated existing load for the temperature TMDL to be completed on Willow Creek is elevated above the load capacity of the water body. The existing load (535,072.5 kWh/day) for temperature TMDLs was calculated as the sum of the amount of solar radiation for the segments of the creek. This value represents the estimated existing load of pollutant occurring in the water body.

Load Allocation

The wasteload allocation for Willow Creek is limited to construction storm water wasteload allocations. Wasteload allocations are not made for construction storm water for a temperature TMDL based on canopy cover.

Background, MOS, and FG are values attributed to the watershed that are beyond human control, provide some flexibility (due to uncertainty) within the watershed, and allow for future growth within the watershed. Background loads, MOS, and FG are not determined for a temperature TMDL because the canopy cover targets are set for natural potential vegetation.

The final load allocation for nonpoint source activity is determined by reducing the load capacity of the water body by the wasteload allocations, background, MOS, and FG values. Therefore, the load allocation for temperature in Willow Creek is 520,835.7 kWh/day.

Table 74. Willow Creek load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
Temperature	46.1	55-35-50	520,835.7	535,072.5	2.7

[a]Temperature – target measured in percent canopy cover, load capacity and existing load measured in kWh/day.

Table 75. Willow Creek load allocations.

Pollutant	MOS	BG	FG	Available Load	Wasteload allocation	Load Allocation
Temperature (kWh/day)	n.a.	n.a.	n.a.	520,835.7	0.0	520,835.7

[a]Background (BG), Margin of safety (MOS) and Future growth (FG), n.a.-not applicable.

Beaver Creek

Through the subbasin assessment process, it has been identified that the water quality of Beaver Creek is being impacted by a pollutant. The pollutant of concern in the water body has been found to be temperature. For a summary of load reductions for this water body see Table 76 and for load allocations see Table 77.

Design Conditions

Solar radiation impacts the temperature of a water body during the late spring and summer months, when canopy cover is the major component that maintains cooler water temperatures. As a result the critical period for temperature on Beaver Creek has been identified as occurring from April to September. During this time, the critical flow for the water body, based on the predicted hydrograph, is 8.1 cfs. As a temperature TMDL targets canopy cover of a creek, the critical flow is less important in the development of a temperature TMDL.

Target Selection

Target selections are discussed in more complete detail in the subbasin assessment (SBA) portion of this document under the section *Analysis Process* (page 45). The water quality standards for the various pollutants can also be viewed in Appendix 3.

Temperature is impacting the water quality of Beaver Creek and canopy cover is the method used to determine the amount of solar radiation the creek is receiving. Vegetation type and bankfull width were used to characterize the creek, then the Alvord Lake TMDL was used to aid in target selection based on these values (Table 34, page 83). The targets for the sections of the water bodies are as follows: upper (85%) and lower (60%). If the aerial photo estimates are less than the appropriate canopy cover target, canopy cover needs to be improved within the segment. Aerial photo estimations likely underestimate segments that have higher cover and overestimate segments that have lower cover; however, in terms of the creek as a whole, these balance themselves out. This should be taken into account however during the implementation phase; the more critical areas are likely to be the areas with the least amount of canopy cover.

Monitoring Points

The monitoring point for temperature collection for TMDL development occurred near the mouth and about 2.5 miles upstream of the mouth. Both sites can be used to identify further trends within the system; however, the lower site near the mouth should be used to determine if water quality standards on Beaver Creek are being met.

Load Capacity

The load capacity estimates the quantity of pollutant the water body is believed to be able to assimilate and still maintain beneficial use support status and meet water quality standards. The load capacity (33,948.0 kWh/day) for the temperature TMDL was determined by converting canopy cover targets to solar radiation.

Estimates of Existing Pollutant Loads

The estimated existing load for the temperature TMDL to be completed on Beaver Creek is elevated above the load capacity of the water body. The existing load (74,828.0 kWh/day) for temperature TMDLs was calculated as the sum of the amount of solar radiation for the segments of the creek. These values represent the estimated existing load of pollutant occurring in the water body.

Load Allocation

The wasteload allocation for Beaver Creek is limited to construction storm water wasteload allocations. Wasteload allocations are not made for construction storm water for a temperature TMDL based on canopy cover.

Background, MOS, and FG are values attributed to the watershed that are beyond human control, provide some flexibility (due to uncertainty) within the watershed, and allow for future growth within the watershed. Background loads, MOS, and FG are not determined for a temperature TMDL because the canopy cover targets are set for natural potential vegetation.

The final load allocation for nonpoint source activity is determined by reducing the load capacity of the water body by the wasteload allocations, background, MOS, and FG values. Therefore, the load allocation for temperature in Beaver Creek is 33,948.0 kWh/day.

Table 76. Beaver Creek load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
temperature	8.1	85-60	33,948.0	74,828.0	54.6

[a]Temperature – target measured in percent canopy cover, load capacity and existing load measured in kWh/day.

Table 77. Beaver Creek load allocations.

Pollutant	MOS	BG	FG	Available Load	Wasteload allocation	Load Allocation
Temperature (kWh/day)	n.a.	n.a.	n.a.	33,948.0	0.0	33,948.0

[a]Background (BG), Margin of safety (MOS) and Future growth (FG), n.a.-not applicable.

Little Beaver Creek

Through the subbasin assessment process, it has been identified that the water quality of Little Beaver is being impacted by a pollutant. The pollutant of concern in the water body has been found to be temperature. For a summary of load reductions for this water body see Table 78 and for load allocations see Table 79.

Design Conditions

Solar radiation impacts the temperature of a water body during the late spring and summer months, when canopy cover is the major component that maintains cooler water temperatures. As a result the critical period for temperature on Little Beaver Creek has been identified as occurring from April to September. During this time, the critical flow for the water body, based on the predicted hydrograph, is 5.8 cfs. As a temperature TMDL targets canopy cover of a creek, the critical flow is less important in the development of a temperature TMDL.

Target Selection

Target selections are discussed in more complete detail in the subbasin assessment (SBA) portion of this document under the section *Analysis Process* (page 45). The water quality standards for the various pollutants can also be viewed in Appendix 3.

Temperature is impacting the water quality of Little Beaver Creek and canopy cover is the method used to determine the amount of solar radiation the creek is receiving. Vegetation type and bankfull width were used to characterize the creek, then the Alvord Lake TMDL was used to aid in target selection based on these values (Table 40, page 91). The targets for the sections of the water bodies are as follows: upper (85%) and lower (75%). If the aerial photo estimates are less than the appropriate canopy cover target, canopy cover needs to be improved within the segment. Aerial photo estimations likely underestimate segments that have higher cover and overestimate segments that have lower cover; however, in terms of the creek as a whole, these balance themselves out. This should be taken into account however during the implementation phase; the more critical areas are likely to be the areas with the least amount of canopy cover.

Monitoring Points

The monitoring point for temperature collection for TMDL development occurred near the mouth and about 2.5 miles upstream of the mouth. Both sites can be used to identify further trends within the system; however, the lower site near the mouth should be used to determine if water quality standards on Little Beaver Creek are being met.

Load Capacity

The load capacity estimates the quantity of pollutant the water body is believed to be able to assimilate and still maintain beneficial use full support status and meet water quality standards. The load capacity (8,609.4 kWh/day) for the temperature TMDL was determined by converting canopy cover targets to solar radiation.

Estimates of Existing Pollutant Loads

The estimated load for the temperature TMDL to be completed on Little Beaver Creek is elevated above the load capacity of the water body. The existing load (32,597.6 kWh/day) for temperature TMDLs was calculated as the sum of the amount of solar radiation for the segments of the creek. These values represent the estimated existing load of pollutant occurring in the water body.

Load Allocation

The wasteload allocation for Little Beaver Creek is limited to construction storm water wasteload allocations. Wasteload allocations are not made for construction storm water for a temperature TMDL based on canopy cover.

Background, MOS, and FG are values attributed to the watershed that are beyond human control, provide some flexibility (due to uncertainty) within the watershed, and allow for future growth within the watershed. Background loads, MOS, and FG are not determined for a temperature TMDL because the canopy cover targets are set for natural potential vegetation.

The final load allocation for nonpoint source activity is determined by reducing the load capacity of the water body by the wasteload allocations, background, MOS, and FG values. Therefore, the load allocation for temperature in Little Beaver Creek is 8,609.4 kWh/day.

Table 78. Little Beaver Creek load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
temperature	5.8	85-75	8,609.4	32,597.6	73.6

[a]Temperature – target measured in percent canopy cover, load capacity and existing load measured in kWh/day.

Table 79. Little Beaver Creek load allocations.

Pollutant	MOS	BG	FG	Available Load	Wasteload allocation	Load Allocation
Temperature (kWh/day)	n.a.	n.a.	n.a.	8,609.4	0.0	8,609.4

[a]Background (BG), Margin of safety (MOS) and Future growth (FG), n.a.-not applicable.

Camp Creek

Through the subbasin assessment process, it has been identified that the water quality of Camp Creek is impacted by pollutants. The pollutants of concern in the water body have been found to be sediment and temperature. For a summary of load reductions for this water body see Table 80, for load allocations see Table 81, and for segmental breakdown of stream bank erosion values see Table 82.

Lack of flow is the largest impact to beneficial uses of Camp Creek. Camp Creek is impaired due to a lack of flow; however, EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for water bodies impaired by pollution, a TMDL has not been established for Camp Creek for flow.

Design Conditions

Sediment impacts a water body during higher flow events, when the carrying capacity of the stream is greater and erosion is more likely to occur. Typically the higher flow events occur during spring runoff or periodically during storm situations; as a result the critical period for sediment on Camp Creek has been identified as occurring from March to May. During this period the critical flow for the water body based on the predicted hydrograph is 7.3 cfs. As sediment has been found to be occurring as a result of stream bank erosion, the critical flow period is less important in the development of stream bank stability TMDLs.

Solar radiation impacts the temperature of a water body during the late spring and summer months, when canopy cover is the major component that maintains cooler water temperatures. As a result, the critical period for temperature on Camp Creek has been identified as occurring from April to September. During this time, the critical flow for the water body, based on the predicted hydrograph, is 1.5 cfs. As a temperature TMDL targets canopy cover of a creek, the critical flow is less important in the development of a temperature TMDL.

Target Selection

Target selections are discussed in more complete detail in the subbasin assessment (SBA) portion of this document under the section *Analysis Process* (page 45). The water quality standards for the various pollutants can also be viewed in Appendix 3.

Sediment is impacting beneficial uses of Camp Creek in the form of bedload sediment. Suspended sediment measured during drought years is not impacting water quality of the stream, but bedload sediment measured in the form of percent fines indicates that sediment is impacting water quality. A value greater than 35% for percent fines was used to indicate that sediment was impacting the water body. If this was the case then stream bank erosion inventories were completed to determine if stream bank erosion was the contributor of sediment impact. The target for stream bank erosion is 80% bank stability.

Temperature is impacting the water quality of Camp Creek, and canopy cover is the method used to determine the amount of solar radiation the creek is receiving. Vegetation type and bankfull width were used to characterize the creek, then the Alvord Lake TMDL was used to aid in target selection based on these values (Table 45, page 100). The targets for the sections of the water bodies are as follows: upper (75%), upper middle (35%), lower middle (65%), and lower portions (50%). If the aerial photo estimates are less than the appropriate canopy cover target, canopy cover needs to be improved within the segment. Aerial photo estimations likely underestimate segments that have higher cover and overestimate segments that have lower cover; however, in terms of the creek as a whole, these balance themselves out. This should be taken into account however during the implementation phase; the more critical areas are likely to be the areas with the least amount of canopy cover.

Monitoring Points

As a stream bank erosion TMDL is site specific and can not be measured by a pour point value as some of the other constituents can there is no monitoring point to be measured for identification. One possible way of tracking changes within the system would be various Wohlman pebble counts in locations that have been used in the past. For the stream bank erosion TMDL the water body has been divided into five segments. These segments are as follows: upper, upper lower, middle, middle lower, and lower.

The monitoring point for temperature collection for TMDL development occurred about half a mile upstream of the mouth and 2.5 miles downstream of the headwaters. Both sites can be used to identify further trends within the system; however, the site upstream of the mouth should be used to determine if water quality standards on Camp Creek are being met.

Load Capacity

The load capacities of the two TMDLs to be completed on Camp Creek have been determined in different ways.

- The load capacity (89.4 t/yr) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability.
- The load capacity (256,830.2 kWh/day) for the temperature TMDL was determined by converting canopy cover targets to solar radiation.

These values represent the estimated quantity of pollutant the water bodies are believed to be able to assimilate and still maintain beneficial uses full support status and meet water quality standards.

Estimates of Existing Pollutant Loads

The estimated existing loads for the two TMDLs to be completed on Camp Creek are elevated above the load capacity of the water body:

- The existing load (278.3 t/yr) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability.
- The existing load (320,219.8 kWh/day) for temperature TMDLs was calculated as the sum of the amount of solar radiation for the segments of the creek.

These values represent the estimated existing loads of pollutant occurring in the water body.

Load Allocation

The wasteload allocation for Camp Creek is limited to construction storm water wasteload allocations. The wasteload allocation for construction storm water was determined by allocating 2% of the load capacity to construction storm water. As this is the only point source in the watershed the allocation for sediment is 1.5 t/yr. Wasteload allocations are not made for construction storm water for a temperature TMDL based on canopy cover.

Background, MOS, and FG are values attributed to the watershed that are beyond human control, provide some flexibility within the watershed, and allow for future growth within the watershed. Calculations for each of these components were determined in various ways:

- Background loads are not determined for a stream bank erosion TMDL because it is implied that background loads occur within the target.
- Background loads, MOS, and FG are not determined for a temperature TMDL because the canopy cover targets are set for natural potential vegetation.
- The MOS for the sediment TMDL for Camp Creek is 10% of the load capacity (8.9 t/yr).
- The FG for the sediment TMDL for Camp Creek is 5% of the load capacity (4.5 t/yr).

The final load allocations for nonpoint source activity are determined by reducing the load capacity of the water body by the wasteload allocations, background, and MOS values. Therefore, the load allocation for sediment is 74.5 t/yr and for temperature is 193,274.4 kWh/day.

Table 80. Camp Creek load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
sediment	7.3	80	89.4	278.3	67.9
temperature	1.5	75-35-65-50	256,830.2	320,219.8	19.8

[a]Sediment- target measured in percent bank stability, load capacity and existing load measured in t/yr.
[b]Temperature – target measured in percent canopy cover, load capacity and existing load measured in kWh/day.

Table 81. Camp Creek load allocations.

Pollutant	MOS	BG	FG	Available Load	Wasteload allocation	Load Allocation
sediment (t/yr)	8.9	implicit	4.5	76.0	1.5	74.5
Temperature (kWh/day)	n.a.	n.a.	n.a.	256,830.2	0.0	256,830.2

[a]Implicit- Background (BG) is implied within the target.
[b]Margin of safety (MOS) and Future growth (FG), n.a.-not applicable.

Table 82. Camp Creek stream bank erosion values.

Reach	Existing Erosion rate	Proposed Erosion rate	Existing Total Erosion	Proposed Total Erosion	Erosion Rate Percent Reduction	Percent of Existing Total Load
Upper	9.5	5.2	29.3	16.1	45	11
Lower upper	36.8	4.8	45.4	5.9	87	16
Middle	9.7	6.3	50.7	32.9	35	18
Lower middle	39.4	6.8	101.5	17.5	83	36
Lower	35.9	11.9	51.5	17.1	67	19
Total			278.3	89.4		

[a]See Appendix 4 for site descriptions
[b]Erosion rates measured in tons/mile/year. Total erosion measured in tons/year.

Reasonable Assurance

There is reasonable assurance that implementation as the next step of the water body management process will occur. First this document includes implementation strategies that are in the subsequent pages. Idaho's water quality standards identify designated agencies that are responsible for evaluating and modifying best management practices to protect impaired water bodies. The state has committed itself to having implementation plans developed within 18 months of approval of the TMDL document. DEQ, the WAG, and the designated agencies will develop implementation plans, and DEQ will incorporate them into the states water quality management plan. Also in measuring the effectiveness of an implementation activity, DEQ will reassess the support status of the water body to determine if the water body has reached full support status. If full support status has not been obtained then further implementation will be necessary and further reassessment completed until full support status is completed. If full support status is completed then the requirements of the TMDL will be considered completed.

Elk Creek

Through the subbasin assessment process, it has been identified that the water quality of Elk Creek is being impacted by a pollutant. The pollutant of concern in the water body has been found to be sediment. For a summary of load reductions for this water body see Table 83, for load allocations see Table 84, and for segmental breakdown of stream bank erosion values see Table 85.

Lack of flow is the largest impact to beneficial uses of Elk Creek. Elk Creek is impaired due to a lack of flow; however, EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for water bodies impaired by pollution, a TMDL has not been established for Elk Creek for flow.

Design Conditions

Sediment impacts a water body during higher flow events, when the carrying capacity of the stream is greater and erosion is more likely to occur. Typically the higher flow events occur during spring runoff or periodically during storm situations; as a result the critical period for sediment on Elk Creek has been identified as occurring from March to May. During this period the critical flow for the water body based on predicted hydrograph is 5.0 cfs. As sediment has been found to be occurring as a result of stream bank erosion the critical flow period is less important in the development of stream bank stability TMDLs.

Target Selection

Target selections are discussed in more complete detail in the subbasin assessment (SBA) portion of this document under the section *Analysis Process* (page 45). The water quality standards for the various pollutants can also be viewed in Appendix 3.

Sediment is impacting water quality of Elk Creek in the form of bedload sediment. Suspended sediment measured during drought years is not impacting water quality of the stream, however bedload sediment measured in the form of percent fines indicates that sediment is impacting water quality. A value greater than 35% for percent fines was used to indicate that sediment was impacting the water body. If this was the case then stream bank erosion inventories were completed to determine if stream bank erosion was the contributor of sediment impact. As a result if TMDLs for stream bank erosion are completed the target is for 80% bank stability.

Monitoring Points

As a stream bank erosion TMDL is site specific and can not be measured by a pour point value as some of the other constituents can there is no monitoring point to be measured for identification. One possible way of tracking changes within the system would be various

Wohlman pebble counts in locations that have been used in the past. For the stream bank erosion TMDL the water body has been divided into two segments. These segments are as follows: upper and lower.

Load Capacity

The load capacity estimates the quantity of pollutant the water body is believed to be able to assimilate and still maintain beneficial use full support status and meet water quality standards. Load capacity (63.6 t/yr) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability.

Estimates of Existing Pollutant Loads

The estimated existing load for the sediment TMDL to be completed on Elk Creek is elevated above the load capacity of the water body. The existing load (142.1 t/yr) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability. This value represents the estimated existing loads of pollutant occurring in the water body.

Load Allocation

The wasteload allocation for Elk Creek is limited to construction storm water wasteload allocations. The wasteload allocation for construction storm water was determined by allocating 2% of the load capacity to construction storm water. As this is the only point source in the watershed the wasteload allocation for sediment is 1.1 t/yr.

Background, MOS, and FG are values attributed to the watershed that are beyond human control, provide some flexibility within the watershed, and allow for future growth within the watershed. Calculations for each of these components were determined in various ways:

- Background loads are not determined for a stream bank erosion TMDL because it is implied that background loads occur within the target.
- The MOS for the sediment TMDL of Elk Creek is 10% of the load capacity (6.4 t/yr).
- The FG for the sediment TMDL of Elk Creek is 5% of the load capacity (3.2 t/yr).

The final load allocation for nonpoint source activity is determined by reducing the load capacity of the water body by the wasteload allocations, background, MOS, and FG values. *Therefore, the load allocation for sediment is 53.0 t/yr.*

Table 83. Elk Creek load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
sediment	5.0	80	63.6	142.1	55.2

[a]Sediment- target measured in percent bank stability, load capacity and existing load measured in t/yr.

Table 84. Elk Creek load allocations.

Pollutant	MOS	BG	FG	Available Load	Wasteload allocation	Load Allocation
Sediment (t/yr)	6.4	implicit	3.2	54.1	1.1	53.0

[a]Implicit- Background (BG) is implied within the target, Margin of safety (MOS) and Future growth (FG).

Table 85. Elk Creek stream bank erosion values.

Reach	Existing Erosion rate	Proposed Erosion rate	Existing Total Erosion	Proposed Total Erosion	Erosion Rate Percent Reduction	Percent of Existing Total Load
Lower	14.1	4.3	60.9	18.4	70	43
Upper	13.0	7.2	81.3	45.1	44	57
Total			142.1	63.6		

[a]See Appendix 4 for site descriptions
[b]Erosion rates measured in tons/mile/year. Total erosion measured in tons/year.

Reasonable Assurance

There is reasonable assurance that implementation as the next step of the water body management process will occur. First this document includes implementation strategies that are in the subsequent pages. Idaho's water quality standards identify designated agencies that are responsible for evaluating and modifying best management practices to protect impaired water bodies. The state has committed itself to having implementation plans developed within 18 months of approval of the TMDL document. DEQ, the WAG, and the designated agencies will develop implementation plans, and DEQ will incorporate them into the states water quality management plan. Also in measuring the effectiveness of an implementation activity, DEQ will reassess the support status of the water body to determine if the water body has reached full support status. If full support status has not been obtained then further implementation will be necessary and further reassessment completed until full support status is completed. If full support status is completed then the requirements of the TMDL will be considered completed.

Corral Creek

Through the subbasin assessment process, it has been identified that the water quality of Corral Creek is being impacted by pollutants. The pollutants of concern in the water body have been found to be sediment and temperature. For a summary of load reductions for this water body see Table 86, for load allocations see Table 87, and for segmental breakdown of stream bank erosion values see Table 88.

Lack of flow is the largest impact to beneficial uses of Corral Creek. Corral Creek is impaired due to a lack of flow; however, EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for water bodies impaired by pollution, a TMDL has not been established for Corral Creek for flow.

Design Conditions

Sediment impacts a water body during higher flow events, when the carrying capacity of the stream is greater and erosion is more likely to occur. Typically the higher flow events occur during spring runoff or periodically during storm situations; as a result the critical period for sediment on Corral Creek has been identified as occurring from March to May. During this period the critical flow for the water body based on predicted hydrograph is 42.4 cfs. As sediment has been found to be occurring as a result of stream bank erosion the critical flow period is less important in the development of stream bank stability TMDLs.

Solar radiation impacts the temperature of a water body during the late spring and summer months, when canopy cover is the major component that maintains cooler water temperatures. As a result the critical period for temperature on Corral Creek has been identified as occurring from April to September. During this time, the critical flow for the water body, based on the predicted hydrograph, is 20.4 cfs. As a temperature TMDL targets canopy cover of a creek, the critical flow is less important in the development of a temperature TMDL.

Target Selection

Target selections are discussed in more complete detail in the subbasin assessment (SBA) portion of this document under the section *Analysis Process* (page 45). The water quality standards for the various pollutants can also be viewed in Appendix 3.

Sediment is impacting water quality of Corral Creek in the form of bedload sediment. Suspended sediment measured during drought years is not impacting water quality of the stream, however bedload sediment measured in the form of percent fines indicates that sediment is impacting water quality. A value greater than 35% for percent fines was used to indicate that sediment was impacting the water body. If this was the case then stream bank erosion inventories were completed to determine if stream bank erosion was a contributor of sediment impact. The target for stream bank erosion is 80% bank stability.

Temperature is impacting the water quality of Corral Creek and canopy cover is the method used to determine the amount of solar radiation the creek is receiving. Vegetation type and bankfull width were used to characterize the creek, then the Alvord Lake TMDL was used to aid in target selection based on these values (Table 51). The target for the water body is 50%. If the aerial photo estimates are less than the appropriate canopy cover target, canopy cover needs to be improved within the segment. Aerial photo estimations likely underestimate segments that have higher cover and overestimate segments that have lower cover, however in terms of the creek as a whole, these balance themselves out. This should be taken into account however during the implementation phase; the more critical areas are likely to be the areas with the least amount of canopy cover.

Monitoring Points

As a stream bank erosion TMDL is site specific and can not be measured by a pour point value as some of the other constituents can there is no monitoring point to be measured for identification. One possible way of tracking changes within the system would be various Wohlman pebble counts in locations that have been used in the past. For the stream bank erosion TMDL the water body has been divided into two segments. These segments are as follows: upper and lower.

The monitoring point for temperature collection for TMDL development occurred about 1.5 miles upstream of the mouth and about half a mile downstream of the East and West Forks of Corral Creek. Both sites can be used to identify further trends within the system; however the lower site upstream of the mouth should be used to determine if water quality standards on Corral Creek are being met.

Load Capacity

The load capacities of the two TMDLs to be completed on Corral Creek have been determined in different ways.

- The load capacity (35.8 t/yr) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability.
- The load capacity (201,544.2 kWh/day) for the temperature TMDL was determined by converting canopy cover targets to solar radiation.

These values represent the estimated quantity of pollutant the water bodies are believed to be able to assimilate and still maintain beneficial uses full support status and meet water quality standards.

Estimates of Existing Pollutant Loads

The estimated existing loads for the two TMDLs to be completed on Corral Creek are elevated above the load capacity of the water body:

- The existing load (121.5 t/yr) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability.
- The existing load (322,974.6 kWh/day) for temperature TMDLs was calculated as the sum of the amount of solar radiation for the segments of the creek.

These values represent the estimated existing load of pollutant occurring in the water body.

Load Allocation

The wasteload allocation for Corral Creek is limited to construction storm water wasteload allocations. The wasteload allocation for construction storm water was determined by allocating 2% of the load capacity to construction storm water. As this is the only point source in the watershed the allocation for sediment is 0.6 t/yr. Wasteload allocations are not made for construction storm water for a temperature TMDL based on canopy cover.

Background, MOS, and FG are values attributed to the watershed that are beyond human control, provide some flexibility within the watershed, and allow for future growth within the watershed. Calculations for each of these components were determined in various ways:

- Background loads are not determined for a stream bank erosion TMDL because it is implied that background loads occur within the target.
- Background loads, MOS, and FG are not determined for a temperature TMDL because the canopy cover targets are set for natural potential vegetation.
- The MOS for the sediment TMDL for Corral Creek is 10% of the load capacity (3.6 t/yr).
- The FG for the sediment TMDL for Corral Creek is 5% of the load capacity (1.8 t/yr).

The final load allocations for nonpoint source activity are determined by reducing the load capacity of the water body by the wasteload allocations, background, MOS, and FG values. Therefore, the load allocation for sediment is 29.8 t/yr and for temperature is 201,544.2 kWh/day.

Table 86. Corral Creek load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
sediment	42.4	80	35.8	121.5	70.5
temperature	20.4	50	201,544.2	322,974.6	37.6

[a]Sediment- target measured in percent bank stability, load capacity and existing load measured in t/yr.
[b]Temperature – target measured in percent canopy cover, load capacity and existing load measured in kWh/day.

Table 87. Corral Creek load allocations.

Pollutant	MOS	BG	FG	Available Load	Wasteload allocation	Load Allocation
Sediment (t/yr)	3.6	implicit	1.8	30.4	0.6	29.8
Temperature (kWh/day)	n.a.	n.a.	n.a.	201,544.2	0.0	201,544.2

[a]Implicit- Background (BG) is implied within the target.
[b]Margin of safety (MOS) and Future growth (FG), n.a.-not applicable.

Table 88. Corral Creek stream bank erosion values.

Reach	Existing Erosion rate	Proposed Erosion rate	Existing Total Erosion	Proposed Total Erosion	Erosion Rate Percent Reduction	Percent of Existing Total Load
Upper	5.2	3.4	22.3	14.7	34	18
Lower	24.2	5.1	99.2	21.0	79	82
Total			121.5	35.8		

[a]See Appendix 4 for site descriptions
[b]Erosion rates measured in tons/mile/year. Total erosion measured in tons/year.

Reasonable Assurance

There is reasonable assurance that implementation as the next step of the water body management process will occur. First this document includes implementation strategies that are in the subsequent pages. Idaho's water quality standards identify designated agencies that are responsible for evaluating and modifying best management practices to protect impaired water bodies. The state has committed itself to having implementation plans developed within 18 months of approval of the TMDL document. DEQ, the WAG, and the designated agencies will develop implementation plans, and DEQ will incorporate them into the states water quality management plan. Also in measuring the effectiveness of an implementation activity, DEQ will reassess the support status of the water body to determine if the water body has reached full support status. If full support status has not been obtained then further implementation will be necessary and further reassessment completed until full support status is completed. If full support status is completed then the requirements of the TMDL will be considered completed.

Cow Creek above the Reservoir

Through the subbasin assessment process, it has been identified that the water quality of Cow Creek above the reservoir is being impacted by pollutants. The pollutants of concern in the water body have been found to be sediment and nutrients. Nutrients are not impacting this segment of Cow Creek; however as the creek discharges into a reservoir a TMDL will be completed to limit nutrient delivery to the reservoir. For a summary of load reductions for this water body see Table 89, for load allocations see Table 90, and for segmental breakdown of stream bank erosion values see Table 91.

Design Conditions

Sediment impacts a water body during higher flow events, when the carrying capacity of the stream is greater and erosion is more likely to occur. Typically the higher flow events occur during spring runoff or periodically during storm situations; as a result the critical period for sediment on Cow Creek has been identified as occurring from March to May. During this period the critical flow for the water body based on the predicted hydrograph is 7.8 cfs. As sediment has been found to be occurring as a result of stream bank erosion the critical flow period is less important in the development of stream bank stability TMDLs.

Nutrients in a water body that is delivering to a storage system are more likely to impact a reservoir when the creek is delivering water to the reservoir as the reservoir acts as a sink and drops nutrients out of the water column. As a result the critical period for nutrients for Cow Creek is from March to June, and the critical flow for this period based on the predicted hydrograph is 6.4 cfs. The average flow during the critical period aids in determining the loading capacity of the water body.

Target Selection

Target selections are discussed in more complete detail in the subbasin assessment (SBA) portion of this document under the section *Analysis Process* (page 45). The water quality standards for the various pollutants can also be viewed in Appendix 3.

Sediment is impacting the water quality of Cow Creek in the form of bedload sediment. Suspended sediment measured during drought years is not impacting water quality of the stream, however bedload sediment measured in the form of percent fines indicates that sediment is impacting water quality. A value greater than 35% for percent fines was used to indicate that sediment was impacting the water body. If this was the case then stream bank erosion inventories were completed to determine if stream bank erosion was the contributor of sediment impact. The target for stream bank erosion TMDLs is for 80% bank stability.

Nutrients are not impacting the water quality of Cow Creek, but as the creek discharges into a reservoir a TMDL is completed to limit nutrient delivery. The target for water bodies discharging into a storage system is 0.050 mg/L. This goal should aid limiting excessive delivery of nutrients to the reservoir. As a result 0.050 mg/L is the target to be used in the development of a nutrient TMDL for Cow Creek.

Monitoring Points

As a stream bank erosion TMDL is site specific and can not be measured by a pour point value as some of the other constituents can there is no monitoring point to be measured for identification. One possible way of tracking changes within the system would be various Wohlman pebble counts in locations that have been used in the past. For the stream bank erosion TMDL the water body has been divided into three segments. These segments are as follows: upper, middle, and lower.

The monitoring point for nutrient collection for TMDL development was located at the road crossing upstream of the reservoir. This site was located approximately a quarter of a mile upstream of the reservoir. This site should be used to identify further trends or to assess the water body in the future.

Load Capacity

The load capacities of the two TMDLs to be completed on Cow Creek have been determined in different ways.

- The load capacity for (1.72 lbs/day) for nutrient TMDLs was calculated based on target selection and average critical flow.
- The load capacity (15.5 t/yr) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability.

These values represent the estimated quantity of pollutant the water bodies are believed to be able to assimilate and still maintain beneficial uses full support status and meet water quality standards.

Estimates of Existing Pollutant Loads

The estimated existing loads for the two TMDLs to be completed on Cow Creek are elevated above the load capacity of the water body:

- The existing load (4.0 lbs/day) for nutrient TMDLs was calculated based on average annual values of TP and average critical flow.
- The existing load (81.5 t/yr) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability.

These values represent the estimated existing load of pollutant occurring in the water body.

Load Allocation

The wasteload allocation for Cow Creek (above the reservoir) is limited to construction storm water wasteload allocations. The wasteload allocation for construction storm water was determined by allocating 2% of the load capacity to construction storm water. As this is the only point source in the watershed the allocation for nutrients is 0.02 lbs/day and for sediment is 0.3 t/yr.

Background, MOS, and FG are values attributed to the watershed that are beyond human control, provide some flexibility within the watershed, and allow for future growth within the watershed. Calculations for each of these components were determined in various ways:

- Background for TP has been established as being 0.02 mg/L, which accounts for a load allocation of 0.7 lbs/day.
- Background loads are not determined for a stream bank erosion TMDL because it is implied that background loads occur within the target.
- The MOS for the TMDLs for Cow Creek is 10% of the load capacity, for nutrients 0.17 lbs/day and for sediment 1.6 t/yr.
- The FG for the TMDLs for Cow Creek is 5% of the load capacity, for nutrients 0.09 lbs/day and for sediment 0.8 t/yr.

The final load allocations for nonpoint source activity are determined by reducing the load capacity of the water body by the wasteload allocations, background, and MOS values. Therefore, the load allocation for nutrients is 0.76 lbs/day and for sediment is 12.9 t/yr.

Table 89. Cow Creek load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
sediment	7.8	80	15.5	81.5	81.0
nutrients	6.4	0.05	1.72	4.0	56.5

[a]Sediment- target measured in percent bank stability, load capacity and existing load measured in t/yr.
[b]Nutrients – target measured in mg/L, load capacity and existing load measured in lbs/day.

Table 90. Cow Creek load allocations.

Pollutant	MOS	BG	FG	Available Load	Wasteload allocation	Load Allocation
Sediment (t/yr)	1.6	implicit	0.8	13.2	0.3	12.9
Nutrient (lbs/day)	0.17	0.7	0.09	0.78	0.02	0.76

[a]Implicit- Background (BG) is implied within the target, Margin of safety (MOS) and Future growth (FG).

Table 91. Cow Creek stream bank erosion values.

Reach	Existing Erosion rate	Proposed Erosion rate	Existing Total Erosion	Proposed Total Erosion	Erosion Rate Percent Reduction	Percent of Existing Total Load
Upper	2.6	1.8	2.2	1.6	30	3
Middle	66.8	11.0	75.5	12.4	84	93
Lower	4.1	1.7	3.8	1.5	60	5
Total			81.5	15.5		

[a]See Appendix 4 for site descriptions
[b]Erosion rates measured in tons/mile/year. Total erosion measured in tons/year.

Reasonable Assurance

There is reasonable assurance that implementation as the next step of the water body management process will occur. First this document includes implementation strategies that are in the subsequent pages. Idaho's water quality standards identify designated agencies that are responsible for evaluating and modifying best management practices to protect impaired water bodies. The state has committed itself to having implementation plans developed within 18 months of approval of the TMDL document. DEQ, the WAG, and the designated agencies will develop implementation plans, and DEQ will incorporate them into the states water quality management plan. Also in measuring the effectiveness of an implementation activity, DEQ will reassess the support status of the water body to determine if the water body has reached full support status. If full support status has not been obtained then further implementation will be necessary and further reassessment completed until full support status is completed. If full support status is completed then the requirements of the TMDL will be considered completed.

Wild Horse Creek

Through the subbasin assessment process, it has been identified that the water quality of Wild Horse Creek is being impacted by pollutants. The pollutants of concern in the water body have been found to be sediment, bacteria, and temperature. For a summary of load reductions for this water body see Table 92, for load allocations see Table 93, and for segmental breakdown of stream bank erosion values see Table 94.

Lack of flow and channelization are the largest impact to beneficial uses of Wild Horse Creek. Wild Horse Creek is impaired due to a lack of flow; however, EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for water bodies impaired by pollution, a TMDL has not been established for Wild Horse Creek for flow.

Design Conditions

Sediment impacts a water body during higher flow events, when the carrying capacity of the stream is greater and erosion is more likely to occur. Typically the higher flow events occur during spring runoff or periodically during storm situations; as a result the critical period for sediment on Wild Horse Creek has been identified as occurring from March to May. During this period the critical flow for the water body based on predicted hydrograph is 4.9 cfs. As sediment has been found to be occurring as a result of stream bank erosion the critical flow period is less important in the development of stream bank stability TMDLs.

Bacteria are more likely to impact a water body during lower base flow events, when flushing events are not occurring. The critical period as a result is from June to September, and the critical flow for this period based on predicted hydrograph is 1.5 cfs. The flow of Wild Horse Creek during the critical period is less critical in determining load capacity of the stream, as water quality standards set the limit for contact recreation beneficial uses. However, these critical periods are the time when impacts are more critical.

Solar radiation impacts the temperature of a water body during the late spring and summer months, when canopy cover is the major component that maintains cooler water temperatures. As a result the critical period for temperature on Wild Horse Creek has been identified as occurring from April to September. During this time, the critical flow for the water body, based on the predicted hydrograph, is 2.3 cfs. As a temperature TMDL targets canopy cover of a creek, the critical flow is less important in the development of a temperature TMDL.

Target Selection

Target selections are discussed in more complete detail in the subbasin assessment (SBA) portion of this document under the section *Analysis Process* (page 45). The water quality standards for the various pollutants can also be viewed in Appendix 3.

Sediment is impacting water quality of Wild Horse Creek in the form of bedload sediment. Suspended sediment measured during drought years is not impacting water quality of the stream, however bedload sediment measured in the form of percent fines indicates that sediment is impacting water quality. A value greater than 35% for percent fines was used to indicate that sediment was impacting the water body. If this was the case then stream bank erosion inventories were completed to determine if stream bank erosion was the contributor of sediment impact. The target for stream bank erosion TMDLs is 80% bank stability.

Bacteria are impacting the secondary contact recreation beneficial uses of Wild Horse Creek and are measured by *E. coli* values. According to Idaho Code 58.01.02.251.02a, waters with secondary contact recreation use are not to exceed 576 colonies of *E. coli* organisms per 100ml of sample. If an exceedance of this value occurs then a four additional samples have to be taken within the 30 day period and must not exceed a geometric mean of 126 cfu/100ml. As a result 576 colonies of *E. coli* organisms will be the target for the bacteria TMDL on Wild Horse Creek. However, the geometric mean value of 126 cfu/100 ml will be the value used to determine compliance with the standards.

Temperature is impacting the water quality of Wild Horse Creek and canopy cover is the method used to determine the amount of solar radiation the creek is receiving. Vegetation type and bankfull width were used to characterize the creek, then the Alvord Lake TMDL was used to aid in target selection based on these values (Table 56). The target for the water body is 50%. If the aerial photo estimates are less than the appropriate canopy cover target, canopy cover needs to be improved within the segment. Aerial photo estimations likely underestimate segments that have higher cover and overestimate segments that have lower cover, however in terms of the creek as a whole, these balance themselves out. This should be taken into account however during the implementation phase; the more critical areas are likely to be the areas with the least amount of canopy cover.

Monitoring Points

As a stream bank erosion TMDL is site specific and can not be measured by a pour point value as some of the other constituents can there is no monitoring point to be measured for identification. One possible way of tracking changes within the system would be various Wohlman pebble counts in locations that have been used in the past. For the stream bank erosion TMDL the water body has been divided into three segments. These segments are as follows: upper, middle, and lower.

The monitoring point for bacteria collection for TMDL development was located at the upper end of the lower segment of Wild Horse Creek. This site was located approximately two miles upstream of the mouth, at the road crossing downstream of the highway. This site should be used to identify further trends or to assess secondary contact recreation beneficial uses within the water body in the future.

The monitoring point for temperature collection for TMDL development occurred about one mile upstream of the mouth. This site can be used to identify further trends within the system, and should also be used to determine if water quality standards on Wild Horse Creek are being met.

Load Capacity

The load capacities of the three TMDLs to be completed on Wild Horse Creek have been determined in different ways.

- The load capacity (576 cfu/100ml) for bacteria TMDLs was set at values set by the instantaneous water quality standards for secondary contact recreation.
- The load capacity (18.3 t/yr) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability.
- The load capacity (169,873.0 kWh/day) for the temperature TMDL was determined by converting canopy cover targets to solar radiation.

These values represent the estimated quantity of pollutant the water bodies are believed to be able to assimilate and still maintain beneficial uses full support status and meet water quality standards.

Estimates of Existing Pollutant Loads

The estimated existing loads for the three TMDLs to be completed on Wild Horse Creek are elevated above the load capacity of the water body:

- The existing load (2500 cfu/100ml) for bacteria TMDLs was set at the values elevated above secondary contact recreation water quality standards.
- The existing load (46.5 t/yr) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability.
- The existing load (283,983.3 kWh/day) for temperature TMDLs was calculated as the sum of the amount of solar radiation for the segments of the creek.

These values represent the estimated existing load of pollutant occurring in the water body.

Load Allocation

The wasteload allocation for Wild Horse Creek is limited to construction storm water wasteload allocations. The wasteload allocation for construction storm water was determined by allocating 2% of the load capacity to construction storm water. As this is the only point source in the watershed the allocation for bacteria is 9.8 cfu/100ml and for sediment is 0.3 t/yr. Wasteload allocations are not made for construction storm water for a temperature TMDL based on canopy cover.

Background, MOS, and FG are values attributed to the watershed that are beyond human control, provide some flexibility within the watershed, and allow for future growth within the watershed. Calculations for each of these components were determined in various ways:

- The winter months were observed to determine the background levels of bacteria in the watershed, background is 2 cfu/100ml.
- Background loads are not determined for a stream bank erosion TMDL because it is implied that background loads occur within the target.
- Background loads, MOS, and FG are not determined for a temperature TMDL because the canopy cover targets are set for natural potential vegetation.
- The MOS for the TMDLs for Wild Horse Creek is 10% of the load capacity, for bacteria 57.6 cfu/100ml and for sediment 1.8 t/yr.
- The FG for the TMDLs for Wild Horse Creek is 5% of the load capacity, for bacteria 28.8 cfu/100ml and for sediment 0.9 t/yr.

The final load allocations for nonpoint source activity are determined by reducing the load capacity of the water body by the wasteload allocations, background, MOS, and FG values. Therefore, the load allocation for bacteria is 477.8 cfu/100ml, for sediment is 15.2 t/yr, and for temperature is 169,873.0 kWh/day.

Table 92. Wild Horse Creek load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
sediment	4.9	80	18.3	46.5	60.6
bacteria	1.5	576	576	2,500	77.0
temperature	2.3	50	169,873.0	283,983.3	40.2

[a]Sediment- target measured in percent bank stability, load capacity and existing load measured in t/yr.
[b]Bacteria- target, load capacity, existing load measured in cfu/100ml.
[c]Temperature – target measured in percent canopy cover, load capacity and existing load measured in kWh/day.

Table 93. Wild Horse Creek load allocations.

Pollutant	MOS	BG	FG	Available Load	Wasteload allocation	Load Allocation
Sediment (t/yr)	1.8	implicit	0.9	15.6	0.3	15.2
Bacteria (cfu/100ml)	57.6	2	28.8	487.6	9.8	477.8
Temperature (kWh/day)	n.a.	n.a.	n.a.	169,873.0	0.0	169,873.0

[a]Implicit- Background (BG) is implied within the target.
[b]Margin of safety (MOS) and Future growth (FG), n.a.-not applicable.

Table 94. Wild Horse Creek stream bank erosion values.

Reach	Existing Erosion rate	Proposed Erosion rate	Existing Total Erosion	Proposed Total Erosion	Erosion Rate Percent Reduction	Percent of Existing Total Load
Upper	0.1	0.5	0.1	1.1	0	0.3
Middle	1.7	1.9	4.5	5.0	0	9.6
Lower	10.6	3.1	41.9	12.2	71	90
Total			46.5	18.3		

[a]See Appendix 4 for site descriptions
[b]Erosion rates measured in tons/mile/year. Total erosion measured in tons/year.

Reasonable Assurance

There is reasonable assurance that implementation as the next step of the water body management process will occur. First this document includes implementation strategies that are in the subsequent pages. Idaho's water quality standards identify designated agencies that are responsible for evaluating and modifying best management practices to protect impaired water bodies. The state has committed itself to having implementation plans developed within 18 months of approval of the TMDL document. DEQ, the WAG, and the designated agencies will develop implementation plans, and DEQ will incorporate them into the states water quality management plan. Also in measuring the effectiveness of an implementation activity, DEQ will reassess the support status of the water body to determine if the water body has reached full support status. If full support status has not been obtained then further implementation will be necessary and further reassessment completed until full support status is completed. If full support status is completed then the requirements of the TMDL will be considered completed.

McKinney Creek

Through the subbasin assessment process, it has been identified that the water quality of McKinney Creek is being impacted by a pollutant. The pollutant of concern in the water body has been found to be sediment. For a summary of load reductions for this water body see Table 95, for load allocations see Table 96, and for segmental breakdown of stream bank erosion values see Table 97.

Lack of flow is also an impact to beneficial uses of McKinney Creek. McKinney Creek is impaired due to a lack of flow; however, EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for water bodies impaired by pollution, a TMDL has not been established for McKinney Creek for flow.

Design Conditions

Sediment impacts a water body during higher flow events, when the carrying capacity of the stream is greater and erosion is more likely to occur. Typically the higher flow events occur during spring runoff or periodically during storm situations; as a result the critical period for sediment on McKinney Creek has been identified as occurring from March to May. During this period the critical flow for the water body based on predicted hydrograph is 2.5 cfs. As sediment has been found to be occurring as a result of stream bank erosion the critical flow period is less important in the development of stream bank stability TMDLs.

Target Selection

Target selections are discussed in more complete detail in the subbasin assessment (SBA) portion of this document under the section *Analysis Process* (page 45). The water quality standards for the various pollutants can also be viewed in Appendix 3.

Sediment is impacting beneficial uses of McKinney Creek in the form of bedload sediment. Suspended sediment measured during drought years is not impacting water quality of the stream, however bedload sediment measured in the form of percent fines indicates that sediment is impacting water quality. A value greater than 35% for percent fines was used to indicate that sediment was impacting the water body. If this was the case then stream bank erosion inventories were completed to determine if stream bank erosion was the contributor of sediment impact. The target for stream bank erosion TMDLs is 80% bank stability.

Monitoring Points

As a stream bank erosion TMDL is site specific and can not be measured by a pour point value as some of the other constituents can there is no monitoring point to be measured for identification. One possible way of tracking changes within the system would be various Wohlman pebble counts in locations that have been used in the past. For the stream bank erosion TMDL the water body has been divided into six segments. These segments are as follows: upper, lower upper, upper middle, lower middle, upper lower, and lower lower.

Load Capacity

The load capacity estimates the quantity of pollutant the water body is believed to be able to assimilate and still maintain beneficial use full support status. Load capacity (72.4 t/yr) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability.

Estimates of Existing Pollutant Loads

The estimated existing load for the sediment TMDL to be completed on McKinney Creek is elevated above the load capacity of the water body. The existing load (646.6 t/yr) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability. This value represents the estimated existing loads of pollutant occurring in the water body.

Load Allocation

The wasteload allocation for McKinney Creek is limited to construction storm water wasteload allocations. The wasteload allocation for construction storm water was determined by allocating 2% of the load capacity to construction storm water. As this is the only point source in the watershed the allocation for sediment is 1.2 t/yr.

Background, MOS, and FG are values attributed to the watershed that are beyond human control, provide some flexibility within the watershed, and allow for future growth within the watershed. Calculations for each of these components were determined in various ways:

- Background loads are not determined for a stream bank erosion TMDL because it is implied that background loads occur within the target.
- The MOS for the sediment TMDLs for McKinney Creek is 10% of the load capacity (7.2 t/yr).
- The FG for the sediment TMDL for McKinney Creek is 5% of the load capacity (3.6 t/yr).

The final load allocations for nonpoint source activity are determined by reducing the load capacity of the water body by the wasteload allocations, background, MOS, and FG values. Therefore, the load allocation for sediment is 60.3 t/yr.

Table 95. McKinney Creek load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
sediment	2.5	80	72.4	646.6	88.8

[1]Sediment- target measured in percent bank stability, load capacity and existing load measured in t/yr.

Table 96. McKinney Creek load allocations.

Pollutant	MOS	BG	FG	Available Load	Wasteload allocation	Load Allocation
Sediment (t/yr)	7.2	Implicit	3.6	61.5	1.2	60.3

[a]Implicit- Background (BG) is implied within the target, Margin of safety (MOS) and Future growth (FG),

Table 97. McKinney Creek stream bank erosion values.

Reach	Existing Erosion rate	Proposed Erosion rate	Existing Total Erosion	Proposed Total Erosion	Erosion Rate Percent Reduction	Percent of Existing Total Load
Upper	45.0	6.8	126.1	19.0	85	19
Lower upper	25.0	7.7	24.5	7.5	69	4
Upper middle	62.0	14.7	83.8	19.8	76	13
Lower middle	7.3	5.0	7.9	5.4	32	1
Upper lower	82.4	2.7	171.3	5.5	97	26
Lower	96.3	6.2	233.1	15.1	94	36
Total			646.6	72.4		

[a]See Appendix 4 for site descriptions
[b]Erosion rates measured in tons/mile/year. Total erosion measured in tons/year.

Reasonable Assurance

There is reasonable assurance that implementation as the next step of the water body management process will occur. First this document includes implementation strategies that are in the subsequent pages. Idaho's water quality standards identify designated agencies that are responsible for evaluating and modifying best management practices to protect impaired water bodies. The state has committed itself to having implementation plans developed within 18 months of approval of the TMDL document. DEQ, the WAG, and the designated agencies will develop implementation plans, and DEQ will incorporate them into the states water quality management plan. Also in measuring the effectiveness of an implementation activity, DEQ will reassess the support status of the water body to determine if the water body has reached full support status. If full support status has not been obtained then further implementation will be necessary and further reassessment completed until full support status is completed. If full support status is completed then the requirements of the TMDL will be considered completed.

Dairy Creek

Through the subbasin assessment process, it has been identified that the water quality of Dairy Creek is being impacted by a pollutant as well as impacting the water quality of Mormon Reservoir. The pollutant of concern in the water body has been found to be sediment. Nutrients are a pollutant to Mormon Reservoir and as Dairy Creek is delivering an excessive load of nutrients to the reservoir a nutrient TMDL is being completed to restore water quality of the reservoir. For a summary of load reductions for this water body see Table 98, for load allocations see Table 99, and for segmental breakdown of stream bank erosion values see Table 100.

Design Conditions

Sediment impacts a water body during higher flow events, when the carrying capacity of the stream is greater and erosion is more likely to occur. Typically the higher flow events occur during spring runoff or periodically during storm situations; as a result the critical period for sediment on Dairy Creek has been identified as occurring from March to May. During this period the critical flow for the water body based on predicted hydrograph is 7.4 cfs. As sediment has been found to be occurring as a result of stream bank erosion the critical flow period is less important in the development of stream bank stability TMDLs.

Nutrients in a water body that is delivering to a storage system are more likely to impact a reservoir when the creek is supplying the reservoir with water as a reservoir acts as a sink and drops nutrients out of the water column. As a result the critical period for nutrients for Dairy Creek is from March to June, and the critical flow for this period based on the predicted hydrograph is 6.0 cfs. The average flow during the critical period aids in determining the loading capacity of the water body.

Target Selection

Target selections are discussed in more complete detail in the subbasin assessment (SBA) portion of this document under the section *Analysis Process* (page 45). The water quality standards for the various pollutants can also be viewed in Appendix 3.

Sediment is impacting the water quality of Dairy Creek in the form of bedload sediment. Suspended sediment measured during drought years is not impacting water quality of the stream, however bedload sediment measured in the form of percent fines indicates that sediment is impacting water quality. A value greater than 35% for percent fines was used to indicate that sediment was impacting the water body. If this was the case then stream bank erosion inventories were completed to determine if stream bank erosion was the contributor of sediment impact. The target for stream bank erosion TMDLs is 80% bank stability.

Nutrients are not impacting the water quality of Dairy Creek, but as the creek discharges into a reservoir a TMDL is completed to limit nutrient delivery. The target for water bodies discharging into a storage system is 0.050 mg/L. This goal should aid limiting excessive delivery of nutrients to the reservoir. As a result 0.050 mg/L is the target to be used in the development of a nutrient TMDL for Dairy Creek.

Monitoring Points

As a stream bank erosion TMDL is site specific and can not be measured by a pour point value as some of the other constituents can there is no monitoring point to be measured for identification. One possible way of tracking changes within the system would be various Wohlman pebble counts in locations that have been used in the past. For the stream bank erosion TMDL the water body has been divided into three segments. These segments are as follows: upper and lower.

The monitoring point for nutrient collection for TMDL development was located at the road crossing upstream of the reservoir. This site was located approximately a mile upstream of the reservoir. This site should be used to identify further trends or to assess the water body in the future.

Load Capacity

The load capacities of the two TMDLs to be completed on Dairy Creek have been determined in different ways.

- The load capacity (1.62 lbs/day) for nutrient TMDLs was calculated based on target selection and average critical flow.
- The load capacity (52.2 t/yr) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability.

These values represent the estimated quantity of pollutant the water bodies are believed to be able to assimilate and still maintain beneficial uses full support status and meet water quality standards.

Estimates of Existing Pollutant Loads

The estimated existing loads for the two TMDLs to be completed on Dairy Creek are elevated above the load capacity of the water body:

- The existing load (2.7 lbs/day) for the nutrient TMDL was calculated based on average annual values of TP and the average critical flow.
- The existing load (1,677.2 t/yr) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability.

These values represent the estimated existing load of pollutant occurring in the water body.

Load Allocation

The wasteload allocation for Dairy Creek is limited to construction storm water wasteload allocations. The wasteload allocation for construction storm water was determined by allocating 2% of the load capacity to construction storm water. As this is the only point source in the watershed the allocation for nutrients is 0.01 lbs/day and for sediment is 0.9 t/yr.

Background, MOS, and FG are values attributed to the watershed that are beyond human control, provide some flexibility within the watershed, and allow for future growth within the watershed. Calculations for each of these components were determined in various ways:

- Background for TP has been established as being 0.02 mg/L, which accounts for a load allocation of 0.65 lbs/day.
- Background loads are not determined for a stream bank erosion TMDL because it is implied that background loads occur within the target.

- The MOS for the TMDLs for Dairy Creek is 10% of the load capacity, for nutrients 0.16 lbs/day and for sediment 5.2 t/yr.
- The FG for the TMDLs for Dairy Creek is 5% of the load capacity, for nutrients 0.08 lbs/day and for sediment 2.6 t/yr.

The final load allocations for nonpoint source activity are determined by reducing the load capacity of the water body by the wasteload allocations, background, MOS, and FG values. Therefore, the load allocation for nutrients is 0.71 lbs/day and for sediment is 43.5 t/yr.

Table 98. Dairy Creek load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
sediment	7.4	80	52.2	1677.2	96.9
nutrient	6.0	0.050	1.62	2.75	41.2

[a]Sediment- target measured in percent bank stability, load capacity and existing load measured in t/yr.
[b]Nutrient- target measured in mg/L, load capacity and existing load measured in lbs/day.

Table 99. Dairy Creek load allocations.

Pollutant	MOS	BG	FG	Available Load	Wasteload allocation	Load Allocation
Sediment (t/yr)	5.2	Implicit	2.6	44.4	0.9	43.5
Nutrient (lbs/day)	0.16	0.65	0.08	0.73	0.01	0.71

[a]Implicit- Background (BG) is implied within the target.
[b]Margin of safety (MOS) and Future growth (FG), n.a.-not applicable.

Table 100. Dairy Creek stream erosion values.

Reach	Existing Erosion rate	Proposed Erosion rate	Existing Total Erosion	Proposed Total Erosion	Erosion Rate Percent Reduction	Percent of Existing Total Load
Upper	76.9	6.2	166.7	13.4	92	10
Lower	399.5	10.3	1,510.5	38.8	97	90
Total			1,677.2	52.2		

[a]See Appendix 4 for site descriptions
[b]Erosion rates measured in tons/mile/year. Total erosion measured in tons/year.

Reasonable Assurance

There is reasonable assurance that implementation as the next step of the water body management process will occur. First this document includes implementation strategies that are in the subsequent pages. Idaho's water quality standards identify designated agencies that are responsible for evaluating and modifying best management practices to protect impaired water bodies. The state has committed itself to having implementation plans developed within 18 months of approval of the TMDL document. DEQ, the WAG, and the designated agencies will develop implementation plans, and DEQ will incorporate them into the states water quality management plan. Also in measuring the effectiveness of an implementation activity, DEQ will reassess the support status of the water body to determine if the water body has reached full support status. If full support status has not been obtained then further implementation will be necessary and further reassessment completed until full support status is completed. If full support status is completed then the requirements of the TMDL will be considered completed.

Camas Creek

Through the subbasin assessment process, it has been identified that the water quality and beneficial uses of Camas Creek are being impacted by pollutants. The pollutants of concern in the water body have been found to be sediment, nutrients, and temperature. Nutrients are a pollutant to Camas Creek as well as to Magic Reservoir the receiving water of Camas Creek. For a summary of load reductions for this water body see Table 101, for load allocations see Table 102, and for segmental breakdown of stream bank erosion values see Table 103.

Lack of flow is the largest impact to beneficial uses of Camas Creek. Camas Creek is impaired due to a lack of flow; however, EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for water bodies impaired by pollution, a TMDL has not been established for Camas Creek for flow.

Design Conditions

Sediment impacts a water body during higher flow events, when the carrying capacity of the stream is greater and erosion is more likely to occur. Typically the higher flow events occur during spring runoff or periodically during storm situations; as a result the critical period for sediment on Camas Creek has been identified as occurring from March to May. During this period the critical flow for the water body based on predicted hydrograph is 543.0 cfs. As sediment has been found to be occurring as a result of stream bank erosion the critical flow period is less important in the development of stream bank stability TMDLs.

Nutrients in a water body that is delivering to a storage system are more likely to impact a reservoir year round as the reservoir acts as a sink and drops nutrients out of solution. As a result the critical period for nutrients for Camas Creek is from March to October, and the critical flow for this period based on the predicted hydrograph is 228.4 cfs. The average flow during the critical period aids in determining the loading capacity of the water body.

Solar radiation impacts the temperature of a water body during the late spring and summer months, when canopy cover is the major component that maintains cooler water temperatures. As a result the critical period for temperature on Camas Creek has been identified as occurring from April to September. During this time, the critical flow for the water body, based on the predicted hydrograph, is 257.5 cfs. As a temperature TMDL targets canopy cover of a creek, the critical flow is less important in the development of a temperature TMDL.

Target Selection

Target selections are discussed in more complete detail in the subbasin assessment (SBA) portion of this document under the section *Analysis Process* (page 45). The water quality standards for the various pollutants can also be viewed in Appendix 3.

Sediment is impacting beneficial uses of Camas Creek in the form of bedload sediment. Suspended sediment measured during drought years is not impacting water quality of the stream, however bedload sediment measured in the form of percent fines indicates that sediment is impacting water quality. A value greater than 35% for percent fines was used to indicate that sediment was impacting the water body. If this was the case then stream bank erosion inventories were completed to determine if stream bank erosion was the contributor of sediment impact. The target for stream bank erosion TMDLs is 80% bank stability.

Nutrients are impacting the CWAL beneficial uses of Camas Creek, but as the creek discharges into a reservoir the TMDL is completed to limit nutrient delivery to the reservoir. The target for water bodies discharging into a storage system is 0.050 mg/L. This goal should aid limiting excessive delivery of nutrients to the reservoir. As a result 0.050 mg/L is the target to be used in the development of a nutrient TMDL for Camas Creek.

Temperature is impacting the water quality of Camas Creek and canopy cover is the method used to determine the amount of solar radiation the creek is receiving. Vegetation type and bankfull width were used to characterize the creek, then the Alvord Lake TMDL was used to aid in target selection based on these values (Table 66). The targets for the segments of the water body are as follows: upper (30%), lower upper (30%), upper middle (18%), lower middle (15%) and lower (15%). If the aerial photo estimates are less than the appropriate canopy cover target, canopy cover needs to be improved within the segment. Aerial photo estimations likely underestimate segments that have higher cover and overestimate segments that have lower cover, however in terms of the creek as a whole, these balance themselves out. This should be taken into account however during the implementation phase; the more critical areas are likely to be the areas with the least amount of canopy cover.

Monitoring Points

As a stream bank erosion TMDL is site specific and can not be measured by a pour point value as some of the other constituents can there is no monitoring point to be measured for identification. One possible way of tracking changes within the system would be various Wohlman pebble counts in locations that have been used in the past. For the stream bank erosion TMDL the water body has been divided into six segments. These segments are as follows: upper, lower upper, upper middle, lower middle, upper lower, and lower.

The monitoring point for nutrient collection for TMDL development was located in the lower portion of the watershed, at the Macon Flat bridge road crossing. This site was located approximately 4.5 miles upstream of the reservoir. This site should be used to identify further trends or to assess the water body in the future.

The monitoring point for temperature collection for TMDL development occurred at the USGS gauge station about 4 miles upstream of the mouth and in the spring complex of the creek about 4 miles downstream of the headwaters. Both sites can be used to identify further trends within the system; however the lower site upstream of the mouth should be used to determine if water quality standards on Camas Creek are being met.

Load Capacity

The load capacities of the three TMDLs to be completed on Camas Creek have been determined in different ways.

- The load capacity (61.55 lbs/day) for nutrient TMDLs was calculated based on target selection and average critical flow.
- The load capacity (512.6 t/yr) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability.
- The load capacity (4,506,297.5 kWh/day) for the temperature TMDL was determined by converting canopy cover targets to solar radiation.

These values represent the estimated quantity of pollutant the water bodies are believed to be able to assimilate and still maintain beneficial uses full support status and meet water quality standards.

Estimates of Existing Pollutant Loads

The estimated existing loads for the three TMDLs to be completed on Camas Creek are elevated above the load capacity of the water body:

- The existing load (130.49 lbs/day) for nutrient TMDLs was calculated based on average annual values of TP and the average critical flow.
- The existing load (8,018.8 t/yr) for stream bank erosion TMDLs was set at calculations that took into account erosion rates, bank height, and quantity of stream bank stability.
- The existing load (4,969,018.0 kWh/day) for temperature TMDLs was calculated as the sum of the amount of solar radiation for the segments of the creek.

These values represent the estimated existing load of pollutant occurring in the water body.

Load Allocation

The wasteload allocation for Camas Creek is limited to construction storm water wasteload allocations. The wasteload allocation for construction storm water was determined by allocating 2% of the load capacity to construction storm water. As this is the only point source in the watershed the allocation for nutrients is 0.55 lbs/day and for sediment is 8.7 t/yr. Wasteload allocations are not made for construction storm water for a temperature TMDL based on canopy cover.

Background, MOS, and FG are values attributed to the watershed that are beyond human control, provide some flexibility within the watershed, and allow for future growth within the watershed. Calculations for each of these components were determined in various ways:

- The BG for TP has been established as being 0.02 mg/L, which accounts for a load allocation of 24.62 lbs/day.
- The BG is not determined for a stream bank erosion TMDL because it is implied that background loads occur within the target.
- The BG, MOS, and FG are not determined for a temperature TMDL because the canopy cover targets are set for natural potential vegetation.
- The MOS for the TMDLs for Camas Creek is 10% of the load capacity, for nutrients 6.16 lbs/day and for sediment 51.3 t/yr.
- The FG for the TMDLs for Camas Creek is 5% of the load capacity, for nutrients 3.08 lbs/day and for sediment 25.6 t/yr.

The final load allocations for nonpoint source activity are determined by reducing the load capacity of the water body by the wasteload allocations, background, MOS, and FG values. Therefore, the load allocation for nutrients is 27.15 lbs/day, for sediment is 427.0 t/yr, and for temperature is 4,506,297.5 kWh/day.

Table 101. Camas Creek load reductions.

Pollutant	Critical flow (cfs)	Target	Load capacity	Existing Load	Percent reduction
sediment	543.0	80	512.6	8,018.8	93.6
nutrient	228.4	0.050	61.55	130.49	52.8
temperature	257.5	30-30-18-15-15	4,506,297.5	4,969,018.0	9.3

[a]Sediment- target measured in percent bank stability, load capacity and existing load measured in t/yr.
[b]Nutrient- target measured in mg/L, load capacity and existing load measured in lbs/day.
[c]Temperature – target measured in percent canopy cover, load capacity and existing load measured in kWh/day.

Table 102. Camas Creek load allocations.

Pollutant	MOS	BG	FG	Available Load	Wasteload allocation	Load Allocation
Sediment (t/yr)	51.3	implicit	25.6	435.7	8.7	427.0
Nutrient (lbs/day)	6.16	24.62	3.08	27.70	0.55	27.15
Temperature (kWh/day)	n.a.	n.a.	n.a.	4,506,297.5	0.0	4,506,297.5

[a]Implicit- Background (BG) is implied within the target.
[b]Margin of safety (MOS) and Future growth (FG), n.a.-not applicable.

Table 103. Camas Creek stream erosion values.

Reach	Existing Erosion rate	Proposed Erosion rate	Existing Total Erosion	Proposed Total Erosion	Erosion Rate Percent Reduction	Percent of Existing Total Load
Upper	6.2	3.5	29.3	16.8	43	0.4
Lower upper	28.2	11.3	267.7	107.3	60	3.3
Upper middle	2.4	1.7	19.0	13.1	31	0.2
Lower middle	5.4	4.1	68.6	13.1	24	0.9
Upper lower	535.9	23.5	7,566.6	331.5	96	94.4
Lower	9.6	4.4	67.6	30.9	54	0.8
Total			8,018.8	512.6		

[a]See Appendix 4 for site descriptions
[b]Erosion rates measured in tons/mile/year. Total erosion measured in tons/year

Reasonable Assurance

There is reasonable assurance that implementation as the next step of the water body management process will occur. First this document includes implementation strategies that are in the subsequent pages. Idaho's water quality standards identify designated agencies that are responsible for evaluating and modifying best management practices to protect impaired water bodies. The state has committed itself to having implementation plans developed within 18 months of approval of the TMDL document. DEQ, the WAG, and the designated agencies will develop implementation plans, and DEQ will incorporate them into the states water quality management plan. Also in measuring the effectiveness of an implementation activity, DEQ will reassess the support status of the water body to determine if the water body has reached full support status. If full support status has not been obtained then further implementation will be necessary and further reassessment completed until full support status is completed. If full support status is completed then the requirements of the TMDL will be considered completed.

Construction Storm Water and TMDL Wasteload Allocations

Construction Storm Water

The Clean Water Act requires operators of construction sites to obtain permit coverage to discharge storm water to a water body or to a municipal storm sewer. In Idaho, EPA has issued a general permit for storm water discharges from construction sites. In the past storm water was treated as a non-point source of pollutants. However, because storm water can be managed on site through management practices or when discharged through a discrete conveyance such as a storm sewer, it now requires a National Pollution Discharge Elimination System (NPDES) Permit.

The Construction General Permit (CGP)

If a construction project disturbs more than one acre of land (or is part of larger common development) that will disturb more than one acre), the operator is required to apply for permit coverage from EPA after developing a site-specific Storm Water Pollution Prevention Plan.

Storm Water Pollution Prevention Plan (SWPPP)

In order to obtain the Construction General Permit operators must develop a site-specific Storm Water Pollution Prevention Plan. The operator must document the erosion, sediment, and pollution controls they intend to use, inspect the controls periodically and maintain the *best management practices* (BMPs) through the life of the project.

Construction Storm Water Requirements

When a stream is on Idaho's § 303(d) list and has a TMDL developed DEQ now incorporates a gross wasteload allocation (WLA) for anticipated construction storm water activities. TMDLs developed in the past that did not have a WLA for construction storm water activities will also be considered in compliance with provisions of the TMDL if they obtain a CGP under the NPDES program and implement the appropriate Best Management Practices. Typically there are specific requirements you must follow to be consistent with any local pollutant allocations. Many communities throughout Idaho are currently developing rules for post-construction storm water management. Sediment is usually the main pollutant of concern in storm water from construction sites. The application of specific best management practices from *Idaho's Catalog of Storm Water Best Management Practices for Idaho Cities and Counties* is generally sufficient to meet the standards and requirements of the General Construction Permit, unless local ordinances have more stringent and site specific standards that are applicable.

Future Growth Potential

Nonpoint source future growth potential such as subdivision development or similar ventures within the stream corridors must provide sufficient protection of nutrient (TP and nitrogen), sediment (TSS and stream bank stability), temperature (canopy cover), and bacteria pollutants so that TMDL targets and goals are maintained. Subdivisions, although defined as a nonpoint source, have the tendency with septic systems to produce more TP than what would be allocated to straight agricultural lands. This assumes that the septic discharge enters the associated water body. Consequently, the TP loading limit for subsurface sewage disposal (IDAPA 58.01.03) or wastewater land application (IDAPA 58.01.17) is contained in the

TMDL as part of the nonpoint source load allocation. Point source wasteload allocations are enforceable under NPDES permits and IDAPA 58.01.02.400. Moreover, nonpoint source load allocations are enforceable under the Idaho Administrative Procedures Act (IDAPA 58.01.02.250). In addition, DEQ policy relative to subdivision development within stream corridors should be reviewed in consultation with local planning and zoning restrictions for appropriate consideration.

5.2 Implementation Strategies

The implementation strategy of the Camas Creek Subbasin is written to provide a brief outline of the implementation plan to be completed 18 months after EPA approval of this document. This strategy will also provide reasonable assurance that Best Management Practices (BMPs) will be implemented to help bring back beneficial use support status. 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. The implementation strategy is discussed further in Appendix 6.

5.3 Conclusions

This section of the document will summarize available data and assessment outcomes for each of the water bodies.

The following table (Table 104) describes the available data and whether or not assessment criteria were met in the water bodies.

Table 104. Summary of assessment criteria results.

Data type	Soldier Creek	Willow Creek	Beaver Creek	Little Beaver Creek	Camp Creek	Elk Creek	Corral Creek	Wild Horse Creek	Camas Creek	McKinney Creek	Dairy Creek
Hydrology	P/I	P	P	P	P/I	P/I	P/I	I/P	P/I	P/I	I
Flow alteration	IBU	NIBU	NIBU	NIBU	IBU	IBU	IBU	IBU	IBU	IBU	IBU
Biological data (BURP)	NA	MBU	MBU	MBU	NA	NA	NA	NA	NA	NMBU	NA
DO, pH, turbidity	M	M	M	DG	M	M	M	M	M	M	M
TSS	M	M	M	M	M	M	M	M	M	M	M
% fines	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Bank Erosion	NM	NM	M	DG	NM	NM	NM	NM	NM	NM	NM
Nutrients	M	M	M	DG	M	M	M	M	NM	NM	NM
Bacteria	M	M	M	DG	M	M	M	NM	M	M	M
Temperature	NM	NM	NM	NM	NM	DG	NM	NM	NM	DG	DG
Canopy Cover	NM	NM	NM	NM	NM	NA	NM	NM	NM	NA	NA

[a] Abbreviations: P-perennial water body, I-intermittent water body, NIBU-not impacting beneficial uses, IBU-impacting beneficial uses, MBU-meeting beneficial uses, NA-not assessed, DG-data gap, M-meeting standards or assessment criteria, NM-not meeting standards or assessment criteria.

The following table (Table 105) describes the assessment outcomes made for the Camas Creek Subbasin through the SBA and TMDL process. Table 106 identifies the water bodies impacted by flow alteration.

Table 105. Summary of assessment outcomes.

Water body	Assessment Unit	Pollutant	TMDL Done	Recommended Changes to §303(d) List	Justification
Camas Creek	ID17040220SK013_05 ID17040220SK001_05 ID17040220SK007_05 ID17040220SK018_04 ID17040220SK018_03 ID17040220SK018_02	SED, TEMP, NUT	Yes	Add TEMP, NUT, and QALT,	Not meeting standards, delivery to storage system, channelization and diversion
Soldier Creek	ID17040220SK011_02	SED, TEMP	Yes	Remove DO, BACT, NUT Add TEMP	Meeting standards or criteria, Not meeting standards
Mormon Reservoir	ID17040220SK023L_0L	SED, TEMP	Yes	Remove BAC	Meeting standards
Little Beaver Creek	ID17040220SK004_02	TEMP	Yes	Add TEMP	Not meeting standards
Camp Creek	ID17040220SK002_02 ID17040220SK002_03	SED, TEMP	Yes	Remove UNK, Add SED, TEMP, QALT	Not meeting standards or criteria, channelization and storage
Willow Creek	ID17040220SK003_04	TEMP	Yes	Remove UNK, Add TEMP	Not meeting standards
Elk Creek	ID17040220SK006_02	SED	Yes	Remove UNK, Add SED	Not meeting criteria
McKinney Creek	ID17040220SK025_02	SED	Yes	Remove UNK, Add SED	Not meeting criteria
Corral Creek	ID17040220SK015_03	SED, TEMP	Yes	Remove UNK, Add SED, TEMP	Not meeting criteria or standards
Cow Creek	ID17040220SK018_02	SED, NUT	Yes	Remove UNK, Add SED, NUT	Delivering to storage system, not meeting criteria
Wild Horse Creek	ID17040220SK021_03	SED, BACT, TEMP	Yes	Remove UNK, Add SED, BACT, TEMP	Not meeting criteria or standards
Beaver Creek	ID17040220SK004_02	TEMP	Yes	Remove UNK, Add TEMP	Not meeting standards
Dairy Creek	ID17040220SK024_02	SED, NUT	Yes	Add SED, NUT	Delivering to storage system, not meeting criteria

[a]1998 303(d) 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.
[b]AU- assessment unit (assessment unit prefix to values in table is Id17040221), SED- sediment, NUT- nutrient, BAC- bacteria, TEMP- temperature, DO- dissolved oxygen, QALT- flow alteration, UNK-Unknown.
[c]303(d) listed segments will remain the same; however TMDLs will be completed on the entire stretch of the creek.

Table 106. Flow alteration impacting water quality.

Water body Segment	Assessment Unit	Flow Alteration Impacting Water Quality
Camas Creek	ID17040220SK013_05	Yes
Camas Creek	ID17040220SK001_05	Yes
Camas Creek	ID17040220SK007_05	Yes
Camas Creek	ID17040220SK018_04	Yes
Camas Creek	ID17040220SK018_03	Yes
Camas Creek	ID17040220SK018_02	Yes
Soldier Creek	ID17040220SK011_02	Yes
Mormon Reservoir	ID17040220SK023L_0L	Yes
Little Beaver Creek	ID17040220SK004_02	No
Camp Creek	ID17040220SK002_02	Yes
Camp Creek	ID17040220SK002_03	Yes
Willow Creek	ID17040220SK003_04	No
Elk Creek	ID17040220SK006_02	Yes
McKinney Creek	ID17040220SK025_02	Yes
Corral Creek	ID17040220SK015_03	Yes
Cow Creek	ID17040220SK018_02	No
Wild Horse Creek	ID17040220SK021_03	Yes
Beaver Creek	ID17040220SK004_02	No
Dairy Creek	ID17040220SK024_02	Yes

References Cited

American Geologic Institute. 1962. Dictionary of geologic terms. Garden City, NY: Doubleday and Company. 545 p.

Armantrout, N.B., compiler. 1998. Glossary of aquatic habitat inventory terminology. American Fisheries Society. Bethesda, MD. 136 p.

Batt, P.E. 1996. Governor Philip E. Batt's Idaho bull trout conservation plan. State of Idaho, Office of the Governor. Boise, ID. 20 p + appendices.

Boettger, S. 1998. The Willow Creek Project. http://www.mtnvisions.com/Aurora/wrltproj.html

Buhidar, B. 2001. The Big Wood River Watershed Management Plan. Idaho Department of Environmental Quality (DEQ). Twin Falls, ID.

Buhidar, B. 2002. Personal communication. Watershed attributes. Idaho Department of Environmental Quality (DEQ). Twin Falls, ID.

Buhidar, B. 2004. Personal communication. Nitrogen sources. Idaho Department of Environmental Quality (DEQ). Twin Falls, ID.

Chorney, R. 2005. Personal communication. Drinking water facilities using surface water as water source. Idaho Department of Environmental Quality (DEQ). Twin Falls, ID.

Clark, W.H. 2003. Camas Creek (HUC 17040220) Subbasin Assessment Macroinvertebrate Biotic Integrity Report. Idaho Department of Environmental Quality (DEQ). Boise, ID.

Clean Water Act (Federal water pollution control act), 33 U.S.C. § 1251-1387. 1972.

Clean Water Act (Federal water pollution control act), U.S.C. § 1251-1387 (1972).

CPC, Climate Prediction Center. 2004. http://www.cpc.ncep.noaa.gov/soilmst/eclim_frame.html

CSCD, Camas Soil Conservation District. 2001. Personal communication. Pollution control efforts in the Camas Subbasin.

Denny, P. 1980. Solute movement in submerged angiosperms. Biology Review. 55:65-92.

DEQ, Idaho Department of Environmental Quality. 1993-2001. BURP information. BURP files. DEQ, Twin Falls, ID.

DEQ, Idaho Department of Environmental Quality. 2002. Stream Channel Alteration Permit Application files. DEQ. Twin Falls, ID.

DEQ, Idaho Department of Environmental Quality. 2004. NPDES information. NPDES files. DEQ, Twin falls, ID.

EIFAC, European Inland Fisheries Advisory Commission. 1964. Water quality criteria for European freshwater fish. Report on finely divided solids and inland fisheries. EIFAC (European Inland Fisheries Advisory Commission) Technical Paper 1.

EPA, United States Environmental Protection Agency. 1996. Biological criteria: technical guidance for streams and small rivers. EPA 822-B-96-001. Washington, DC: U.S. Environmental Protection Agency, Office of Water. 162 p.

EPA, United States Environmental Protection Agency. 1997. Guidelines for preparation of the comprehensive state water quality assessments (305(b) reports) and electronic updates: supplement. EPA-841-B-97-002B. Washington, DC: U.S. Environmental Protection Agency. 105 p.

EPA, United States Environmental Protection Agency. 1986. Quality criteria for water, 1986. USEPA, Report 440/5-86-001, Washington D. C.

EPA, United States Environmental Protection Agency. 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 p.

EPA, United States Environmental Protection Agency. 2004. Aquatic biodiversity, Carlsons Trophic State Index. http://www.epa.gov/bioiweb1/aquatic/carlson.html

ESCD, Elmore Soil Conservation District. 2002. Personal communication. Pollution control efforts in the Camas Subbasin.

Federal Interagency Stream Restoration Working Group. 1998. Stream Corridor Restoration Principles:, Process, and Practices 1998. http://www.nrcs.usda.gov/technical/stream_restoration/newgra.html

Franson, M.A.H., L.S. Clesceri, A.E. Greenberg, and A.D. Eaton, editors. 1998. Standard methods for the examination of water and wastewater, twentieth edition. American Public Health Association. Washington, DC. 1,191 p.

Gordon, N., McMahon, T., Finlayson, B. 1992. Steam Hydrology an Introduction for Ecologists.

Grafe CS, Mebane CA, McIntyre MJ, Essig DA, Brandt DH, Mosier DT. 2002. The Idaho Department of Environmental Quality water body assessment guidance, 2nd ed. Boise, ID: Department of Environmental Quality. 114 p.

Grafe, C.S., ed. 2000. Idaho Small Stream Ecological Assessment Framework: An Integrated Approach. Idaho Department of Environmental Quality; Boise, Idaho.

Greenborg AE, Clescevi LS, Eaton AD, editors. 1992. Standard methods for the examination of water and wastewater, 18th edition. Washington, DC: American Public Health Association. 900 p.

Hammon, B., Lamb, B., Nichols, D., Kasper, B., Boyd, M. 2003. Alvord Lake Subbasin Total Maximum Daily Load (TMDL) & Water Quality Management Plan (WQMP). State of Oregon Department of Environmental Quality. Bend, Oregon.

Herron, T. 2004. Personal communication. Stream bank erosion inventories. Idaho Department of Environmental Quality (DEQ). Idaho Falls, ID.

Hughes RM. 1995. Defining acceptable biological status by comparing with reference condition. In: Davis WS, Simon TP, editors. Biological assessment and criteria: tools for water resource planning. Boca Raton, FL: CRC Press. p 31-48.

Idaho Code § 3615. Creation of watershed advisory groups.

Idaho Code § 39.3611. Development and implementation of total maximum daily load or equivalent processes.

Idaho Code § 39.3611. Development and implementation of total maximum daily load or equivalent processes.

Idaho Code § 39.3615. Creation of watershed advisory groups.

IDAPA 58.01.02. Idaho water quality standards and wastewater treatment requirements.

IDAPA 58.01.02. Idaho water quality standards and wastewater treatment requirements.

IDFG, Idaho Fish and Game. 1987. Federal Aid in Fish Restoration, Job Performance Report, Project F-71-R-11. Boise (ID):IDFG.

IDFG, Idaho Fish and Game. 1993. Federal Aid in Fish Restoration, Job Performance Report, Project F-71-R-15. Boise (ID):IDFG.

IDFG, Idaho Fish and Game. 1994. Federal Aid in Fish Restoration, Job Performance Report, Project F-71-R-17. Boise (ID):IDFG.

IDFG, Idaho Fish and Game. 2001. Fisheries Management Plan 2001-2006. Boise (ID); IDFG.

IDFG. Idaho Fish and Game. 1995. Federal Aid in Fish Restoration, Job Performance Report, Project F-71-R-18. Boise (ID):IDFG.

IDHW, Idaho Department of Health and Welfare. 1980. Idaho water quality status report 1980. Boise, ID: Idaho Division of Environmental Quality.

IDOC, Idaho Department of Commerce. 2001. http://www.idoc.state.id.us

IDPR, Idaho Department of Parks and Recreation. 2005. Online Boating Guide. http://www.idahoparks.org/rec/Boating/boating_guide.cfm?RegionID=10

IDWR, Idaho Department of Water Resources. 2002. Water right search. http://www.idwr.idaho.gov/apps/ExtSearch/SearchWRAJ.asp

IDWR, Idaho Department of Water Resources. 2003. Personal communication. Domestic water supply water rights information. Twin Falls, ID.

ISAS, Illinois State Academy of Science. 2004. http://www.il-st-acad-sci.org/kingdom/geol1005.html

Karr JR. 1991. Biological integrity: a long-neglected aspect of water resource management. Ecological Applications 1:66-84.

Lay, C. 2000. Bruneau Subbasin Assessment and Total Maximum Daily Loads of the 303(d) Water Bodies. Idaho Department of Environmental Quality (DEQ). Twin Falls, ID.

Lay, C. 2003. Raft River Subbasin Assessment and Total Maximum Daily Loads. Idaho Department of Environmental Quality (DEQ). Twin Falls, ID.

Lay, C. 2003. Goose Creek Subbasin Assessment and Total Maximum Daily Loads. Idaho Department of Environmental Quality (DEQ). Twin Falls, ID.

Mebane, C. 2002. Personal communication. WBAG applicability. Idaho Department of Environmental Quality (DEQ). Boise, ID.

MSU, Michigan State University, Institute of Water Research. 2005. RUSLE on line soil erosion assessment tool. K factor. http://www.iwr.msu.edu/rusle/kfactor.htm.

Newcombe, C.P. and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management. Volume 16(4): 693-727.

NRCS, Natural Resource Conservation Services. 2001a. www.id.nrcs.usda.gov/sol/sol2.html

NRCS, Natural Resource Conservation Services. 2001b. http://idsnow.id.nrcs.usda.gov

NWOSSP, Northwestern Ohio Soil Survey Project. 2004. http://www2.wcoil.com/~rfrobb/Geogloss.html

Prescott, S.C., Winslow, C.A. 1931. Elements of Water Bacteriology. New York:John Wiley & Sons, Inc.

Rand GW, editor. 1995. Fundamentals of aquatic toxicology: effects, environmental fate, and risk assessment, second edition. Washington, DC: Taylor and Francis. 1125 p.

Rand, G.W., editor. 1995. Fundamentals of aquatic toxicology: effects, environmental fate, and risk assessment, second edition. Taylor and Francis. Washington, DC. 1,125 p.

Ritter. D. F. 1978. Process Geomorphology (pg. 170). WM. C. Brown Company Publishers. Dubuque, Iowa.

Shumar, M. 2004. Personal communication. Aerial photo interpretation of canopy cover for 303(d) listed water bodies. Idaho Department of Environmental Quality (DEQ). Boise, ID.

Staufer, S. 2003. Personal communication. Drinking water facilities using surface water as water source. Department of Environmental Quality (DEQ). Twin Falls, ID.

Strahler AN. 1957. Quantitative analysis of watershed geomorphology. American Geophysical Union Transactions 38:913-920.

Strahler, A.N. 1957. Quantitative analysis of watershed geomorphology. Transactions American Geophysical Union 38:913-920.

USBR, United States Bureau of Reclamation. 2001. Agrimet http://www.usbr.gov/pn/agrimet/yearrpt.html

USDA, United States Department of Agriculture. 1981. Soil Survey of Camas County Area Idaho. USDA Soil Conservation Service, USDA Science and Education Administration, USDI BLM, University of Idaho College of Agriculture, Idaho Agricultural Experiment Station. Kimberly, ID.

USDA, United States Department of Agriculture. 1999. A procedure to estimate the response of aquatic systems to changes in phosphorus and nitrogen inputs. National Water and Climate Center, Natural Resources Conservation Service. Portland, OR.

USFS, United States Department of Agriculture Forest Service. 1990. Salmonid-habitat relationships in the Western United States: a review and indexed bibliography (p.11).

USFS, United States Department of Agriculture Forest Service. General Technical Report RM-188. Fort Collins (CO): Rocky Mountain Forest and Range Experiment Station, USDA FS.

USFWS, United States Fish and Wildlife Service. 2001. Threatened and endangered species. http://idahoes.fws.gov

USGS, United States Geological Survey. 1987. Hydrologic unit maps. Denver, CO: United States Geological Survey. Water supply paper 2294. 63 p.

USGS, United States Geological Survey. 1987. Hydrologic unit maps. Water supply paper 2294. United States Geological Survey. Denver, CO. 63 p.

USGS, United States Geological Survey. 2004. http://nwis.waterdata.usgs.gov/id/nwis/sw

USNO, United States Naval Observatory. 2001. http://aa.usno.navy.mil/data/docs/RS_OneYear.html

Warren, C (IDFG). 2001. Personal communication. Bull trout presence in Camas Creek and Little Wood River Subbasins. Idaho Fish and Game (IDFG). Jerome, ID.

Water Environment Federation. 1987. The Clean Water Act of 1987. Water Environment Federation. Alexandria, VA. 318 p.

Water Pollution Control Federation. 1987. The Clean Water Act of 1987. Alexandria, VA: Water Pollution Control Federation. 318 p.

Water Quality Act of 1987, Public Law 100-4 (1987).

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

Water quality planning and management, 40 CFR 130.

Water quality planning and management, 40 CFR Part 130.

Welch, E. B., Jacoby, J.M., Horner, R.R., & Seeley, M.R. 1987. Nuisance biomass levels of periphytic algae in streams. Hydrobiologia 157, pp. 161-166.

Wetzel, R.G. 1983. Limnology. Saunders College Publishing. New York, NY.

WRCC, Western Regional Climate Center. 2001. http://www.wrcc.dri.edu/summary/climsmid.html

Zaroban, D. 2003. Occurrence, Distribution, and Age Class Structure of Fishes in the Camas Creek and Little Wood River Subbasins. Idaho Department of Environmental Quality (DEQ). Boise, ID.

Zaroban, D., Mulvey, M., Maret, T., Hughes, R., and Merrit, G. Classification of Species Attributes for Pacific Northwest Freshwater Fishes. Northwest Science. 1999.

Geographic Information System (GIS) Coverages

ArcView Coverage. 1992-1996.

City coverage. Idaho Department of Water Resources. 1980s.

County coverage. Idaho Department of Water Resources. 1990.

Ecoregion coverage. International Columbia Basin Ecosystem Management Project. 1994.

Hydrological unit code coverage. Idaho Department of Water Resources. 1998.

Hydrology coverage. United States Geological Survey.

Land ownership coverage. Idaho Department of Water Resources. 1975-1992.

Landuse coverage. United States Geological Survey & Idaho Department of Water Resources. 1970/1990.

Mine coverage. Idaho Department of Lands. 1999.

NPDES facilities coverage. Idaho Department of Environmental Quality/ United States Environmental Protection Agency. 1998.

Vegetation coverage. United States Department of Agriculture Forest Service. 1998.

Water quality limited streams. Idaho Department of Environmental Quality. 1993-1996.

GIS Coverages:

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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.

Acre-Foot
A volume of water that would cover an acre to a depth of one foot. Often used to quantify reservoir storage and the annual discharge of large rivers.

Adsorption
The adhesion of one substance to the surface of another. Clays, for example, can adsorb phosphorus and organic molecules

Aeration
A process by which water becomes charged with air directly from the atmosphere. Dissolved gases, such as oxygen, are then available for reactions in water.

Aerobic
Describes life, processes, or conditions that require the presence of oxygen.

Assessment Database (ADB)
The ADB is a relational database application designed for the U.S. Environmental Protection Agency for tracking water quality assessment data, such as use attainment and causes and sources of impairment. States need to track this information and many other types of assessment data for thousands of water bodies, and integrate it into meaningful reports. The ADB is designed to make this process accurate, straightforward, and user-friendly for participating states, territories, tribes, and basin commissions.

Adfluvial
Describes fish whose life history involves seasonal migration from lakes to streams for spawning.

Adjunct
In the context of water quality, adjunct refers to areas directly adjacent to focal or refuge habitats that have been degraded by human or natural disturbances and do not presently support high diversity or abundance of native species.

Alevin	A newly hatched, incompletely developed fish (usually a salmonid) still in nest or inactive on the bottom of a water body, living off stored yolk.
Algae	Non-vascular (without water-conducting tissue) aquatic plants that occur as single cells, colonies, or filaments.
Alluvium	Unconsolidated recent stream deposition.
Ambient	General conditions in the environment. 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).
Anadromous	Fish, such as salmon and sea-run trout, that live part or the majority of their lives in the salt water but return to fresh water to spawn.
Anaerobic	Describes the processes that occur in the absence of molecular oxygen and describes the condition of water that is devoid of molecular oxygen.
Anoxia	The condition of oxygen absence or deficiency.
Anthropogenic	Relating to, or resulting from, the influence of human beings on nature.
Anti-Degradation	Refers to the U.S. Environmental Protection Agency's interpretation of the Clean Water Act goal that states and tribes maintain, as well as restore, water quality. This applies to waters that meet or are of higher water quality than required by state standards. State rules provide that the quality of those high quality waters may be lowered only to allow important social or economic development and only after adequate public participation (IDAPA 58.01.02.051). In all cases, the existing beneficial uses must be maintained. State rules further define lowered water quality to be 1) a measurable change, 2) a change adverse to a use, and 3) a change in a pollutant relevant to the water's uses (IDAPA 58.01.02.003.56).
Aquatic	Occurring, growing, or living in water.
Aquifer	An underground, water-bearing layer or stratum of permeable rock, sand, or gravel capable of yielding of water to wells or springs.
Assemblage (aquatic)	An association of interacting populations of organisms in a given water body; for example, a fish assemblage, or a benthic macroinvertebrate assemblage (also see Community) (EPA 1996).
Assimilative Capacity	The ability to process or dissipate pollutants without ill effect to beneficial uses.
Autotrophic	An organism is considered autotrophic if it uses carbon dioxide as its main source of carbon. This most commonly happens through photosynthesis.

Batholith	A large body of intrusive igneous rock that has more than 40 square miles of surface exposure and no known floor. A batholith usually consists of coarse-grained rocks such as granite.
Bedload	Material (generally sand-sized or larger sediment) that is carried along the streambed by rolling or bouncing.
Beneficial Use	Any of the various uses of water, including, but not limited to, aquatic biota, recreation, water supply, wildlife habitat, and aesthetics, which are recognized in water quality standards.
Beneficial Use Reconnaissance Program (BURP)	A program for conducting systematic biological and physical habitat surveys of water bodies in Idaho. BURP protocols address lakes, reservoirs, and wadeable streams and rivers
Benthic	Pertaining to or living on or in the bottom sediments of a water body
Benthic Organic Matter.	The organic matter on the bottom of a water body.
Benthos	Organisms living in and on the bottom sediments of lakes and streams. Originally, the term meant the lake bottom, but it is now applied almost uniformly to the animals associated with the lake and stream bottoms.
Best Management Practices (BMPs)	Structural, nonstructural, and managerial techniques that are effective and practical means to control nonpoint source pollutants.
Best Professional Judgment	A conclusion and/or interpretation derived by a trained and/or technically competent individual by applying interpretation and synthesizing information.
Biochemical Oxygen Demand (BOD)	The amount of dissolved oxygen used by organisms during the decomposition (respiration) of organic matter, expressed as mass of oxygen per volume of water, over some specified period of time.
Biological Integrity	1) The condition of an aquatic community inhabiting unimpaired water bodies of a specified habitat as measured by an evaluation of multiple attributes of the aquatic biota (EPA 1996). 2) The ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the natural habitats of a region (Karr 1991).
Biomass	The weight of biological matter. Standing crop is the amount of biomass (e.g., fish or algae) in a body of water at a given time. Often expressed as grams per square meter.
Biota	The animal and plant life of a given region.
Biotic	A term applied to the living components of an area.

Clean Water Act (CWA) The Federal Water Pollution Control Act (commonly known as as the Clean Water Act), as last reauthorized by the Water Quality Act of 1987, establishes a process for states to use to develop information on, and control the quality of, the nation's water resources.

Coliform Bacteria A group of bacteria predominantly inhabiting the intestines of humans and animals but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms (also see Fecal Coliform Bacteria).

Colluvium Material transported to a site by gravity.

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

Conductivity The ability of an aqueous solution to carry electric current, expressed in micro (µ) mhos/cm at 25 °C. Conductivity is affected by dissolved solids and is used as an indirect measure of total dissolved solids in a water sample.

Cretaceous The final period of the Mesozoic era (after the Jurassic and before the Tertiary period of the Cenozoic era), thought to have covered the span of time between 135 and 65 million years ago.

Criteria In the context of water quality, numeric or descriptive factors taken into account in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels, and to limit the number of violations per year. EPA 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.

Cultural Eutrophication The process of eutrophication that has been accelerated by human-caused influences. Usually seen as an increase in nutrient loading (also see Eutrophication).

Culturally Induced Erosion Erosion caused by increased runoff or wind action due to the work of humans in deforestation, cultivation of the land, overgrazing, and disturbance of natural drainages; the excess of erosion over the normal for an area (also see Erosion).

Debris Torrent The sudden down slope movement of soil, rock, and vegetation on steep slopes, often caused by saturation from heavy rains.

Decomposition The breakdown of organic molecules (e.g., sugar) to inorganic molecules (e.g., carbon dioxide and water) through biological and nonbiological processes.

Depth Fines Percent by weight of particles of small size within a vertical core of volume of a streambed or lake bottom sediment. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 6.5 mm depending on the observer and methodology used. The depth sampled varies but is typically about one foot (30 cm).

Designated Uses Those water uses identified in state water quality standards that must be achieved and maintained as required under the Clean Water Act.

Discharge The amount of water flowing in the stream channel at the time of measurement. Usually expressed as cubic feet per second (cfs).

Dissolved Oxygen (DO) The oxygen dissolved in water. Adequate DO is vital to fish and other aquatic life.

Disturbance Any event or series of events that disrupts ecosystem, community, or population structure and alters the physical environment.

E. coliE. coli Short for *Escherichia Coli*, *E. coliE. coli* are a group of bacteria that are a subspecies of coliform bacteria. Most *E. coliE. coli* are essential to the healthy life of all warm-blooded animals, including humans. Their presence is often indicative of fecal contamination.

Ecology The scientific study of relationships between organisms and their environment; also defined as the study of the structure and function of nature.

Ecological Indicator A characteristic of an ecosystem that is related to, or derived from, a measure of a biotic or abiotic variable that can provide quantitative information on ecological structure and function. An indicator can contribute to a measure of integrity and sustainability. Ecological indicators are often used within the multimetric index framework.

Ecological Integrity The condition of an unimpaired ecosystem as measured by combined chemical, physical (including habitat), and biological attributes (EPA 1996).

Ecosystem The interacting system of a biological community and its non-living (abiotic) environmental surroundings.

Effluent A discharge of untreated, partially treated, or treated wastewater into a receiving water body.

Endangered Species Animals, birds, fish, plants, or other living organisms threatened with imminent extinction. Requirements for declaring a species as endangered are contained in the Endangered Species Act.

Environment	The complete range of external conditions, physical and biological, that affect a particular organism or community.
Eocene	An epoch of the early Tertiary period, after the Paleocene and before the Oligocene.
Eolian	Windblown, referring to the process of erosion, transport, and deposition of material by the wind.
Ephemeral Stream	A stream or portion of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no long continued supply from melting snow or other sources. Its channel is at all times above the water table. (American Geologic Institute 1962).
Erosion	The wearing away of areas of the earth's surface by water, wind, ice, and other forces.
Eutrophic	From Greek for "well nourished," this describes a highly productive body of water in which nutrients do not limit algal growth. It is typified by high algal densities and low clarity.
Eutrophication	1) Natural process of maturing (aging) in a body of water. 2) The natural and human-influenced process of enrichment with nutrients, especially nitrogen and phosphorus, leading to an increased production of organic matter.
Exceedance	A violation (according to DEQ policy) of the pollutant levels permitted by water quality criteria.
Existing Beneficial Use or Existing Use	A beneficial use actually attained in waters on or after November 28, 1975, whether or not the use is designated for the waters in Idaho's *Water Quality Standards and Wastewater Treatment Requirements* (IDAPA 58.01.02).
Exotic Species	A species that is not native (indigenous) to a region.
Extrapolation	Estimation of unknown values by extending or projecting from known values.
Fauna	Animal life, especially the animals characteristic of a region, period, or special environment.
Fecal Coliform Bacteria	Bacteria found in the intestinal tracts of all warm-blooded animals or mammals. Their presence in water is an indicator of pollution and possible contamination by pathogens (also see Coliform Bacteria).
Fecal Streptococci	A species of spherical bacteria including pathogenic strains found in the intestines of warm-blooded animals.
Feedback Loop	In the context of watershed management planning, a feedback loop is a process that provides for tracking progress toward goals and revising actions according to that progress.
Fixed-Location Monitoring	Sampling or measuring environmental conditions continuously or repeatedly at the same location.

Flow	See Discharge.
Fluvial	In fisheries, this describes fish whose life history takes place entirely in streams but migrate to smaller streams for spawning.
Focal	Critical areas supporting a mosaic of high quality habitats that sustain a diverse or unusually productive complement of native species.
Fully Supporting	In compliance with water quality standards and within the range of biological reference conditions for all designated and exiting beneficial uses as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).
Fully Supporting Cold Water	Reliable data indicate functioning, sustainable cold water biological assemblages (e.g., fish, macroinvertebrates, or algae), none of which have been modified significantly beyond the natural range of reference conditions (EPA 1997).
Fully Supporting but Threatened	An intermediate assessment category describing water bodies that fully support beneficial uses, but have a declining trend in water quality conditions, which if not addressed, will lead to a "not fully supporting" status.
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.
Grab Sample	A single sample collected at a particular time and place. It may represent the composition of the water in that water column.
Gradient	The slope of the land, water, or streambed surface.
Ground Water	Water found beneath the soil surface saturating the layer in which it is located. Most ground water originates as rainfall, is free to move under the influence of gravity, and usually emerges again as stream flow.
Growth Rate	A measure of how quickly something living will develop and grow, such as the amount of new plant or animal tissue produced per a given unit of time, or number of individuals added to a population.
Habitat	The living place of an organism or community.
Headwater	The origin or beginning of a stream.
Hydrologic Basin	The area of land drained by a river system, a reach of a river and its tributaries in that reach, a closed basin, or a group of streams forming a drainage area (also see Watershed).

Hydrologic Cycle	The cycling of water from the atmosphere to the earth (precipitation) and back to the atmosphere (evaporation and plant transpiration). Atmospheric moisture, clouds, rainfall, runoff, surface water, ground water, and water infiltrated in soils are all part of the hydrologic cycle.
Hydrologic Unit	One of a nested series of numbered and named watersheds arising from a national standardization of watershed delineation. The initial 1974 effort (USGS 1987) described four levels (region, subregion, accounting unit, cataloging unit) of watersheds throughout the United States. The fourth level is uniquely identified by an eight-digit code built of two-digit fields for each level in the classification. Originally termed a cataloging unit, fourth field hydrologic units have been more commonly called subbasins. Fifth and sixth field hydrologic units have since been delineated for much of the country and are known as watershed and subwatersheds, respectively.
Hydrologic Unit Code (HUC)	The number assigned to a hydrologic unit. Often used to refer to fourth field hydrologic units.
Hydrology	The science dealing with the properties, distribution, and circulation of water.
Impervious	Describes a surface, such as pavement, that water cannot penetrate.
Influent	A tributary stream.
Inorganic	Materials not derived from biological sources.
Instantaneous	A condition or measurement at a moment (instant) in time.
Intergravel Dissolved Oxygen	The concentration of dissolved oxygen within spawning gravel. Consideration for determining spawning gravel includes species, water depth, velocity, and substrate.
Intermittent Stream	1) A stream that flows only part of the year, such as when the ground water table is high or when the stream receives water from springs or from surface sources such as melting snow in mountainous areas. The stream ceases to flow above the streambed when losses from evaporation or seepage exceed the available stream flow. 2) A stream that has a period of zero flow for at least one week during most years.
Interstate Waters	Waters that flow across or form part of state or international boundaries, including boundaries with Indian nations.
Irrigation Return Flow	Surface (and subsurface) water that leaves a field following the application of irrigation water and eventually flows into streams.

Key Watershed	A watershed that has been designated in Idaho Governor Batt's *State of Idaho Bull Trout Conservation Plan* (1996) as critical to the long-term persistence of regionally important trout populations.
Knickpoint	Any interruption or break of slope.
Land Application	A process or activity involving application of wastewater, surface water, or semi-liquid material to the land surface for the purpose of treatment, pollutant removal, or ground water recharge.
Limiting Factor	A chemical or physical condition that determines the growth potential of an organism. This can result in a complete inhibition of growth, but typically results in less than maximum growth rates.
Limnology	The scientific study of fresh water, especially the history, geology, biology, physics, and chemistry of lakes.
Load Allocation (LA)	A portion of a water body's load capacity for a given pollutant that is given to a particular nonpoint source (by class, type, or geographic area).
Load(ing)	The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. Loading is the product of flow (discharge) and concentration.
Loading Capacity (LC)	A determination of how much pollutant a water body can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, and a margin of safety, it becomes a total maximum daily load.
Loam	Refers to a soil with a texture resulting from a relative balance of sand, silt, and clay. This balance imparts many desirable characteristics for agricultural use.
Loess	A uniform wind-blown deposit of silty material. Silty soils are among the most highly erodible.
Lotic	An aquatic system with flowing water such as a brook, stream, or river where the net flow of water is from the headwaters to the mouth.
Luxury Consumption	A phenomenon in which sufficient nutrients are available in either the sediments or the water column of a water body, such that aquatic plants take up and store an abundance in excess of the plants' current needs.
Macroinvertebrate	An invertebrate animal (without a backbone) large enough to be seen without magnification and retained by a 500µm mesh (U.S. #30) screen.

Macrophytes	Rooted and floating vascular aquatic plants, commonly referred to as water weeds. These plants usually flower and bear seeds. Some forms, such as duckweed and coontail (*Ceratophyllum sp.*), are free-floating forms not rooted in sediment.
Margin of Safety (MOS)	An implicit or explicit portion of a water body's loading capacity set aside to allow the uncertainly about the relationship between the pollutant loads and the quality of the receiving water body. This is a required component of a total maximum daily load (TMDL) and is often incorporated into conservative assumptions used to develop the TMDL (generally within the calculations and/or models). The MOS is not allocated to any sources of pollution.
Mass Wasting	A general term for the down slope movement of soil and rock material under the direct influence of gravity.
Mean	Describes the central tendency of a set of numbers. The arithmetic mean (calculated by adding all items in a list, then dividing by the number of items) is the statistic most familiar to most people.
Median	The middle number in a sequence of numbers. If there are an even number of numbers, the median is the average of the two middle numbers. For example, 4 is the median of 1, 2, 4, 14, 16; 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).
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 water body.
Mouth	The location where flowing water enters into a larger water body.
National Pollution Discharge Elimination System (NPDES)	A national program established by the Clean Water Act for permitting point sources of pollution. Discharge of pollution from point sources is not allowed without a permit.
Natural Condition	A condition indistinguishable from that without human-caused disruptions.
Nitrogen	An element essential to plant growth, and thus is considered a nutrient.

Nodal	Areas that are separated from focal and adjunct habitats, but serve critical life history functions for individual native fish.
Nonpoint Source	A dispersed source of pollutants, generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernable point or origin. They include, but are not limited to, irrigated and non-irrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.
Not Assessed (NA)	A concept and an assessment category describing water bodies that have been studied, but are missing critical information needed to complete an assessment.
Not 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).
Not Fully Supporting	Not in compliance with water quality standards or not within the range of biological reference conditions for any beneficial use as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).
Not Fully Supporting Cold Water	At least one biological assemblage has been significantly modified beyond the natural range of its reference condition (EPA 1997).
Nuisance	Anything which is injurious to the public health or an obstruction to the free use, in the customary manner, of any waters of the state.
Nutrient	Any substance required by living things to grow. An element or its chemical forms essential to life, such as carbon, oxygen, nitrogen, and phosphorus. Commonly refers to those elements in short supply, such as nitrogen and phosphorus, which usually limit growth.
Nutrient Cycling	The flow of nutrients from one component of an ecosystem to another, as when macrophytes die and release nutrients that become available to algae (organic to inorganic phase and return).
Oligotrophic	The Greek term for "poorly nourished." This describes a body of water in which productivity is low and nutrients are limiting to algal growth, as typified by low algal density and high clarity.
Organic Matter	Compounds manufactured by plants and animals that contain principally carbon.
Orthophosphate	A form of soluble inorganic phosphorus most readily used for algal growth.

Oxygen-Demanding Materials Those materials, mainly organic matter, in a water body that consume oxygen during decomposition.

Parameter A variable, measurable property whose value is a determinant of the characteristics of a system, such as temperature, dissolved oxygen, and fish populations are parameters of a stream or lake.

Partitioning The sharing of limited resources by different races or species; use of different parts of the habitat, or the same habitat at different times. Also the separation of a chemical into two or more phases, such as partitioning of phosphorus between the water column and sediment.

Pathogens Disease-producing organisms (e.g., bacteria, viruses, parasites).

Perennial Stream A stream that flows year-around in most years.

Periphyton Attached microflora (algae and diatoms) growing on the bottom of a water body or on submerged substrates, including larger plants.

Pesticide Substances or mixtures of substances intended for preventing, destroying, repelling, or mitigating any pest. Also, any substance or mixture intended for use as a plant regulator, defoliant, or desiccant.

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.

Phased TMDL A total maximum daily load (TMDL) that identifies interim load allocations and details further monitoring to gauge the success of management actions in achieving load reduction goals and the effect of actual load reductions on the water quality of a water body. Under a phased TMDL, a refinement of load allocations, wasteload allocations, and the margin of safety is planned at the outset.

Phosphorus An element essential to plant growth, often in limited supply, and thus considered a nutrient.

Physiochemical In the context of bioassessment, the term is commonly used to mean the physical and chemical factors of the water column that relate to aquatic biota. Examples in bioassessment usage include saturation of dissolved gases, temperature, pH, conductivity, dissolved or suspended solids, forms of nitrogen, and phosphorus. This term is used interchangeable with the terms “physical/chemical” and “physicochemical.”

Plankton Microscopic algae (phytoplankton) and animals (zooplankton) that float freely in open water of lakes and oceans.

Point Source	A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable "point" of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.
Pollutant	Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.
Pollution	A very broad concept that encompasses human-caused changes in the environment which alter the functioning of natural processes and produce undesirable environmental and health effects. This includes human-induced alteration of the physical, biological, chemical, and radiological integrity of water and other media.
Population	A group of interbreeding organisms occupying a particular space; the number of humans or other living creatures in a designated area.
Pretreatment	The reduction in the amount of pollutants, elimination of certain pollutants, or alteration of the nature of pollutant properties in wastewater prior to, or in lieu of, discharging or otherwise introducing such wastewater into a publicly owned wastewater treatment plant.
Primary Productivity	The rate at which algae and macrophytes fix carbon dioxide using light energy. Commonly measured as milligrams of carbon per square meter per hour.
Protocol	A series of formal steps for conducting a test or survey.
Qualitative	Descriptive of kind, type, or direction.
Quality Assurance (QA)	A program organized and designed to provide accurate and precise results. Included are the selection of proper technical methods, tests, or laboratory procedures; sample collection and preservation; the selection of limits; data evaluation; quality control; and personnel qualifications and training. The goal of QA is to assure the data provided are of the quality needed and claimed (Rand 1995, EPA 1996).
Quality Control (QC)	Routine application of specific actions required to provide information for the quality assurance program. Included are standardization, calibration, and replicate samples. QC is implemented at the field or bench level (Rand 1995, EPA 1996).
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 water body that is minimally impaired and is representative of reference conditions for similar water bodies.
Representative Sample	A portion of material or water that is as similar in content and consistency as possible to that in the larger body of material or water being sampled.
Resident	A term that describes fish that do not migrate.
Respiration	A process by which organic matter is oxidized by organisms, including plants, animals, and bacteria. The process converts organic matter to energy, carbon dioxide, water, and lesser constituents.
Riffle	A relatively shallow, gravelly area of a streambed with a locally fast current, recognized by surface choppiness. Also an area of higher streambed gradient and roughness.
Riparian	Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a water body.
River	A large, natural, or human-modified stream that flows in a defined course or channel, or a series of diverging and converging channels.
Runoff	The portion of rainfall, melted snow, or irrigation water that flows across the surface, through shallow underground zones (interflow), and through ground water to creates streams.
Sediments	Deposits of fragmented materials from weathered rocks and organic material that were suspended in, transported by, and eventually deposited by water or air.
Settleable Solids	The volume of material that settles out of one liter of water in one hour.
Species	1) A reproductively isolated aggregate of interbreeding organisms having common attributes and usually designated by a common name. 2) An organism belonging to such a category.
Spring	Ground water seeping out of the earth where the water table intersects the ground surface.
Stagnation	The absence of mixing in a water body.
Stenothermal	Unable to tolerate a wide temperature range.

Stratification	A Department of Environmental Quality classification method used to characterize comparable units (also called classes or strata).
Stream	A natural water course containing flowing water, at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.
Stream Order	Hierarchical ordering of streams based on the degree of branching. A first-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher order streams result from the joining of two streams of the same order.
Storm Water Runoff	Rainfall that quickly runs off the land after a storm. In developed watersheds the water flows off roofs and pavement into storm drains that may feed quickly and directly into the stream. The water often carries pollutants picked up from these surfaces.
Stressors	Physical, chemical, or biological entities that can induce adverse effects on ecosystems or human health.
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 Fines	Sediments of small size deposited on the surface of a streambed or lake bottom. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 605 mm depending on the observer and methodology used. Results are typically expressed as a percentage of observation points with fine sediment.
Surface Runoff	Precipitation, snow melt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants in rivers, streams, and lakes. Surface runoff is also called overland flow.
Surface Water	All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors that are directly influenced by surface water.

Suspended Sediments	Fine material (usually sand size or smaller) that remains suspended by turbulence in the water column until deposited in areas of weaker current. These sediments cause turbidity and, when deposited, reduce living space within streambed gravels and can cover fish eggs or alevins.
Taxon	Any formal taxonomic unit or category of organisms (e.g., species, genus, family, order). The plural of taxon is taxa (Armantrout 1998).
Tertiary	An interval of geologic time lasting from 66.4 to 1.6 million years ago. It constitutes the first of two periods of the Cenozoic Era, the second being the Quaternary. The Tertiary has five subdivisions, which from oldest to youngest are the Paleocene, Eocene, Oligocene, Miocene, and Pliocene epochs.
Thalweg	The center of a stream's current, where most of the water flows.
Threatened Species	Species, determined by the U.S. Fish and Wildlife Service, which are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.
Total Maximum Daily Load (TMDL)	A TMDL is a water body's loading capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual bases. TMDL = Loading 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 Dissolved Solids	Dry weight of all material in solution in a water sample as determined by evaporating and drying filtrate.
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 1995) 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.
Toxic Pollutants	Materials that cause death, disease, or birth defects in organisms that ingest or absorb them. The quantities and exposures necessary to cause these effects can vary widely.
Tributary	A stream feeding into a larger stream or lake.

Trophic State	The level of growth or productivity of a lake as measured by phosphorus content, chlorophyll *a* concentrations, amount (biomass) of aquatic vegetation, algal abundance, and water clarity.
Total Dissolved Solids	Dry weight of all material in solution in a water sample as determined by evaporating and drying filtrate.
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 1995) 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.
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Tributary	A stream feeding into a larger stream or lake.
Trophic State	The level of growth or productivity of a lake as measured by phosphorus content, chlorophyll *a* concentrations, amount (biomass) of aquatic vegetation, algal abundance, and water clarity.
Turbidity	A measure of the extent to which light passing through water is scattered by fine suspended materials. The effect of turbidity depends on the size of the particles (the finer the particles, the greater the effect per unit weight) and the color of the particles.
Vadose Zone	The unsaturated region from the soil surface to the ground water table.
Wasteload Allocation (WLA)	The portion of receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. Wasteload allocations specify how much pollutant each point source may release to a water body.
Water body	A stream, river, lake, estuary, coastline, or other water feature, or portion thereof.
Water Column	Water between the interface with the air at the surface and the interface with the sediment layer at the bottom. The idea derives from a vertical series of measurements (oxygen, temperature, phosphorus) used to characterize water.

Water Pollution	Any alteration of the physical, thermal, chemical, biological, or radioactive properties of any waters of the state, or the discharge of any pollutant into the waters of the state, which will or is likely to create a nuisance or to render such waters harmful, detrimental, or injurious to public health, safety, or welfare; to fish and wildlife; or to domestic, commercial, industrial, recreational, aesthetic, or other beneficial uses.
Water Quality	A term used to describe the biological, chemical, and physical characteristics of water with respect to its suitability for a beneficial use.
Water Quality Criteria	Levels of water quality expected to render a body of water suitable for its designated uses. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, or industrial processes.
Water Quality Limited	A label that describes water bodies for which one or more water quality criterion is not met or beneficial uses are not fully supported. Water quality limited segments may or may not be on a §303(d) list.
Water Quality Management Plan	A state or area-wide waste treatment management plan developed and updated in accordance with the provisions of the Clean Water Act.
Water Quality Modeling	The prediction of the response of some characteristics of lake or stream water based on mathematical relations of input variables such as climate, stream flow, and inflow water quality.
Water Quality Standards	State-adopted and EPA-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.
Water Table	The upper surface of ground water; below this point, the soil is saturated with water.
Watershed	1) All the land which contributes runoff to a common point in a drainage network, or to a lake outlet. Watersheds are infinitely nested, and any large watershed is composed of smaller "subwatersheds." 2) The whole geographic region which contributes water to a point of interest in a water body.
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.
Young of the Year	Young fish born the year captured, evidence of spawning activity.

Appendix 1. Unit Conversion Chart

Table 107. Metric - English unit conversions.

	English Units	Metric Units	To Convert	Example
Distance	Miles (mi)	Kilometers (km)	1 mi = 1.61 km 1 km = 0.62 mi	3 mi = 4.83 km 3 km = 1.86 mi
Length	Inches (in) Feet (ft)	Centimeters (cm) Meters (m)	1 in = 2.54 cm 1 cm = 0.39 in 1 ft = 0.30 m 1 m = 3.28 ft	3 in = 7.62 cm 3 cm = 1.18 in 3 ft = 0.91 m 3 m = 9.84 ft
Area	Acres (ac) Square Feet (ft^2) Square Miles (mi^2)	Hectares (ha) Square Meters (m^2) Square Kilometers (km^2)	1 ac = 0.40 ha 1 ha = 2.47 ac 1 ft^2 = 0.09 m^2 1 m^2 = 10.76 ft^2 1 mi^2 = 2.59 km^2 1 km^2 = 0.39 mi^2	3 ac = 1.20 ha 3 ha = 7.41 ac 3 ft^2 = 0.28 m^2 3 m^2 = 32.29 ft^2 3 mi^2 = 7.77 km^2 3 km^2 = 1.16 mi^2
Volume	Gallons (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 2. Endangered, Threatened, and Sensitive Species.

Table 108. Endangered, threatened and sensitive species.

Species	Counties			
	Blaine	Camas	Gooding	Elmore
Listed Species				
Canada lynx	X	X		X
Gray wolf	X	X	X	X
Bull trout	X	X		X
Bald eagle	X		X	X
Bliss Rapids snail	X		X	X
Ute ladies'-tresses	X	X	X	X
Utah valvata snail			X	
Snake River physa snail			X	X
Banbury springs limpet				
Idaho springsnail				X
Candidate species				
Slick spot peppergrass				X
Sensitive species				
Mammals				
Yuma myotis	X			X
Long-eared myotis	X		X	
Long-legged myotis	X			
Western small-footed myotis	X			X
Townsend's big eared bat	X		X	
Pygymy rabbit	X	X	X	X
Wolverine	X	X		X
Western pipistrelle			X	
Kit fox				X
Fisher				X
Merriam's shrew				X
Fish				
Redband trout	X	X	X	X
Wood River sculpin	X	X		
Leatherside chub				
Shoshone sculpin			X	
White sturgeon				X
Birds				
Columbian sharp-tailed grouse	X			X
Greater sage-grouse	X	X	X	X
Yellow-billed cuckoo	X			X
White-faced ibis	X			
Trumpeter swan	X	X	X	
Northern goshawk	X	X		X
Ferruginous hawk	X			X
Black tern	X	X		
Long billed curlew	X	X	X	X

Species	Counties			
	Blaine	Camas	Gooding	Elmore
Flammulated owl	X	X		X
Boreal owl	X			
Three-toed woodpecker	X			
Western burrowing owl				X
Mountain quail				X
White-headed woodpecker				X
Invertebrates				
Idaho Dunes tiger beetle	X			
California floater				
Amphibians and Reptiles				
Western toad	X	X		X
Northern leopard frog	X	X	X	X
Columbia spotted frog	X	X	X	X
Common garter snake	X	X	X	X
Short-horned lizard	X	X	X	X
Mojave black-collared lizard	X	X	X	X
Woodhouse's toad				X
Idaho giant salamander				X
Longnose snake				X
Ground snake				X
Plants				
Slender moonwart	X	X	X	X
Meadow pussytoes	X			
Mourning milkvetch	X	X	X	X
Bugleg goldenweed	X	X		X
Obscure phacelia	X			
Least phacelia		X		
Idaho douglasia				X
Davis' peppergrass				X
Lichens				
Wovenspore lichen				X

[a]Data collected from USFWS Web site (2001).

Appendix 3. State and Site-Specific Standards and Criteria

Table 109. Surface water quality criteria.

IDAPA58.01.02	Criteria
200.	**General Surface Water Quality Criteria**. The following general water quality criteria apply to all surface waters of the state, in addition to the water quality criteria set forth for specifically designated waters.
01.	**Hazardous Materials**. Surface waters of the state shall be free from hazardous materials in concentrations found to be of public health significance or to impair designated beneficial uses.
02.	**Toxic Substances**. Surface waters of the state shall be free from toxic substances in concentrations that impair designated beneficial uses.
03.	**Deleterious Materials**. Surface waters of the state shall be free from deleterious materials in concentrations that impair designated uses.
04.	**Radioactive Materials**.
a.	Radioactive materials or radioactivity shall not exceed the values listed in the Code of Federal Regulations, Title 10, Chapter 1, Part 20, Appendix B, Table 2, Effluent Concentrations, Column 2.
b.	Radioactive materials or radioactivity shall not exceed concentrations required to meet the standards set forth in Title 10, Chapter 1, Part 20 of the Code of Federal Regulations for maximum exposure of critical human organs in the case of foodstuffs harvested from these waters for human consumption.
05.	**Floating, Suspended or Submerged Matter**. Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses.
06.	**Excess Nutrients**. Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses.
07.	**Oxygen-Demanding Materials**. Surface waters of the state shall be free from oxygen-demanding materials in concentrations that would result in an anaerobic water condition.
08.	**Sediment.** Sediment shall not exceed quantities specified in Sections 250 and 252, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses.
09.	**Natural Background Conditions**. When natural background conditions exceed any applicable water quality criteria set forth in Sections 210,250, 251, 252, or 253 the applicable water quality criteria shall not apply; instead, pollutant levels shall not exceed the natural background conditions, except that temperature levels may be increased above natural background conditions when allowed under Section 401.
250.	**Surface Water Quality Criteria for Aquatic Life Use Designations**
01.	**General Criteria**
a.	Hydrogen Ion Concentration(pH) values within the range of 6.5 to 9.0
b.	The total concentration of dissolved gas not exceeding 110% of saturation at atmospheric pressure at the point of sample collection
c.	Total chlorine residual. One hour average concentration not to exceed 19ug/l or four day average concentration not to exceed 11ug/l
02.	**Cold Water**
a.	Dissolved Oxygen Concentrations exceeding 6 mg/l at all times. In lakes and reservoirs this standard does not always apply
b.	Water temperatures of 22 degrees C or less with a maximum daily average of no greater than 19 degrees C.

IDAPA58.01.02	Criteria
c.	Temperature in lakes shall have no measurable change from natural background conditions.
d.	Ammonia. The following criteria are not to be exceeded dependent on the temperature and pH of the water body
i.	Acute Criterion. The one hour average concentration of total ammonia nitrogen is not to exceed more than once every 3 years, the calculated CMC value
ii.	Chronic Criterion. The thirty day average concentration of total ammonia nitrogen is not to exceed, more than once every 3 years, the calculated CCC value.
d.	Turbidity, below any applicable mixing zone set by the Department, shall not exceed background turbidity by more than 50NTU instantaneously or more than 25 NTU for more than 10 consecutive days.
e.	**Salmonid spawning**: waters designated for salmonid spawning are to exhibit the following characteristics during the spawning period and incubation for the particular species inhabiting those waters:
i.(1)	Dissolved Oxygen. Intergravel dissolved oxygen. One day minimum of not less than 5.0 mg/l.
i.(2)	Water-Column dissolved Oxygen. One day minimum of not less than 6.0 mg/l or 90% of saturation, whichever is greater
ii.	Water temperatures of 13 degrees C or less with a maximum daily average no greater than 9 degrees C
251.	**Surface water quality criteria for recreation use designations**
01.	**Primary Contact recreation**. Waters designated for primary contact recreation are not to contain *E. coli* bacteria significant to the public health in concentrations exceeding
b.	For all other waters designated for primary contact recreation, a single sample of four hundred six *E. coli* organisms per 100ml or
c.	A geometric mean of 126 *E. coli* organisms per 100ml based on a minimum of 5 samples taken every 3 to 5 days over a 30 day period.
02.	**Secondary Contact recreation**. Waters designated for secondary contact recreation are not to contain *E. coli* bacteria significant to the public health in concentrations exceeding:
a.	A single sample of 576 *E. coli* organisms per 100ml or
b.	A geometric mean of 126 *E. coli* organisms per 100 ml based on a minimum of 5 samples taken every 3 to 5 days over a 30day period.
252.	**Surface Water Quality Criteria for Water Supply Use Designation**
02.	**Agricultural.** Water quality criteria for agricultural water supplies will generally be satisfied by the water quality criteria set for in Section 200.
03.	**Industrial**. Water quality criteria for industrial water supplies will generally be satisfied by the general water quality criteria set forth in Section 200.
253.	**Surface Water Quality Criteria for Wildlife and Aesthetic Use Designations**
01.	**Wildlife Habitats**. Water quality criteria for wildlife habitats will generally be satisfied by the general water quality criteria set forth in Section 200.
02.	**Aesthetics**. Water quality criteria for aesthetics will generally be satisfied by the general water quality criteria set forth in Section 200.
401.03	**Treatment Requirements**. Unless more stringent limitations are necessary to meet the applicable requirements of Sections 200 through 300 or unless specific exemptions are made pursuant to Subsection 080.02 or 401.05, wastewaters discharged into surface waters of the state must have the following characteristics:
a.	Temperature-the wastewater must not affect the receiving water outside the mixing zone so that
i.	The temperature of the receiving water or of downstream waters will interfere with designated beneficial uses

IDAPA58.01.02	Criteria
ii.	Daily and seasonal temperature cycles characteristic of the water body are not maintained
iii.	If the water is designated for warm water aquatic life, the induced variation is more than plus two (+2) degrees C
iv.	If the water is designated for cold water aquatic life, seasonal cold water aquatic life, or salmonid spawning, the induced variation is more than plus one (+1) degree C.
v.	If temperature criteria for the designated aquatic life use are exceeded in the receiving waters upstream of the discharge due to natural background conditions, then Subsections 401.03.a.iii. and 401.03.a.iv. do not apply and instead wastewater must not raise the receiving water temperatures by more than three tenths (0.3) degrees C.

[a]Criteria copied from Water Quality Standards and Wastewater Treatment Requirements.

Appendix 4. Stream bank erosion inventory segments.

This appendix includes the segment breaks for the stream bank erosion inventories completed for each creek that has had a sediment TMDL completed and the methodology for the NRCS Stream Bank Erosion Inventory Process.

Table 110 identifies the segment breaks for each segment of the creeks that have had sediment TMDLs completed

Table 110. Stream bank erosion segmentation identification.

Creek	Segment	Upper GPS point			Lower GPS point		
		deg	min	sec	deg	min	sec
Beaver	Upper (headwater to 1.6 miles upstream of mouth)	43	29	26	43	26	49
		114	31	10	114	33	36
	Lower (1.6 miles upstream of mouth to mouth)	43	26	49	43	26	44
		114	33	36	114	35	25
Little Beaver	Upper (headwater to 1.4 miles upstream of mouth)	43	29	25	43	27	32
		114	32	24	114	33	31
	Lower (1.4 miles upstream of mouth to mouth)	43	27	32	43	26	51
		114	33	31	114	34	41
Willow	Upper (headwaters to Cherry Creek)	43	34	13	43	27	53
		114	37	22	114	37	00
	Middle (Cherry Creek to Severe Creek)	43	27	53	43	24	13
		114	37	00	114	34	21
	Lower (Severe Creek to mouth)	43	24	13	43	20	04
		114	34	21	114	32	42
Camp	Upper (headwaters to road crossing 2.3 miles upstream of Eagle Creek)	43	28	31	43	26	4
		114	30	19	114	29	44
	Lower upper (road crossing 2.3 miles upstream of Eagle Creek to 1.1 miles upstream of Eagle Creek)	43	26	4	43	25	4
		114	29	44	114	29	56
	Upper middle (1.1 miles upstream of Eagle Creek to 0.8 miles downstream of Spare Creek)	43	25	4	43	21	52
		114	29	56	114	31	21
	Lower middle (0.8 miles downstream of Spare Creek to spring confluence above highway)	43	21	52	43	20	44
		114	31	21	114	29	01
	Lower (spring confluence above highway to mouth)	43	20	44	43	19	52
		114	29	01	114	28	35
Elk	Upper (headwaters to 4.3 miles upstream of mouth)	43	28	22	43	23	45
		114	40	45	114	37	58
	Lower (4.3 miles upstream of mouth to mouth)	43	23	45	43	20	20
		114	37	58	114	37	57
Soldier	Upper (Forks to Sampson Creek)	43	29	52	43	25	43

Creek	Segment	Upper GPS point			Lower GPS point		
		deg	min	sec	deg	min	sec
		114	49	58	114	48	06
	Middle (Sampson Creek to highway 20)	43	25	43	43	20	33
		114	48	06	114	47	13
	Lower (highway 20 to mouth)	43	20	33	43	17	31
		114	47	13	114	45	10
Corral	Upper (Forks to highway 20)	43	24	01	43	20	33
		114	55	59	114	55	31
	Lower (highway 20 to mouth)	43	20	33	43	17	36
		114	55	31	114	54	14
Cow	Upper (headwaters to 2.1 miles upstream of reservoir)	43	22	39	43	22	15
		115	7	41	115	07	08
	Middle (2.1 miles upstream of reservoir to 0.9 miles upstream of reservoir)	43	22	15	43	21	30
		115	07	08	115	06	23
	Lower (0.9 miles upstream of reservoir to reservoir)	43	21	30	43	20	49
		115	06	23	115	05	51
Wild Horse	Upper (headwaters to creek confluence 5 miles upstream of mouth)	43	19	11	43	20	03
		115	13	25	115	10	06
	Middle (creek confluence 5 miles upstream of mouth to highway 20)	43	20	03	43	18	34
		115	10	06	115	08	33
	Lower (highway 20 to mouth)	43	18	34	43	16	49
		115	08	33	115	08	18
Camas	Upper (headwaters to spring complex)	43	16	54	43	16	05
		115	20	02	115	15	59
	Lower upper (spring complex to Hall Gulch Creek confluence)	43	16	05	43	16	32
		115	15	59	115	06	24
	Upper middle (Hall Gulch Creek confluence to road crossing on Wolf Lane)	43	16	32	43	17	53
		115	06	24	114	58	03
	Lower middle (road crossing on Wolf Lane to Soldier Creek)	43	17	53	43	17	31
		114	58	03	114	45	11
	Upper lower (Soldier Creek to 2.2 miles upstream of Willow Creek)	43	17	31	43	19	58
		114	45	11	114	34	42
	Lower (2.2 miles upstream of Willow Creek to reservoir)	43	19	58	43	19	32
		114	34	42	114	27	31
Dairy	Upper (headwaters to road crossing 3.7 miles upstream of reservoir)	43	15	30	43	15	23
		114	56	53	114	54	36
	Lower (road crossing 3.7 miles upstream of reservoir to reservoir)	43	15	23	43	15	40
		114	54	36	114	50	38
McKinney	Upper (Headwater to spring confluence)	43	14	39	43	12	52
		114	44	02	114	42	38
	Lower upper (spring confluence to 0.9 miles downstream of spring confluence)	43	12	52	43	12	10
		114	42	38	114	42	48
	Upper middle (0.9 miles downstream of	43	12	10	43	12	28

Creek	Segment	Upper GPS point			Lower GPS point		
		deg	min	sec	deg	min	sec
	spring confluence to 2.1 miles downstream of spring confluence)	114	42	48	114	44	04
	Lower middle (2.1 miles downstream of spring confluence to road crossing at Fir Grove Ranch)	43	12	28	43	12	34
		114	44	04	114	45	10
	Upper lower (road crossing at Fir Grove Ranch to road crossing 2.1 miles upstream of reservoir)	43	12	34	43	13	05
		114	45	10	114	47	12
	Lower (road crossing 2.1 miles upstream of reservoir to reservoir)	43	13	05	43	14	21
		114	47	12	114	49	07

The following information has been provided by Melissa Thompson (DEQ) in 2005 and describes the methodology of the NRCS Stream Bank Erosion Inventory Process.

The stream bank erosion inventory was used to estimate background and existing stream bank erosion following methods outlined in the proceedings from the Natural Resource Conservation Service (NRCS) Channel Evaluation Workshop (NRCS, 1983). Using the direct volume method, sub-sections of 1998 §303(d) watersheds were surveyed to determine the extent of chronic bank erosion and estimate the needed reductions.

Stream bank Erosion Inventory

The NRCS Stream bank Erosion Inventory is a field based methodology, which measures stream bank/channel stability, length of active eroding banks, and bank geometry (Stevenson, 1994). The stream bank/channel stability inventories were used to estimate the long-term lateral recession rate. The recession rate is determined from field evaluation of stream bank characteristics that are assigned a categorical rating ranging from 0 to 3. The categories of rating the factors and rating scores are:

Bank Stability:
- Do not appear to be eroding - 0
- Erosion evident - 1
- Erosion and cracking present - 2
- Slumps and clumps sloughing off - 3

Bank Condition:
- Some bare bank, few rills, no vegetative overhang - 0
- Predominantly bare, some rills, moderate vegetative overhang - 1
- Bare, rills, severe vegetative overhang, exposed roots - 2
- Bare, rills and gullies, severe vegetative overhang, falling trees - 3

Vegetation / Cover On Banks:
- Predominantly perennials or rock-covered - 0
- Annuals / perennials mixed or about 40% bare - 1
- Annuals or about 70% bare - 2
- Predominantly bare – 3

Bank / Channel Shape:

V - Shaped channel, sloped banks - 0
Steep V - Shaped channel, near vertical banks - 1
Vertical Banks, U - Shaped channel - 2
U - Shaped channel, undercut banks, meandering channel - 3

Channel Bottom:

Channel in bedrock / noneroding - 0
Soil bottom, gravels or cobbles, minor erosion - 1
Silt bottom, evidence of active downcutting - 2

Deposition:

No evidence of recent deposition - 1
Evidence of recent deposits, silt bars - 0

Cumulative Rating

Slight (0-4) Moderate (5-8) Severe (9+)

From the Cumulative Rating, the lateral recession rate is assigned.

0.01 - 0.05 feet per year	**Slight**
0.06 - 0.15 feet per year	**Moderate**
0.16 - 0.3 feet per year	**Severe**
0.5+ feet per year	**Very Severe**

Stream bank stability can also be characterized through the following definition and the corresponding stream bank erosion condition rating from Bank Stability or Bank Condition above are included in italics.

Stream banks are considered stable if they do not show indications of any of the following features:

- **Breakdown** - Obvious blocks of bank broken away and lying adjacent to the bank breakage. *Bank Stability Rating 3*
- **Slumping or False Bank** - Bank has obviously slipped down, cracks may or may not be obvious, but the slump feature is obvious. *Bank Stability Rating 2*
- **Fracture** - A crack is visibly obvious on the bank indicating that the block of bank I about to slump or move into the stream. *Bank Stability Rating 2*
- **Vertical and Eroding** - The bank is mostly uncovered and the bank angle is steeper than 80 degrees from the horizontal. *Bank Stability Rating 1*

Stream banks are considered covered if they show any of the following features:

- Perennial vegetation ground cover is greater than 50%. *Vegetation/Cover Rating 0*
- Roots of vegetation cover more than 50% of the bank (deep rooted plants such as willows and sedges provide such root cover). *Vegetation/Cover Rating 1*
- At least 50% of the bank surfaces are protected by rocks of cobble size or larger. *Vegetation/Cover Rating 0*
- At least 50% of the bank surfaces are protected by logs of 4 inch diameter or larger. *Vegetation/Cover Rating 1*

Stream bank stability is estimated using a simplified modification of Platts, Megahan, and Minshall (1983, p. 13) as stated in *Monitoring Protocols to Evaluate Water Quality Effects of Grazing Management on Western Rangeland Streams* (Bauer and Burton, 1993). The modification allows for measuring stream bank stability in a more objective fashion. The lengths of banks on both sides of the stream throughout the entire linear distance of the representative reach are measured and proportioned into four stability classes as follows:

- **Mostly covered and stable (non-erosional).** Stream banks are Over 50% Covered as defined above. Stream banks are Stable as defined above. Banks associated with gravel bars having perennial vegetation above the scourline are in this category. *Cumulative Rating 0 - 4 (slight erosion) with a corresponding lateral recession rate of 0.01 - 0.05 feet per year.*
- **Mostly covered and unstable (vulnerable).** Stream banks are Over 50% Covered as defined above. Stream banks are Unstable as defined above. Such banks are typical of “false banks” observed in meadows where breakdown, slumping, and/or fracture show instability yet vegetative cover is abundant. *Cumulative Rating 5 - 8 (moderate erosion) with a corresponding lateral recession rate of 0.06 - 0.2 feet per year.*
- **Mostly uncovered and stable (vulnerable).** Stream banks are less than 50% Covered as defined above. Stream banks are Stable as defined above. Uncovered, stable banks are typical of stream banks trampled by concentrations of cattle. Such trampling flattens the bank so that slumping and breakdown do not occur even though vegetative cover is significantly reduced or eliminated. *Cumulative Rating 5 - 8 (moderate erosion) with a corresponding lateral recession rate of 0.06 - 0.2 feet per year.*
- **Mostly uncovered and unstable (erosional).** Stream banks are less than 50% Covered as defined above. They are also Unstable as defined above. These are bare eroding stream banks and include ALL banks mostly uncovered, which are at a steep angle to the water surface. *Cumulative Rating 9+ (severe erosion) with a corresponding lateral recession rate of over 0.5 feet per year.*

Stream banks were inventoried to quantify bank erosion rate and annual average erosion. These data were used to develop a quantitative sediment budget to be used for TMDL development.

Site Selection

The first step in the bank erosion inventory is to identify key problem areas. Stream bank erosion tends to increase as a function of watershed area (NRCS, 1983). As a result, the lower stream segments of larger watersheds tend to be problem areas. These stream segments tend to be alluvial streams commonly classified as response reaches (Rosgen B and C channel types) (Rosgen,1996).

Because it is often unrealistic to survey every stream segment, sampled reaches were used and bank erosion rates are extrapolated over a larger stream segment. The length of the sampled reach is a function of stream type variability where streams segments with highly variable channel types need a large sample, whereas segments with uniform gradient and

consistent geometry need less. Typically between 10 and 30 percent of stream bank needs to be inventoried. Often, the location of some stream inventory reaches is more dependent on land ownership than watershed characteristics. For example, private land owners are sometimes unwilling to allow access to stream segments within their property.
Stream reaches are subdivided into *sites* with similar channel and bank characteristics. Breaks between sites are made where channel type and/or dominate bank characteristics change substantially. In a stream with uniform channel geometry there may be only one site per stream reach, whereas in an area with variable conditions there may be several sites. Subdivision of stream reaches is at the discretion of the field crew leader.

Field Methods

Stream bank erosion or channel stability inventory field methods were originally developed by the USDA USFS (Pfankuch, 1975). Further development of channel stability inventory methods are outlined in Lohrey (1989) and NRCS (1983). As stated above, the NRCS (1983) document outlines field methods used in this inventory. However, slight modifications to the field methods were made and are documented.

Bank Erosion Calculations

The direct volume method is used to calculate average annual erosion rates for a given stream segment based on bank recession rate determined in the survey (NRCS, 1983). The erosion rate (tons/mile/year) is used to estimate the total bank erosion of the selected stream corridor.

The direct volume method is summarized in the following equations:

$$E = [A_E * R_{LR} * {}_B]/2000 \text{ (lbs/ton)}$$

where:
E = bank erosion over sampled stream reach (tons/yr/sample reach)
A_E = eroding area (ft^2)
R_{LR} = lateral recession rate (ft/yr)
${}_B$ = bulk density of bank material (lps/ft^3)

The bank erosion rate (E_R) is calculated by dividing the sampled bank erosion (E) by the total stream length sampled:

$$E_R = E/L_{BB}$$

where:
E_R = bank erosion rate (tons/mile/year)
E = bank erosion over sampled stream reach (tons/yr/sample reach)
L_{BB} = bank to bank stream length over sampled reach

Total bank erosion is expressed as an annual average. However, the frequency and magnitude of bank erosion events are greatly a function of soil moisture and stream discharge

(Leopold et al, 1964). Because channel erosion events typically result from above average flow events, the annual average bank erosion value should be considered a long term average. For example, a 50 year flood event might cause five feet of bank erosion in one year and over a ten year period this events accounts for the majority of bank erosion. These factors have less of an influence where bank trampling is the major cause of channel instability.

The *eroding area* (A_E) is the product of linear horizontal bank distance and average bank slope height. Bank length and slope heights are measured while walking along the stream channel. Pacing is used to measure horizontal distance, and bank slope heights are continually measured and averaged over a given reach or site. The horizontal length is the length of the right or left bank, not both. Typically, one bank along the stream channel is actively eroding. For example, the bank on the outside of a meander. However, both banks of channels with severe headcuts or gullies will be eroding and are to be measured separately and eventually summed.

Determining the *lateral recession rate* (R_{LR}) is one of the most critical factors in this methodology (NRCS, 1983). Several techniques are available to quantify bank erosion rates: for example, aerial photo interpretation, anecdotal data, bank pins, and channel cross-sections.

To facilitate consistent data collection, the NRCS developed rating factors used to estimate lateral recession rate. Similar to methods developed by Pfankuch (1975), the NRCS method measures bank and channel stability, and then uses the ratings as surrogates for bank erosion rates.

The *bulk density* (ρ_B) of bank material is measured ocularly in the field. Soil bulk density is the weight of material divided by its volume, including the volume of its pore spaces. A table of typical soil bulk densities can be used, or soil samples can be collected and soil bulk density measured in the laboratory.

References

Compton, R.R. 1996. Interpretation of aerial photos.

Flanagan, D.C., and M.A. Nearing (Editors). USDA Water Erosion Prediction Project Hillslope Profile and Watershed Model Documentation. NSERL Report No. 10. USDA-ARS National Soil Erosion Laboratory, W. Lafayette IN. 9.1-9.16

Hall, T.J. 1986. A laboratory study of the effects of fine sediments on survival of three species of Pacific salmon from eyed egg to fry emergence. National Council of the Paper Industry for Air and Stream Improvement. Technical Bulletin 482. New York.

IDEQ. 1999b. 1998 303(d) List. Idaho Division of Environmental Quality. Surface Water Program. January. 473 pp.

Leopold, L.B., M.G. Wolman and J.P. Miller. 1964. Fluvial processes in geomorphology. Freeman. San Francisco, CA.

Lohrey, M.H. 1989. Stream channel stability guidelines for range environmental assessment and allotment management plans. U.S. Forest Service, Northwest Region (unpublished).

McNeil W.J. and W.H. Ahnell. 1964. Success of pink salmon spawning relative to size of spawning bed materials. US Fish and Wildlife Service, Special Scientific Report-Fisheries No. 469.

Pfankuch, D.J. 1975. Stream reach inventory and channel stability evaluation. U.S. Forest Service, Northern Region. Missoula, MT.

Reiser, D.W. and R.G. White. 1988. Effects of two sediment size-classes on survival of steelhead and Chinook salmon eggs. North American Journal of Fisheries Management. 8: 432-437.

Rosgen, D.L. 1996 Applied River Morphology. Wildland Hydrology. Pagosa Springs, CO. 378pp.

Stevenson, T.K. 1994. USDA-NRCS, Idaho. Channel erosion condition inventory description. Memorandum to Paul Shelton, District Conservationist, Montpelier FO, Idaho, 5/24/94: describing estimation of stream bank, road and gully erosion.

USDA NRCS. 1983.Channel evaluation Workshop, Ventura, California, November 14-18, 1983. Presented at U.S. Army Corps of Engineers Hydrologic Engineering Center training session by Lyle J. Steffen, Geologist, Soil Conservation Service, Davis, CA. December 14,1982.

USDA FS. 1997. Challis Creek Watershed Analysis. Salmon-Challis National Forest, Challis Ranger District. June 1997.

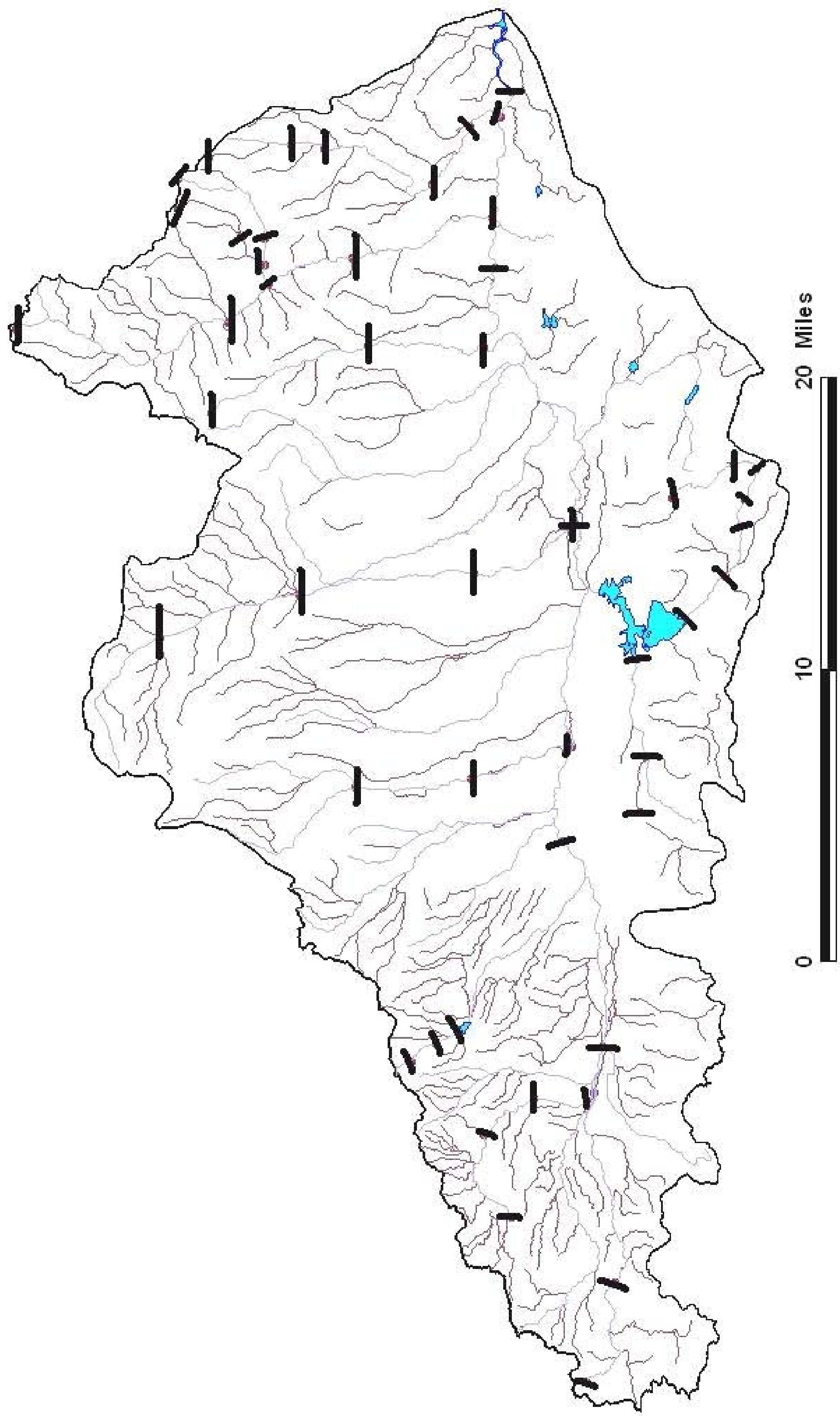

Figure 51. Camas Creek Subbasin stream bank erosion segmentation.

Appendix 5. Canopy Cover Estimates and Targets

This appendix includes the segment breaks for the canopy cover targets and existing loads, solar path finder field data comparisons to aerial photo interpretations, and the methodology for the aerial photo interpretation.

Table 111 identifies the segment breaks and existing and potential load for each segment of the creeks that have had temperature TMDLs completed. ArcView maps of the creeks showing existing canopy cover and canopy cover targets can be obtained at the DEQ Twin Falls office.

Table 111. Canopy cover estimates and targets.

Creek	Segment	Segment Length	Existing Shade	Existing Summer Load	Target or Potential Shade	Potential Summer Load	Existing load minus potential load
Camp Creek	Upper (headwaters to main road crossing 0.5 miles upstream of Eagle Creek)	1.7	0.6	11,066.2	0.75	6,916.3	4,149.81
		0.6	0.5	4,882.1	0.75	2,441.1	2,441.06
	Upper Middle (main road crossing 0.5 miles upstream of Eagle Creek to Spare Creek)	1.2	0.3	45,711.4	0.35	42,446.3	3,265.10
		0.3	0.2	13,060.4	0.35	10,611.6	2,448.83
		0.4	0.3	15,237.1	0.35	14,148.8	1,088.37
		0.2	0.2	8,712.7	0.35	7,079.1	1,633.64
		1.3	0.4	42,474.5	0.35	46,014.1	0.00
		0.5	0.3	19,059.1	0.35	17,697.7	1,361.36
		0.4	0.1	19,603.6	0.35	14,158.2	5,445.45
		0.7	0.3	26,682.7	0.35	24,776.8	1,905.91
		0.4	0.2	17,425.4	0.35	14,158.2	3,267.27
	Lower Middle (Spare Creek to spring confluence)	0.8	0.4	12,768.6	0.65	7,448.4	5,320.27
		0.4	0.3	7,448.4	0.65	3,724.2	3,724.19
		0.5	0.1	11,970.6	0.65	4,655.2	7,315.37
		0.9	0.3	16,758.8	0.65	8,379.4	8,379.42
		0.2	0.1	4,788.2	0.65	1,862.1	2,926.15
		0.3	0.3	5,586.3	0.65	2,793.1	2,793.14
	Lower (spring confluence to mouth)	0.4	0.5	7,803.4	0.5	7,803.4	0.00
		0.3	0.3	8,280.8	0.5	5,914.9	2,365.95
		0.4	0.2	12,618.4	0.5	7,886.5	4,731.91
		0.3	0.3	8,280.8	0.5	5,914.9	2,365.95
Willow Creek	Upper (headwaters to Wine Creek)	1.6	0.6	38,856.7	0.55	43,713.8	0.00
		0.5	0.5	15,178.4	0.55	13,660.6	1,517.84
		0.5	0.4	18,214.1	0.55	13,660.6	4,553.52
		0.3	0.2	14,571.3	0.55	8,196.3	6,374.93
	Middle (Wine Creek to braid 1.6 miles upstream of mouth)	1	0.4	49,284.6	0.35	53,391.6	-4,107.05
		1.2	0.3	68,998.4	0.35	64,069.9	4,928.46
		0.6	0.4	29,518.1	0.35	31,977.9	0.00

Creek	Segment	Segment Length	Existing Shade	Existing Summer Load	Target or Potential Shade	Potential Summer Load	Existing load minus potential load
		2.4	0.45	108,233.0	0.35	127,911.7	0.00
		0.2	0.3	11,479.3	0.35	10,659.3	819.95
		0.4	0.4	19,678.7	0.35	21,318.6	0.00
		0.4	0.5	16,398.9	0.35	21,318.6	0.00
		0.4	0.4	19,678.7	0.35	21,318.6	0.00
	Lower (braid 1.6 miles upstream of mouth to mouth)	0.3	0.3	11,427.9	0.5	8,162.8	3,265.10
		0.5	0.2	21,767.3	0.5	13,604.6	8,162.75
		0.4	0.1	19,590.6	0.5	10,883.7	8,706.94
		0.6	0.4	19,590.6	0.5	16,325.5	0.00
		0.4	0.2	17,413.9	0.5	10,883.7	6,530.20
		0.3	0.3	11,369.7	0.5	8,121.2	3,248.49
		0.4	0.4	12,994.0	0.5	10,828.3	2,165.66
		0.4	0.5	10,828.3	0.5	10,828.3	0.00
Beaver Creek	Upper (headwaters to 1.7 miles upstream of mouth)	1	0.6	9,388.7	0.85	3,520.8	5,867.9
		0.7	0.5	8,215.1	0.85	2,464.5	5,750.6
		0.3	0.4	4,224.9	0.85	1,056.2	3,168.7
		0.4	0.5	4,694.4	0.85	1,408.3	3,286.0
		0.5	0.4	7,041.5	0.85	1,760.4	5,281.1
		0.4	0.3	6,572.1	0.85	1,408.3	5,163.8
		0.6	0.5	7,041.5	0.85	2,112.5	4,929.1
	Lower (1.7 miles upstream of mouth to mouth)	0.5	0.4	8,919.3	0.6	5,946.2	2,973.1
		0.9	0.5	13,378.9	0.6	10,703.1	2,675.8
		0.3	0.4	5,351.6	0.6	3,567.7	1,783.9
Little Beaver Creek	Upper (headwaters to tributary 1.5 miles upstream of mouth)	0.7	0.2	7,360.7	0.85	1,380.1	5,980.6
		0.2	0.5	1,314.4	0.85	394.3	920.1
		0.4	0.3	3,680.4	0.85	788.7	2,891.7
		0.2	0.5	1,314.4	0.85	394.3	920.1
		0.4	0.3	3,680.4	0.85	788.7	2,891.7
		0.8	0.45	5,783.4	0.85	1,577.3	4,206.1
		0.5	0.4	3,943.3	0.85	985.8	2,957.4
	Lower (tributary 1.5 miles upstream of mouth to mouth)	0.3	0.3	3,220.3	0.75	1,150.1	2,070.2
		0.3	0.5	2,300.2	0.75	1,150.1	1,150.1
Soldier Creek	Upper (headwaters to road crossing upstream of baseline road)	0.2	0.4	8,487.4	0.55	6,365.5	2,121.8
		2.2	0.6	62,240.9	0.55	70,021.0	0.0
		1.7	0.55	54,107.1	0.55	54,107.1	0.0
		0.5	0.4	21,218.5	0.55	15,913.9	5,304.6
		1.4	0.3	69,313.7	0.55	44,558.8	24,754.9
		1.3	0.4	55,168.0	0.55	41,376.0	13,792.0
	Lower (road crossing upstream of baseline road to mouth)	1	0.1	78,583.5	0.3	61,120.5	17,463.0
		0.2	0.2	13,970.4	0.3	12,224.1	1,746.3
		0.7	0.3	42,784.3	0.3	42,784.3	0.0
		0.5	0.2	34,926.0	0.3	30,560.2	4,365.7

Creek	Segment	Segment Length	Existing Shade	Existing Summer Load	Target or Potential Shade	Potential Summer Load	Existing load minus potential load
		0.9	0.1	70,725.1	0.3	55,008.4	15,716.7
		1.5	0.2	104,778.0	0.3	91,680.7	13,097.2
		0.3	0.1	23,575.0	0.3	18,336.1	5,238.9
		2.6	0	227,018.9	0.3	158,913.3	68,105.7
Corral Creek	Main stem (Forks to mouth)	0.7	0.2	28,216.2	0.50	17,635.1	10,581.1
		0.2	0.1	9,069.5	0.50	5,038.6	4,030.9
		1.6	0.4	48,370.6	0.50	40,308.8	8,061.8
		0.6	0.1	27,208.5	0.50	15,115.8	12,092.7
		0.2	0.3	7,054.0	0.50	5,038.6	2,015.4
		0.2	0.2	8,061.8	0.50	5,038.6	3,023.2
		1.2	0.3	42,324.3	0.50	30,231.6	12,092.7
		0.5	0.2	20,154.4	0.50	12,596.5	7,557.9
		1.1	0.1	49,882.2	0.50	27,712.3	22,169.9
		0.3	0.2	12,092.7	0.50	7,557.9	4,534.7
		1.4	0	70,540.5	0.50	35,270.2	35,270.2
Wild Horse Creek	Main stem (Forks to mouth)	2	0	73,857.8	0.50	36,928.9	36,928.9
		0.8	0.4	17,725.9	0.50	14,771.6	2,954.3
		0.2	0.2	5,908.6	0.50	3,692.9	2,215.7
		0.5	0.1	16,618.0	0.50	9,232.2	7,385.8
		0.5	0.3	12,925.1	0.50	9,232.2	3,692.9
		1.2	0.1	39,883.2	0.50	22,157.3	17,725.9
		0.5	0.2	14,771.6	0.50	9,232.2	5,539.3
		0.4	0.3	10,340.1	0.50	7,385.8	2,954.3
		0.8	0.2	23,634.5	0.50	14,771.6	8,862.9
		0.5	0.3	12,925.1	0.50	9,232.2	3,692.9
		1.2	0.2	35,451.8	0.50	22,157.3	13,294.4
		0.6	0.1	19,941.6	0.50	11,078.7	8,862.9
Camas Creek	Upper (headwaters to spring complex)	0.5	0.1	7,041.5	0.3	5,476.7	1,564.78
		0.5	0.4	4,694.4	0.3	5,476.7	0.00
		0.3	0.3	3,286.0	0.3	3,286.0	0.00
		0.5	0.4	4,694.4	0.3	5,476.7	0.00
		0.6	0.5	4,694.4	0.3	6,572.1	0.00
		0.5	0.4	4,694.4	0.3	5,476.7	0.00
		0.2	0.1	2,816.6	0.3	2,190.7	625.91
	Lower upper (spring complex to Cow Creek confluence)	0.7	0.3	46,286.4	0.3	46,286.4	0.00
		0.3	0.1	25,434.0	0.3	19,782.0	5,652.00
		0.6	0.2	45,216.0	0.3	39,564.0	5,652.00
		1.5	0.4	84,780.0	0.3	98,910.0	0.00
		0.8	0.2	60,288.0	0.3	52,752.0	7,536.00
		1.7	0.1	144,126.0	0.3	112,098.0	32,028.01
		0.3	0.3	19,782.0	0.3	1,9782.0	0.00
		0.6	0.4	33,912.0	0.3	39,564.0	0.00
		0.4	0.5	18,840.0	0.3	26,376.0	0.00

Creek	Segment	Segment Length	Existing Shade	Existing Summer Load	Target or Potential Shade	Potential Summer Load	Existing load minus potential load
		0.5	0.3	32,970.0	0.3	32,970.0	0.00
		1	0.1	84,780.0	0.3	65,940.0	18,840.01
		0.5	0.2	37,680.0	0.3	32,970.0	4,710.00
		0.8	0.4	45,216.0	0.3	52,752.0	0.00
		0.5	0.3	32,970.0	0.3	32,970.0	0.00
	Upper middle (Cow Creek confluence to Soldier Creek confluence)	0.6	0.2	76,883.9	0.18	78,806.0	-1,922.10
		8.4	0	1,343,336.2	0.18	1,101,535.7	241,800.51
		1.2	0.1	172,714.7	0.18	157,362.2	15,352.41
		0.4	0	63,968.4	0.18	52,454.1	11,514.31
	Lower middle (Soldier Creek confluence to Elk Creek confluence)	0.8	0.1	121,979.3	0.18	111,136.7	10,842.60
		0.2	0.2	27,039.5	0.18	27,715.5	0.00
		0.4	0.1	60,838.8	0.18	55,430.9	5,407.90
		0.5	0.2	67,598.7	0.18	69,288.7	0.00
		0.4	0.1	60,838.8	0.18	55,430.9	5,407.90
		0.8	0.1	121,677.6	0.18	110,861.9	10,815.79
		6	0	1,013,980.3	0.18	831,463.9	182,516.46
		0.8	0.1	121,677.6	0.18	110,861.9	10,815.79
		1	0	168,996.7	0.18	138,577.3	30,419.41
	Lower (Elk Creek confluence to mouth)	1.2	0.1	139,253.3	0.15	131,517.0	7,736.29
		1.6	0.4	123,780.7	0.15	175,356.0	0.00
		0.6	0.2	61,890.4	0.15	65,758.5	0.00
		0.2	0.3	18,051.4	0.15	21,919.5	0.00
		0.2	0.2	20,630.1	0.15	21,919.5	0.00
		0.2	0.4	15,472.6	0.15	21,919.5	0.00
		0.8	0.2	82,520.5	0.15	87,678.0	0.00
		0.4	0.1	46,417.8	0.15	43,839.0	2,578.76
		0.4	0.3	36,102.7	0.15	43,839.0	0.00
		0.3	0.2	30,945.2	0.15	32,879.3	0.00
		1	0.3	90,256.8	0.15	109,597.5	0.00
		1	0.2	103,150.6	0.15	109,597.5	0.00
		0.3	0.1	34,813.3	0.15	32,879.3	1,934.07

[a]Segment length measured in approximate miles, existing shade and target or potential shade in decimal form for percentage, Existing summer load, potential summer load, and existing load minus potential load measured in kWh/day.

Table 112 identifies the similarities between aerial photo interpretations and solar path finder field data for canopy cover.

Table 112. Aerial versus pathfinder data.

Water body	Average Annual Shade	Average Summer Shade	Aerial Photo Cover	Aerial minus Summer Average	Aerial minus Annual Average
Corral Creek	21.1	14	20	6	11
Soldier Creek	19.2	18.7	10	-8.7	1
Elk Creek	15.1	12	20	8	11
Little Beaver Creek	37.3	32.9	50	17.1	41
Beaver Creek	35.9	23.5	40	16.5	31
Willow Creek	36.6	23.4	20	-3.4	11
Camp Creek	15.0	11.1	30	18.9	21
Camas Creek	11.5	5.9	20	14.1	11
Average	24.0	17.7	26.3	8.6	17.3

[a] Pathfinder data provided by DEQ Twin Falls, Aerial Photo interpretation provided by Mark Shumar (DEQ state office).

The following information was provided by Mark Shumar (DEQ) in 2005 and describes the usage of potential natural vegetation for temperature TMDLs and the methodology for aerial photo interpretation of canopy cover.

Potential Natural Vegetation for Temperature TMDLs

There are a several important contributors of heat to a stream including ground water temperature, air temperature and direct solar radiation. Of these, direct solar radiation is the source of heat that is easiest to control or manipulate. The parameter that affects or controls the amount of solar radiation hitting a stream throughout its length is shade. Shade is provided by the surrounding vegetation and other physical features such as hillsides, canyon walls, terraces, and high banks. Again, the amount of shade provided by objects other than vegetation is not easy to control or manipulate. This leaves vegetation as the most likely source of change in solar radiation hitting a stream.

Depending on how much vertical elevation also surrounds the stream, vegetation further away from the riparian corridor can provide shade. However, riparian vegetation provides a substantial amount of shade on a stream by virtue of its proximity. We can measure the amount of shade that a stream enjoys in a number of ways. Effective shade, that shade provided by all objects that intercept the sun as it makes its way across the sky, can be measured in a given spot with a solar pathfinder or with optical equipment similar to a fish-eye lens on a camera. Effective shade can also be modeled using detailed information about riparian plants and their communities, topography, and the stream's aspect. In addition to shade, canopy cover is a similar parameter that affects solar radiation. Canopy cover is the vegetation that hangs directly over the stream, and can be measured using a densiometer, or estimated visually either on site or on aerial photography. All of these methods tell us information about how much the stream is covered and how much of it is exposed to direct solar radiation.

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

Existing shade or cover will be estimated for entire lengths of streams from visual observations of aerial photos. These estimates can be field verified by measuring shade with solar pathfinders or cover with densiometers at randomly or systematically located points along the stream (see below for methodology). PNV will be determined from existing shade curves developed for similar vegetation communities. A shade curve shows the relationship between effective shade and stream width. As a stream gets wider, the shade decreases as the vegetation has less ability to shade the center of wide streams. Existing and PNV shade can be converted to solar load from data collected on flat plate collectors at the nearest weather station collecting these data. The difference between existing and potential solar load, assuming existing load is higher, is the load reduction necessary to bring the stream back into compliance with water quality standards. Existing shade cannot be greater than PNV shade, thus existing loads cannot be less than PNV loads. PNV shade and loads are assumed to be the natural condition, thus stream temperatures under PNV conditions are considered to be the lowest achievable temperatures (so long as there are no point sources or any other anthropogenic sources of heat in the watershed).

Pathfinder Methodology

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

At each sampling location the solar pathfinder should be placed in the middle of the stream about one foot above the water. Follow the manufacturer’s instructions (orient to true south and level) for taking traces. Systematic sampling is easiest to accomplish and still not bias the location of sampling. Start at a unique location such as 100 m from a bridge or fence line and then proceed upstream or downstream stopping to take additional traces at fixed intervals (e.g. every 100m, every half-mile, every degree change on a GPS, every 0.5 mile change on an odometer, etc.). On can also randomly locate points of measurement by generating random numbers to be used as interval distances. The more traces the better, for example, if the stream is four miles long paralleled by a road, you could stop at every ¼ mile to take a trace resulting in a good number of traces (about 17). If you stopped at every 0.1 mile interval, you could take over 40 traces.

It is a good idea to take notes while taking solar pathfinder traces, and to photograph the stream at several unique locations. Pay special attention to changes in riparian plant communities and what kinds of plant species (the large, dominant, shade producing ones) are present. Additionally, one can take densiometer readings at the same location as solar pathfinder traces. This provides the potential to develop relationships between canopy cover and effective shade for a given stream.

Aerial Photo Interpretation

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

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

Additionally, a code can be provided to indicate condition or type of vegetation seen at that interval. These codes are as follows:

N = natural forest or larger than a buffer area around stream
B = buffer area around stream, cut or open area with a short distance from stream
C = opening or clearcut on stream itself (stream exposed)
M = meadow/shrubland or alpine type
NA = In some cases no recognizable channel was seen on the photo even though the map shows a stream at 1:100K hydrography. In these few instances we have marked them as NA, no channel visible. Doesn't mean that there is not something down there, we just can't see it.

The visual estimates of cover should be field verified with either a densiometer or a solar pathfinder. The pathfinder measures effective shade and is taking into consideration other physical features that block the sun from hitting the stream surface (e.g. hillsides, canyon walls, terraces, man-made structures). The densiometer simply measures the more immediate canopy surrounding the stream. The estimate of cover made visually from an aerial photo does not take into account topography or any shading that may occur from physical features other than vegetation. However, research has shown that measurements taken by the two techniques are remarkably similar (OWEB, no date).

References

IDL. 2000. Forest Practices Cumulative Watershed Effects Process for Idaho. Idaho Department of Lands. March 2000.

OWEB. (no date). Addendum to Water Quality Monitoring Technical Guide Book: Chapter 14 Stream Shade and Canopy Cover Monitoring Methods. Oregon's Watershed Enhancement Board. 775 Summer St. NE., Suite 360, Salem, OR 97301-1290.

Appendix 6. Implementation Strategies.

Camas Creek Implementation Strategies

As part of the Camas Creek Total Maximum Daily Load

Although only a segment may be listed in this document as being impaired the TMDLs incorporate the entire length of the water body.

Camas Creek (2532)

Boundary: Headwaters to Macon Flat Bridge
Primary Pollutant-of-Concern: Sediment, Nutrients, Temperature, Flow Alteration
TMDLs Completed: Sediment, Nutrients, Temperature
Delisting: Not Applicable (n.a.)
TMDL Modification: Not Applicable
Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2045	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys IDEQ Lakes/Reservoir Project
IDL	2045	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	2045	Grazing Allotment Permit	USFS PFC Process Other USFS Mechanisms
BLM	2045	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2045	BURP Program WBAG d	IDEQ WQ Monitoring IDEQ WQ Assessment

Soldier Creek (2537)

Boundary: Baseline Road to Camas Creek
Primary Pollutant-of-Concern: Bacteria, DO, Flow Alteration, Nutrients, Sediment, Temperature
TMDLs Completed: Sediment, Temperature
Delisting: Nutrients, DO, Bacteria
TMDL Modification: Not Applicable
Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2025	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys IDEQ Lakes/Reservoir Project
IDL	n.a.	n.a.	n.a.
USFS	2025	Grazing Allotment Permit	USFS PFC Process Other USFS Mechanisms

BLM	2025	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2025	BURP Program WBAG d	IDEQ WQ Monitoring IDEQ WQ Assessment

Mormon Reservoir (2539)

Boundary: The entire reservoir
Primary Pollutant-of-Concern: Bacteria, DO, Flow Alteration, Nutrients, Sediment
TMDLs Completed: Nutrients, Sediment
Delisting: Bacteria
TMDL Modification: Not Applicable
Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2045	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys IDEQ Lakes/Reservoir Project
IDL	2045	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	n.a.	n.a.	n.a.
BLM	2045	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2045	BURP Program WBAG d	IDEQ WQ Monitoring IDEQ WQ Assessment

Little Beaver Creek (5301)

Boundary: Headwaters to Beaver Creek
Primary Pollutant-of-Concern: Unknown, temperature
TMDLs Completed: Temperature
Delisting: Not Applicable
TMDL Modification: Not Applicable
Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	n.a.	n.a.	n.a.
IDL	2025	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	2025	Grazing Allotment Permit	USFS PFC Process Other USFS Mechanisms
BLM	2025	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2025	BURP Program WBAG d	IDEQ WQ Monitoring IDEQ WQ Assessment

Camp Creek (5302)

Boundary: Headwaters to Camas Creek
Primary Pollutant-of-Concern: Unknown, Sediment, Temperature, Flow alteration
TMDLs Completed: Sediment and Temperature

Delisting: Not Applicable
TMDL Modification: Not Applicable
Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2025	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys IDEQ Lakes/Reservoir Project
IDL	2025	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	n.a.	n.a.	n.a.
BLM	2025	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2025	BURP Program WBAG d	IDEQ WQ Monitoring IDEQ WQ Assessment

Willow Creek (5303)
Boundary: Beaver Creek to Camas Creek
Primary Pollutant-of-Concern: Unknown, Temperature
TMDLs Completed: Temperature
Delisting: Not Applicable
TMDL Modification: Not Applicable
Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2025	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys IDEQ Lakes/Reservoir Project
IDL	2025	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	2025	Grazing Allotment Permit	USFS PFC Process Other USFS Mechanisms
BLM	2025	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2025	BURP Program WBAG d	IDEQ WQ Monitoring IDEQ WQ Assessment

Elk Creek (5304)
Boundary: Base Line Road to Camas Creek
Primary Pollutant-of-Concern: Unknown, Sediment, Flow alteration
TMDLs Completed: Sediment
Delisting: Not Applicable
TMDL Modification: Not Applicable
Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2025	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys IDEQ Lakes/Reservoir Project
IDL	2025	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	2025	Grazing Allotment Permit	USFS PFC Process Other USFS Mechanisms
BLM	2025	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2025	BURP Program WBAG d	IDEQ WQ Monitoring IDEQ WQ Assessment

McKinney Creek (5305)

Boundary: Headwaters to Mormon Reservoir
Primary Pollutant-of-Concern: Unknown, Sediment, Flow alteration
TMDLs Completed: Sediment
Delisting: Not Applicable
TMDL Modification: Not Applicable
Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2045	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys IDEQ Lakes/Reservoir Project
IDL	2045	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	n.a.	n.a.	n.a.
BLM	2045	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2045	BURP Program WBAG d	IDEQ WQ Monitoring IDEQ WQ Assessment

Corral Creek (5306)

Boundary: Highway 20 to Camas Creek
Primary Pollutant-of-Concern: Unknown, Sediment, Temperature, Flow alteration
TMDLs Completed: Sediment and Temperature
Delisting: Not Applicable
TMDL Modification: Not applicable
Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2025	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys

			IDEQ Lakes/Reservoir Project
IDL	2025	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	n.a.	n.a.	n.a.
BLM	2025	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2025	BURP Program WBAG d	IDEQ WQ Monitoring IDEQ WQ Assessment

Cow Creek (5307)

Boundary: Headwaters to Cow Creek Reservoirs
Primary Pollutant-of-Concern: Unknown, Sediment, Nutrients
TMDLs Completed: Sediment and Nutrients
Delisting: Not Applicable
TMDL Modification: Not applicable
Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2025	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys IDEQ Lakes/Reservoir Project
IDL	2025	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	2025	Grazing Allotment Permit	USFS PFC Process Other USFS Mechanisms
BLM	2025	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2025	BURP Program WBAG d	IDEQ WQ Monitoring IDEQ WQ Assessment

Wild Horse Creek (5308)

Boundary: Highway 20 to Camas Creek
Primary Pollutant-of-Concern: Unknown, Sediment, Bacteria, Temperature, Flow alteration
TMDLs Completed: Sediment, Bacteria, Temperature
Delisting: Not Applicable
TMDL Modification: Not Applicable
Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2025	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys IDEQ Lakes/Reservoir Project
IDL	2025	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	2025	Grazing Allotment Permit	USFS PFC Process Other USFS Mechanisms

BLM	2025	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2025	BURP Program WBAG d	IDEQ WQ Monitoring IDEQ WQ Assessment

Beaver Creek (5309)

Boundary: Headwaters to Willow Creek
Primary Pollutant-of-Concern: Unknown, Temperature
TMDLs Completed: Temperature
Delisting: Not Applicable
TMDL Modification: No Applicable
Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2025	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys IDEQ Lakes/Reservoir Project
IDL	2025	Grazing Allotment Permit	IDL PFC Process Other IDL Mechanisms
USFS	2025	Grazing Allotment Permit	USFS PFC Process Other USFS Mechanisms
BLM	2025	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2025	BURP Program WBAG d	IDEQ WQ Monitoring IDEQ WQ Assessment

Dairy Creek – THIS STREAM WAS ADDED TO THE 303(d) LIST

Boundary: Headwaters to Mormon Reservoir
Primary Pollutant-of-Concern: Sediment, Nutrients, Flow alteration
TMDLs Completed: Sediment, Nutrients
Delisting: Not Applicable
TMDL Modification: Not Applicable
Implementation Strategies:

PARTIES	TIME FRAME	APPROACHES	MONITORING
ISCC, IASCD, Private	2045	Irrigated Cropland BMPs Grazing BMPs SCD Involvement Cleanup Project Development	I&E Public Outreach Photo-point Documentation Grazing Management IDFG Fish Surveys IDEQ Lakes/Reservoir Project
IDL	n.a.	n.a.	n.a.
USFS	n.a.	n.a.	n.a.
BLM	2045	Grazing Allotment Permit	BLM PFC Process Other BLM Mechanisms
Other Parties: IDEQ	2045	BURP Program WBAG d	IDEQ WQ Monitoring IDEQ WQ Assessment

Personnel from the various agencies involved in the interpretation of the time frame, approaches, and monitoring strategy are summarized as follows:

ISCC Personnel:	Charles Pentzer, Water Quality Resource Conservationist Joe Schwarzbach, Water Quality Resource Conservationist
IDL Personnel:	Timothy C. Duffner, Area Supervisor, South Central Area, Gooding ID
USFS Personnel:	Valdon Hancock, Hydrologist, Sawtooth National Forest, Region 4, Twin Falls Field Office
BLM Personnel: Field	Doug Barnum, Supervisory Natural Resource Specialist, Shoshone Office
IDFG Personnel:	n.a.
IDEQ Personnel:	Jennifer Claire, Senior Water Quality Analyst Dr. Balthasar B. Buhidar, Regional Manager – WQ Protection Mike Etcheverry, Senior Water Quality Analyst

Appendix 7. Data Sources

Table 113. Data sources for Camas Creek Subbasin assessment.

Water body	Data Source	Type of Data	When Collected
BURP data-Habitat (H), Macroinvertebrate (M), Fish (F)			
Soldier Creek	BURP files, DEQ Twin falls	H, M, F	1993, 1995
Willow Creek	BURP files, DEQ Twin falls	H, M, F	1993, 1995, 2001
Beaver Creek	BURP files, DEQ Twin falls	H, M, F	1993, 1995, 1997, 2001
Little Beaver Creek	BURP files, DEQ Twin falls	H, M, F	1993, 1995, 1997, 2001
Camp Creek	BURP files, DEQ Twin falls	H, M, F	1996, 2001
Elk Creek	BURP files, DEQ Twin falls	H, M	1993
Corral Creek	BURP files, DEQ Twin falls	H, M, F	1993
Cow Creek	BURP files, DEQ Twin falls	H, M	1993, 1996
Wild Horse Creek	BURP files, DEQ Twin falls	H, M	1993, 1996
McKinney Creek	BURP files, DEQ Twin falls	H, M	1993
Camas Creek	BURP files, DEQ Twin falls	H, M, F	1993, 1995, 2001
Fish data			
Soldier Creek	Twin falls files (USFS)	fish	2002
Willow Creek	Twin falls files (USFS, BLM, DEQ, IDFG)	fish	1990, 1992, 1993, 1994, 2000, 2001, 2002
Beaver Creek	Twin falls files (IDFG, BLM)	fish	1995, 1998
Little Beaver Creek	Twin falls files (IDFG)	fish	1998
Camas Creek	Twin falls files (DEQ, BLM)	fish	1993, 2000, 2002
Flow data			
Soldier Creek	Twin falls files (DEQ), USGS Web site	flow	1973-1978, 1992-1993, 2001-2003
Willow Creek	Twin falls files (DEQ), USGS Web site	flow	1977, 1992-1993, 2001-2003
Beaver Creek	Twin falls files (DEQ)	flow	2001-2003
Little Beaver Creek	Twin falls (DEQ)	flow	2001-2003
Camp Creek	Twin falls files (DEQ), USGS Web site	flow	1977, 2001-2003
Elk Creek	Twin falls files (DEQ), USGS Web site	flow	1977, 1992-1993, 2001-2003
Corral Creek	Twin falls files (DEQ)	flow	1992-1993, 2001-2003
Cow Creek	Twin falls files (DEQ), USGS Web site	flow	1977, 2001-2003
Wild Horse Creek	Twin falls files (DEQ),	flow	2001-2004
McKinney Creek	Twin falls files (DEQ), USGS Web site	flow	1977, 2001-2003
Camas Creek	Twin falls files (DEQ), USGS Web site	flow	1912-2003
Stream bank inventories (sbi), canopy cover (cc) , Wolman pebble counts (wp)			
Soldier Creek	Twin falls files (DEQ)	sbi,cc,wp	2001-2003
Willow Creek	Twin falls files (DEQ)	sbi,cc,wp	2001-2003
Beaver Creek	Twin falls files (DEQ)	sbi,cc,wp	2001-2003
Little Beaver Creek	Twin falls files (DEQ)	sbi,cc,wp	2001-2003
Camp Creek	Twin falls files (DEQ)	sbi,cc,wp	2001-2003
Elk Creek	Twin falls files (DEQ)	sbi, wp	2001-2003
Corral Creek	Twin falls files (DEQ)	sbi,cc,wp	2001-2003
Cow Creek	Twin falls files (DEQ)	sbi,cc,wp	2001-2003
Wild Horse Creek	Twin falls files (DEQ)	sbi,cc,wp	2001-2003
McKinney Creek	Twin falls files (DEQ)	sbi, wp	2001-2003
Camas Creek	Twin falls files (DEQ)	sbi,cc,wp	2001-2003

Appendix 8. Distribution List

Balthasar Buhidar. Idaho Department of Environmental Quality, Twin Falls Office.
Clyde Lay. Idaho Department of Environmental Quality, Twin Falls Office.
Sean Woodhead. Idaho Department of Environmental Quality, Twin Falls Office.
Rob Sharpnack. Idaho Department of Environmental Quality, Twin Falls Office.
Mike Etcheverry. Idaho Department of Environmental Quality, Twin Falls Office.
Marti Bridges. Idaho Department of Environmental Quality, state office (Boise).
Mike McDonald. Idaho Department of Fish and Game, Jerome Office.
Terry Blau. Idaho Department of Water Resources, Twin Falls Office.
Tim Duffner. Idaho Department of Lands, Shoshone Office.
Valdon Hancock. United States Department of Agriculture Forest Service, Twin Falls Office.
Doug Barnum. United States Bureau of Land Management, Shoshone Office.
Chuck Caranaha. Idaho Department of Transportation, Shoshone Office.
Jennifer Clawson. Idaho Association of Soil Conservation Districts, Twin Falls ID.
Chuck Pentzer. Idaho Soil Conservation Commission, Jerome ID.
Joe Schwarzbach.
Steve Thompson. Natural Resources Conservation Service, Gooding Office.
Bill Hazen. University of Idaho County Extension Services, Gooding County.
Polly Huggins. Resource Conservation and Development, Gooding ID.
Blaine County Soil Conservation District, Hailey ID.
Elmore County Soil Conservation District, Mountain Home ID.
Camas County Commissioners, Fairfield ID.
Blaine County Commissioners, Hailey ID.
Idaho Rivers United, Boise ID.
Western Watersheds Project, Hailey ID.
City of Fairfield, Fairfield ID.
Roger Blew, Upper Snake BAG Committee, Rep-at-Large, Idaho Falls ID.
Matt Woodard, Upper Snake BAG Committee, Environment East Side Soil & Water, Idaho Falls ID.
Brian Olmstead, Upper Snake BAG Committee, Irrigated Ag, Twin Falls ID.
Hunter Osborne, Upper Snake BAG Committee, Sho-Ban Tribes, Fort Hall ID.
Brad Orme, Upper Snake BAG Committee, Livestock, St Anthony, ID.
Gary Marquardt, Upper Snake BAG Committee, Non-Municipal Permittee, Buhl ID.
Don Mays, Upper Snake BAG Committee, Recreation, Gooding ID.
Chris Randolph, Upper Snake BAG Committee, Hydropower, Boise ID.
Greg Shenton, Upper Snake BAG Committee, Local Government, DuBois ID.
Dennis Facer, Upper Snake BAG Committee, Mining, DuBois ID.
Mark Toone, Wood River WAG Committee, Gooding ID.
Clint Krahn, Wood River WAG Committee, Fairfield ID.
Bob Simpson, Wood River WAG Committee, Carey ID.
Rob Struthers, Wood River WAG Committee, Bellevue ID.
Jerry Nance, Wood River WAG Committee, Dietrich ID.
Carl Rey, Wood River WAG Committee, Fairfield ID.
Lee Brown, Wood River WAG Committee, Ketchum ID.

Roger Parker, Wood River WAG Committee, Hailey ID.
Dennis Strom, Wood River WAG Committee, Hill City ID.
Daryle James, Wood River WAG Committee, Hailey ID.
Kent Scott, Wood River WAG Committee, Gooding ID.
Carol Blackburn, Wood River WAG Committee, Shoshone ID.
Lynn Harmon, Wood River WAG Committee, Shoshone ID.
Jo Lowe, Wood River WAG Committee, Idaho Conservation League, Ketchum ID.
Dennis Koyle, Wood River WAG Committee, Gooding ID.
Bill Davis, Wood River WAG Committee, Fairfield ID.
Bryan Ravenscroft, Wood River WAG Committee, Bliss ID.
Scott Boettger, Wood River WAG Committee, Ketchum ID.
Tom Pomeroy, Wood River WAG Committee, Ketchum ID.
Bob Bolte, Wood River WAG Committee, Gooding ID.
Jack Straubhar, Wood River WAG Committee, Twin Falls ID.
Martha Turvey, EPA, Seattle WA.
Leigh Woodruff, EPA, Boise ID.

Appendix 9. Public Comments

The 30 day public comment period closed on April 13, 2005 at 5:00 p.m. During this period comments were received from the Preserve the Camas Prairie ("Coalition"), the US Forest Service, and the US Environmental Protection Agency. Those comments that were editorial were incorporated into the document. The remainder of the comments is addressed in this appendix and DEQ's responses follow the comments in italics.

PRESERVE THE CAMAS PRAIRIE ("COALITION")

PCP #1. The assessment should include an analysis of and TMDLs for all potentially-impaired water bodies within the subbasin, and at the very least for Fricke Creek.

A.) As currently drafted, the scope of the assessment is not sufficiently comprehensive. This is due in part to the fact that the assessment does not discuss all water bodies in the subbasin. The assessment states that its "starting point" for determining which TMDLs will be completed is Idaho's 1998 list of 303(d) waters. From that "starting point," the assessments purpose and goal is to "ensure impairment listings are up to date and accurate." Yet the content of the assessment indicates that those impairments listings are not complete and up to date. As a result, a number of waters which warrant TMDLs are not included in the assessment.

A list of the water bodies in the subbasin that have had data collected on them will be added to the document whether they were identified as impaired or not.

B). There are twelve water bodies of the subbasin included in the 1998 303(d) list, which include Beaver Creek, Camas Creek, Camp Creek, Corral Creek, Cow Creek, Elk Creek, Little Beaver Creek, McKinney Creek, Soldier Creek, Wild Horse Creek, Willow Creek, and the Mormon Reservoir. All of these water bodies are appropriately included in the assessment. In contrast, the assessment does not address water bodies within the subbasin that were not included on the 1998 303(d) list. One such example is Fricke Creek, discussed in detail below, which is impaired and should receive TMDLs for several impacts.

Collecting data on water bodies can be very expensive and funds lately have been limited as a result water bodies that were already identified as being impaired were identified as the high priority water bodies in the subbasin and thus were the focus of the SBA-TMDL.

C). Fricke Creek is a water body that requires close evaluation since there is a strong likelihood that it is impaired in several ways. The creek flows south from the Soldier Mountains through Camas Prairie and eventually into Camas Creek. The land surrounding the creek is farmed to its edges in many portions of its length, leaving its banks largely void of canopy cover in those areas. As with other creeks in the subbasin, this lack of shade likely causes the temperature of Fricke Creeks waters to be elevated above what is natural and what can adequately support its beneficial uses. These elevated temperatures, therefore, are likely impairing the Creeks beneficial uses and violating state water quality standards.

In addition to temperature, Fricke Creek is likely impaired by sedimentation for the same reasons. Many areas along its banks have insufficient plant growth to prevent stream bank erosion and the release of sediment from surrounding lands into the water. Lastly, Fricke Creek is also likely impaired by nutrients, since this same lack of riparian buffer allows direct flows of nutrient-containing agricultural or other runoff into the creek. Thus, it is likely that Fricke Creek is impaired by temperature, sediment, and nutrients. Such waters failing to meet water quality standards are water-quality limited and must be included in the states 303(d) list of impaired waters, or at the very least be identified and analyzed in the subbasin assessment to determine proper TMDLs. If the Department has current data from the creek which indicates it is not impaired, then such relevant data should be set forth and explained in the assessment.

DEQ is to protect the beneficial uses of the water bodies. When these uses are not fully supported TMDLs are to be developed to aid in restoring the full support of the beneficial uses. The process used within the agency is to determine the beneficial uses and the support status of a water body through the collection and analysis of biological data through the Beneficial Use Reconnaissance Program. When it is determined that beneficial uses are not being met the creek is identified on the list of impaired waters. Then data is further collected to identify pollutants within the system and to develop TMDLs if appropriate. Fricke Creek at this time, has not been assessed through the BURP protocol, likely due to the lack of water during the sampling period. And records do not indicate that data has been collected on the water body through other programs or by other agencies.

Moreover, even if the Department were to determine that Fricke Creek does not, in fact, belong on the 303(d) list, the assessment should nevertheless establish TMDLs for that water body. Section 303(d)(3) of the Clean Water Act requires states to develop TMDLs for unimpaired waters within its boundaries, taking into account "seasonal variations and margins of safety." To be sufficiently comprehensive, and to ensure that the subbasins waters are not only restored, but also maintained, the assessment should include an analysis of (1) whether the waters of Fricke Creek are impaired and thus warrant the establishment of TMDLs, and (2) whether, if the creek is not impaired, a TMDL should nevertheless be prepared for the segment pursuant to 303(d)(3).

According to IDAPA 58.01.02.054.03, Priority of TMDL Development, "The priority of TMDL development for water quality limited water bodies identified in Subsection 054.02 shall be determined by the Director in consultation with the Basin Advisory Groups as described in Sections 39-3601, et seq., Idaho Code, depending upon the severity of pollution and the uses of the water body, including those of unique ecological significance. Water bodies identified as a high priority through this process will be the first to be targeted for development of a TMDL or equivalent process." The high priority water bodies at this time are those identified in the settlement agreement and are the 303(d) listed water bodies.

PCP #2. TMDLs should be developed for flow alteration to comply with water quality laws and adequately protect subbasin water quality.

A). Further, the assessment does not include TMDLs for all causes of impairment. In the assessment, the Department acknowledges that “flow alteration or lack of flow has been identified as a pollutant for many of the water bodies.” Flow alteration or lack of flow is frequently cited in the assessment as impacting the beneficial uses of water bodies in the subbasin. The Department also frequently mentions the importance of the relationship between the groundwater and surface water in the subbasin. Groundwater use in the subbasin has been noted by both Department and by other scientists studying the region as negatively affecting the flow of streams in the subbasin, causing streams that were once perennial to now be intermittent, or to be dry in certain segments. Notwithstanding this, TMDLs have not been established for waters impaired by flow or lack of flow. The assessment reasons that TMDLs need not be completed for those causes of impairment because they are sources of “pollution” and are not “pollutants”, and that only “pollutants” require the development of TMDLs.

As was stated in the document, “(Name of creek) is impaired due to a lack of flow; however, EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for water bodies impaired by pollution, a TMDL has not been established for (Name of creek) for flow.”

B). First, even the Department seems to view the distinction between “pollution”- which does not need a TMDL- and a “pollutant” – which does need a TMDL as artificial. It specifically refers to flow alteration or lack of flow in the assessment as both a “pollutant” and as “pollution.” Second, courts in several states have recognized that the definition of a “pollutant” in the Clean Water Act is a broad definition and have held that flow alteration falls within the Clean Water Act’s definition of a “pollutant.” These holdings reflect the expansive definition of “pollutant” necessary to ensure that the goals of the Clean Water Act can be met.

Flow alteration or lack of flow is “pollution,” it was misidentified in the Executive Summary as being a “pollutant”. This error has been corrected.

C). Idaho’s statutes addressing water quality further support a functional definition of “pollutant.” Section 39-3601 of the Idaho Code, for example, states that the legislatures intent in enacting its water quality laws was to ensure “that the state of Idaho fully meet the goals and requirements of the federal clean water act.” In other words, not only must the assessment comply with the letter of the Clean Water Act, but also the spirit. By not including TMDLs for flow, though it specifically recognized that flow is often a significant, if not the most significant cause of a water body’s impairment, the assessment does not comply with the spirit or the goals of the Clean Water Act and, therefore, is also inconsistent with the Idaho’s water quality laws.

Furthermore, section 39-3611 of the Idaho Code, the section describing the TMDL process, states that the TMDL process “shall include…pollution control strategies for both point sources and nonpoint sources for reducing those sources of pollution.” Thus, even if one were to concede a difference between “pollutants” and “pollution,” it nevertheless appears that the Idaho legislature believed TMDLs should be created for both types of impacts to water quality.

Section 39-3601also states that "The legislature recognizing that surface water is one of the state's most valuable natural resources, has approved the adoption of water quality standards and authorized the director of the department of environmental quality in accordance with the provisions of this chapter, to implement these standards." In addition, IDAPA 58.01.02.050.01 under Administrative Policy and Apportionment of Water states "The adoption of water quality standards and the enforcement of such standards is not intended to conflict with the apportionment of water to the state through any of the interstate compacts or court decrees, or to interfere with the rights of Idaho appropriators, either now or in the future, in the utilization of the water appropriations which have been granted to them under the statutory procedure, or to interfere with water quality criteria established by mutual agreement of the participants in interstate water pollution control enforcement procedures." We do not complete TMDLs for flow, however sediment, temperature, and TP TMDLs and the resulting implementation plans will aid in restoring water quality of the creeks during low flows as well as restoring some of the natural storage of water that are lacking as a result of poor riparian zones, stream bank stability and channelization.

PCP #3. Domestic water supply is an existing beneficial use that should be identified and considered in the assessment and TMDL development process.

Identifying the beneficial uses of the water bodies in the subbasin is a significant step in determining whether waters in the subbasin are impaired. The assessment concludes that even though "domestic water supply is listed as a water use in most of the water rights that have been searched…domestic water supply is not considered an existing beneficial use for any of the water bodies that are 303(d) listed, unless designated as such." If "domestic water supply is listed as a water use" for the subbasins waters, then domestic water supply must be a beneficial use for those water bodies addressed in the report. Residents of the Camas Prairie draw their water for domestic use from ground water. Because of that interchange between surface and groundwater in the subbasin, many of the surface streams in the area should, like the groundwater, have domestic water supply listed as a beneficial use. Failing to designate the subbasins surface waters would create an impermissible gap in the state's water quality protection system and would jeopardize the state's ability to protect its vital aquifers.

Historically, in water right claims domestic water supply was used as another term for livestock water supply (IDWR 2003). Therefore, a listing on a water right of domestic water supply does not necessarily mean that the waters were used as drinking water to a group of people. In the south central region of Idaho regulated by the Twin Falls office there are no public water systems that are supplied by surface water (Staufer 2003, Chorney 2005). In addition IDAPA 58.01.02.252.01 identifies that "(Surface) waters designated for domestic water supplies are to exhibit the following characteristics: a. Radioactive materials or radioactivity not to exceed concentrations specified in Idaho Department of Environmental Quality Rules and b. Small public water supplies (Surface Water)." There is one small *public water supply that is identified in one of the counties (Elmore County) of the Camas Creek Subbasin, however the supply system is not located within the Camas Creek Subbasin.*

Influences between surface water and ground water are more likely to be seen as a result of quantity of the water rather than quality. Differing beneficial uses between the two water systems lead to different water quality standards that protect the beneficial uses differently.

PCP #4. Impaired water bodies in the subbasin should remain listed as being impaired by "unknown" pollutants given the lack of data relied upon in the study.

The assessment recommends "de-listing" certain water bodies so that they will no longer be labeled as impaired by "unknown" pollutants. Such a move would be premature in this case and should be postponed. As the assessment consistently acknowledges, the conclusions reached in that document are derived from an extremely limited and inadequate amount of data. Labeling water bodies as being impaired by "unknown" pollutants helps offset this lack of data by making it explicit that the impacts to water quality in the subbasin are still not fully known or understood. Removing "unknown" from the list and replacing it with specific pollutants establishes a misleading impression of certainty regarding the pollutants affecting the subbasins waters. It is appropriate and desirable to list streams as being impaired by certain pollutants when those pollutants have been identified; yet it is also important to ensure that the stream is not "de-listed" for unknown pollutants before the Department can adequately demonstrate the certainty of its knowledge and data regarding the causes of harm to a given water body. Due to the lack of data on this subbasin, it would currently be impossible for the Department to present enough evidence to demonstrate it has sufficient information to safely "de-list" a water body for impairment by "unknown" pollutants.

There are no water bodies in the Camas Creek Subbasin that are being delisted. However, pollutants have been identified within the subbasin. When we collect biological data we can determine if beneficial uses are impaired. If they are impaired we can not determine from the biological data what the source of pollutant is. Therefore, it becomes listed as impaired by "unknown" until data is obtained that identifies the pollutant impairing the beneficial uses. Through the subbasin assessment and TMDL we have identified the pollutants impacting the waters of the subbasin. Although the quantity of water column data is not what would be preferred due to the lack of water in the subbasin, habitat data has been collected throughout the subbasin and has aided in determining the pollutants impacting the waters of the subbasin. "Unknown" will be removed from the list for the water bodies discussed in this document.

PCP #5. TMDLs are needed for sediment and nutrients in several additional subbasin water bodies due to lack of data.

A). As discussed above, the general lack of data is very problematic with respect to making scientifically-sound and effective water quality and TMDL determinations. Even more problematic, however, is the fact that much of the limited data collected was collected between 2001 and 2003, which were recognized drought years. The assessments heavy reliance on data derived from limited flow years could only result in the assessments underestimating the load of sediments and nutrients that are released into the subbasins water bodies, making water quality and TMDL determinations (or lack thereof) based on this low estimate inaccurate and consequently inappropriate with respect to nutrients and sediments in several water bodies.

*Ideally, there would be a great deal more data collected and the data would be collected throughout many years. However, resources are not such that we are capable of collecting this type of data throughout the region let alone the state so we have to use the best available data that we have. Water chemistry data within the water bodies has been identified as a data gap within the subbasin (*2.5 Data Gaps*).*

B). The assessments discussion of sediment impairment reveals this fundamental flaw in its current analysis. The assessment acknowledges that much of the data relied upon in the assessment was collected during "drought years," between 2001 and 2003. But then the assessment continues by stating that "the critical period for sediment transport is typically…when flow is elevated due to runoff events." Thus, the assessment recognizes that use of data from flow-limited years not only does not represent average sediment levels, but that it is probably a low estimate of sediment pollution since such pollution is elevated during high flow years and events. Determinations of whether there is an excess level of sediment in the waters should be based on how much sediment is in the water in an average or normal flow year, not how much sediment is in the water in a low flow year, since it is impossible to predict or ensure that the flow in future years will be equally low. Given this relationship between flow and sedimentation, the assessment appears to have underestimated the extent of sedimentation problems in the subbasin.

In addition to water column data (TSS), habitat data (percent fines and stream bank erosion) was collected within the subbasin. Although the TSS data has not indicated impairment, the percent fines data has indicated that there is impairment and stream bank erosion inventories have indicated that in most water bodies that there is an excessive load of sediment being delivered into the system. The stream bank erosion inventories are not dependent on flow; as a result the evaluation of sediment influences within the listed water bodies in the subbasin has been covered at various levels and is complete.

C). The assessment currently recommends that nine of the twelve 303(d) listed water bodies be listed and have TMDLs prepared for sediment. Based on the above analysis, the assessment should: (1) average its underlying data with data from above-normal and normal flow years; (2) modify TMDLs (i.e. by proportionately decreasing allowed sediment pollutant) in the draft assessment recommended for those nine listed water bodies; and (3) develop sediment TMDLs for the remaining three listed water bodies: Willow Creek, Beaver Creek, and Little Beaver Creek. As noted in the assessment, both the bedload sediment data and the stream bank stability data on Willow Creek and Little Beaver Creek indicate that even during drought years sediment is impairing beneficial uses of those creeks. Yet according to the assessment, because biological data does not seem to support the conclusion that sediment transport or erosion is impacting beneficial uses of either of those creeks, the Department decided not to complete sediment TMDLs. Given, however, that the percent fines data and the stream bank erosion data are so elevated even in drought years, a TMDL should be completed for Willow Creek and Little Beaver Creek so as to prevent additional sediment transport and corresponding harm during normal flow years.

Stream bank erosion inventories were completed to determine if stream banks were an excessive source of bedload sediment. Two of the reaches on Willow Creek were near 70% while the third reach was at 80%. The target for stream bank stability is suggested to be 80%; however, that target may vary from subbasin to subbasin depending on subbasin characteristics. Biological data on Willow Creek indicates that beneficial uses are fully supported. It would appear that stream bank stabilities of 70% or greater are capable of fully supporting beneficial uses within the subbasin. Targets for stream bank stability in the subbasin could likely be set at 70%. However as the number of larger, consistently perennial water bodies that is meeting beneficial uses is limited in the subbasin; the 70% target would be hard to attribute to other watersheds with only one water body confirming the 70% target. As a result, the stream bank stability target of 80% has been retained and applied throughout the subbasin.

Sediment is narrative criteria rather than numerical criteria so we protect for beneficial uses rather than protect a numerical value. The beneficial uses are fully supported therefore sediment does not appear to be impacting them. However, temperature TMDLs have been completed on both of these water bodies and will likely result in an increase in bank stability and limit further erosion.

D). With respect to Beaver Creek, a sediment TMDL should also be completed. The assessment states that although bedload sediment appears to be impacting beneficial uses, a sediment TMDL will not be completed. The rationale for this decision is apparently that the causes of the increased sediment are historical events and insufficient flows. It is unclear just why such events are sufficient to justify a decision not to create a sediment TMDL for Beaver Creek. The Clean Water Act specifies that establishment of TMDLs should allow for margins of safety and for variations in flows. Historical events and low flows should therefore be part of the equation when TMDLs are calculated; they should not give as reasons to avoid completing TMDLs in the first place.

The reasons for not completing a sediment TMDL on Beaver Creek are that beneficial uses are fully supported and that bank stability of the two segments of the creek are both above the 80% target. Historical events and insufficient flows due to drought are only given as possibilities of why the bedload sediment within the creek has not flushed out of the system as yet. In addition, there are beaver dams (which are building up flood plains) within the lower stretches of the creek which might be preventing the sediment from moving out of the system.

E). Similar to how data derived from low-flow years might have caused the assessment to underestimate the subbasins problems with sediment, it is likely that such low flow data also caused the assessment to underestimate the subbasins problems with nutrients. The assessment noted that several of the waters such as Soldier Creek, Willow creek and Camp Creek have elevated levels of nitrogen, but did not prepare TMDLs for nitrogen because those waters were phosphorous limited. In years with normal and above-normal flows, however, increased runoff will consequently increase the phosphorous load (which has a high tendency to bind with sediments) and other nutrients from nearby farms, livestock operations, or other sources into the area's surface waters. These sources of phosphorous, especially from cattle operations, are abundant throughout the Camas Prairie and especially on land adjacent to Willow Creek, making this high-flow high-phosphorous relationship a likely scenario. The data shows that the current levels of nitrogen in the waters present conditions that would encourage and cause nuisance aquatic growth. Even in those waters where both nitrogen and phosphorous are currently at acceptable levels, the Department should ensure that these levels do not indicate the possibility of nutrient-derived problems during normal flow years. The assessment should include complete nutrient TMDLs for waters with elevated levels of nitrogen such as Soldier, Willow, and Camp Creeks; and should establish nutrient TMDLs for other waters in the subbasin if it appears that the nutrient levels could cause nuisance aquatic growth during non drought years.

The majority of Soldier Creek and Camp Creek and most of the water bodies within the subbasin have a shortage of water during the summer months during the growing period. As a result aquatic vegetation is not going to be a nuisance when there is no water in the channel to support the vegetation. As for Willow Creek, the aquatic vegetation water quality standard again is a narrative criteria set to protect beneficial uses. Beneficial uses of Willow Creek are fully supported. Again implementation plans addressing temperature and sediment TMDLs will also aid in nutrient delivery into the streams. If water is returned to the water bodies in perennial flows nutrients within the water bodies may need to be readdressed as it is currently a data gap due to lack of flow. However, nutrients would likely not be a problem because BMPs addressing temperature and sediment are also likely to aid in limiting solar radiation delivery to the stream and thus limit plant growth.

PCP #6. Due to the high degree of interaction between surface and groundwater in the subbasin, TMDLs should be completed for nitrogen in the subbasins surface waters.

Another reason why TMDLs should be completed for water bodies in the Subbasin with elevated levels of nitrogen is that groundwater in the Camas Prairie currently is contaminated with unacceptably high levels of nitrates. According to a 2002 study, twenty-four percent of wells, or twenty-nine wells, in the Camas Prairie have levels of nitrate exceeding the maximum contaminant level ("MCL") of 10 mg/L. In contrast, only three percent of sampled wells in Idaho as a whole have nitrate levels exceeding the 10mg/L standard. The Camas Prairie also ranked fifth in a 2002 list of the top twenty-five nitrate degraded areas or "nitrate priority areas" in Idaho. Only four areas in the entire state of Idaho were deemed by the Department to have more serious problems with nitrate contamination than the Camas Prairie. Contaminated groundwater is a problem because it can affect the quality of other water bodies in the subbasin (in violation of surface water antidegradation policies), and because it impedes the ability of inhabitants of the Camas Prairie to utilize a crucial natural resource: Most residents of the Camas Prairie rely upon the groundwater for their drinking water, as well as for other domestic and municipal uses. Groundwater contamination threatens these uses and threatens the health of Camas Prairie residents who draw water from local wells.

The contamination of the groundwater should have significant ramifications for management of the surface waters in the subbasin. This is because, as is recognized in the assessment, there is (1) considerable interaction between surface and groundwater in the subbasin, and (2) a number of the subbasins surface waters contain elevated levels of nitrogen. Consequently, it appears likely that the high levels of nitrogen in the surface waters are contributing to the contamination of the groundwater. This is inconsistent with Idaho's Ground Water Quality Rule (IDAPA 58.01.11) which states, in part, that "the implementation of water quality programs shall ensure that surface water infiltration does not impair beneficial uses of ground water."

Additionally, because of the high degree of surface-groundwater interaction in the subbasin, elevated nitrogen levels in one surface water body are likely impacting other surface water bodies in the subbasin and causing degradation of waters in violation of water quality laws. Surface waters with elevated nitrogen levels can mix with the groundwater which, in turn, can contribute to flows in other surface waters. As a result, waters with low nitrogen content can be degraded with flows from other, high-nitrogen waters in the subbasin. Again this can cause violations of the state's antidegradation policies.

Nitrogen inputs into the surface waters must be controlled to protect the ecological integrity of those waters from degradation by nitrogen, but also to prevent further degradation of the groundwater. The Department should use the TMDL process to guarantee that there are adequate controls regarding the amount of nitrogen flowing into surface waters from point and nonpoint sources of pollution.

The Camas Prairie referred to in the 2002 nitrate study refers to the Camas Prairie located in northern Idaho in Idaho County.

PCP #7. The department should more fully describe the authorities relied upon in its assessment and TMDL development, and its reasons for selecting those authorities.

A). The mandate by both state and federal lawmakers for agencies to provide to the public a meaningful opportunity for comment on critical decisions they make demonstrates the importance of the public's role in helping shape these decisions and their outcomes. In order for the public comment process to be efficient and useful, however, there must be an adequate flow of information between both the agencies responsible for formulating the rules, and the public seeking to comment on those rules.

In addition to the public comment period, public meetings in the form of the Watershed Advisory Group meetings were held once a month. At these meetings the subbasin assessment and TMDL was discussed along with other water quality issues. Meetings were advertised in the newspaper frequently and were posted on the DEQ calendar. The public's ability to comment on decisions made in the document or to question aspects of the document incorporated the three years of development.

The assessment should include a description of the sources relied upon in the assessment, and the reasons why those sources were chosen as authorities. The Coalition, for example, would like to know why the assessment uses water quality criteria established by the EPA in some portions of the document, but uses other authorities, such as the European Inland Fisheries Advisory Commission, in other portions of the assessment. Similarly, the assessment should explain why targets used in establishing TMDLs in other areas of Idaho are (1) valid and (2) appropriate to use in establishing targets for this particular subbasin. The absence of such elaboration on the sources and authorities behind the assessment effectively prevents the public from providing meaningful comment on the methodology used and the conclusions reached in assessment.

The goal of a TMDL is to restore the beneficial uses of the water body to full support status, in doing so targets were developed. It may be found that targets were not sufficient to restore beneficial uses for a given water body. Further monitoring in the future will help us identify if sufficient BMPs are being completed to restore the beneficial uses. Future monitoring may also indicate that targets and load allocations for certain pollutants will need to be adjusted to restore beneficial uses. The TMDL is not the end of the monitoring and evaluation of pollutants within the subbasin and water bodies. Further monitoring when possible will aid in determining the progress that is occurring and the steps that need to be taken.

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USFS #1. Tables 1 and 14 provide the boundaries of the 1998 303(d) stream segments and Tables 3 and 102, among other things, mention recommended changes to the list, but the latter two lists (and the text as far as I could tell) don't say anything about the boundaries on the segments. Can it be assumed that the boundaries will stay the same? I suggest that the document show what changes in 303(d) boundaries are proposed or explicitly state that there are no proposed changes in the 303 (d) section boundaries.

The stream segments for impairment will remain the same; however the TMDL still incorporates the entire length of the stream. This statement will be placed as a footnote in the above mentioned tables.

USFS #2. In Section 2.3, assessments are provided for water quality characteristics of the various streams in the subbasin and stream sections are often referred to as "upper," "middle," "lower," etc. As far as I could see though, these reach descriptions are not specified anywhere in the document. I suggest that narrative descriptions of the stream reach boundaries or a map showing the same be provided.

Reach descriptions in the tables and descriptions referring to biological data collection often refer to general representative descriptions of lower reaches, middle reaches, and upper reaches of the creek. Stream bank stability reaches are identified with GPS coordinates and a rough map of the segments in Appendix 4, however verbal descriptions will be added to the GPS coordinates table. Verbal descriptions of canopy cover reaches will be added to Appendix 5.

USFS#3. In Section 2.3, the potential irrigation diversion volumes (most showing startling over appropriation) for the various streams and tributaries are shown at the end of the "Hydrology" section for each stream but, while other causes are discussed for low flows, intermittent reaches, or water temperature increases, these diversions are not mentioned (as far as I could see). Table 103 at the end of the Section 5 notes whether flow alteration are judged to have impacts to water quality for specific stream reaches, this table is far away from the technical discussions in Section 2.3 and doesn't provide any details. A complete report would have a full discussion of the effects of irrigation diversions on water quality.

The following statement has been added to the discussions of events that may be contributing to elevated temperatures: Removal of water for water use demands reduces the quantity of water and allows solar radiation to elevate temperatures more rapidly.

USFS #4. On page 63, it is stated in the text that brook trout have been found to occur in Willow Creek and references Table 24. The table does not show the presence of brook trout at any of the sampling sites, and this absence comports with my personal knowledge. I believe that the text should be modified.

The correction has been made.

USFS #5. On page 72, mention is made of the 1st fire in the Beaver Creek drainage during 2001. Contrary to what the document states, I remember that a portion of the Beaver Creek riparian zone near the Willow Creek road crossing was burned during this fire.

The previously written statement has been replaced with the following: In 2001 two range fires burned through or near the Beaver Creek drainage. These fires greatly impacted Beaver Creek and destroyed most of the riparian zone in the lower half of the creek.

USFS #6. On page 98, a mention of the origins of Elk Creek on USFS-managed land is omitted.

This has been added to the document.

USFS #7. On page 115, the gradient of the 303(d) section of Corral Creek is states as 7.52%, which seems unlikely.

The gradient of 7.52% refers to the 303(d) listed segment of Cow Creek rather than Corral Creek.

EPA #1. I would like to recommend that you use the Ecoregional Criteria for Nutrients that was published in the federal register in January 2003. It seems that it would be more applicable to addressing this issue than the 1986 Gold Book standard.

Reasons for not using the Ecoregional Criteria were given in the section entitled Analysis Process.

EPA #2. Page 36. In the last paragraph which discussed the results of a WBAG study. It concludes that no fish data was collected in Elk Creek or Cow Creek. It is therefore assumed that salmonid spawning does not occur. I would take the more conservative approach and assume that it does occur until data indicates otherwise. If there are other circumstances that would lead you to this conclusion from field observation than please add that.

A further explanation of the SS spawning criteria has been added to the document…"and there has been no fish data collected on Elk Creek or Cow Creek. As a result, salmonid spawning is not identified as an existing use at this time. It is unlikely that SS is occurring in Cow Creek as the 303(d) listed portion is a short first order segment and the remaining portions of Cow Creek are intermittent and has water during spring runoff. Elk Creek similarly has few tributaries and is intermittent. The water body in the Elk Creek drainage that provides limited perennial waters in the upper end of Elk Creek is a geothermically warm water body fed by hot springs. Salmonid spawning is likely not to occur in these watersheds due to the lack of water or warm water influence. The SS criteria will not be assessed, but may need to be readdressed at a later date when data gaps are filled."

EPA #3. Page 190. The target for bacteria is identified as the 576 col/100 ml of E. coli organisms, instead of the geometric mean of 126 col/100ml. In our comments on the Goose and Raft TMDLs we asked that the average value be the target to meet Idaho's water quality standard. To be consistent with the changes that were made in that document, please revise this section accordingly.

The document in the subheading Targets now reads as follows in "As a result 576 colonies of E. coli organisms will be the target for the bacteria TMDL on Wild Horse Creek. However, the geometric mean value of 126 cfu/100 ml will be the value used to determine compliance with the standards."