Goose Creek Subbasin Assessment and Total Maximum Daily Loads

FINAL

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Cover photo by Karen Georgeson.

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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 millionth

µg/L microgram per liter

µS/cm microsiemens per centimeter

§ Section (usually a section of federal or state rules or statutes)

AMP Allotment Management Plan

ANOVA Analysis of Variance

BAER Burned Area Emergency Rehabilitation

BAG Basin Advisory Group

BLM United States Bureau of Land Management

BMP best management practice

BOD biochemical oxygen demand

BOR United States Bureau of Reclamation

BURP Beneficial Use Reconnaissance Program

BYU Brigham Young University

C Celsius, Centigrade

C&H Cattle and Horse

CAFO Confined Animal Feeding Operation

CFR Code of Federal Regulations (refers to citations in the federal administrative rules)

cfs cubic feet per second

cfu Colony forming units

cm centimeters

col Colonies

CWA Clean Water Act

DEQ Department of Environmental Quality

DO dissolved oxygen

EA Environmental Assessment

E. coli *Esherichia coli*

EPA United States Environmental Protection Agency

EQUIP Environmental Quality Incentive Program

F Fahrenheit

FPA Idaho Forest Practices Act

Ft Feet

FWS U.S. Fish and Wildlife Service

GIS Geographical Information Systems

GPM Gallons per minute

gpm/ft Gallons per minute per foot

GW Ground water

H_a Alternative hypothesis

HIP Habitat improvement project

H_o Null Hypothesis

HUC Hydrologic Unit Code

I.C. Idaho Code

IDA Idaho Department of Agriculture

IDT Idaho Department of Transportation

IDAPA Refers to citations of Idaho administrative rules

IDFG Idaho Department of Fish and Game

IDL Idaho Department of Lands

IDWR Idaho Department of Water Resources

INFISH The federal Inland Native Fish Strategy

IRIS Integrated Risk Information System

ISCC Idaho Soil Conservation Commission

km kilometer

km^2 square kilometer

$kwh/m^2/day$ Kilowatt per hour per square meter per day

LA load allocation

LC load capacity

m meter

m^3 cubic meter

m^3/s cubic meter per second

mi mile

mi^2 square miles

MBI macroinvertebrate index

MGD million gallons per day

Mg Megagram or Metric Ton

Mg/y Metric ton per year

mg/L milligrams per liter

mg/m^2 milligram per square meter

mm millimeter

MOS margin of safety

MWMT maximum weekly maximum temperature

N Nitrogen

n.a. not applicable

NH_3 Ammonia

NO_x General symbol for nitrite and nitrate in a solution

NA not assessed

NB natural background

nd no data (data not available)

PCR primary contact recreation

ppm part(s) per million

NFS not fully supporting

NPDES National Pollutant Discharge Elimination System

NRCS Natural Resources Conservation Service

P Phosphorus

PFC proper functioning condition

Q Discharge, flow

RM River Mile

S&G Sheep and Goat

SBA SBA

SC Specific conductivity

SCD Soil Conservation District

SFI DEQ's stream fish index

SMI DEQ's stream macroinvertebrate index

SMZ Streamside Management Zone

SR-HC Snake River, Hells Canyon

STATSGO State Soil Geographic Database

TDS total dissolved solids

T&E threatened and/or endangered species

TFRO Twin Falls regional Office

TMDL total maximum daily load

TN total nitrogen

TP total phosphorus

TS total solids

TSI trophic state index

TSS total suspended solids

U.S. United States

USC United States Code

USDA United States Department of Agriculture

USDI United States Department of the Interior

USFS United States Forest Service

USFWS United States Fish and Wildlife Service

USGS United States Geological Survey

WAG Watershed Advisory Group

WBAG Water Body Assessment Guidance

WLA wasteload allocation

WQLS water quality limited segment

WQMP water quality management plan

WQRP water quality restoration plan

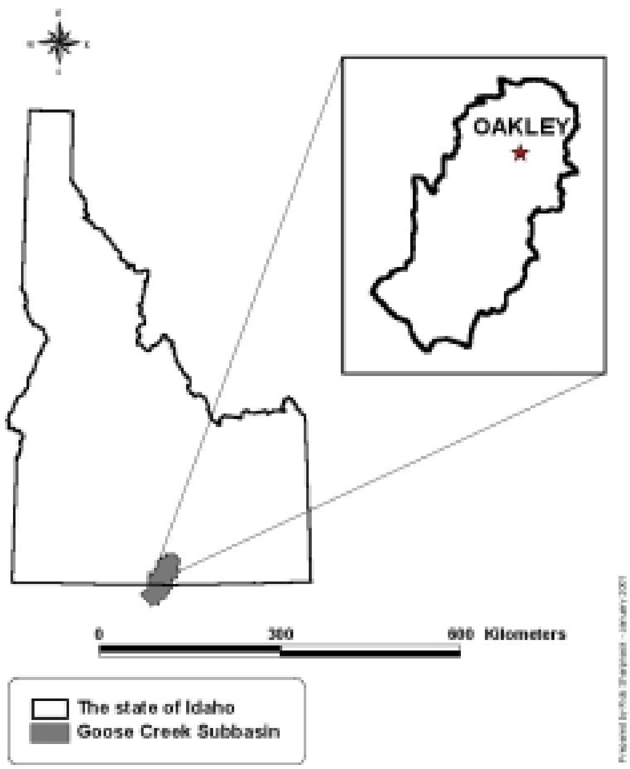
WQS water quality standard

Executive Summary

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to §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 Goose Creek Subbasin that have been placed on what is known as the "§303(d) list."

This SBA (SBA) 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 Goose Creek Subbasin located in south central Idaho. The first part of this document, the SBA, is an important first step in leading to the TMDL. The starting point for this assessment was Idaho's current 1998 §303(d) list of water quality limited water bodies. Eight segments of the Goose Creek Subbasin were listed on this list. The SBA 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.

The 1996 §303(d) list for the state of Idaho (DEQ 1994) included four stream segments occurring within the region designated as the Goose Creek Subbasin. These same four stream segments remain on the 1998 §303(d) list, although nearly 9 miles of Trapper Creek (from the headwaters to Ibex Hollow) were removed. Four additional waters were added to the list in 1998 by the state and one by the U.S. Environmental Protection Agency (EPA). The *Goose Creek SBA and Total Maximum Daily Loads* (SBA-TMDL) for surface waters of hydrological unit code 17040211 describes those nine water bodies and 17 pollutants that are listed on the 1998 §303(d) list prepared by the state of Idaho, including the EPA addition (see table 1). In addition, four other pollutant/water body combinations are included in the SBA-TMDL due to water quality monitoring within the subbasin. The listed water bodies are considered "water quality limited" and do not meet their beneficial uses as defined by state of Idaho water quality standards. The SBA provides information pertaining to existing and designated beneficial uses. The information in the SBA includes those pollutants and the sources of pollutants that are affecting these beneficial uses. The information was obtained from a variety of sources including monitoring efforts of the Department of Environmental Quality (DEQ) and other agencies and individuals. The public has also been involved in the development of the SBA-TMDL through a variety of venues. Most notably, public meetings were held in the towns of Burley and Oakley.



Hydrologic Unit Code	17040211
Subbasin Drainage Size	1,791 km^2 in Idaho 2,902 km^2 Total
Total Stream Length	2,522 km
Listed Stream Lenght	147.6 km
Applicable Water Quality Standards	▪ IDAPA 58.01.02.200-General Surface Water Quality Criteria ▪ IDAPA 58.01.02.250-Surface Water Quality Criteria for Aquatic Life Use Designations
Beneficial Uses Affected	▪ Cold water aquatic life ▪ Salmonid spawning ▪ Secondary contact recreation
Pollutants of Concern	▪ Sediment ▪ Nutrients (Total phosphorus) ▪ Bacteria ▪ Temperature ▪ Low Dissolved Oxygen

Figure 1. Goose Creek Subbasin and vital statistics.

Table 1. 1998 §303 (d) list.

Water body	Pollutants
Goose Creek	BACT[a], DO[b], QALT[c], NUT[d], SED[e], TEMP[f]
Trapper Creek	BACT, DO, QALT, SED.
Birch Creek	BACT, DO, SED
Cold Creek	UNKN[g]
Bluehill Creek	UNKN
Beaverdam Creek	UNKN
Big Cottonwood Creek	UNKN
Mill Creek	TEMP
Lower Goose Creek Reservoir	DO, QALT, NUT, SED

a BACT = bacteria
b DO = low dissolved oxygen
c QALT = flow alteration
d NUT = nutrients
e SED = sediment
f TEMP = elevated water temperature
g UNKN = unknown pollutants

Subbasin at a Glance

The general physical and biological characteristics (Figure 1) of the Goose Creek Subbasin have a strong influence on the water quality of the subbasin. Land use in the subbasin is predominantly rangeland (≅ 43 percent). Irrigated agriculture also exists in the lower elevation, northern portion of the subbasin where water is either pumped from the ground or diverted from Goose Creek Reservoir. The major population center of the basin is the town of Oakley. The subbasin contains three different water sources. The first of these is runoff from the snowpack and other precipitation events in the mountainous region to the east and west. The second is the Goose Creek-Golden Valley Aquifer below Oakley, which is part of the Eastern Snake River Plain Aquifer. The final source is a geothermal layer that feeds several geothermal springs along the ecoregional boundary. These sources affect water quality to varying degrees. To a small extent, stream temperatures may be slightly elevated due to geothermal activity in the region. The water from the local aquifer likely does not affect water quality significantly, as the amount of water entering the streams and rivers of the subbasin from this source and the geothermal source is minor in comparison with snowpack and precipitation.

The subbasin land forms, vegetation, topography, and precipitation can be defined by two ecoregions. The predominant ecoregion of the subbasin is the Northern Basin and Range. The Northern Basin and Range ecoregion is predominantly sage-steppe-juniper mountain lands. Most of the surface streams are intermittent or ephemeral in nature due to low annual precipitation and evaporation. Consequently, limited riparian habitat exists within the subbasin. Those streams that remain perennial usually form from spring sources in the more mountainous regions of the subbasin. Along these stream courses some riparian habitats persist.

Sediment, low dissolved oxygen, and bacteria are the most common listed pollutants in the subbasin. These pollutants were listed for the four 1996 §303(d) listed water bodies within the subbasin. Other listed pollutants and stressors include nutrients, flow, temperature, and “unknown”. The SBA portion of the SBA-TMDL determines the current amount of each particular pollutant in each of the watersheds of the §303(d) listed water bodies. The SBA also determines what impact to the beneficial uses each pollutant may have.

Key Findings

In general, the impacts to the beneficial uses were determined by assessing the biological communities and the limited water chemistry data available. When these two data sets were in agreement with one another, appropriate actions, such as completing a TMDL or delisting the stream, were undertaken.

The water quality of the Goose Creek Subbasin, in general, is of high quality. Nutrients are a listed pollutant in the Goose Creek Reservoir and Goose Creek segments of the subbasin. In these reaches it was determined that total phosphorus (TP) may be a limiting nutrient. In the Beaverdam Creek Watershed it was also determined that TP was in excess, but that a natural source of TP existed within the watershed. In the Beaverdam Creek and other watersheds nitrogen compounds are not in excess of EPA "Blue Book" (*Water Quality Criteria 1972*) recommendations (EPA 1975). Background TP concentrations at a Nevada sampling site in Goose Creek averaged 0.083 milligrams per liter (mg/L) annually, while concentrations near the end of the reach averaged 0.099 mg/L. Only nonpoint sources and natural soil-associated phosphorus contribute to this increase in TP concentration, as there are no point sources located within the watershed. In the reservoir annual TP concentrations averaged 0.026 mg/L. Total phosphorus concentrations in the Trapper Creek Watershed have averaged 0.117 mg/L annually. Natural background levels in the Beaverdam Creek Watershed were determined to be 0.129 mg/L TP. Consequently, the target selected for the Beaverdam Creek Watersheds was also set at natural background. The EPA has set guidelines for TP concentrations in streams flowing into lakes and reservoirs. As such, Goose Creek and Trapper Creek TP concentration targets are set at 0.05 mg/L. If the analysis were based solely upon TP concentrations, then a 49 percent reduction in TP would be required for nonpoint sources within the Goose Creek Watershed and a 59 percent reduction would be required for Trapper Creek. However, taken in context with the other nutrients (which are often below detection limits) and chlorophyll *a* concentrations, a nutrient TMDL is not warranted in Goose Creek whereas one is required in the Trapper Creek drainage.

For lakes and reservoirs, the EPA has set guidelines for TP concentrations at 0.025 mg/L. As a result, the Goose Creek Reservoir TP concentration target is set at 0.025 mg/L. No reductions in TP will be required for nonpoint sources within the Goose Creek Subbasin in order to meet these targets within the reservoir. The other listed streams and pollutants in the subbasin, in general, were below any nutrient standard or guideline established for the protection of beneficial uses.

Flow and habitat alteration issues were not discussed in the SBA-TMDL due to current DEQ policy. It is DEQ policy that flow and habitat alterations are pollution, but not pollutants requiring TMDLs. 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. These forms of pollution will remain on the §303(d) list; however, TMDLs will not be completed on segments listed with altered flow or habitat as a pollutant at this time.

Temperature, under the current standards, is a listed pollutant for Goose Creek and Mill Creek. In other areas of the state, bioassessment data conflict with current temperature information and water quality standards. This is likely the result of the state's current water quality standards being derived from an outdated understanding of the cold water aquatic life's temperature requirements. Consequently, DEQ is participating in a regional review of temperature criteria, which is being organized by EPA Region 10. Following the conclusion of the temperature review, temperature exceedances documented now in the Goose Creek Subbasin will be reassessed and, if needed, temperature TMDLs will be completed. Until that review is completed, temperature TMDLs in the Goose Creek Subbasin will proceed. Streams with fully supported beneficial uses and the different shade components of those streams will be used to set the shade components for temperature TMDLs developed and presented in this document.

The following tables (2-4) summarize the TMDLs that were completed, recommended delisting actions as a result of the Goose Creek SBA, and stream/pollution combinations retained on the §303(d) list.

Table 2. Delistings in the Goose Creek Subbasin

Segment	TMDL-pollutant	TMDL-pollutant	TMDL-pollutant
Goose Creek	Nutrients –TP[a]	Bacteria	Dissolved Oxygen
Trapper Creek	Bacteria	Dissolved Oxygen	
Birch Creek	Sediment- TSS[b]	Dissolved Oxygen	
Cold Creek	Unknown		
Blue Hill Creek	Unknown		
Big Cottonwood Creek	Unknown		
Emery Creek	Bacteria		
Mill Creek	Temperature		
Goose Creek Reservoir	Nutrients - TP	Sediment- TSS	

a TP = Total Phosphorus

b TSS = Total Suspended Sediment

Table 3. Stream/pollution combinations retained on the §303(d) list.

SEGMENT	TMDL-POLLUTANT
Goose Creek Reservoir	Flow Alteration
Goose Creek	Flow Alteration
Trapper Creek	Flow Alteration
Big Cottonwood Creek	Flow Alteration

Table 4. Streams and pollutants for which TMDLs were developed.

Segment	TMDL-pollutant	TMDL-pollutant	TMDL-pollutant	TMDL-pollutant	TMDL-pollutant
Goose Creek	Temperature	Sediment-Bedload			
Trapper Creek	Nutrients –TP[a]	Sediment-Bedload			
Birch Creek	Nutrients -TP	Bacteria			
Cold Creek	Temperature				
Beaverdam Creek	Nutrients -TP	Temperature	Bacteria	Sediment-TSS[b]	Dissolved Oxygen
Little Cottonwood Creek	Bacteria				
Left Hand Fork Beaverdam Creek	Nutrients -TP	Sediment-TSS	Bacteria		

a TP = Total Phosphorus

b TSS = Total Suspended Sediment

1. Subbasin Assessment – Watershed Characterization

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters (33 USC § 1251.101). States and tribes, pursuant to section 303 of the CWA are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters whenever possible. Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list of impaired waters, currently every two years. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. This document addresses the water bodies in the Goose Creek Subbasin on the 1998 "§303(d) list."

The overall purpose of this SBA (SBA) and TMDL is to characterize and document pollutant loads within the Goose Creek Subbasin. The first portion of this document, the SBA, is partitioned into four major sections: watershed characterization, water quality concerns and status, pollutant source inventory, and a summary of past and present pollution control efforts (Chapters 1 – 4). From the subbasin information, a TMDL will be developed for each pollutant of concern for the listed Goose Creek systems (Chapter 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 county. 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 SBA and TMDL provide a summary of the water quality status and allowable TMDL for water bodies on the §303(d) list. *Goose Creek Subbasin Assesssment and Total Maximum Daily Loads* provides this summary for the currently listed waters in the Goose Creek Subbasin.

The SBA section of this report (Chapters 1 – 4) includes an evaluation and summary of the current water quality status, pollutant sources, and control actions in the Goose 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 (40 CFR Part 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 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 from the Idaho water quality standards 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 the default designated uses.

A SBA 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 characterization of the Goose Creek Subbasin will be based on its physical and biological features and how they interplay with ecoregional and hydrological traits. The Goose Creek Subbasin is complex in its characterization, principally due to a plurality of land types within the Idaho portion of the subbasin. There are highly accessible river corridors where agricultural pastureland activities dominate the land use. Adjacent to these lands are the low mountainous areas from which the majority of water in the subbasin comes and rangeland land use activities dominate. In contrast to these areas is the wide, relatively flat, valley floor of the Snake River Basin from the city of Oakley to the lower reaches of the subbasin where row crop agriculture dominates the land use. Additionally, there are many sources of water in the subbasin. Much of the water for the two large streams (Goose Creek and Trapper Creek) comes from snowpack and rainfall in the mountain ranges in the western portion of the subbasin. However, many of these small feeder streams arise from springs and precipitation events on the eastern mountains. An additional factor in the subbasin complexity is the issue of nonpoint source pollution within the watersheds. Many factors influence the type and rate of nonpoint source pollution, such as soil characteristics, climate, vegetation, topography, and human activities.

Climate

The Goose Creek Subbasin begins in the mountains of the Northern Basin and Range ecological province and reaches northward to the lowlands of the Snake River Basin/High Desert. The pronounced differences in climate from the mountains to the Snake River Plain are due to the elevation difference across the subbasin. Precipitation varies from 28 to 48 centimeters (cm)/year on the lower elevations to 53 to 97 cm/year on the mountain summits (Figure 3) (See Appendix A for unit conversion factors). Using the Koeppen system of climate classification, the plains are “cold steppes” and the mountains are “undifferentiated highland climates” (Hansen 1975).

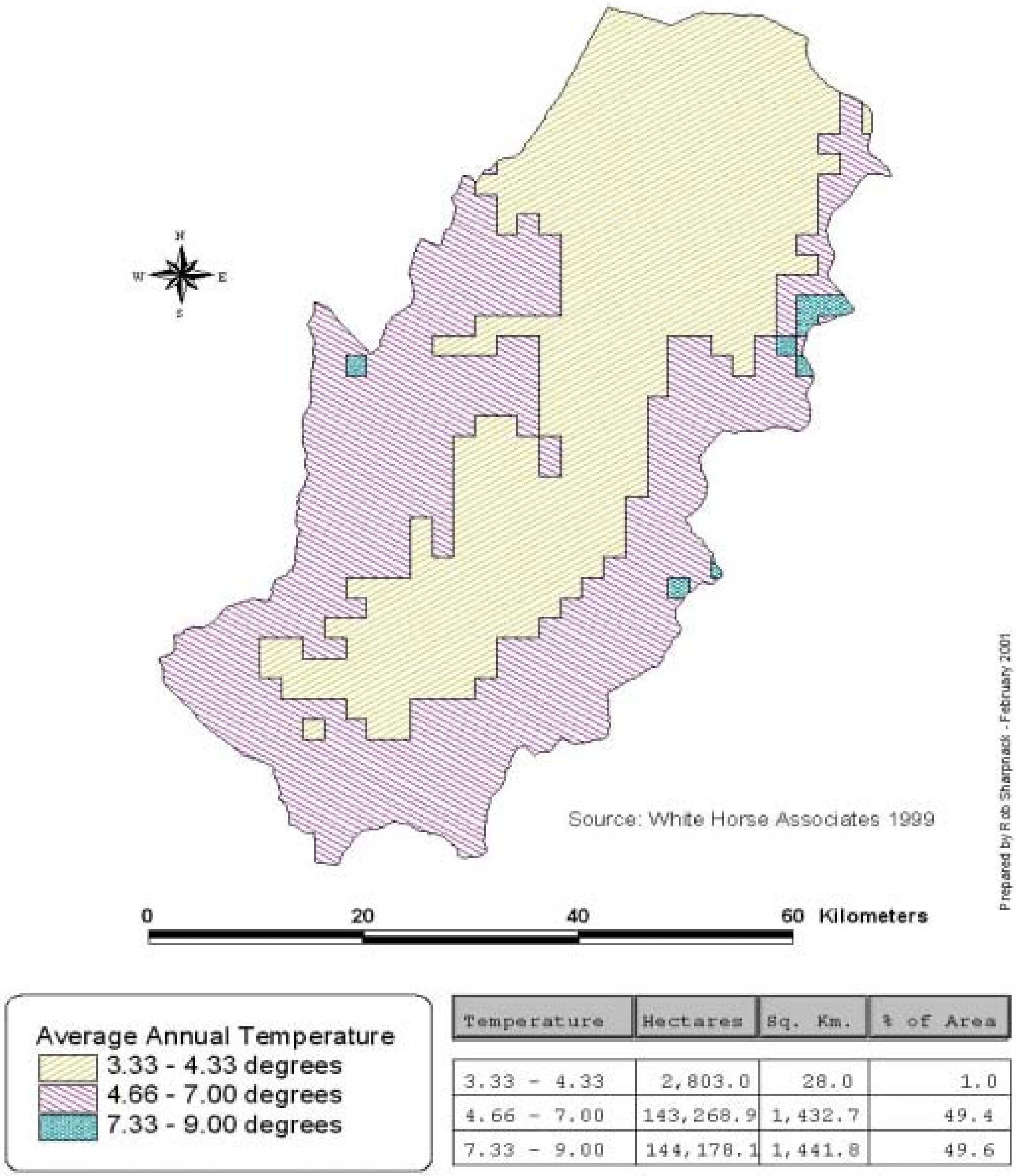
Only one climate station (Oakley) from the Western Regional Climate Center (www.wrcc.dri.edu 2000) is available within the subbasin to characterize the watershed. However, five others are near the subbasin. These are the Burley, Idaho airport; Grouse Creek, Utah; Jackpot, Nevada; Hollister, Idaho; and Strevell, Idaho. Because the majority of the climate stations are outside of the subbasin, there are few data sets available to characterize the bulk of the subbasin. As noted, nearly all the perennial flow in this watershed comes from the mountains to the south of the Snake River Plain, which do not have climate stations.

The town of Oakley is in the southern portion of the subbasin. The town is near the Snake River Plain at approximately 1,400 meters (m) in elevation. The climate is arid with an annual precipitation of 28 cm. Over one-half of the precipitation falls in March to June. The average snow depth in the winter months is 0 cm, except in January, which averages 2.54 cm. This indicates that precipitation in the form of snow does not accumulate to provide for a spring snowmelt runoff in the lower portions of the subbasin. The wettest months of the year are April, May, and June (3.05, 3.94, and 3.18 cm, respectively), while the driest months are February (1.68 cm), July (1.83 cm), and August (1.91 cm). However, for most months, outside of the wettest three, average precipitation is near the values for July and August. Monthly average precipitation is approximately 2.32 cm a month.

The town of Burley is approximately 32 kilometers (km) North of Oakley in the Snake River Basin Ecoregion. Burley lies between 1,264 m and 1,273 m elevation. It is in an arid climate, with an annual mean precipitation of just under 25.4 cm. The annual average temperature is 8.88 $^{\circ}$C, with cool winters and warm summers (Figure 3.).

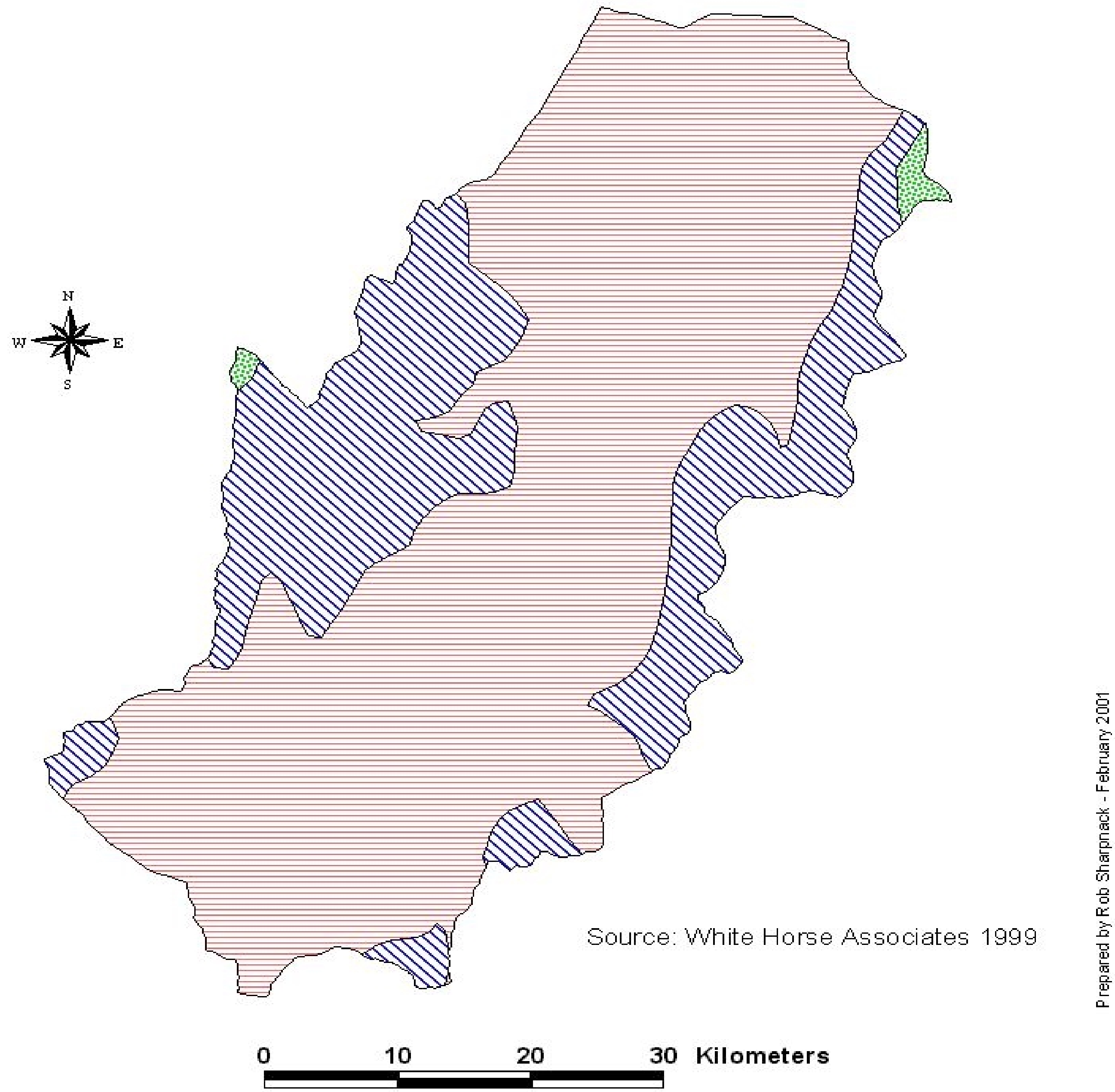
Subbasin Characteristics

Generally, the natural hydrology of an area is the result of its climactic regime, topography, and geology. Water in the Goose Creek Subbasin moves through a variety of pathways, dominated by the Goose Creek and Trapper Creek routes. Except for the two major mountainous southern drainages (Goose Creek and Trapper Creek), most of the surface channels are intermittent or ephemeral tributaries. Seasonally, ground water plays an unknown but significant role in the hydrology of several streams and rivers of the subbasin. Discussions of the hydrology of each stream will follow much later in this document.



Temperature	Hectares	Sq. Km.	% of Area
3.33 - 4.33	2,803.0	28.0	1.0
4.66 - 7.00	143,268.9	1,432.7	49.4
7.33 - 9.00	144,178.1	1,441.8	49.6

Figure 2. Average annual temperatures (in ° C) in the Goose Creek Subbasin.



Precipitation	Hectares	Sq. Km.	% of Area
27.94 - 43.18	208,348.0	2,083.5	71.8
43.18 - 66.04	79,950.0	799.5	27.5
66.04 - 96.52	1,951.1	19.5	0.7

Average Annual Precipitation (cm)
- 27.94 - 43.18
- 43.18 - 66.04
- 66.04 - 96.52

Figure 3. Average annual precipitation in the Goose Creek Subbasin.

The EPA Reach File, Version 3 (Basins 2.01 2000), was queried to generate a list of the perennial streams in the Idaho portion of the subbasin. Some of these streams may be intermittent or ephemeral, but the EPA reach file identifies them as perennial streams of the subbasin. Further investigations, ground-truthing, and cross-referencing with United States Geological Service (USGS) topographic maps will be required to determine if a stream is perennial. The reach file identified 60 streams as perennial in addition to the ones assessed in this document that are on the §303(d) list. Some of these streams will be assessed in upcoming years. Future iterations of the SBA-TMDL will include new streams not meeting their beneficial uses. Many of the remaining streams have had Beneficial Use Reconnaissance Program (BURP) data collected on them. Updated assessment guidance is available in *the Water Body Assessment Guidance*, second edition (WBAG II) (Grafe et al.2002), and will be used on these streams with BURP data collected between 1997 and 2000. Those streams will be assessed for the next §303(d) list. Table 5 lists all streams identified by EPA as perennial. The table also indicates if DEQ has determined the perennial status of the stream. These determinations are based upon observations made by field personnel. This list is for those interested parties that might have data on these streams. Subsequently, those streams added to the §303(d) list would be included in future iterations of the Goose Creek SBA-TMDL.

Table 5. Streams under consideration as perennial streams.

Stream Name	Perennial Status[a]	Stream Name	Perennial Status[a]
Badger Creek	Unknown	Little Cedar Canyon Creek	Unknown
Bear Flat Creek	Unknown	Little Cottonwood Creek	Perennial
Beaverdam Creek	Perennial	Little Goose Creek	Perennial
Big Canyon Creek	Unknown	Little Piney Creek	Perennial
Big Cottonwood Creek	Perennial	Little Squaw Creek	Perennial
Big Rocky Creek	Unknown	Mackey Wash	Unknown
Billys Hole Creek	Perennial	Mill Creek	Perennial
Birch Creek	Perennial	NE Creek	Unknown
Blue Hill Creek	Intermittent	North Carson Creek	Unknown
Boulder Canyon Creek	Unknown	Owens Corral Creek	Unknown
Buck Corral Creek	Unknown	Pickett Spring Creek	Unknown
Cabin Spring Creek	Unknown	Piney Creek	Perennial
Carlson Creek	Ephemeral	Quartz Gulch	Ephemeral
Cave Canyon Creek	Unknown	Right Hand Fork Beaverdam Creek	Ephemeral
Cave Gulch	Unknown	Robber Gulch	Ephemeral

Stream Name	Perennial Status[a]	Stream Name	Perennial Status[a]
Coal Banks Creek	Ephemeral	Rodeo Creek	Ephemeral
Cold Creek	Perennial	Sawmill Creek	Unknown
Coyote Creek	Ephemeral	Smith Creek	Unknown
Devine Canyon Creek	Ephemeral	South Carson Creek	Unknown
Dry Fork Creek	Ephemeral	South Cottonwood Creek	Unknown
Dry Gulch	Ephemeral	South Fork Little Piney Creek	Perennial
East Fork Thoroughbred Creek	Unknown	Spring Creek	Perennial
Ecklund Creek	Unknown	Squaw Creek	Unknown
Elison Hole Creek	Unknown	Summit Creek	Perennial
Emery Canyon Creek	Unknown	Summit Station Creek	Ephemeral
Emery Creek	Perennial	Swanty Creek	Perennial
Fall Creek	Perennial	Terrells Corral Creek	Unknown
Flatiron Creek	Unknown	Thoroughbred Creek	Perennial
Franks Canyon Creek	Unknown	Trapper Creek	Perennial
Goose Creek	Perennial	Trout Creek	Perennial
Humphrey Creek	Unknown	Walker Hollow Creek	Unknown
Jay Creek	Perennial	Walters Creek	Unknown
Lake Creek	Unknown	West Fork Thoroughbred Creek	Perennial
Land Creek	Unknown	Willow Creek	Unknown
Left Hand Fork Beaverdam Creek	Perennial	Wilson Gulch	Unknown
Little Birch Creek	Perennial	Winecup Creek	Intermittent

a Based on DEQ observation.

Goose Creek Reservoir supplies water for irrigation in the northern valley of the subbasin. The reservoir discharges into a main canal, which then splits into two feeder canals, one on the east side of the valley and one on the west side. The Oakley Canal Company provided information on total discharge for the reservoir since 1996. From this data, DEQ estimates that during the irrigation season about 3.45 cubic meters per second (m^3/s) on average are diverted from the reservoir. Monthly and daily discharge rates vary throughout the irrigation season. Typically, peak discharge is in July. Annual discharge from the reservoir, within the data set, appears to have peaked in 1999. Furthermore, a drought period appears to have begun in June, 1999 and has continued through to date as evidenced by the reservoir discharge. The diversion structures for the Goose Creek and Trapper Creek ditches are located approximately 1 km downstream from the reservoir. Limited irrigation water returns exist in the Oakley Valley and northern portions of the subbasin.

Ground Water

Ground water in the Goose Creek Subbasin is an important aspect of the water quality and quantity of some streams. Typically, the streams that lie within the limestone belts of the subbasin are more directly influenced by spring sources than those in the volcanic geological areas. For example, in the Beaverdam Creek and Big Cottonwood Creek areas, springs and dissolved materials in the ground water have a great impact on water quality. In addition, total phosphorus (TP) from ground water affects water quality in Beaverdam Creek. However, for the most, part springs are limited in the subbasin. Some of the springs within the area are warm or hot springs which may influence stream temperatures, although the impact from these geothermal sources is unknown at this time. The Goose Creek-Golden Valley aquifer is the aquifer over which most of the subbasin lies (Figure 4). The elevation of ground water in the Oakley area was estimated to be near 4,000-4,100 feet (ft) above sea level in 1980 (Garabedian 1992). In the Oakley area, this translates to a water table depth of 500-600 ft. However, for most wells in the area, pumping lifts are ordinarily near 400 ft (Young and Newton 1989). The mean specific capacity of wells in Cassia County and the Goose Creek-Golden Valley area is 1,100 gallons per minute per foot (gpm/ft) of draw down. The specific capacity of the count is among the highest in the Eastern Snake River Plain Aquifer, which ranges from 2,120 to 220 gpm/ft (Garabedian 1992). In some areas of the aquifer the transmissivity can be very high, such as in the Quaternary basalts. However, in fine-grained sediments and older tertiary rhyolite the transmissivity is much lower. These factors indicate that time of travel in the lower Goose Creek-Golden Valley area can be very short while in the upper rhyolitic volcanics and sedimentary alluvium areas, time of ground water travel is much longer. Young and Newton (1989) estimated time of travel to be in the area of 9-13 feet per day. Furthermore, typical water movement in the area is from recharge areas in the mountains down gradient towards Murtaugh Lake. The Churchill knobs fault forms a ground water movement barrier that prevents water movement towards Burley and the Snake River.

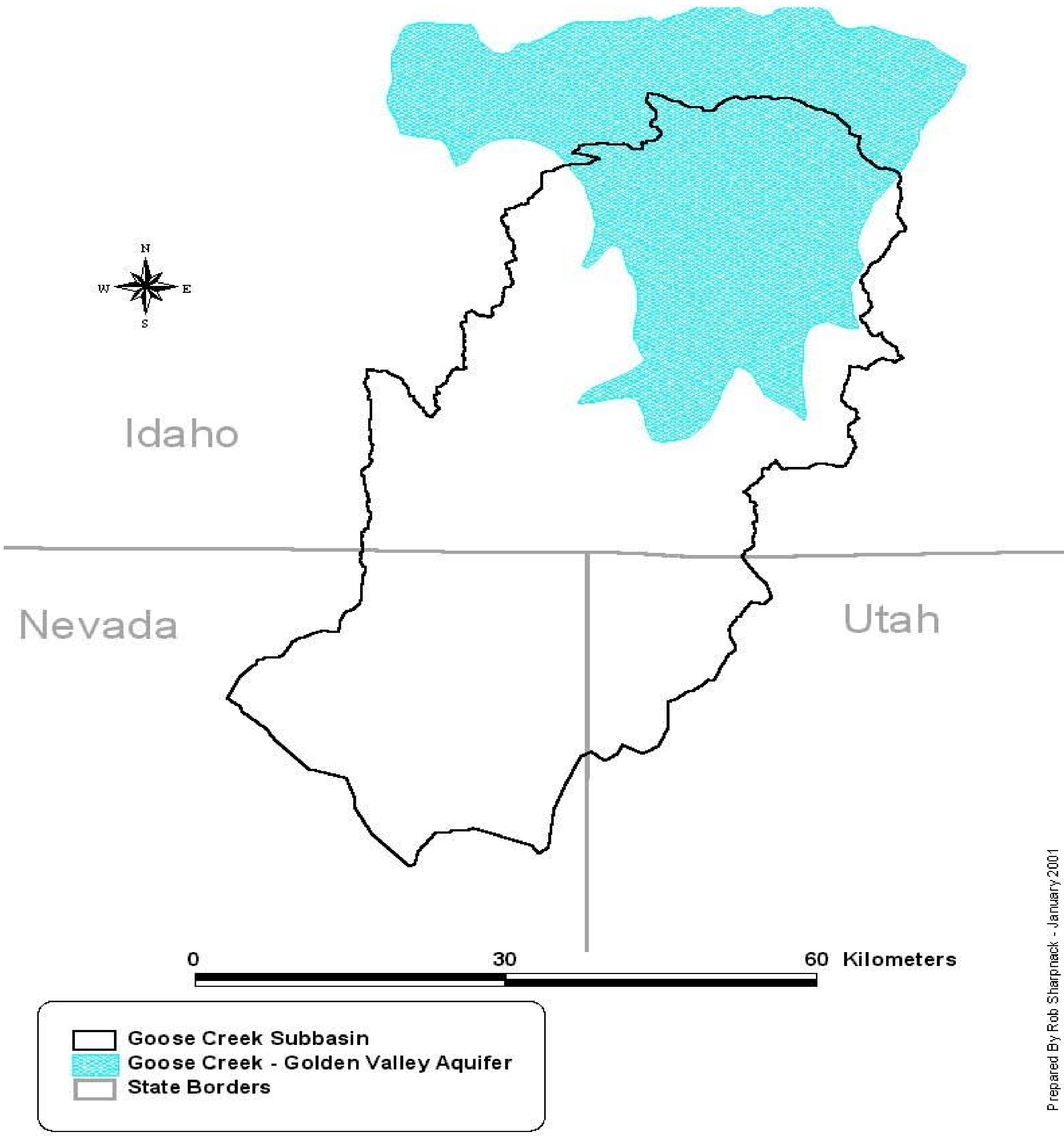


Figure 4. The location of the Goose Creek-Golden Valley Aquifer in relationship to the subbasin.

Some ground water level monitoring was done in the Goose Creek-Golden Valley area (1979 to 1984) to assist in the development of a ground water model (Young and Newton 1989). Most of the monitored wells in the subbasin show a seasonally steady volume of ground water, both predicted and measured, up to the year 1984 (Young and Newton 1989). This may indicate that over the period of record to 1984, recharge and ground water withdrawals have been at equilibrium or at a slight loss. However, some wells have shown steady losses following this period. In general Young and Newton (1989) estimate that ground water declines of 3 to 5 feet annually have occurred. Currently ground water recharge is a topic of great concern in the subbasin. Some ground water recharge projects are underway and others are planned near the lower end of Big Cottonwood Creek. Young and Newton (1989) noted that a substantial amount of ground water recharge occurs from the surface and ground water source irrigation in the Milner Low Lift and Burley Irrigation Districts. Additional recharge is from precipitation and from stream systems in the mountains to the south.

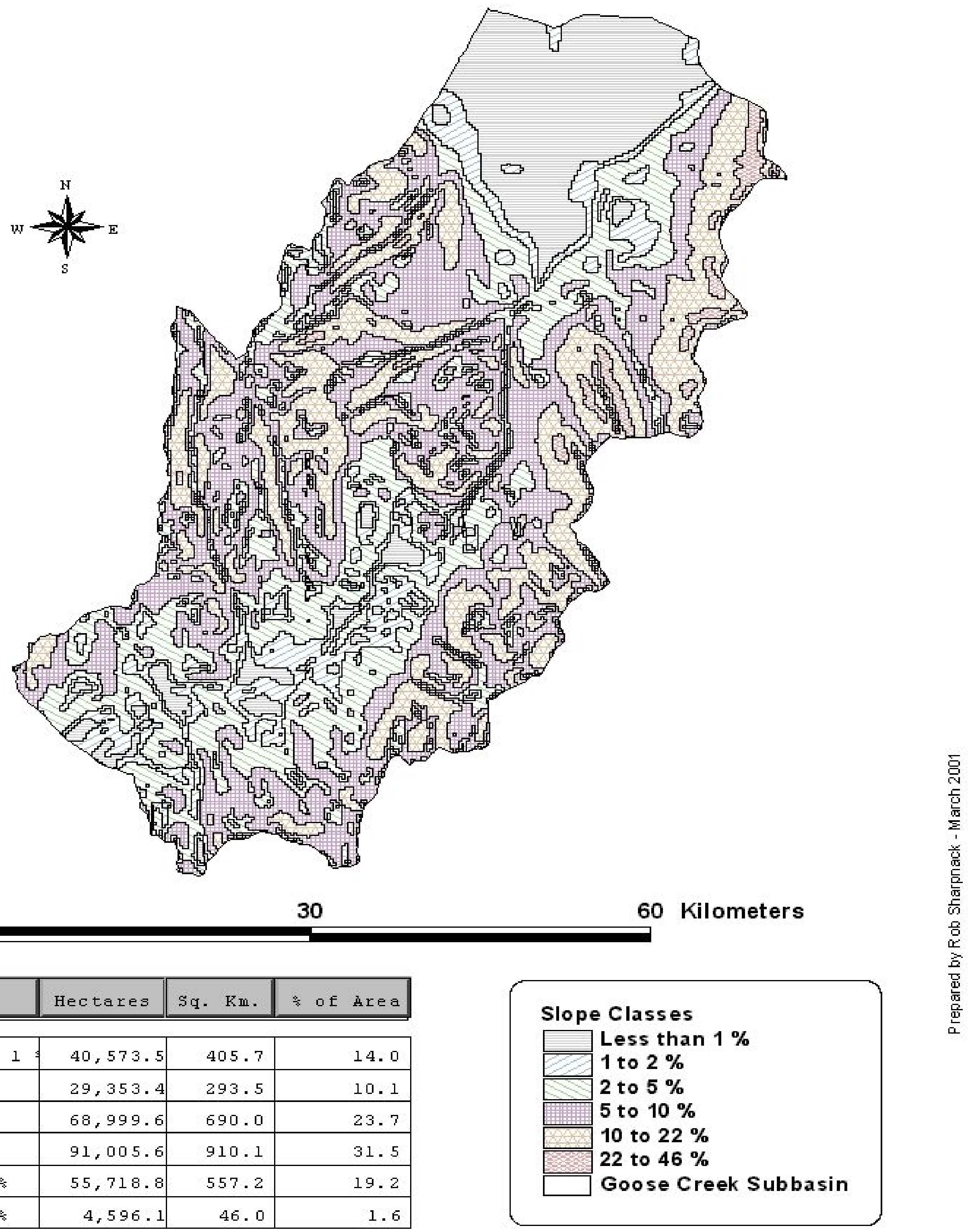
In the aquifer system model analysis done by Young and Newton (1989), they estimated that 390,000 acre/feet per year from ground water and surface water irrigation was recharged to the aquifer. They also noted that only 127,000 to 218,000 acre/feet were removed per year by ground water pumping in the area. Natural springs are another source of recharge loss, and a substantial amount is lost due to evapotranspiration in the non-irrigated lands of the area.

In addition to the Goose Creek-Golden Valley Aquifer, there is a pressurized geothermal layer in the subbasin below the reservoir. Throughout southern Idaho, when the Idavada layer of volcanics exists geothermal activity also exists (Young and Whitehead 1974). The Idavada volcanics are found in the lower portion of the Goose Creek Subbasin (Alt and Hyndman 1989).

Soils/Geology/K-Factor

Local soils can be conceptualized as four soil provinces: the clayey and loamy soils of volcanic areas, the loamy soils of the fluvial canyons, the highly stratified alluvial soils of the area near the town of Oakley, and the alpine glacial soils of the Middle Mountain province.

The average soil slope provides a gauge of potential soil erosion, or risk erodibility. The topographic maps show that slopes are low (0-5 percent) on the agricultural plains and river channel network, moderately steeper in the areas forming the watersheds surrounding this stream network (5-22 percent), and increase appreciably as one approaches the bordering mountain ranges. The slopes are fairly steep in the mountain ranges, ranging from 22-46 percent (Figure 5.).



Slope	Hectares	Sq. Km.	% of Area
Less than 1 %	40,573.5	405.7	14.0
1 to 2 %	29,353.4	293.5	10.1
2 to 5 %	68,999.6	690.0	23.7
5 to 10 %	91,005.6	910.1	31.5
10 to 22 %	55,718.8	557.2	19.2
22 to 46 %	4,596.1	46.0	1.6

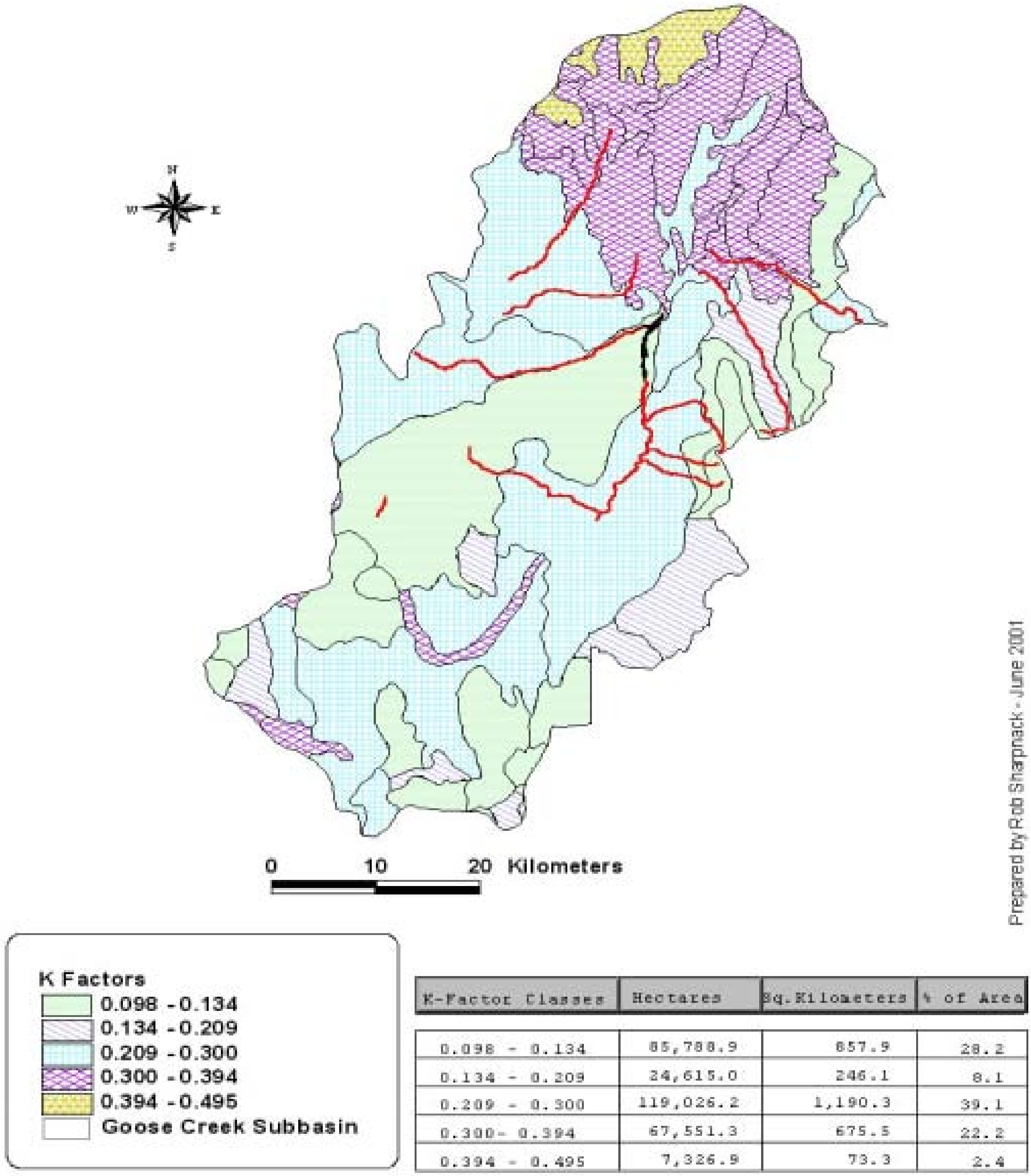
Figure 5. Slope classes of the Goose Creek Subasin.

The "K-factor" is the soil erodibility factor in the Universal Soil Loss Equation (Wischmeier and Smith 1965). The factor is comprised of four soil properties: texture, organic matter content, soil structure, and permeability. The K-factor values range from 1.0 (most erosive) to 0 (nearly non-erosive). K-factors for the Goose Creek Subbasin were calculated from the EPA BASINS (http://www.epa.gov/OST/BASINS/) soil information and range from 0.098 to 0.495. This indicates that the soils in the subbasin are relatively stable with the highest K-factor at nearly the mid point between highly erodible and nonerosive. Soils on the flat slope of the plains and agricultural areas have the most erodible soils, with K-factors that range from 0.3 to 0.495. The K-factors range from 0.209 to 0.3 on the soils of the main rangeland areas, such as in the Goose Creek and Trapper Creek Canyons. On the slopes forming the stream network of eastern watersheds, the erosion potential is low, with K-factors ranging from 0.098 to 0.3. See Figure 6 for area weighted K-factors of the Goose Creek Subbasin soils.

In general, the K-factors indicate that the rangeland have low soil erosion potentials. Because of this, the amount of sediment from rangeland entering streams is also low. Due to the low erosion potential from the uplands, the Goose Creek SBA and following Total Maximum Daily Loads (TMDL) will focus on valley bottom and channel sources of sediment for those streams on the 1998 §303(d) list with sediment as a pollutant.

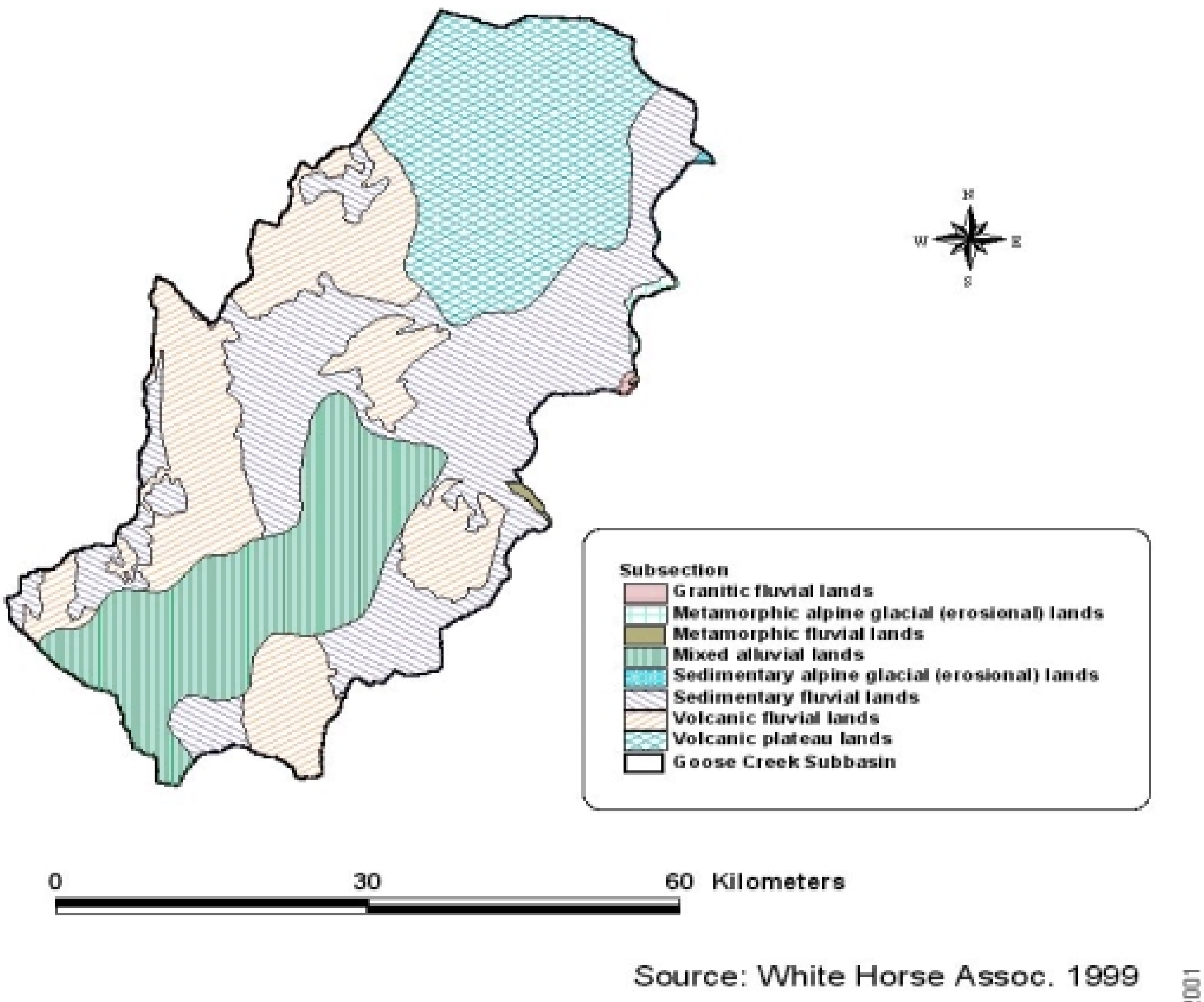
The overall geologic structure of the area is within the southern extent of the Northern Basin and Range ecoregion. The Basin and Range is an area of faulted metamorphic and sedimentary rocks uplifted into mountains, separated by basins deeply filled with alluvium and colluvium. In addition, areas of the Goose Creek Subbasin that lie within the Northern Basin and Range contain granitic intrusions in scattered locations. Also prominent in the ecoregion, beside the volcanic geology common to southern Idaho, are the Pliocene and Miocene lake and stream deposits through which Trapper, Goose, and Beaverdam Creeks flow (Geology from ArcView shapefile).

The Snake River Basin/High Desert ecoregion crosscuts the Goose Creek Subbasin in the north. Locally thick deposits of loess (wind-blown silt) overlie these rocks, particularly in the volcanic Snake River Plain (Alt and Hyndman 1989). The Snake River Plain is a deep, wide, structural basin filled with a veneer of volcanic basalt deposits overlying rhyolite. The rocks in the Snake River Plain decrease in age, from west to east, due to the migration of a magma source that has migrated to present-day Yellowstone National Park.



K-Factor Classes	Hectares	Sq.Kilometers	% of Area
0.098 - 0.134	85,788.9	857.9	28.2
0.134 - 0.209	24,615.0	246.1	8.1
0.209 - 0.300	119,026.2	1,190.3	39.1
0.300- 0.394	67,551.3	675.5	22.2
0.394 - 0.495	7,326.9	73.3	2.4

Figure 6. Soil erosion index and location of water quality limited streams within the subbasin.



Subsection	Hectares	Sq. Kilometer	% of Area
Granitic fluvial lands	294.3	2.9	0.1
Metamorphic alpine glacial (erosional) lands	964.5	9.6	0.3
Metamorphic fluvial lands	501.6	5.0	0.2
Mixed alluvial lands	54,202.9	542.0	18.7
Sedimentary alpine glacial (erosional) lands	231.3	2.3	0.1
Sedimentary fluvial lands	96,946.8	969.5	33.4
Volcanic fluvial lands	72,450.6	724.5	25.0
Volcanic plateau lands	64,658.0	646.6	22.3

Figure 7. Major geological subdivisions of the Goose Creek Subbasin.

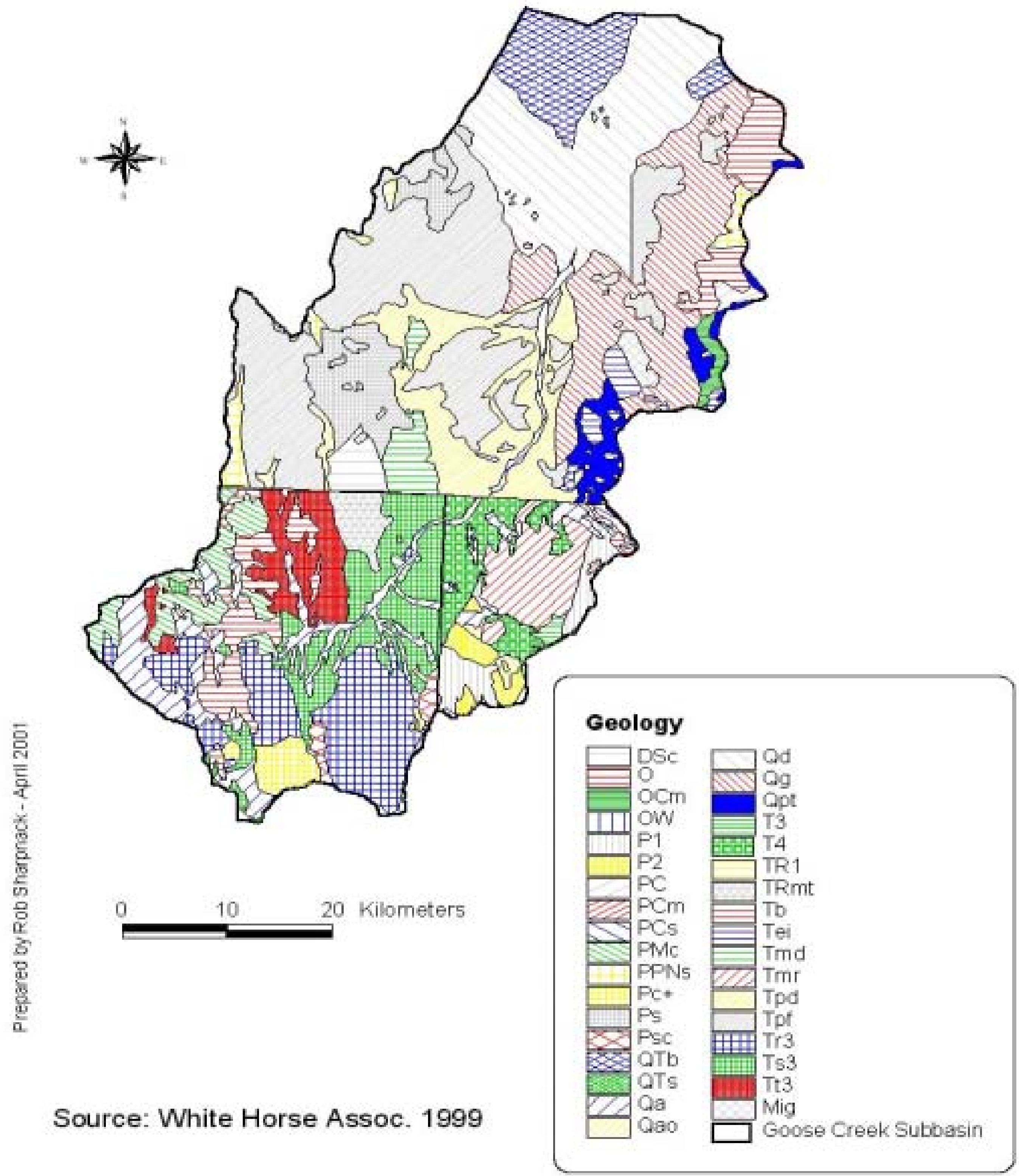


Figure 8. Geological formations within the Goose Creek Subbasin.

Table 6. Geologic description for various formations

Formation	Goose Creek Subbasin Geologic Descriptions
Ms	Mississippian shallow-water coralline limestone interval of southern Idaho
O	Ordovician marine dolomite quartzite and limestone
OCm	Schist quartzite and other metasediments of probable Lower Ordovician
OW	Open Water
PC	Precambrian high-grade metamorphic rocks
PNs	Pennsylvanian beds; lowermost portion of southern Idaho sequence
PPNs	Lower Permian to Middle Pennsylvanian chert limestone and sandstone
PZu	Upper Paleozoic marine sediments in southern Idaho
Ps	Lower Permian beds; uppermost portion of southern Idaho sequence
QTb	Lower Pleistocene to Pliocene basalts with associated tuffs and volcanic detritus
Qa	Quaternary alluvium
Qd	Quaternary detritus
Qg	Quaternary colluvium fanglomerate and talus
Qpt	Pleistocene till moraines and similar unsorted glacial debris
Qpu2b	Upper Pleistocene Snake Plain lava flows
Qs	Quaternary surficial cover
TR	Triassic shallow-marine to non-marine sediments of eastern Idaho
Tei	Eocene intrusions
Tpd	Pliocene stream and lake deposits
Tpf	Pliocene silicic welded tuff ash and flow rocks
Tpv	Pliocene volcanic units

*GIS coverage changes at state lines due to different state descriptions for geological types.
Various agencies are working to have the descriptions the same for all areas.

The geomorphology of the subbasin can be divided into four main geological subsections (Figure 7). Within each of these subsections, locally distinct geological formations can be found. The majority of the subbasin (33.4 percent including the Utah and Nevada portions) lies within the sedimentary fluvial subsection. Each geological subsection contributes sediment to the streams in various volumes. From Figures 6 and 7 it can be seen that the volcanic plateau subsection (22.3 percent of the subbasin) likely does not contribute significant sediment loads to the streams and rivers as its slopes are usually less than 5 percent and it is below Goose Creek Reservoir. Therefore, only three geological subsections play any factor in water quality in the Goose Creek Subbasin.

For a more complete discussion of the geology of the Goose Creek Subbasin Figure 8 and Appendix B (Geology of the Goose Creek Subbasin) contributed by Carl Austin, a local area geological expert.

Topography

The region is cartographically covered by 1:24,000-scale and higher USGS topographic quadrangle maps. The total vertical relief in the area is 2,019 m, from an elevation of 1,284 m near the town of View (the closest town to the northern boundary; View is outside of the subbasin by approximately 4.5 km) to 3,303 m in the Albion Mountains (Mount Independence). Slopes in the agricultural areas are quite gentle (less than 1 percent) with considerably steeper slopes in the foothills and mountains (5-46 percent) (Figure 5).

The topography is an expression of the geologic structure and historical glacial and volcanic processes. Chiefly the faulted, linear mountain chains of the Northern Basin and Range ecoregion, which are bordered by the Snake River Plain to the north, are the basis for most of the topography. The mountainous areas of the subbasin can be generally broken into several provinces. The first of these are low volcanic (rhyolite) mountains in the Big and Little Cottonwood Creek areas. Second are the limestone Albion Mountains from which spring sources dominate and form Mill Creek and Summit Creek. Third are the granitic intrusions and quartzite Middle Mountain upon which Blue Hill, Cold, and Emery Creeks are formed. Next are the limestone and very old lake and ocean deposits found in the Beaverdam Creek area. The final province is made of basalts and quaternary detritus, which form the fertile agricultural Snake River Plain area (Figure 8).

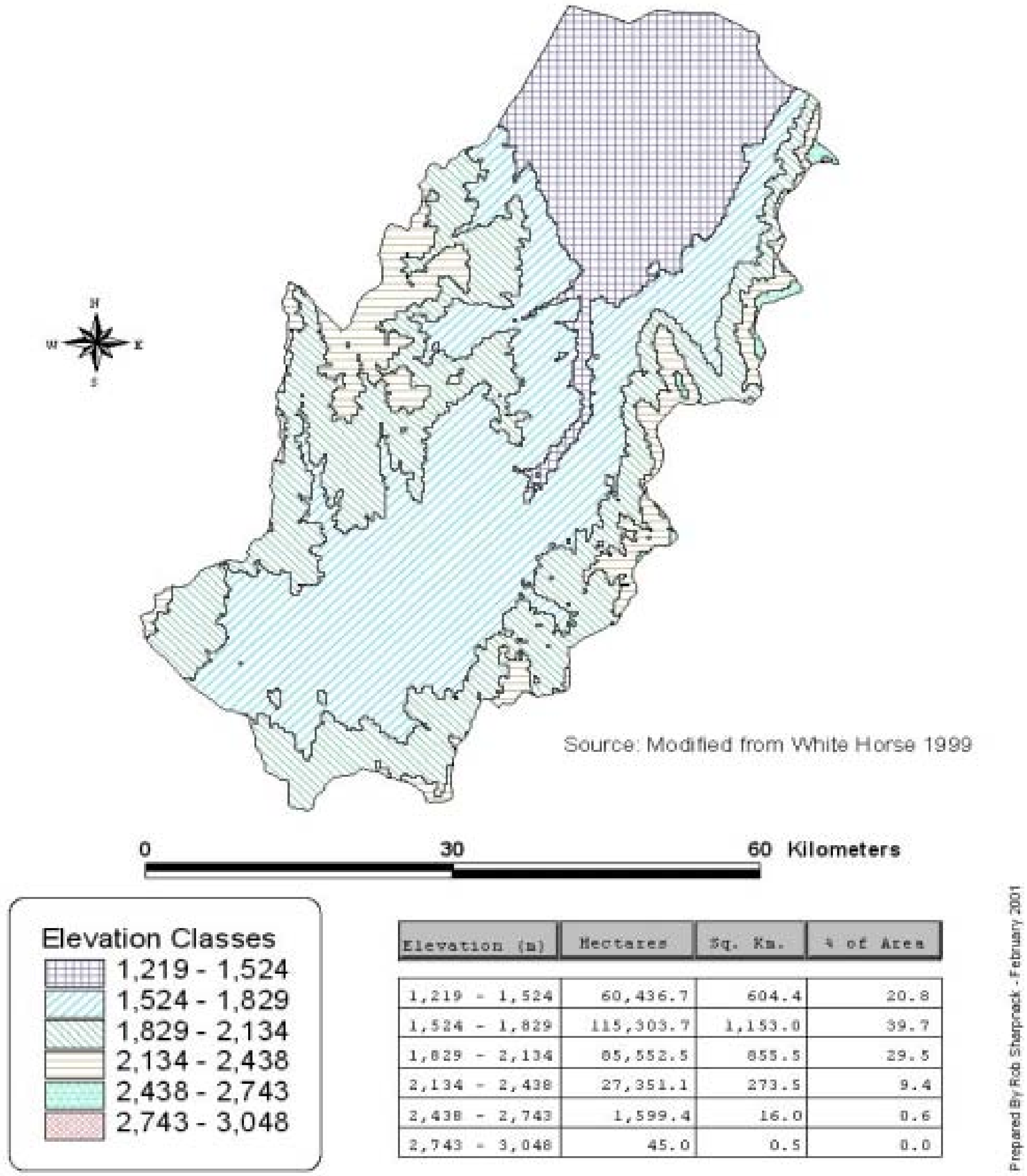
The Goose Creek and Trapper Creek streams bisect the subbasin and flow through small open valleys. Alluvial terraces rise above these streams along their courses. The town of Oakley sits within the alluvial fan of these streams.

Elevation

The Goose Creek Subbasin covers approximately 2,902 square kilometers (km^2) in total area. Nearly 1,791 km^2, or 62 percent of the subbasin, lies within the state of Idaho. The elevation range within the Idaho portion of the subbasin is from 1,219 to 3,048 m. The average elevation of the entire subbasin is approximately 1,600-1,900 m (Figure 9). The entire subbasin slope range is from less than 1 percent to 46 percent. The average subbasin slope is approximately 4.4 to 9.6 percent. Generally, the stream bottoms have slopes of less than 2 percent, while the mountains have slopes 5 to 22 percent. Overall, the subbasin has a northeast aspect. The stream channels and mainstem rivers follow a dendritic drainage pattern throughout the subbasin. In the subbasin, there are 569.77 km of perennial streams, 1951.92 km of ephemeral and intermittent streams, and 352.15 km of canals and ditches (Table 7). Roughly, 61 percent of the perennial streams are located within the area of the subbasin located in Idaho. Approximately 76 percent of the intermittent and ephemeral streams are located in this same area.

Table 7. Elevation ranges of the different water body types in the Goose Creek Subbasin.

Elevation Range (meters)	1,219-1,524	1,525-1,829	1,830-2,134	2,135-2,438	2,439-2,743	2,744-3,048	Subbasin Total	Percent in Subbasin
Water Body Type	***Kilometers***							
Ditch	342.75	6.95	2.45	0	0	0	352.15	12.1
Intermittent and Ephemeral Streams	409.53	989.11	483.30	67.68	2.30	0	1,951.92	67.3
Intermittent Shoreline	1.63	0	0	0	0	0	1.63	0.06
Shoreline	24.00	0	0	0	0	0	24.00	0.83
Perennial Streams	77.69	269.88	180.57	39.96	1.67	0	569.77	19.7
Total	855.60	1,265.94	666.32	107.64	3.97	0.00	2,899.47	99.99



Elevation (m)	Hectares	Sq. Km.	% of Area
1,219 - 1,524	60,436.7	604.4	20.8
1,524 - 1,829	115,303.7	1,153.0	39.7
1,829 - 2,134	85,552.5	855.5	29.5
2,134 - 2,438	27,351.1	273.5	9.4
2,438 - 2,743	1,599.4	16.0	0.6
2,743 - 3,048	45.0	0.5	0.0

Figure 9. Elevation ranges of the Goose Creek Subbasin.

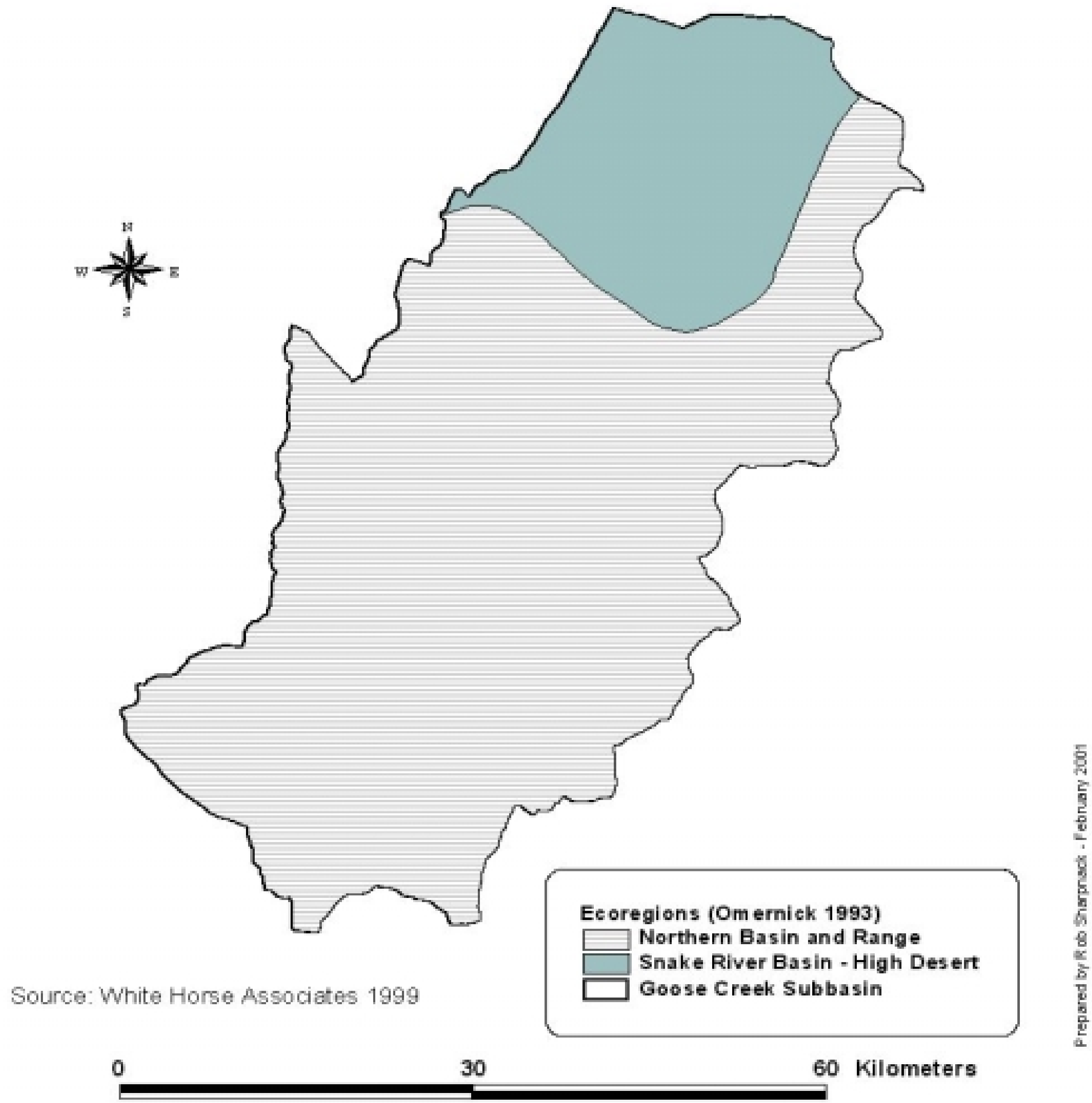
Vegetation

The Goose Creek Subbasin is predominantly within the Northern Basin and Range ecological region (79.4 percent of the subbasin) as described by Omernik and Gallant (1986) and Omernik (1986), with a small area of Snake River Basin/High Desert in the north (Figure 10).

Sagebrush/wheatgrass/needlegrass steppe is the dominant vegetation type throughout the region. Large tracts of juniper are also found in this area; although, recent, large-scale fires have removed significant portions of the juniper community in many of the watersheds. Saltbrush and greasewood are also found within the subbasin. Streamside vegetation is generally the same as the surrounding regional vegetation due to the intermittent or ephemeral nature of most streams. Where perennial flow does occur, dense stands of sedges and forbs line the riparian zone. In perennial streams with moderate annual flow, woody vegetation consists of alder, willow, cottonwood, clematis, rose, and mock orange.

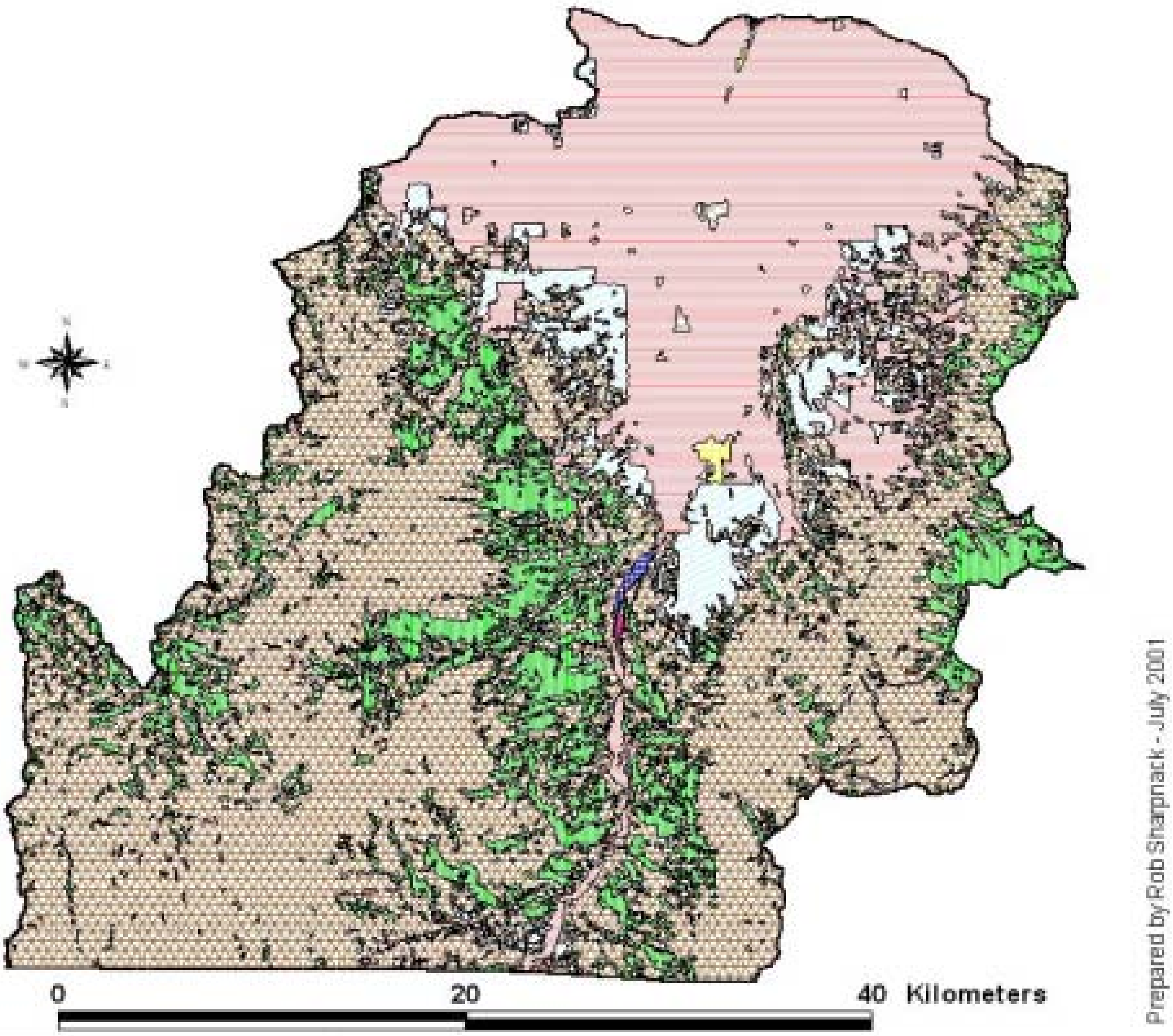
Most of the Northern Basin and Range ecoregion (Figure 10) is used as rangeland. However, some areas within basins or bordering large streams are irrigated for pasture. Where access by livestock is concentrated, loss or reduction of streamside vegetation is severe causing stream bank erosion and sedimentation. Water withdrawal for pasture irrigation or stock water can result in completely dry channels downstream from diversions.

Variability in the makeup of natural vegetation in the Goose Creek Subbasin is minimal. Shrubland vegetation predominates the entire subbasin (54.2 percent in the Idaho portion) with limited riparian vegetation (0.5 percent of the Idaho portion of the subbasin) in the mainstem streams and rivers. Following the construction of irrigation canals and irrigation return drains, some of the natural sage-grass areas have been changed to support agricultural crops, pasture grasses, hay, and riparian vegetation (Figure 11).



Ecoregion	Hectares	Sq. Km	% of Area
Snake River Basin - High Desert	59,853.1	598.5	20.6
Northern Basin and Range	230,396.9	2,304.0	79.4

Figure 10. The two ecoregions of the Goose Creek Subbasin.



Description	Hectares	Sq. Kilometer	% of Area
Urban/Developed	349.0	3.5	0.2
Agriculture	44,238.7	442.4	24.1
Grassland	11,941.7	119.4	6.5
Shrubland	99,884.1	998.8	54.3
Forested	26,222.6	262.2	14.3
Water	170.9	1.7	0.1
Riparian	867.0	8.7	0.5
Wetlands	78.7	0.8	0.0
Barren/Rock	2.7	0.0	0.0

Figure 11. Vegetation classes within the Idaho portion of the Goose Creek Subbasin.

Fish and Wildlife

Within the Goose Creek Subbasin there are several state and federal agencies that list species of special concern; candidate species; or endangered, threatened, and sensitive species. The United States Fish and Wildlife Service (USFWS) is the main (non-anadromous, nonmarine species) listing agency. The USFWS lists 21 animals and 3 plants as endangered, threatened, or as candidate species within the state of Idaho (*http://ecos.fws.gov/webpage/webpage_region_lists.html?lead_region=1*). However, in Cassia County there are only seven endangered or threatened species with two additional candidate species (Table 8). Of these nine species, four are aquatic, and one is a semiaquatic plant. Three of the animals are snails, which are found only in the mainstem of the Snake River and as such are not influenced by activities within the Goose Creek Subbasin. Therefore, the only federally listed aquatic plants and animals that will be influenced by the SBA or TMDL are the spotted frog (*Rana luteiventris*) and the Ute ladies'-tresses (*Spiranthes diluvalis*). The Ute ladies'-tresses has the potential to be found in wet meadows, along riparian zones, and in other wetlands (USFS 2001). The spotted frog is an aquatic animal found in and near streams, lakes, marshes, and ponds. The spotted frog frequents these aquatic habitats in mixed coniferous forests, subalpine forests, grasslands, and sage and rabbitbrush shrublands (Stebbins 1985). Management decisions, as a result of the SBA-TMDL, should address these two species and may affect upland species as well. These should be addressed in any implementation plans developed by state and federal land management agencies.

There is only one threatened species (bald eagle), no endangered species, and only one candidate species (yellow-billed cuckoo), that need to be considered in any planning efforts and management decisions by the BLM Burley Field Office. This is in accordance with the most recent official species list (1-4-03-SP-283) received from the U. S. Fish and Wildlife Service on June 3, 2003.

In addition to the listed and candidate species, the United States Forest Service (USFS) through the USFWS, maintains a list of species of interest, or watch species. These plants and animals are those that are not listed but that the USFWS suggests that federal agencies consider in the management and planning activities. The Sawtooth National Forest contains 44 species found on this list.

The Idaho Department of Fish and Game (IDFG) maintains a statewide list of species of special concern. Many of the species on this list are duplicates of those listed by the USFWS and other federal agencies. However, the list does not contain plant species. Table 8 displays the federally listed threatened, endangered, and federal species of special concern found within the Goose Creek Subbasin. A list of the Idaho Department of Fish and Game's species of special concern can be found at *www2.state.id.us/fishgame/info/nongame/ngconcern.htm*.

Table 8. Threatened, endangered, and other species of federal concern in the Goose Creek Subbasin.

Species Common Name	Scientific Name	Comments
Spotted Frog	*Rana lateiventris*	Considered the Great Basin sub-populations of the Columbian spotted frog. Determined that listing was warranted 1993. Currently a candidate species.
Ute Ladies'-Tresses	*Spiranthes diluvialis*	Recognized as a distinct species in 1984. Listed as threatened in 1992.
Canada Lynx	*Lynx canadensis*	Proposed for listing as threatened.
Gray Wolf	*Canus lupus*	Currently listed as endangered.
Bald Eagle	*Haliaeetus leucocephalus*	First protected in 1966 by the Endangered Species Preservation Act. Listed in 1973 under the Endangered Species Act. Down-listed from endangered to threatened in 1995.
Utah Valvata Snail	*Valvata utahensis*	Listed as endangered in 1992.
Snake River Physa Snail	*Physa natricina*	Listed as endangered in 1992.
Bliss Rapids Snail	*Taylorconcha serpenticola*	Listed as threatened in 1992.
Christ's Paintbrush	*Castilleja christii*	Candidate species.
Yellow-billed Cookoo	*Coccyzus americanus*	July 2001, USFWS published findings that indicated the yellow-billed cookoo should be listed. Other priorities preclude this listing; therefore, it is considered a candidate species. (This information is not on current USFWS Web site listed on pg. 23)

Fisheries

There are many species of fishes in the streams and reservoirs of the Goose Creek Subbasin (Table 9). The various fish species found within the basin include rainbow trout, brown trout, brook trout, cutthroat trout, cutthroat/rainbow trout hybrid, kokanee salmon, sculpin species, shiners, long nose dace, speckled dace, and sucker species such as Utah, mountain, and blue head suckers.

Table 9. Fish species and pollution tolerance in the Goose Creek Subbasin

Species	Scientific Name	Tolerance to Pollution[a]
Yellowstone cutthroat trout	*Oncorhynchus clarki bouvieri*	II
Rainbow trout	*Oncorhynchus mykiss*	II
Brown trout	*Salmo trutta*	MI
Brook trout	*Salvelinus fontinalis*	MI
Cutthroat/rainbow hybrid	*Oncorhynchus clarki X O. mykiss*	II
Kokanee salmon	*Oncorhynchus nerka*	II
Sculpin	*Cottus sp.*	
Utah sucker	*Catostomus ardens*	TT
Mountain sucker	*Catostomus platyrhychus*	MT
Shiners	*Richardsonius sp.*	
Longnose dace	*Rhinichthys cataractae*	MI
Specked dace	*Rhinichthys osculus*	MI
Leatherside chub	*Gila copei*	MT
Spottail shiner	*Notropis hudsonius*	
Walleye	*Stizostendion viteum*	MT

a From: *1996 Water Body Assessment Guidance, A Stream to Standard Process* (DEQ 1996)
Tolerance Value: II = Highly intolerant, MI = Moderately intolerant, MT = Moderately tolerant, TT = Highly tolerant

In addition, DEQ has recently developed a fish index for assessing water bodies for upcoming §303d lists. The stream fish index is part of WBAG II (Grafe et al. 2002) document and uses the fish community to determine the support status of cold water aquatic life. The individual metrics within the index are slightly different depending upon which ecoregion the stream falls within. For rangeland type streams the metrics used were percent cold water individuals, Jaccard's community similarity coefficient, percent omnivores and herbivores, percent cyprinids as longnose dace, percent of fish with abnormalities, and catch per unit effort.

Macroinvertebrates

DEQ has developed two multi-metric indices for macroinvertebrate communities over the past decade. Both share many of the same metrics, plus there are metrics unique to each. The first of these was developed in 1996 as part of the original WBAG. It was called the macroinvertebrate biotic index (MBI) and was intended to be used as an indicator of stream health (DEQ 1996). The MBI assessed the status of aquatic life beneficial uses primarily in wadeable streams in Idaho. Seven metrics (measures of certain aspects of the macroinvertebrate community structure based upon the species present and their relative abundance) were combined. These metrics were normalized by calculating the ratio to their ecoregion benchmarks (thus giving equal weight to each with a maximum score of 7), and then summed. The macroinvertebrate community, and the water body in which it resides, was considered impaired if the MBI score was less than or equal to 2.5. With a score greater than or equal to 3.5, the water body was considered not impaired, or in good health. Values between 2.5 and 3.5 were considered inconclusive, and required verification before the status of the beneficial uses could be determined.

Following the development of WBAG II, a new multi-metric tool was used to assess the aquatic life beneficial uses of wadeable streams in Idaho (Grafe et al. 2002). DEQ staff and Tetra Tech, a private consulting firm often employed by the EPA, developed the new tool. The new macroinvertebrate tool is called the Stream Macroinvertebrate Index (SMI). Within the index nine metrics are used: total taxa, Ephemeroptera taxa, Plecoptera taxa, Trichoptera taxa, percent Plecoptera, Hilsenhoff Biotic Index, percent five dominant taxa, scraper taxa, and clinger taxa. Further descriptions of scoring and breakpoint determinations can be found in WBAG II (Grafe et al. 2002). Theoretically, the SMI yields scores that range from 0 to 100. Break points used to assign rating conditions were based on reference conditions found in desert basin streams. These break points and condition ratings allow DEQ to integrate the scores from other indices into one final score for a given stream. The condition ratings range from 0, the minimum threshold, to 3, the maximum rating a stream can receive. The condition ratings from all indices used in an assessment are averaged to determine the final assessment outcome. For the desert basin ecoregions a SMI score greater than or equal to 51 yields a condition rating value of 3. For scores less than 33 a condition rating value of 0 is given. In general, if a stream receives an average condition rating of 2 or more it would be considered fully supporting its beneficial uses.

For the Goose Creek SBA, DEQ assessed the macroinvertebrate communities using both multi-metric indices in conjunction with other biological communities and water chemistry. These other data sources will augment any perceived shortcomings of the MBI and SMI in assessing the status of aquatic life beneficial uses in streams in the Goose Creek Subbasin. Moreover, the use of the macroinvertebrate community will lend further weight to fishery and water chemistry assessments made in previous and following sections. The assessment of the macroinvertebrate information will be based on the WBAG II, corroborating information from other sources, and the best professional judgment of DEQ staff involved with the collection and assessment of this type of data.

Aquatic Vegetation

Throughout the spring and summer of 2001, DEQ conducted water quality monitoring on the §303(d) listed water bodies within the Goose Creek Subbasin. During these monitoring events, DEQ made other water quality observations. These included the number and type of fishes observed and the approximate dates the various streams in the subbasin went dry. In addition to these observations, DEQ has noted the distribution of aquatic plants in the streams. Most locations are completely devoid of aquatic plant mats that would indicate excessive aquatic growths due to excess nutrients. In other locations the aquatic plants are localized and do not cover large portions of the streambeds. In addition, DEQ has not received any complaints concerning aquatic vegetation within the subbasin.

1.3 Cultural Characteristics

The cultural characteristics of the Goose Creek Subbasin have not changed dramatically since members of the Church of Jesus Christ of Latter Day Saints first settled the area. The area's first inhabitants arrived in 1879-80. In the following years, several hundred people were living in the Oakley area. Later the area would boast a population of nearly 2,000 after several mines were opened (Hedberg 1993). Meanwhile, water projects, such as the Milner Dam and the Minidoka Dam, were beginning to be built in surrounding communities. These large water projects assured the surrounding areas of a steady supply of water in areas where water was limited. Consequently, the communities flourished. In 1909, developers from the east decided to build a dam in the Oakley area. The idea of a steady flow of water for the Oakley area was appealing, and the local paper was predicting that in 10-20 years following the completion of the dam there would be 10,000-30,000 people living in the Oakley area (Hedberg 1993). However, the water quantity stored by the dam did not live up to its original billing. The Oakley area now supports a small farming community of nearly 1,000 people.

Land Use

As seen in Figures 12 and 13 and Table 10, 42 percent of the lands within the Idaho portion of the subbasin are considered rangeland (according to GIS maps). Nearly all the remaining lands are in open agricultural areas, which are classified as irrigated agriculture. Goose Creek has been legally declared nonexistent in this area. A very small portion of the subbasin is classified as urban (4.2 percent). The urban areas are scattered in the agricultural areas and are made up of many small town sites that range in size from Oakley (population 600-700) to Trout (population 1-10). A portion of the subbasin is forested, but rangeland activities predominate in those areas as well. While about 42 percent of the subbasin is considered range, in actuality about 62 percent of the Idaho portion of the subbasin is used as rangeland.

Table 10. Land use in the Goose Creek Subbasin (Idaho portion only).

Land Use Type	Area, km^2	Percent of Total Area
Range	754.1	42.1
Forest	449.5	25.1
Irrigated Agriculture	512.2	28.6
Urban	75.2	4.2
Total	1791.0	100.0

Highway 27 is the main road through the subbasin. This highway crosses the northern-most portions of the subbasin and heads southbound down the eastern portion of the subbasin. The only other paved roads in the subbasin are those that connect the small towns in the area and the section roads out of Oakley and Burley. The remainder of the subbasin is covered with numerous dirt and gravel roads, most of which are not maintained (Figure 14).

Land Ownership, Cultural Features, and Population

The Idaho portion of the subbasin lies almost entirely within Cassia County (Figure 15). Privately owned lands (28.90 percent of the entire subbasin) are essentially the same lands that are used for agriculture. The majority of the remainder (68.12 percent of the subbasin) is managed by the federal government (United States Bureau of Land Management [BLM] 42.84 percent and USFS 25.28 percent). Scattered state endowment lands (sections 16 and 36), under the management of Utah, Idaho, and Nevada's respective department of lands, comprise 2.85 percent of the subbasin.

The population in Cassia County was 19,532 in 1990 (www.idoc.state.id.us 2000) and 21,416 in 2000. The majority of the county population lives outside of the subbasin. For example, the population of several of the cities near the subbasin (Burley, Declo, Albion, and Malta) was 10,093 in 2000. Most of the towns in the subbasin are too small to be listed here. The largest municipality in the subbasin is the town of Oakley (population 668). Other small towns in the subbasin include Basin, Trout, and Marion (Figure 15). The underlying foundation for economic activity in the area is agriculture, which consists of ranching and farming. Decreed stock watering rights began in 1872, while decreed surface water rights for irrigation in the subbasin began in 1875.

Recreation is an important water-related industry of the Goose Creek Reservoir, although water delivery for irrigation is the principle use for the reservoir's water. This impoundment provides for recreational experiences throughout the year, most notably fishing for trout and walleye. In addition to fishing, personal watercraft use and water skiing occur on a limited basis.

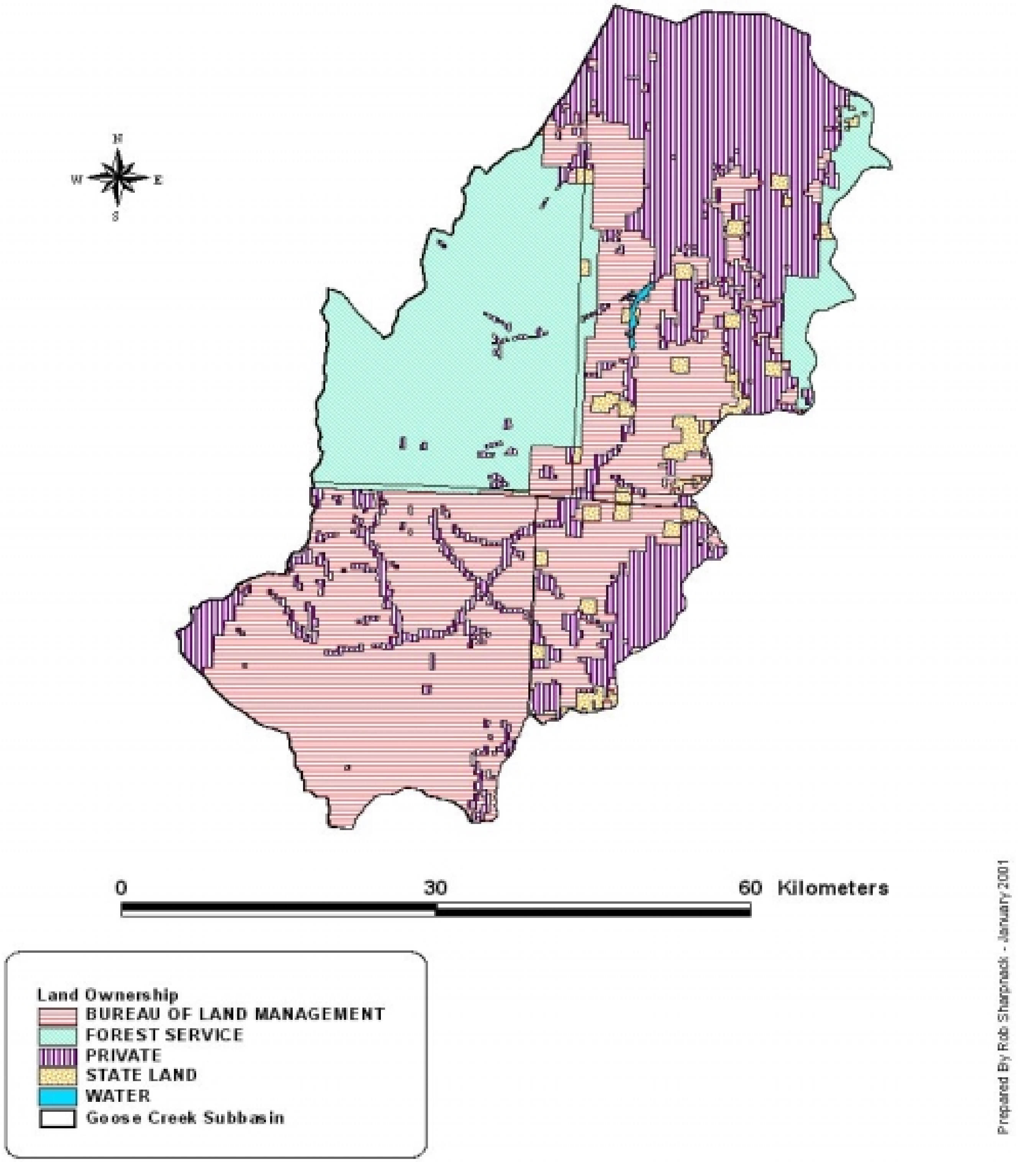
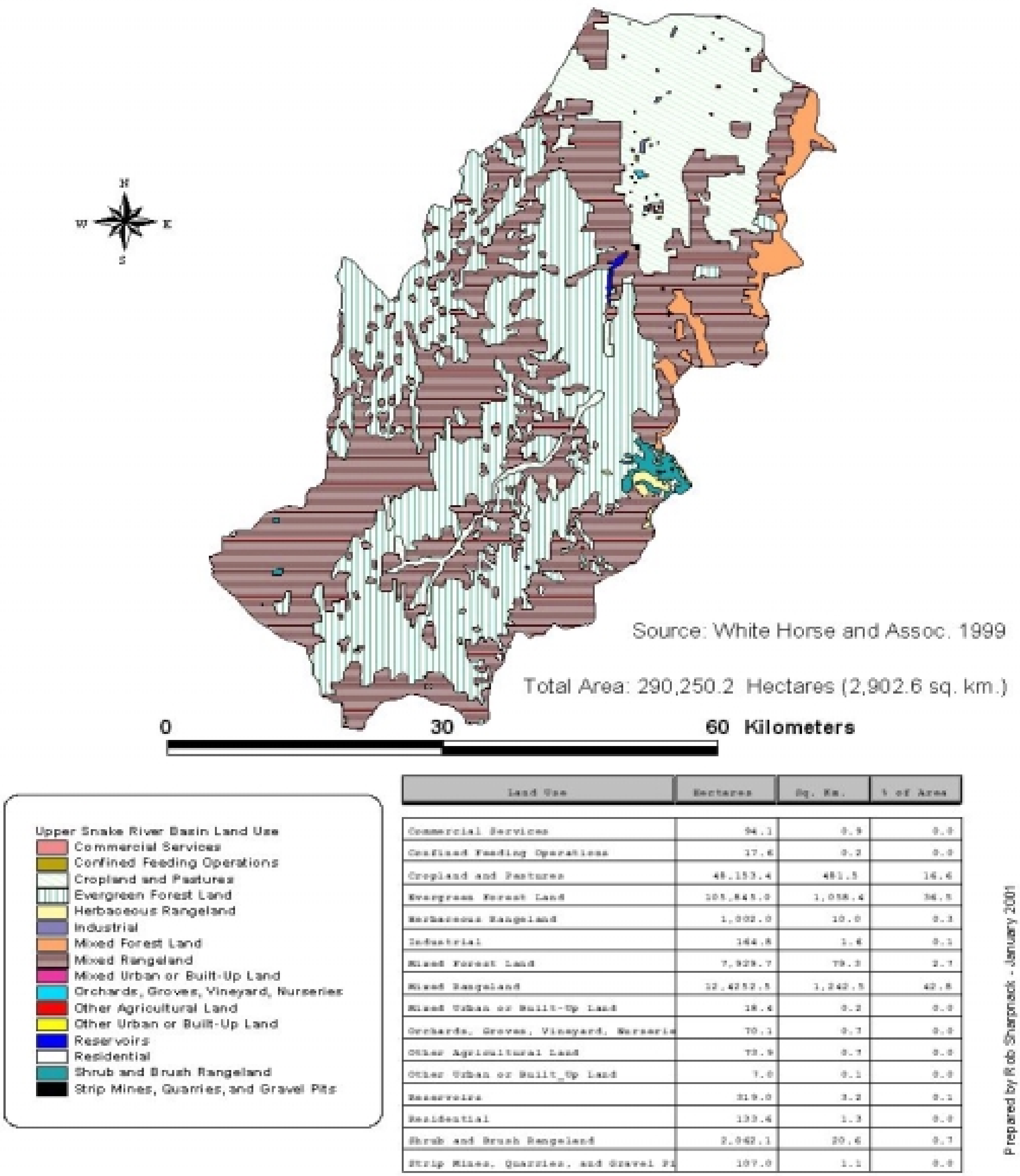


Figure 12. Land ownership of the Goose Creek Subbasin.



Land Use	Hectares	Sq. Km.	% of Area
Commercial Services	94.1	0.9	0.0
Confined Feeding Operations	17.6	0.2	0.0
Cropland and Pastures	48,153.4	481.5	16.6
Evergreen Forest Land	105,845.0	1,058.4	36.5
Herbaceous Rangeland	1,002.0	10.0	0.3
Industrial	164.8	1.6	0.1
Mixed Forest Land	7,929.7	79.3	2.7
Mixed Rangeland	12,4252.5	1,242.5	42.8
Mixed Urban or Built-Up Land	18.4	0.2	0.0
Orchards, Groves, Vineyard, Nurseria	70.1	0.7	0.0
Other Agricultural Land	73.9	0.7	0.0
Other Urban or Built_Up Land	7.0	0.1	0.0
Reservoirs	319.0	3.2	0.1
Residential	133.4	1.3	0.0
Shrub and Brush Rangeland	2,062.1	20.6	0.7
Strip Mines, Quarries, and Gravel Pi	107.0	1.1	0.0

Figure 13. Land use in the Goose Creek Subbasin.

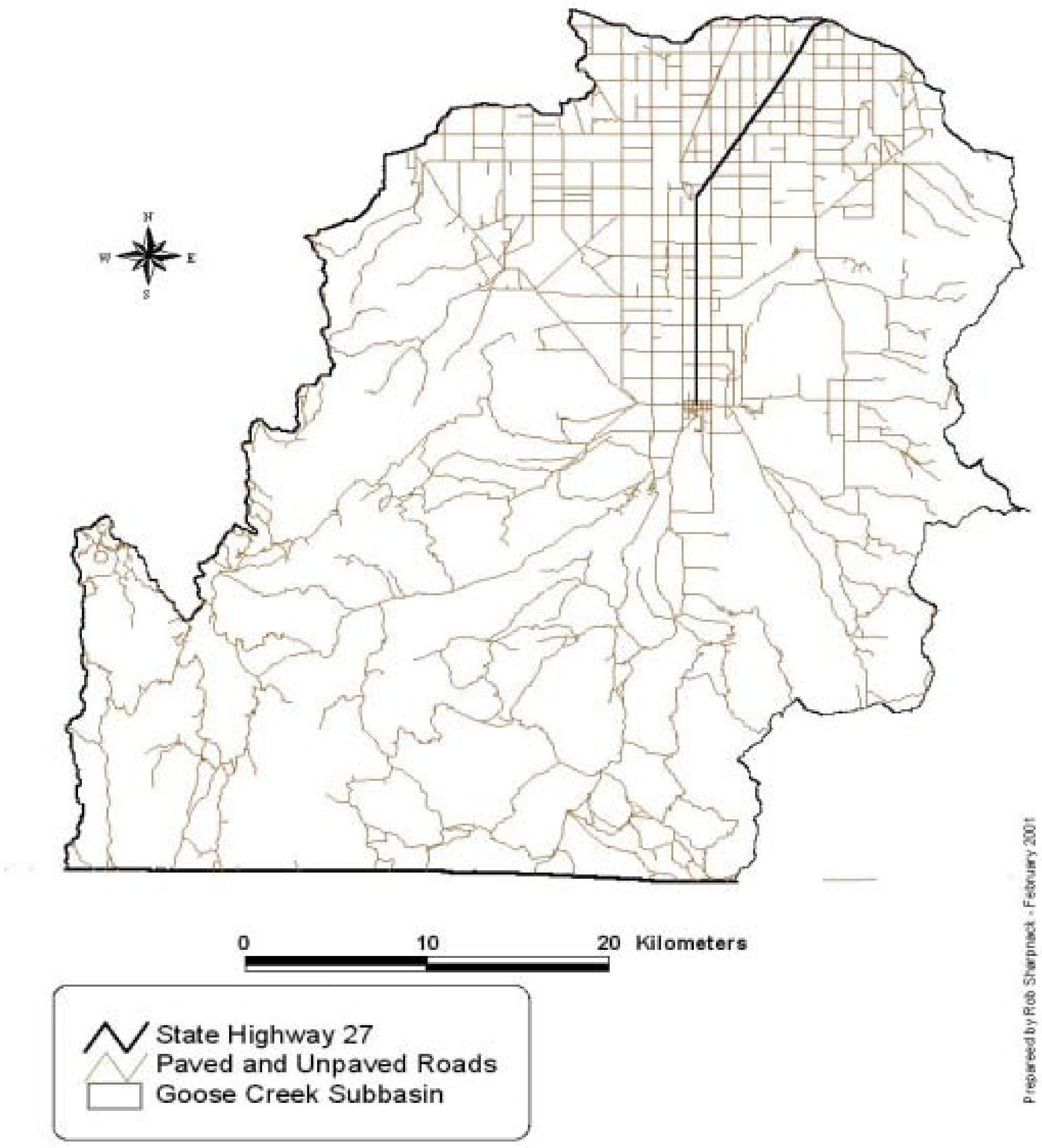


Figure 14. Paved and unpaved roads within the Goose Creek Subbasin (Idaho portion).

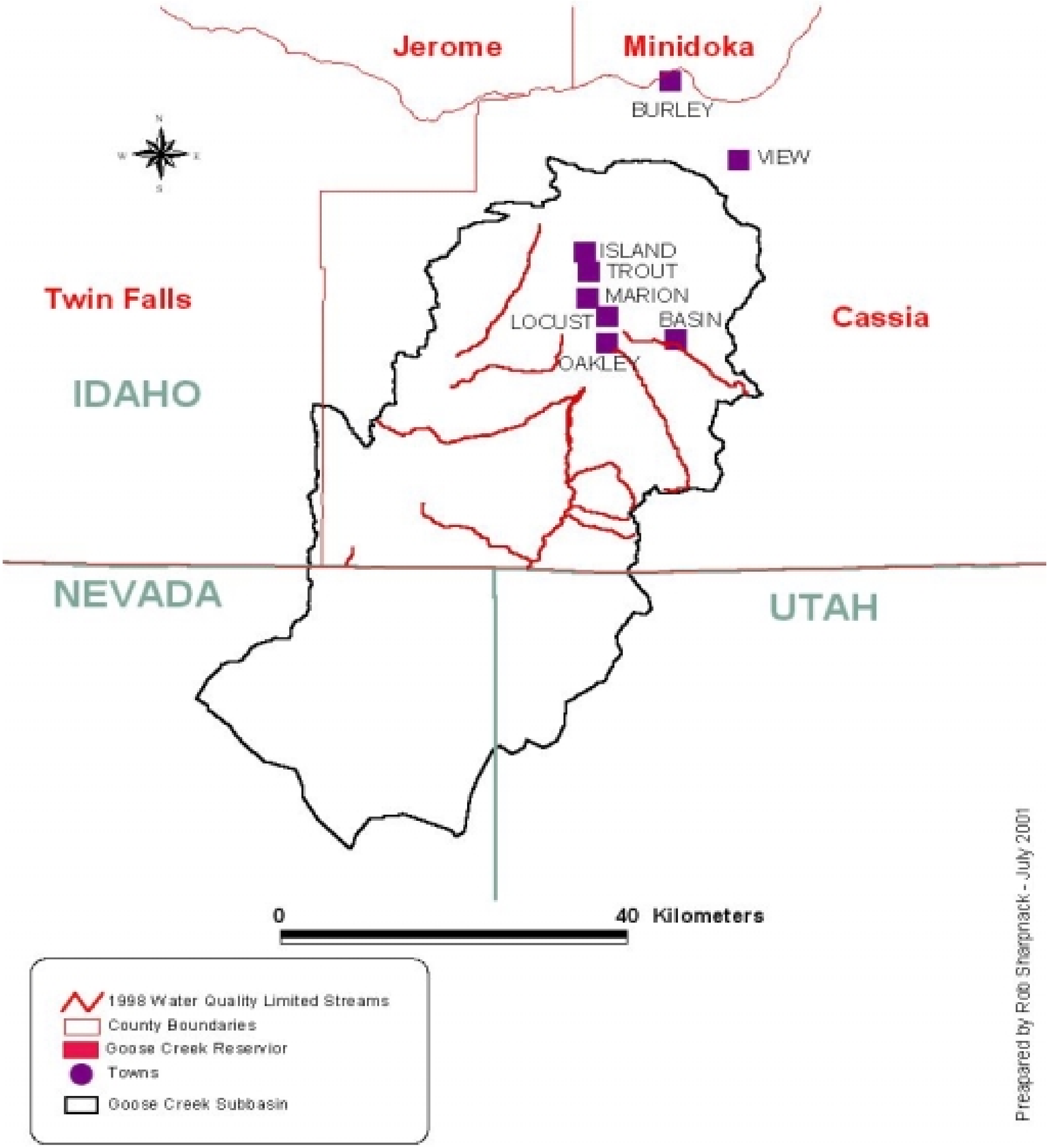


Figure 15. State and county boundaries and the location of several small towns and communities within the Goose Creek Subbasin.

History and Economics

The principal economic activity within the Goose Creek Subbasin is agriculture. In the lower portion of the subbasin, below Goose Creek Reservoir, row crop agriculture dominates. Potatoes, sugar beets, and hay are the primary crops. Two potato processing plants are located in the Burley area. Sugar processing plants are also located in the Paul and Twin Falls areas. Consequently, the farmers find a ready market for their products. In recent years, large industrial dairies and cheese plants have begun to locate in the south central Idaho region. These dairies have added a demand for hay and corn.

In the upper portion of the subbasin, cattle and sheep ranching are the dominant economic activities. However, recreation plays a significant role as well. Hunting and fishing opportunities bring many people into the subbasin throughout the year.

In most areas of the subbasin hydrologic modifications to the tributaries and mainstem streams have been extensive. Goose Creek Reservoir was built in 1911 and has dewatered Goose Creek from the dam to the confluence of the Snake River. In the 1970s a city of Burley judge ruled that the Goose Creek channel through the city of Burley no longer existed. This allowed for development of commercial and residential buildings in the floodplain and stream channel. In 1985, a District Judge for Cassia County declared that the Goose Creek channel below the reservoir no longer existed. Prior even to that ruling the streambed had been plowed in and used for home sites and row crop agriculture. Many streams are diverted from their original streambeds to new locations. For example, Birch Creek is diverted from its original stream course into the Goose Creek Reservoir, and Summit Creek has been diverted from one valley into another since as far back as the 1800s. Other historical modifications include channelization, such as in the lower portions of Mill Creek. Furthermore, most of the water bodies have control structures or pumps fully capable of removing all the water from the stream. However, most of these structures and pumps are the result of water rights that predate the CWA and will be considered as part of the subbasin characteristics in any water quality plan (see IDAPA 58.01.02.050.01).

An integral part of the SBA-TMDL development process is public participation. The public has been invited to participate throughout the process in different forums. These include soliciting input from the interested citizens of the towns of Oakley and Burley, the Upper Snake Basin Advisory Group (BAG), and the planned public release of draft documents for review and comments. A distribution list will be located in Appendix C following the public comment period. Public comments will be located in Appendix D following their receipt. As envisaged in Idaho's 39-3601 et seq. legislation and Idaho's TMDL process, watershed advisory groups (WAGs) are to be used to encourage public participation. Public involvement for the Goose Creek Subbasin has taken place concurrently with the development of the SBA and TMDL. The BAG has also provided input into the Goose Creek SBA-TMDL.

The Upper Snake BAG provides guidance and advice to DEQ in the final development of SBAs and TMDLs in the Upper Snake Basin. Part of this assistance consists of review of documents after formal presentation and providing comments and assistance.
Following public announcements, meetings were held in the Goose Creek Subbasin to relay progress of the SBA and TMDL process. The first of these meeting was held in the city of Oakley in June 2001. There is an informal Goose Creek area citizen's group, but it has not undergone any formal recognition by the BAG and has not undertaken any formal organization into a WAG outside of nominating a local citizen to sit on the Lake Walcott WAG. Carl Austin of Oakley, Idaho, accepted this role. The group is an informal group and will use the Lake Walcott WAG as a platform for organization. The group will also be provided comments on the progress of this SBA-TMDL through Carl Austin and the Lake Walcott WAG.

Local soil conservation districts (SCD) began organizing in Idaho in 1940 and are legal subdivisions of state government whose volunteer district supervisors are locally elected. The district supervisors have encouraged participation from their constituents in the Goose Creek SBA-TMDL activities. Two districts are within the area of the SBA. The main goal of the SCDs at the time of organization was to assist each operator in the district with the development of a soil and water conservation plan for his or her operations. The SCDs currently have placed irrigation water management, rangeland management, animal waste management, and protection of wildlife habitat as high priorities in long-range resources conservation programs.

The East Cassia SCD (Burley) was organized in 1956. Some initial conservation measures undertaken by this organization were windbreak plantings, range improvements, and grass seed plantings. Some later measures included terracing eroding farmland and converting to sprinkler irrigation systems. The district receives operating funds from Cassia County and the state of Idaho and supplements these funds by renting equipment and selling trees for windbreaks (Idaho Association of Soil Conservation Districts 1998).

The West Cassia SCD (Burley) organized in 1958. Its present priorities are improveing water management in irrigated land and installing terraces on non-irrigated cropland. Presently it is working to complete a study in the Oakley Fan area to decide how best to augment underground aquifers and is cooperating with local power companies to increase the efficiency of irrigation pumps. Its programs are also funded by Cassia County and the state of Idaho, and are supplemented by conducting snow surveys for the Natural Resources Conservation Service (NRCS), renting equipment, and holding auctions (Idaho Association of Soil Conservation Districts 1998).

Upper Snake Basin Advisory Group

The BAGs are stewards of water quality in specific basins. The Idaho legislature codified this stewardship role Idaho code 39-3601 et seq. The BAG provides direction, advice, and guidance to DEQ and local WAGs within the different basins. Providing review and comments on the Goose Creek SBA were a part of the Upper Snake BAG's water quality stewardship program. The results of the Goose Creek SBA were presented to the Upper Snake BAG on October 3, 2001.

Goose Creek Committee of the Lake Walcott Watershed Advisory Group

The local citizen groups, such as the Cassia County Public lands Committee and the Lake Walcott WAG, have been a vehicle for public participation concerning the Goose Creek TMDL. An informal group in the town of Oakley has met several times during the development of the SBA. During this time the methods and results of various stages of the assessment and TMDL development processes have been presented to the group. A draft document will be made available to the citizens during the public comment phase. In addition, the Lake Walcott WAG has served as an official public forum for the Goose Creek SBA and TMDL. The Lake Walcott WAG meets bi-monthly in the city of Burley. At these meetings implementation of the Milner Pool TMDL are discussed as well as developments of the Goose Creek and Raft River SBAs and TMDLs.

Public Notice

Although no official public comments were solicited by DEQ concerning the SBA phase of the TMDL development, comments were received and incorporated into the draft SBA-TMDL. An official 30-day public notice and comment period for the draft SBA-TMDL will commence on November 12, 2003. The document will be finalized and presented to EPA on December 31, 2003.

2. Subbasin Assessment – Water Quality Concerns and Status

Under the state water quality standards, Idaho is divided into six separate hydrologic basins. Within each basin, the major rivers, lakes/reservoirs, and creeks are identified (designated) for specific beneficial uses. Most tributary waters are not yet designated. These undesignated waters; however, are protected for beneficial uses, which include all recreational uses in and on the water and the protection and propagation of fish, shellfish, and wildlife wherever attainable (IDAPA 58.01.02.101.01.a). Industrial water supply, wildlife habitats, and aesthetics are minimum designated standards for all waters of the state.

Other water quality standards that apply to the Goose Creek Subbasin are included in IDAPA 58.01.02.051.01-02, which is the state's antidegradation policy. It reads:

> Maintenance of Existing Uses for All Waters. The existing in-stream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.
>
> High Quality Waters. Where the quality of the waters exceeds levels necessary to support propagation of fish, shellfish and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the Department finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the Department's continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the Department shall assure water quality adequate to protect existing uses fully...

IDAPA 58.01.02.50.01 states:

> Apportionment of Water. 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…

IDAPA 58.01.02.50.02.a states:

> Wherever attainable, surface waters of the state shall be protected for beneficial uses which for surface waters includes all recreational use in and on the water surface and the preservation and propagation of desirable species of aquatic life;

IDAPA 58.01.02.50.02.b states:

> In all cases, existing beneficial uses of the waters of the state will be protected.

Table 11 summarizes Idaho's beneficial uses and criteria for its water bodies as defined in IDAPA 58.01.02.100.

Table 11. State of Idaho recognized beneficial uses.

BENEFICIAL USES	APPLICABLE CRITERIA
Agricultural Water Supply	Water quality appropriate for the irrigation of crops or as drinking water for livestock. This use applies to all surface waters of the state (IDAPA 58.01.02.100.03.b). Numeric criteria as needed are derived from the EPAs *Water Quality Criteria 1972* (EPA 1975). (IDAPA 58.01.02.252.02).
Domestic Water Supply	Water quality appropriate for drinking water supplies (IDAPA 58.01.02.100.03.a). Numeric criteria for specific constituents and turbidity (IDAPA 58.01.02.252.01.a-b).
Industrial Water Supply	Water quality appropriate for industrial water supplies. This use applies to all waters of the state (IDAPA 58.01.02.100.03.c). Numeric criteria are categorized as general surface water quality criteria (IDAPA 58.01.02.252.03).
Cold Water Aquatic Life	Water quality appropriate for the protection and maintenance of a viable aquatic life community for cold water species (IDAPA 58.01.02.100.01.a). Numeric criteria are established for pH, dissolved oxygen, gas saturation, residual chlorine, water temperature, ammonia, turbidity, and toxics (IDAPA 58.01.02.250.02.a-g).
Seasonal Cold Water Aquatic Life	Water quality appropriate for the protection and maintenance of a viable aquatic life community of cool and cold water species (IDAPA 58.01.02.100.01.c). Numeric criteria are established for pH, dissolved oxygen, gas saturation, residual chlorine, water temperature, ammonia, turbidity, and toxics (IDAPA 58.01.02.250.03.a-c).
Warm Water Aquatic Life	Water quality appropriate for the protection and maintenance of a viable aquatic life community for warm water species (IDAPA 58.01.02.100.01.d). Numeric criteria are established for pH, dissolved oxygen, gas saturation, residual chlorine, water temperature, ammonia, and toxics (IDAPA 58.01.02.250.04.a-c).
Modified Aquatic Life	Water quality appropriate for an aquatic life community that is limited due to one (1) or more conditions set forth in 40 CFR 131.10(g) which preclude the attainment of reference streams or conditions (IDAPA 58.01.02.100.01.e). Numeric criteria for pH, dissolved oxygen, gas saturation, residual chlorine, water temperature, ammonia, and toxics will be considered on a case by case basis (IDAPA 58.01.02.250.05).

BENEFICIAL USES	APPLICABLE CRITERIA
Salmonid Spawning	Waters which provide or could provide a habitat for active self-propagating populations of salmonid fishes (IDAPA 58.01.02.100.01.b). Numeric criteria are established for pH, gas saturation, residual chlorine, dissolved oxygen, intergravel dissolved oxygen, water temperature, ammonia, and toxics (IDAPA 58.01.02.250.02.e).
Primary Contact Recreation	Water quality appropriate for prolonged and intimate contact by humans or for recreational activities when the ingestion of small quantities of water is likely to occur. Such waters include, but are not restricted to, those used for swimming, water skiing, or skin diving. (IDAPA 58.01.02.100.02.a). Numeric criteria are established for *Escherichia coli* bacteria (IDAPA 58.01.02.251.01.a-b).
Secondary Contact Recreation	Water quality appropriate for recreational uses on or about the water which are not included in the primary contact category. These activities may include fishing, boating, wading, infrequent swimming, and other activities where ingestion of raw water is not likely to occur (IDAPA 58.01.02.100.02.b). Numeric criteria are established for *Escherichia coli* bacteria (IDAPA 58.01.02.251.02.a-b).
Wildlife Habitats	Water quality appropriate for wildlife habitats. This use applies to all surface waters of the state (IDAPA 58.01.02.100.04). Numeric criteria are categorized as general surface water quality criteria (IDAPA 58.01.02.253.01).
Aesthetics	This use applies to all surface waters of the state (IDAPA 58.01.02.100.05). Numeric criteria are categorized as general surface water quality criteria (IDAPA 58.01.02.253.02).
Special Resource Water	Those specific segments or water bodies that are recognized as needing intensive protection to preserve outstanding or unique characteristics. Designation as a special resource water recognizes at least one of the following characteristics: (1) the water is of outstanding high quality, exceeding both criteria for primary contact recreation and cold water aquatic life; (2) the water is of unique ecological significance; (3) the water possesses outstanding recreational or aesthetic qualities; (4) intensive protection of the quality of the water is in paramount interest of the people of Idaho; (5) the water is part of the National Wild and Scenic River System, or is within a state or National Park or wildlife refuge and is of prime or major importance to that park or refuge; (6) intensive protection of the quality of the water is necessary to maintain an existing but jeopardized beneficial use (IDAPA 58.01.02.056). Special resource waters receive additional point source discharge restrictions (IDAPA 58.01.02.054.03 and 400.01.b).
NOTE: All waters are protected through general surface water quality criteria. Narrative criteria prohibit ambient concentrations of certain pollutants that impair designated uses. Narrative criteria are established in Idaho water quality standards for hazardous materials; toxic substances; deleterious materials; radioactive materials; floating, suspended, or submerged matter; excess nutrients; oxygen demanding materials; and sediment (See IDAPA 58.01.02.200.01-08).	

2.1 Water Quality Limited Segments Occurring in the Subbasin

The CWA established a process for restoring the nation's water bodies to health. Part of this was the designation of impacted waters by the states, through listing such waters in §303(d) lists. The 1998 §303(d) list for the state of Idaho (DEQ 2001a) included nine segments occurring within the region designated as the Goose Creek Subbasin (Table 12 and Figures 16 and 17). Other segments will be addressed in this document due to current and past monitoring efforts identifying water quality problems. These additional segments are Little Cottonwood Creek, Emery Creek, and Left Hand Fork Beaverdam Creek. The BURP monitoring identified secondary contact recreational impairment through bacteria monitoring for all three of these streams. These streams will not be added to the next §303(d) list if TMDLs are needed due to the TMDLs being completed through this SBA and TMDL effort. These three segments are therefore included in the SBA-TMDL process and will be described below and in Table 12 as if they were part of the 1998 §303(d) list.

Figures 16 and 17 depicts the location of the Goose Creek Subbasin in relation to other surrounding subbasins and water quality limited water bodies within the Goose Creek Subbasin. The physical descriptions for each water body are located in the following table (12).

Table 12. §303(d) segments in the Goose Creek Subbasin.

Water Body Name	Segment ID Number	1998 §303(d) Boundaries	Pollutants[a]	Listing Basis
Lower Goose Creek Reservoir	2446		DO, Qalt, Nut, Sed	1992 §305 (b) report
Goose Creek	2447	State line to Lower Goose Creek Reservoir	Bac, DO , Qalt, Nut, Sed, Temp	1992 §305 (b) report
Birch Creek	2448	Headwaters to Oakley (town)	Bac, DO, Sed	1992 §305 (b) report
Trapper Creek	2449	Ibex Hollow to Lower Goose Creek Reservoir	Bac, DO, Qalt, Sed	1992 §305 (b) report
Cold Creek	5275	Headwaters to Goose Creek	Unknown	BURP
Blue Hill Creek	5277	Headwaters to Goose Creek	Unknown	BURP
Beaverdam Creek	5278	Right Hand Fork Beaverdam Creek to Goose Creek	Unknown	BURP

Water Body Name	Segment ID Number	1998 §303(d) Boundaries	Pollutants[a]	Listing Basis
Big Cottonwood Creek	5280	Billys Hole to Mouth	Unknown	BURP
Mill Creek		Headwaters to Lower Bounds	Temp	EPA, BURP
Emery Creek		Headwaters to Goose Creek[b]	Bac	DEQ Monitoring
Little Cottonwood Creek		Headwaters to Mouth[b]	Bac	DEQ Monitoring
Left Hand Fork Beaverdam Creek		Headwaters to Beaverdam Creek[b]	Bac	DEQ Monitoring

a Bac = bacteria, DO = dissolved oxygen, Qalt = flow alteration, Nut = nutrients, Sed = sediment, and Temp = temperature.
b Not on 1998 §303(d) List. These are the boundaries for which TMDLs are being developed or assessed.

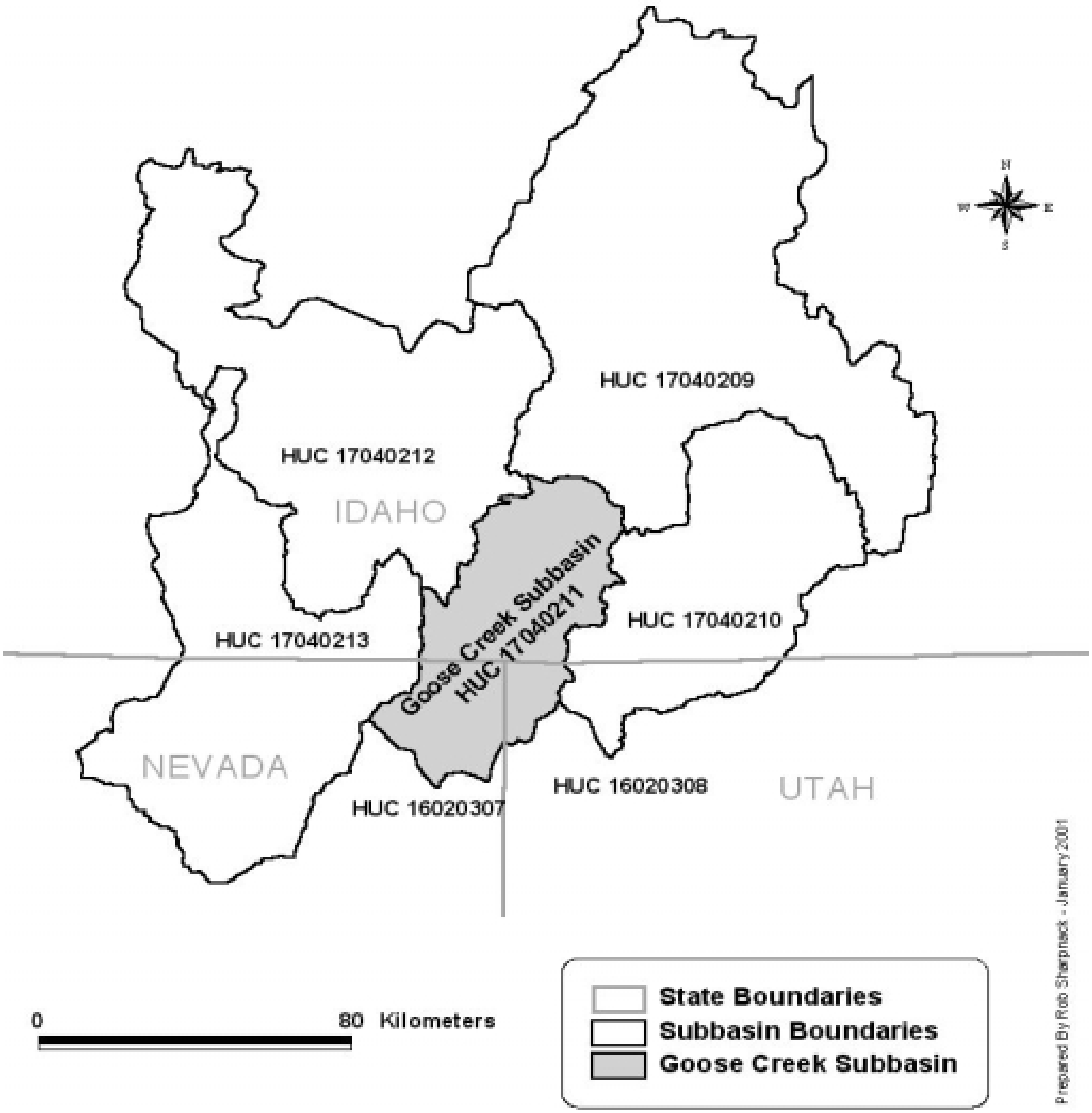


Figure 16. Goose Creek and surrounding subbasins.

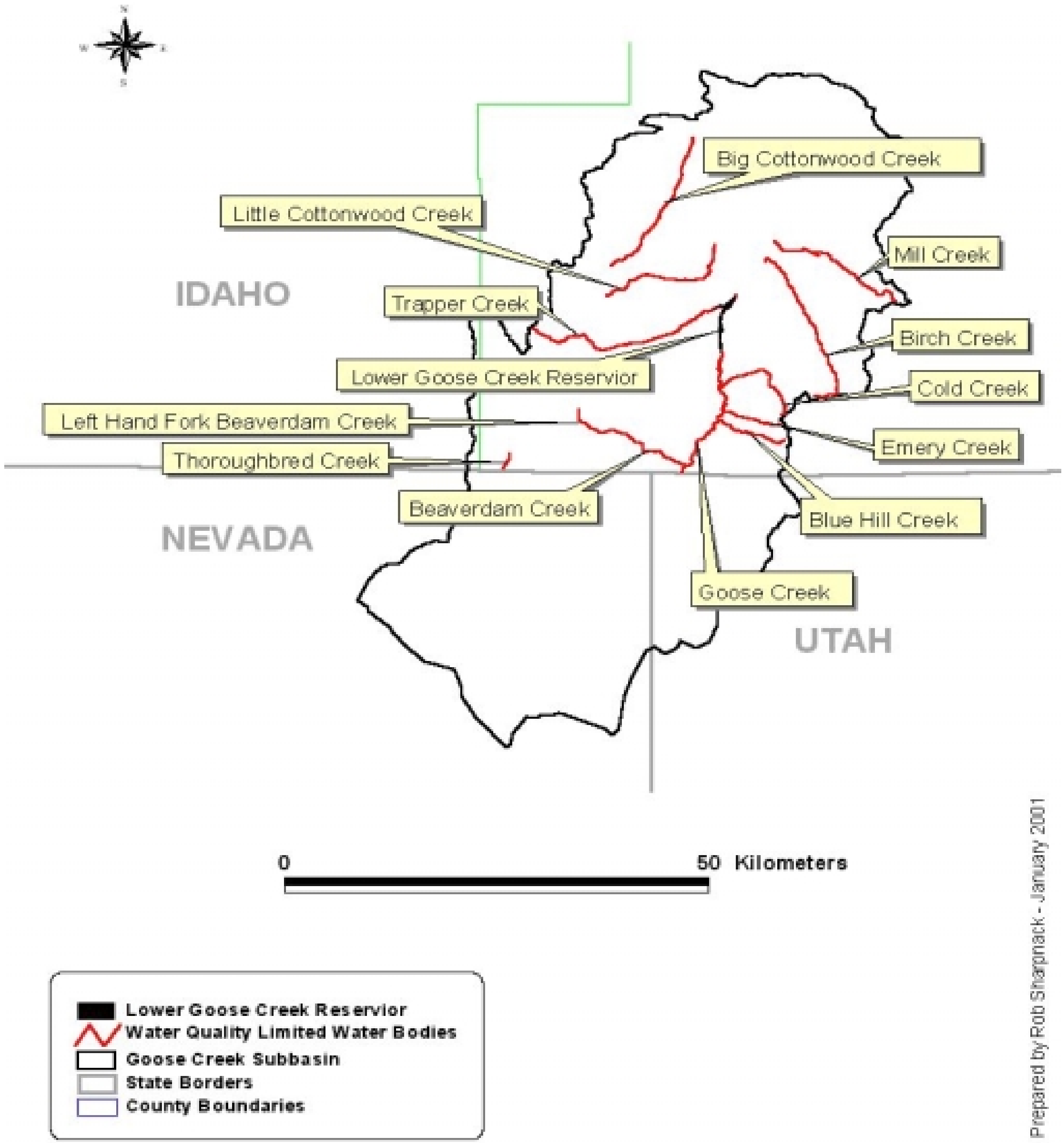


Figure 17. Location of water quality limited water bodies within the Goose Creek Subbasin.

2.2 Applicable Water Quality Standards

Violations of the following narrative standards and their numeric surrogates, numeric water quality standards, DEQ recommendations, and EPA guidelines have been documented through monitoring events in 2001 and data from past studies. Not all listed water bodies have had documented water quality violations. Lists of those water bodies in which violations have been documented follow the descriptions of the criteria that were violated.

Excess Nutrients

IDAPA 58.01.02.200.06 states, "Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses." Nutrients in excess quantities often cause rapid eutrophication of aquatic systems. The primary production in an aquatic system is often limited by the available concentration of one of these micronutrients at a time (Brochardt 1996). In the western United States, phosphorus is typically the nutrient that most limits production of aquatic plants and algae. Nitrogen (N) to phosphorus (P) ratios are often used to determine the limiting factor in aquatic vegetation production and biomass. If all nutrients are in excess quantities; however, the ratios are of little use (Schanz and Juon 1983). Other factors, such as light or available substrates, then may limit production of aquatic macrophytes.

In order to determine if nutrients are in excess, benthic and sestonic chlorophyll *a* samples were analyzed for streams and rivers and water column chlorophyll *a* samples were analyzed for reservoirs. The algae that grow on the stream and river substrates are called periphytic or benthic algae. They typically consist of single celled organisms called diatoms. These diatoms are the primary food source for many pollution intolerant aquatic macroinvertebrates that scrape the diatoms from the substrate. Sestonic forms of algae are free floating algae cells. They may be dislodged diatoms or other types of colonial algae organisms. If nutrients are in excess of the physiological needs of the diatom community, other less palatable forms of algae grow causing a reduction in the intolerant aquatic community. These less palatable forms include filamentous and colonial algae. In addition to being less palatable, these organisms are considered by some to be aesthetically unpleasing and are what typify nuisance aquatic growths.

Because the state does not have a numeric criteria for suspended or benthic chlorophyll *a,* a guideline was developed after referencing the scientific community, other states' targets, and EPA guidelines. It has been suggested by several authors that the threshold nuisance level of benthic algae is 100 to 200 milligrams per square meter (mg/m^2) for free flowing rivers and streams (Horner et al. 1983, Welch et al. 1988, Welch et al. 1989, Watson and Gestring 1996). At levels above 100 to 200 mg/m^2, aesthetics are impaired. DEQ assumes that at these same levels aquatic life communities are also affected. It is assumed that the presence of filamentous and colonial algal forms at these levels will reduce the abundance of pollution intolerant macroinvertebrates and other forms of aquatic life thereby impairing the beneficial uses of the stream or river.

Appropriate indicators for lakes and reservoirs have been developed by a number of states. Oregon has determined that 15 micrograms per liter (µg/L) of chlorophyll *a* is an appropriate indicator of excess nutrients in lakes that do not thermally stratify (EPA 1999), such as Lower Goose Creek Reservoir. North Carolina also uses 15 µg/L chlorophyll *a* for cold water systems (EPA 1999). These indicators are linked to the beneficial use impairment either indirectly or directly. For example, indirect beneficial use impairment presents as low dissolved oxygen (DO) and pH at or above these chlorophyll *a* levels. Beneficial use impairment is directly linked to the chlorophyll *a* indicators during nuisance algal blooms. In streams and other flowing systems , a large meta-data set was analyzed to determine if trophic boundaries could be determined from benthic and sestonic chlorophyll *a* (Dodds et al. 1998). The suggested boundary between mesotrophic and eutrophic levels was 30 µg/L sestonic chlorophyll *a* (Dodds et al. 1998).

If nutrients were the limiting factor in an aquatic system, a reduction in phosphorus would reduce vegetative growths. This shift and reduction in production and biomass is due to the magnitude of vegetative growths associated with the different micronutrients. When nitrogen is limiting, additions of the nutrient can increase vegetation biomass theoretically by 70 times the molecular weight of the nutrient. In contrast, with phosphorus additions the increase is closer to a 500-fold increase in biomass (Wetzel 1975). Because of this, a reduction in phosphorus can reduce the aquatic vegetation to a greater extent than can reductions in nitrogen.

While no state of Idaho standards exist for the numeric value of excess nutrients (phosphorus in this case), EPA has suggested guidelines to determine when phosphorus is in excess. To prevent the development of a biological nuisance and to control accelerated cultural eutrophication, TP (as P) on a monthly average should not exceed 0.05 milligram per liter (mg/L) in streams that enter a lake or reservoir (EPA 1977, 1986). As a guideline, the EPA has suggested that TP (as P) on a monthly average not exceed 0.1 mg/L in any stream or other flowing water (EPA 1986). In reservoirs this guideline has been set at 0.025 mg/L TP. The Goose Creek SBA and TMDL will use both the chlorophyll *a* indicator guidelines and the EPA TP concentration guidelines to determine if beneficial use impairment has occurred and to set future targets for allocations. To determine an appropriate daily maximum value to assess the water quality of the Goose Creek Subbasin Water Bodies the monthly and yearly averages were multiplied by 1.6 to arrive at the daily maximum value. This is a similar method used in NPDES permits. As a result, the daily maximum TP surrogates are 0.16, 0.08, and .0.04 mg/L for free flowing rivers, rivers flowing into reservoirs, and for reservoirs, respectively. Elevated nutrient concentrations alone will not necessitate a TMDL. However, elevated nutrient concentrations and either elevated chlorophyll *a* concentrations or excess biomass will trigger the TMDL development for excess nutrients. The rational for this dual indicator is that elevated nutrient concentrations do not link directly to beneficial use impairment unlike chlorophyll *a*.

Trapper Creek and Goose Creek will be assessed with the 0.05 mg/L TP monthly average the 0.08 mg/L TP daily maximum standard, and the 15 µg/L chlorophyll *a* sestonic indicator, as they discharge directly into a reservoir. The remaining systems will be assessed using 0.1 mg/L TP monthly average and 0.16 mg/L TP daily maximum guidelines and the 15 µg/L chlorophyll *a* sestonic indicator as they are free flowing rivers or streams. Lower Goose Creek Reservoir will be assessed using 0.025 mg/L TP monthly average and 0.04 mg/L TP daily maximum guidelines and the 15 µg/L suspended chlorophyll *a* indicator.

Trapper Creek, which flows into the reservoir, exceeded the instantaneous or daily maximum TP guidelines (0.08 mg/L TP) in all but six sampling events. In addition, in those months with more than one data point, Trapper Creek exceeded the monthly average TP guideline of 0.05 mg/L for rivers and streams flowing into lakes and reservoirs in almost all cases (August 2001 TP mean. = 0.0495 mg/L).

Birch Creek exceeded the instantaneous or daily maximum TP guidelines (0.16 mg/L TP) in five of 18 sampling events. In addition, in three months (April 2002, July 2001, September 2001) with more than one data point each, Birch Creek exceeded the monthly average TP guideline of 0.1 mg/L for free flowing rivers and streams. Furthermore, Birch Creek exceeds the annual average goals of 0.100 mg/L TP used in other TMDLs within south central Idaho.

Goose Creek, which flows into the reservoir, exceeded the monthly average TP guidelines in seven of eight months (in March through September). Goose Creek exceeded the daily maximum TP guideline (0.08 mg/L) for streams flowing into lakes and reservoirs on 15 of 27 sampling events. However, the presence of phosphorus bearing sediments is highly likely within the watershed and confounds typical TP analysis. Other nutrient constituents and chlorophyll *a* samples were very low.

Blue Hill, Cold Creek, Big Cottonwood Creek, Little Cottonwood Creek and Emery Creek, which are free flowing streams, never exceeded the 0.1 mg/L monthly average TP guideline. In no cases did these creeks exceed the daily maximum TP guideline. Other measures used to corroborate nutrient problems in these streams, such as low DO, elevated pH, and elevated chlorophyll *a,* did not exceed state water quality standards or assessment guidelines. Since there were no exceedances and no corroboration with other numeric standards, a nutrient TMDL will not be completed. However, further monitoring of the nutrients of these creeks is proposed.

Beaverdam Creek and Left Hand Fork Beaverdam Creek, which are free flowing streams, exceeded the instantaneous nutrient guideline in 16 of 41 sampling events. However, other nutrient measures were often below detection limits. In addition, it appears that a natural source of phosphorus exists within this watershed. However, at times of the year TP levels increased dramatically. These increases were accompanied by increases in bacteria, low DO, pH changes, and sediment increases. Furthermore, the increases were associated with land use changes. These other measures used to corroborate a nutrient problem in the creeks, such as low DO and elevated pH, often exceeded state water quality standards. Due to the corroboration with other numeric standards, a nutrient TMDL will be completed. However, further monitoring of the nutrients of the systems is proposed. The data collected for this SBA-TMDL and future monitoring of the nutrients in the systems will be used in upcoming listing cycles of the §303(d) list.

Sediment and Settable Solids

Sediment is one of the most common listed pollutants in the state and in the Goose Creek Subbasin. Furthermore, sediment is also the most common nonpoint pollutant in the state of Idaho (IDHW 1989), and the dominant portion of sediment loads in southern Idaho is suspended sediment (IDHW 1989). Sediment is a pollutant listed for all water bodies in this subbasin with identified pollutants in 1998. Sediment impacts the aquatic life beneficial uses by smothering fish spawning and rearing grounds, leading to a homogenization of available habitats. Additionally, it reduces the available habitat for the food organisms of the fish, as well as smothering the food organisms themselves (IDHW 1991). In addition, increased sedimentation leads to a loss of juvenile rearing and over-wintering habitat. As water temperatures decline in the winter, juvenile salmonids seek interstitial spaces in the substrate where they become torpid. When sediment fills the interstitial spaces, it leaves the juvenile fish with no cover during this period of inactivity and makes them more vulnerable to predation.

The IDAPA criteria for suspended sediment are narrative. Therefore, other sources were reviewed to determine appropriate limits and targets for suspended sediment. Suggested limits for suspended sediment have been developed by the European Inland Fisheries Advisory Commission and the National Academy of Sciences and adopted by the state of Idaho in previous TMDLs. A limit of 25 mg/L total suspended solids (TSS) would provide a high level of protection of the aquatic organisms, 80 mg/L TSS moderate protection, 400 mg/L TSS low protection, and over 400 mg/L TSS very low protection (USFS 1990, Thurston et al. 1979). DEQ program managers have proposed a target of suspended solids not to exceed a monthly average of 50 mg/L TSS with a daily maximum of 80 mg/L TSS to allow for natural variability due to storm and seasonal runoff events. All systems within the subbasin will be assessed using the 50 mg/L TSS monthly average and 80 mg/L TSS daily maximum guidelines.

Bedload sediment also impairs the beneficial uses of some streams in the subbasin. In order to restore the beneficial uses, reduction in both the suspended and bedload sediments needs to occur. However, guidelines or recommendations for other components of sediment are lacking. In other cases the ability to correctly monitor bedload or washload is limited by the short time lines under which the Goose Creek SBA-TMDL must be completed. To overcome these shortcomings, the DEQ Twin Falls Regional Office (TFRO) has adopted a method to address sediment. The first of these is to use other streams in the subbasin to set the guidelines and recommendations for sediment targets. Streams in which the beneficial uses are supported will be surveyed to determine appropriate sediment targets and establish criteria to compare to the §303(d) listed water bodies. The rational is that if the beneficial uses in the other stream are fully supported, then the sediment in impaired streams should have goals to meet similar percent surface fines and bank stability, as well as the TSS guidelines. This approach will be used to set targets and determine appropriate reductions for any TMDL developed in the Goose Creek Subbasin.

In the DEQ data set Goose Creek, Trapper Creek, Birch Creek, Little Cottonwood Creek, Beaverdam Creek, and Left Hand Fork Beaverdam Creek exceeded the daily maximum TSS guideline (80 mg/L). These exceedances typically occurred in spring sampling events. However, the exceedances in both Beaverdam Creeks were late summer events. Monthly average exceedances (TSS guideline of 50 mg/L) were less frequent. Goose Creek had elevated sediment in April and May 2002; Trapper Creek had elevated sediment in May 2001 and April, May, and June 2002. The Beaverdam Creeks also had exceedances of the average TSS guideline. These occurred in September for Beaverdam Creek (1,649 mg/L average) and July and August for Left Hand Fork Beaverdam Creek. The Birch Creek and Little Cottonwood Creek events did not exceed the monthly average guideline and the instantaneous events were anomalous with the other sampling events and parameters studied on the creek.

Dissolved Oxygen

Dissolved oxygen is a typical concern in systems with excess nutrients or other sources of organic enrichment. IDAPA 58.01.02.200.07 states that surface waters of the state shall be free from oxygen-demanding materials in concentrations that would result in an anaerobic water condition. Additionally, numeric water quality standards set the lowest level of DO concentrations at not less than 6 mg/L for cold water aquatic life, seasonal cold water aquatic life, and salmonid spawning. The DO level has been set at not less than 5 mg/L for warm water aquatic life. During daylight conditions, these standards are rarely exceeded due to the respiration of aquatic plants, unless large amounts of oxygen demanding materials are present. However, during nighttime periods, systems with large quantities of aquatic plants will exceed the aquatic life standards and in some cases may become anaerobic. As a result, diel studies of the DO concentrations are required. Low DO directly affects the beneficial uses by stressing the organisms and increasing their chances of mortality. In cases of long periods of anaerobic conditions catastrophic fish kills are common. In the macroinvertebrate community the assemblages are more dominated by diptera and other tolerant taxa.

Fish kills have not been noted on any of the listed streams in the subbasin. Additionally, macroinvertebrate analyses indicated that the communities contain taxa intolerant to organic enrichment and the resulting low DO. All streams in the subbasin are listed for DO problems. Daytime DO levels fell below 7 mg/L in two of the creeks. Big Cottonwood Creek experienced low DO levels days prior to the creek drying up. This was not unexpected. Discharge at this time was very near zero. However, low DO in the other creek, Beaverdam, was unexpected. The measurement corresponded with extremely high TP, ammonia, bacteria, and TSS, and low pH. Diel DO measurements are not available at this time for any of the creeks.

Bacteria

IDAPA 58.01.02.251.01 states that waters designated for primary contact recreation are not to contain *Escherichia coli* (*E. coli*) bacteria significant to the public health in concentrations exceeding:

> A single sample of 406 organisms per 100 ml or
> A geometric mean of 126 organisms per 100 ml based on a minimum of five samples taken every three to five days over a 30-day period.

For waters designated for secondary contact recreation according to IDAPA 58.01.02.251.02, the criteria state that waters are not to contain *E. coli* bacteria significant to the public health in concentrations exceeding:

> A single sample of 576 organisms per 100 ml or
> A geometric mean of 126 organisms per 100 ml based on a minimum of five samples taken every three to five days over a 30-day period.

The state has interpreted these standards to mean that the instantaneous standard is used to determine if further monitoring is required. If at such time the geometric mean standard is exceeded then a water quality violation has occurred.

Although only Goose, Birch, and Trapper Creeks were originally listed for bacteria, DEQ collected bacteria samples on all the listed water bodies in the subbasin. Emery Creek has not exceeded the bacteria standards for either primary or secondary recreation. Left Hand Fork Beaverdam Creek and Beaverdam Creek consistently exceed the geometric mean standard for both primary and secondary contact recreation. Other creeks in the subbasin exceeded the instantaneous standard for both primary and secondary contact recreation beneficial uses occasionally, yet don't exceed the geometric mean standard. Therefore these streams do not exceed the water quality standards. Follow-up monitoring was typically conducted twice each month if no exceedance was noted.

Temperature

Applicable water quality standards for cold water aquatic life relating to temperature can be found in IDAPA 58.01.02.250.02.b, which states that waters cannot exceed an instantaneous water temperature of 22 °C and a daily mean of no greater than 19 °C. For warm water aquatic life (IDAPA 58.01.02.250.04.b), the standards are less than 33 °C instantaneous water temperature and not greater than a daily mean of 29 °C.

Temperature, under the current standards, is a listed constituent in one segment of the Goose Creek Subbasin. Statewide temperature standards violations are common. These temperature exceedances may be a natural occurrence in some segments due to geothermal springs. Additionally, in other areas of the state, aquatic life bioassessment data conflict with concurrent temperature information and water quality standards. This is likely the result of the state's current water quality standards being derived from an outdated understanding of the cold water aquatic life's temperature requirements. Consequently, DEQ is participating in a regional review of temperature criteria, which is being organized by EPA Region 10. However, temperature exceedances in the Goose Creek Subbasin will be addressed with the current information and regulations. Following the conclusion of the temperature review, if needed, temperature TMDLs will be reassessed.

Flow Alteration

There are currently no water quality standards, either narrative or numeric, which address flow alteration. Additionally, it is DEQ policy, with concurrence from EPA, that flow and habitat alterations are pollution and therefore not a "TMDLable" pollutant. The EPA considers certain unnatural conditions, such as flow alteration, a lack of flow, or habitat alteration, that are not the result of the discharge of a specific pollutants as "pollution." A TMDL is only required when a pollutant can be identified and in some way quantified. So, TMDLs are not required for water bodies impaired by pollution, but not specific pollutants. The estimation of load capacity and load allocations for flow alteration is not practical. Due to these constraints, a TMDL for flow alteration will not be completed for the segments listed for flow alteration in the Goose Creek Subbasin. These forms of pollution will remain on the §303(d) list of the CWA.

Applicable designated and existing beneficial uses are those uses designated by the Idaho State Legislature through negotiated rule making. The beneficial uses are based on recommendations provided by DEQ via the Board of Environmental Quality and those uses discovered through the BURP process and subsequent water body assessment to be existing in the water body. Those uses designated for selected water bodies within the Goose Creek Subbasin are identified in Table 13, as defined in IDAPA 58.01.02.150.13.

Table 13. Goose Creek Subbasin designated and existing beneficial uses.

Water Body	Aquatic Life[a]		Recreation[b]		Other[c]	
	Designated	Existing	Designated	Existing	Designated	Existing
Big Cottonwood Creek		COLD, SS		SCR		AWS
Lower Goose Creek Reservoir	COLD, SS		PCR			AWS
Trapper Creek - from and including Squaw Creek to Lower Goose Creek Reservoir		COLD, SS		SCR		AWS
Trapper Creek - source to Squaw Creek		COLD, SS		SCR		AWS
Goose Creek - Beaverdam Creek to Lower Goose Creek Reservoir	COLD, SS		PCR	SCR		AWS
Beaverdam Creek - source to mouth		COLD, SS		SCR		AWS
Trout Creek - Source to Utah/Idaho border		COLD, SS		SCR		AWS
Goose Creek - source to Idaho/Utah border	COLD, SS		PCR	SCR		AWS
(little)Birch Creek - Idaho/Utah border to mouth		COLD, SS		SCR		AWS

Water Body	Aquatic Life[a]		Recreation[b]		Other[c]	
	Designated	Existing	Designated	Existing	Designated	Existing
Blue Hill Creek – source to mouth		COLD, SS		SCR		AWS
Cold Creek – source to mouth		COLD, SS		SCR		AWS
Birch Creek – source to mouth		COLD, SS		SCR		AWS
Mill Creek – source to mouth		COLD		SCR		AWS
Land/Willow/Smith creek complex		COLD		SCR		AWS
Badger Creek		COLD		SCR		AWS
Billys Hole Creek		COLD		SCR		AWS
Emery Creek		COLD		SCR		AWS
Left Hand Fork Beaverdam Creek		COLD		SCR		AWS
Fall Creek		COLD		SCR		AWS
Little Cottonwood Creek		COLD		SCR		AWS
Little Squaw Creek		COLD		SCR		AWS
Piney Creek		COLD		SCR		AWS
Spring Creek		COLD		SCR		AWS
Summit Creek		COLD		SCR		AWS
Swanty Creek		COLD		SCR		AWS
Thoroughbred Creek		COLD		SCR		AWS

[a]COLD – Cold Water Aquatic Life, SS – Salmonid Spawning,
[b]PCR – Primary Contact Recreation, SCR – Secondary Contact Recreation,
[c]AWS – Agricultural Water Supply.

2.3 Summary and Analysis of Existing Water Quality Data

Water quality data within the Goose Creek Subbasin are very sparse. Three USGS gauges exist(ed) within the subbasin. These gauges will be used to develop hydrographs for the remaining ungauged watersheds. The IDFG has collected some fish information from streams in the subbasin, but these efforts were very limited. Additionally, these collections were usually done in conjunction with the BLM or USFS for their management needs. Some information exists within the EPA's STORET database. Again, this information is very limited or applicable to nonwater quality limited streams. For example, Utah DEQ collected some information on Little Birch Creek which flows into Idaho. This creek is not currently listed in Idaho. The EPA's STORET database was queried for each water quality limited water body within the subbasin, but for the most part, DEQ TMDL monitoring data and BURP information make up the largest portion of the available data.

The subbasin is cartographically covered by 1:24,000-scale and higher USGS topographic quadrangle maps. The total vertical relief in the area is 1,154 m, from an elevation of 1,300 m near View, to 2,454 m in the South Hills (Trapper Peak), to 3,033 m in the Albion Mountains (Mount Harrison). Locally, slopes on the plateaus are usually quite gentle (although overall relief to the canyons and valley bottoms is considerable), with considerably steeper slopes in the mountains.

The topography is chiefly an expression of the geologic structure and historical glacial and sedimentary processes. The faulted, linear mountain chains of the Northern Basin and Range ecoregion border the Snake River Plain to the south. In general, the subbasin slopes from the southeast and southwest towards the Snake River in the north.

As stated previously, the Goose Creek Subbasin covers approximately 2,903 km^2 in total area. Nearly 1,791 km^2, or 61.69 percent of the subbasin, is within the state of Idaho. The elevation range within the Idaho portion of the subbasin is from 3,033 to 1,300 m. The average elevation of the entire subbasin is approximately 1,600 to 1,900 m. The entire subbasin slope range is from less than 1 percent to 46 percent. The average subbasin slope is approximately 4.5 percent. Generally, the alluvial valleys have slopes of less than 2 percent, while the remainder of the subbasin is mountainous and has slopes greater than 5 percent. Overall, the subbasin has a northern aspect. The stream channels and mainstem rivers follow a dendritic drainage pattern throughout the subbasin. In the subbasin, there are 569.77 km of perennial streams; 1951.92 km of ephemeral and intermittent streams; and 352.15 km of canals and ditches (see Table 7). Roughly 47 percent of the perennial streams are located between 1,524 m and 1,829 m in elevation, which corresponds with the alluvial low slope area of the subbasin. Approximately 97 percent of the ditches are located in the 1,219 m to 1,524 m elevation classification. This area corresponds with the lowland agricultural area near Oakley to View. In this same area only 77.69 km of perennial streams exist.

Additionally, the subbasin has been further subdivided into 18 watersheds (Figure 18). These units will be used extensively in allocating nonpoint source loads.

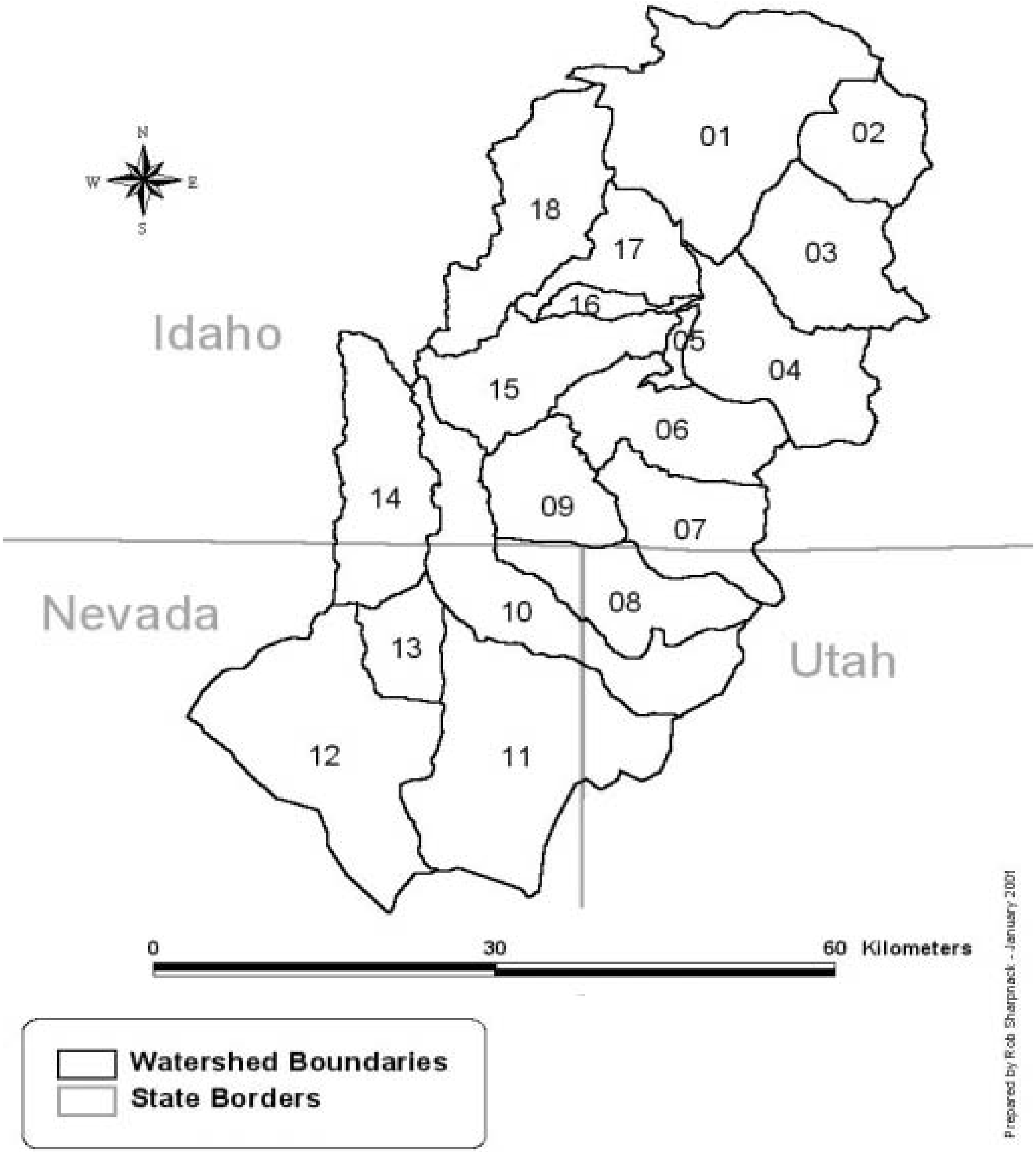


Figure 18. Watershed divisions of the Goose Creek Subbasin.

Goose Creek

Goose Creek begins in the south central mountains of Idaho and flows to the confluence with Lower Goose Creek Reservoir. Throughout its 141 km length, it crosses into three states, from Idaho to Nevada, from Nevada to Utah, and from Utah to Idaho. Along this course, several perennial tributaries (e.g., Trout Creek, Thoroughbred Creek, and Cold Creek) enter the system as do numerous intermittent and ephemeral systems. One USGS gauge location can be found on Goose Creek in Idaho. The location of the gauge is near Lower Goose Reservoir, Idaho. The gauge has been in operation since April 1911, with a contributing watershed area of 1,639 km^2. Given this size watershed, channel characteristics can be extrapolated from regional curves. These regional curves can be found in *Applied River Morphology* (Rosgen 1996). Extrapolating from the regional curve, Goose Creek at this sampling location should have a mean depth of 1.19 m, a bankfull width of 42.82 m, and a cross-sectional area of approximately 56.44 m^2. From the historical gauge data, the period of record average discharge at this location was 1.33 m^3/s. The low discharge usually occurred during the fall quarter with an average of only 0.51 m^3/s. Spring discharge averaged 2.94 m^3/s, while winter base discharge averaged 0.94 m^3/s. Summer discharge averaged 0.90 m^3/s.

Physical Characteristics

The §303(d)-listed segment of Goose Creek begins at the Utah-Idaho border. This segment is 29.26 km long. The valley through which this segment flows is approximately 16.24 km in length. Over the entire listed segment, the creek has a very low slope of 0.208 percent. This slope corresponds to a 2.08 m fall per kilometer. Slopes of this magnitude are usually seen in highly sinuous streams that are by nature depositional. Sinuosity is also classified as moderate to high (1.8) for the listed segment. Floodplain materials are composed of fine textured sands and silts derived from alluvium and glacial till. Consequently, it would be expected that the percent fines of Goose Creek should be elevated in comparison to a channel with much higher slopes, lower sinuosity, and coarser floodplain materials such as Trapper Creek. Bankfull measurements near the USGS gauge indicate that Goose Creek is much smaller than the normal expected parameters of a stream within its watershed size. Creeks within the arid Goose Creek Subbasin may not fit the regional curves developed by Rosgen. The mean bankfull depth averaged 0.61 m, mean bankfull width averaged 9.48 m, and bankfull area averaged 5.82 m^2.

Hydrology

As stated above, a USGS gauge has been in operation since 1911. The average annual hydrograph for Goose Creek for the period of record discharge is shown in Figure 19.

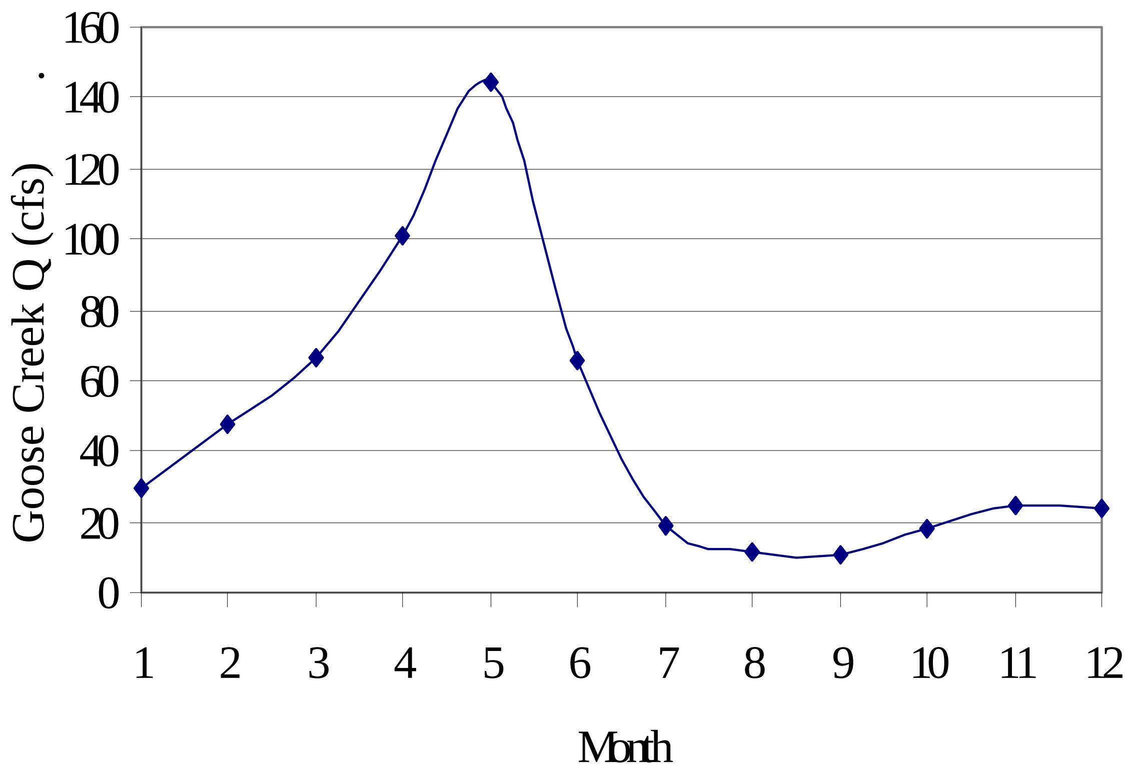


Figure 19. Annual average hydrograph - Goose Creek.

Fisheries

Idaho Department of Fish and Game stocking records indicate that hatchery fish have not been released into Goose Creek since at least 1995. However, Goose Creek Reservoir is stocked with rainbow trout several times each year. It is, however, likely that some of the fish would migrate upstream into the creek. Therefore, hatchery fish and hybrids should be present in the lower bounds of Goose Creek. The distance these fish might travel is unquantified. It is also unlikely that Nevada or Utah fish and game departments stock their portions of the stream. Due to the distance from any large towns in Nevada and Utah it is unlikely that hatchery fish are stocked with any regularity. Therefore, DEQ assumes that salmonids found in the upper reaches of the stream must be from self-sustaining populations of wild cutthroat, naturalized rainbow, or brook trout and populations in the lower bounds must be a mix of hatchery, naturalized, and wild trout.

The IDFG has conducted fish collections for several years. The earliest data (1956) was referred to in a 1986 collection (Grunder et al. 1987). Both of these collections were done in the lower section downstream from the Utah state line. The upper reaches were sampled in various years from 1987 to 1999.

The most recent data (1999) in the upper section of the creek (from the Nevada state line to the headwaters) indicate that the trout population consists mainly of wild cutthroat trout with some naturalized brook trout (Warren 2000). Density estimates at five locations in this reach were calculated from the sampling efforts in 1999. These estimates ranged from 3.9 to 20.41 cutthroat per 100 m^2 and 1.4 brook trout per 100 m^2. Trout were also collected in 1990, but densities were not calculated from those data. However, it should be noted that much greater numbers of cutthroat trout were collected in 1999 than in 1990. Cutthroat trout were collected at only two sites in 1990 (Partridge and Corsi 1993).

The lower, water quality limited segment was sampled in 1956 and in 1987 by IDFG. The IDFG reports that no discernable trend in species composition could be determined from the data (Grunder et al. 1987). Salmonids (cutthroat trout) were present only in the later collection, but only two fish were collected. However, it was noted that several were seen that escaped capture due to the turbid water. The report (Grunder et al. 1987) indicates that the salmonid population is severely impacted by lack of spawning habitat due to sediment impacts from grazing and poor land use practices. Additional impacts from irrigation withdrawals were also noted (Grunder et al. 1987).

DEQ has collected fish information from Goose Creek as well. DEQ fish collections corroborate IDFG findings for both sections of Goose Creek. In 1997 and 1999, DEQ collected several age classes of cutthroat trout in the upper reaches of Goose Creek. In the lower section DEQ collected hatchery rainbow trout that had immigrated to the stream from the reservoir. Additional fishes captured in the lower section included longnose dace (*Rhinichthys cataractae*), speckled dace (*Rhinichthys osculus*), redside shiner (*Richardsonius balteatus*), bluehead sucker (*Catostomus discobolus*), mottled sculpin (*Cottus bairdi*), and yellow perch (*Perca flavescens*). Most of these fishes are moderately intolerant to organic sediment and thermal pollution (DEQ 1996). This may indicate that the water quality in the lower reach is moderately impaired. However, the lack of wild or naturalized salmonids may indicate periods of poor water quality that have eliminated these intolerant species from the community.

Macroinvertebrates

DEQ collected macroinvertebrates in the lower, listed segment of Goose Creek five times from 1993 through 1997. The macroinvertebrate community data corroborate the water quality status indicated by the fish community (see above). In some locations the macroinvertebrate community is healthy and indicates fully supported beneficial uses. However, in others, the community is indicative of an impaired or depressed community. There is no apparent trend in the macroinvertebrate community data along the length of the creek. However, temporal effects due to the samples being collected over five-year period could obscure any trend. The two sites with the highest scores (both full support under the WBAG processes) were at opposite ends of the segment. One was near the Coal Banks Crossing and the other was near the reservoir. The SMI scores were 97.01 (3) and 100.85 (3); condition-rating scores are in parenthesis. The MBI scores were 5.29 and 5.36, respectively. The scores for the whole of the creek ranged from not full support to full support under the 1996 WBAG process (1.78 to 5, respectively). Under the 1996 system, the lowest score had the most weight; therefore, the Goose Creek segment with the MBI score of 1.78 would have remained on the list. An average of the MBI scores (not a normal protocol) results in a score of 3.60, which indicates full support for the creek on average. Under the new WBAG II process the average condition rating score was 2.46. This condition rating score would indicate full support of the beneficial uses as well. However, a minimum threshold condition rating was recorded indicating a non-support area or time. This SMI score (20.78) would have kept Goose Creek on the §303(d) list. The minimum threshold score was from data collected in 1996 in the lower segment of the creek. Additionally, this area is in the transition area from a steep gradient stream to a depositional stream above the reservoir confluence.

These macroinvertebrate communities may reflect the periodic poor water quality events in the stream or may show that some unmeasured water quality constituent may be effecting both the fishery and the aquatic macroinvertebrate community. When combined, these data sets indicate that the water quality in the lower section of the creek is moderately impaired with periods of poor water quality. Moderate levels of nutrients year-round may be on the threshold of causing nuisance aquatic plant growths with low DO problems to follow. Sediment concentrations are also elevated during the spring and following runoff events. Furthermore, bacteria levels are elevated in the stream. Although elevated, the bacteria levels are not water quality standard violations in all cases. Combined, these factors of moderate nutrients, seasonal sediment, and occasional bacteria contamination (as a surrogate for other contaminants) may interact synergistically to impair salmonid spawning and cold water aquatic life. More likely, bedload sediment and flow alteration may affect beneficial uses and obscure any other constituents' effects.

Aquatic Vegetation

The presence of aquatic vegetation was noted in many reaches of the lower segment of Goose Creek. However, these aquatic plant communities were not excessively abundant. In most cases, the community consisted of periphyton with no long filamentous organisms present. A chlorophyll *a* sample was collected during the peak of the summer growing period to determine if nuisance conditions existed. The sample collected was well below (30 mg/m^2) the 200 mg/m^2 value suggested (see Section 2.2) to indicate nuisance aquatic vegetation growths. This value contradicts the beneficial use assessment based upon the fisheries and macroinvertebrate communities. As such, it is unlikely that excessive nutrients are the factor effecting the beneficial uses of Goose Creek. More likely, sediment or some other constituent such as temperature is to blame. However, more samples may be required to definitively exclude nutrients as a pollutant in Goose Creek.

Goose Creek Existing Water Quality Data

Water quality samples containing a full suite of constituents collected within the listed segment of Goose Creek are rare. According to the EPA's STORET database, a few TP samples were collected from the creek and many specific conductivity (SC) measurements were taken. According to EPA's STORET, these TP samples (n = 22) were from Goose Creek upstream from Trapper Creek. This location would be in the reservoir. However, DEQ assumes that the samples must have been collected near the gauge located on Goose Creek. The data cover a range of years (1971-1981) and at least one sample was collected in each month. The overall average of the historical data was 0.168 mg/L TP with a standard deviation of 0.132 mg/L. From this data and the older fisheries information, a sense of the historical water quality can be gathered. In the decades following these collections many nonpoint source changes have occurred. The USFS and BLM have tightened grazing regulations, land ownership has changed, and our knowledge of water quality and best management practices (BMPs) have increased. These changes are evident in the most recent data collected on the lower segment of Goose Creek.

DEQ sampled in the creek over the course of 2001. However, due to the limited number of sampling periods in the 2001 data set, DEQ's confidence in monthly average concentrations is low. The lack of a robust data set was due to limited budgets and, in part, to a limited time frame for collecting data. In most cases one sample was the most collected in any given month. Infrequently, multiple samples were collected in some months. This sampling design was intended to determine annual pollutant loads . The annual load estimated by this type of design would overestimate the annual load by 25 to 50 percent (Robertson and Richards 2000). To assist in the determination of seasonal components and appropriate critical conditions, the data will be presented as monthly averages in the following tables while period of record averages are presented in the text and in the tables and used for any future load calculations. For those cases when a parameter was below detection limits, half the detection limit was used to calculate the monthly average and used as part of the period of record average.

For Goose Creek, two sample locations were set up with sampling beginning in March 2001 (Figure 20). The upper site was used to determine background concentrations and loads from the upstream, full support segments of the stream and from out of state. The lower site was used to determine the percent change in concentrations and loads due to activities along the listed reach.

The chemical constituents at both sites seemed to be very similar throughout the sampling period (see Tables 14 and 15). In order to determine if this was the case, a two-sample t-test was conducted to test the null hypothesis (H_o).

H_o: Goose Creek Lower Mean = Goose Creek Upper Mean.
H_a: Goose Creek Lower Mean ≠ Goose Creek Upper Mean.

Each constituent sampled at the two locations was tested using Systat 7.0. For most constituents the null hypothesis was not rejected ($p > 0.05$). However, TP and SC were significantly different from upstream to downstream ($p = 0.029$ and 0.000; respectively). Therefore, for TP and SC the null hypothesis was rejected. The change in SC is likely a natural phenomenon as several thermal springs (see Appendix B) are present in the tributaries of the lower segment. These springs would be much higher in dissolved salts than the surface runoff waters from the upper reaches. While the change in TP could be associated with anthropogenic disturbances, other constituents (nitrate plus nitrite [NO_X], ammonia [NH_3, and TSS) associated with such disturbances do not reflect the same change.

Consequently, it is more likely that a natural source of TP exists within the lower system (see Appendix B). Geologically this source could be the Miocene lake deposits though which several tributaries flow and through which the lower segment of Goose Creek flows. Based upon these findings and those mentioned in other sections it is unlikely a TMDL based upon TP would be effective or warranted.

Table 14. Measured water quality constituents in Goose Creek, Idaho.

Month	No of Samples	TSS (mg/L)[a]	Total NH_3 as N (mg/L)[b]	Total NO_2 + NO_3 (mg/L) as N[c]	Total P (mg/L)[d]	Temp (°C)	Dissolved Oxygen (mg/L)[e]	Bacteria *E. coli* (Col/100 ml)[f]
January	0							
February	0							
March	1	53	0.016	0.005	0.110	9.03	9.5	26
April	2	26	0.015	<0.005*	0.059	11.74	9.2	17
May	2	25	0.016	0.005	0.124	13.03	9.42	187
June	3	1	0.018	0.016	0.075	20.75	9.02	83
July	2	4	0.013	<0.005*	0.086	26.54	9.41	219
August	1	5	0.016	0.009	0.076	19.57	10.05	82
September	2	8	0.016	<0.005*	0.053	14.68	10.53	103
October	1	<1**	0.012	<0.005*	0.024	6.73	11.75	120
November	0							
December	0							
Annual Average		10	0.016	0.007	0.076	18.68	9.73	115
Standard Deviation		17	0.005	0.008	0.034	8.34	3.12	125

a Total suspended solids in milligrams per liter, TSS detection limit = 1 mg/L.
b Total ammonia as nitrogen in milligrams per liter.
c Nitrite plus nitrate in milligrams per liter, as nitrogen. NO_2+NO_3 detection limit = 0.005mg/L.
d Total phosphorus in milligrams per liter.
e milligrams per liter.
f colonies per 100 milliliters.

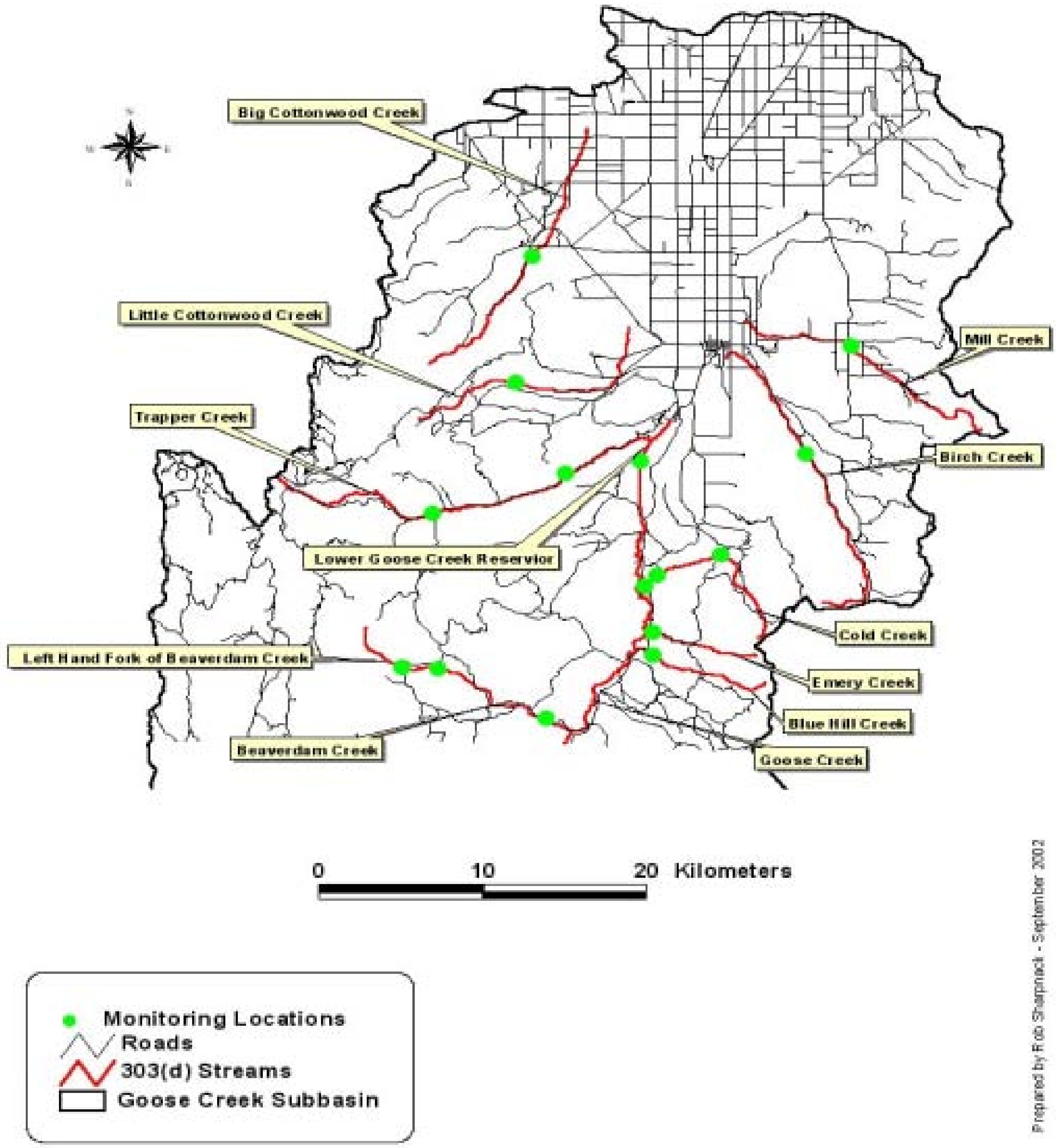


Figure 20. Goose Creek Subbasin sample locations, 2001-2002.

Table 15. Measure water quality constituents in Goose Creek, Nevada.

Month	No of Samples	TSS (mg/L)[a]	Total NH_3 as N (mg/L)[b]	Total NO_2 + NO_3 (mg/L) as N[c]	Total P (mg/L)[d]	Temp (°C)	Dissolved Oxygen (mg/L)[e]	Bacteria *E. coli* (Col/100 ml)[f]
January	0							
February	0							
March	0							
April	1	28	0.013	<0.005*	0.077	10.16	9.36	520
May	2	27	0.019	<0.005*	0.105	10.56	9.08	470
June	3	<1**	0.009	<0.005*	0.032	14.95	10.22	160
July***	2	29	0.277	0.205	0.575	24.66	10.1	107
August	2	<1**	0.014	<0.005*	0.026	22.14	12.85	47
September	2	1	0.011	0.007	0.019	10.76	7.5	171
October	1	2	0.010	<0.005*	0.038	5.01	13.21	NA
November	0							
December	0							
Annual Average		11	0.053	0.035	0.127	15.48	10.51	199
Standard Deviation		18	0.139	0.111	0.288	6.64	2.39	195

a Total suspended solids in milligrams per liter, TSS detection limit = 1 mg/L.
b Total ammonia as nitrogen in milligrams per liter.
c Nitrite plus nitrate in milligrams per liter, as nitrogen. NO_2+NO_3 detection limit = 0.005mg/L.
d Total phosphorus in milligrams per liter.
e milligrams per liter.
f colonies per 100 milliliters.

From the 2001 data set, TSS also appears to be a non-factor affecting beneficial uses. However, 2001 was a drought year in which water levels were diminished. Consequently, much of the sediment stored in the system was never transported out of the reach as a suspended load. In a higher water year, the data from the suspended fraction may support the contention that a sediment TMDL is required. However, DEQ is constrained by the legal system to complete a TMDL for Goose Creek with the data at hand.

Due to DEQ's limited sampling for suspended sediments in the Goose Creek system, additional measures were taken to determine if other forms of sediment were impairing the beneficial uses. From DEQ's sampling regime, it was determined that the suspended fraction of the sediment load was not impairing the uses. Therefore, a series of Wolman pebble counts were conducted at the lower-most sampling location. These Wolman pebble counts was conducted to determine if bedload sediment was impairing beneficial uses. Following the BURP protocols, Wolman pebble counts were conducted on riffles in a 3 km reach of Goose Creek. Counts were conducted from bankfull edge to bankfull edge until at least 50 measurements were taken. Following this, the crew traveled upstream approximately 100 m to another riffle. This was repeated until the crew had collected 30 series of Wolman pebble counts (approximately 3.25 km of the creek). A similar system (one where the beneficial uses have been documented as being fully supported) was chosen from the general area of the §303(d) listed water body for comparison with Goose Creek. In this case the upper segment of Goose Creek was chosen. The upper segment of Goose Creek was determined to be fully supporting its beneficial uses (see the 1998 §303(d) list, chapter 2.5). Wolman pebble counts from eight past BURP sites (24 transects) were used to determine the surface fines (DEQ-TFRO's surrogate for bedload [Lay 2001]) of the upper segment of Goose Creek. Data concerning the stored fraction of sediment and/or bedload (surface fines) were collected in the lower segment at the end of August 2001. The percent surface fines for the lower 3 km of Goose Creek from the USGS gauge upstream was 89.31 percent (fines are particles < 6 millimeters [mm] in median length). Percent fines in the upper fully supported segment were collected in 1994-1999 and averaged 12.85 percent.

To determine if the percent surface fines between the two streams were significantly different, a Chi-squared analysis was completed (see H_o above). The test indicated that the percent surface fines between the fully supported segment and lower Goose Creek were significantly different ($p = 0.000$). As a result of the differences between the percent fines of the two streams, DEQ has determined that bedload sediment as measured by the percent surface fines surrogate is impairing the lower segment of Goose Creek, but that the suspended load is not. Samples collected in other fully supported streams indicate that percent fines within the wetted width should be 25 percent or less (Lay 2001). Thus it appears that bedload is impairing the beneficial uses of the lower segment of Goose Creek and that a TMDL for bedload must be completed.

Bacteria samples were collected with the water chemistry samples at both the upstream and downstream locations. The null hypothesis was not rejected for this set of data. Additionally, at no time in the lower segment did bacteria exceed the instantaneous state water quality standards. In most cases, the bacteria "concentrations" (colonies per 100 ml [col/100 ml]) were lower in the downstream sampling location than in the upper. Several exceedances of Idaho's instantaneous water quality standards were observed at the Nevada (upper) testing location while none occurred at the lower site. However, it should be noted that this upper location is not within the jurisdiction of the Idaho water quality standards. It appears from the data that some improvement in water quality occurs, with regards to bacteria, from the upstream to downstream locations. As a caveat, the sample sets were not significantly different ($p = 0.074$); therefore, the amount of improvement should be considered insignificant as well. Nevertheless, bacteria do not impair the beneficial uses of the lower segment of Goose Creek, as seen by the 2001 data set.

Dissolved oxygen (DO) was also monitored at both locations throughout 2001. At no time did DO fall below state water quality standards at either location. Dissolved oxygen is often used in conjunction with pH to determine if excess nutrients have caused nuisance aquatic growths. As previously stated, DEQ determined that excess aquatic growths had not occurred in Goose Creek during the 2001 sampling period. The DO and pH data support this contention. Therefore, DEQ finds that the lower segment of Goose Creek is not polluted with oxygen demanding materials.

Temperature studies were also undertaken at the two locations. A two-sample t-test was completed to determine if water quality differed between the two locations. Instantaneous temperature measurements from the upstream (Nevada) location and the lower location were statistically similar ($p = 0.191$). This may indicate that that water quality impacts are similar through the lower segment of Goose Creek from Nevada, Utah, and Idaho. HOBO® temperature loggers were placed at several locations in both the upper and lower segments. The uppermost was located just north of the Nevada border near Thoroughbred Creek. Another was placed under a bridge in Nevada where the instantaneous samples were collected. A third was placed near the USGS gauge in Idaho. Data from the temperature loggers were taken concurrent with each other in 2000 and 2001. The 2001 data was truncated at the end of August due to lack of memory in the loggers. This can be seen in the smaller tails in the 2001 box plots. Temperatures seem consistent among the three locations. Box plots of the daily means shows that temperature is slightly lower at the most downstream location (Figure 21) in 2000, but similar at all locations in 2001. Water quality standards violations were common at all three locations, even in the upper segment with many size classes of wild cutthroat trout (see fisheries section above). Future data collections should focus on data logger placements in further upstream locations to determine if water quality violations occur higher in the watershed. As a result of these data, a temperature TMDL for the entire creek is likely needed, including the Utah and Nevada sections. Consequently, EPA may be required to take the lead of this multi-state, multi-regional TMDL.

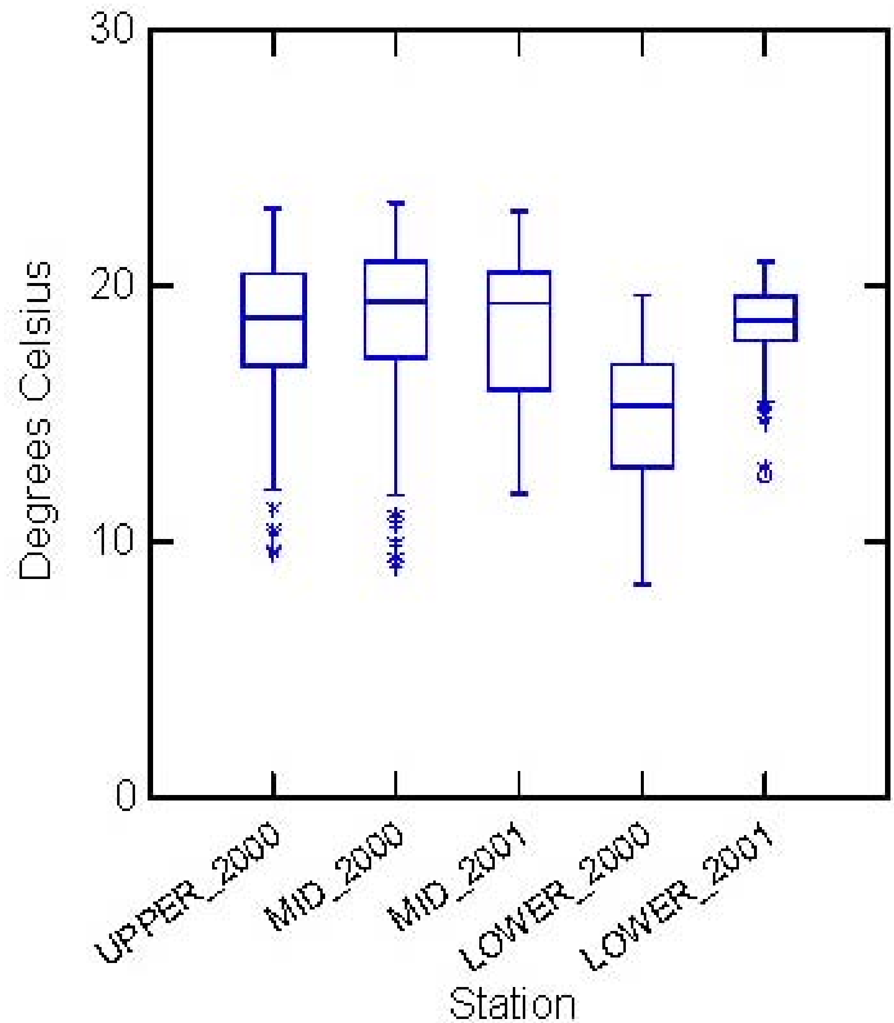


Figure 21. Daily mean temperatures at three Goose Creek locations over two years (2000 and 2001).

Point and Nonpoint Sources

The listed segment of Goose Creek bisects two fifth field hydrological units (hydrological unit codes [HUCs] 1704021107 and 1704021106). The geographical information systems (GIS) coverages indicate that 70.1 percent of the watershed is forest or rangeland, 28.2 percent irrigated croplands, and 1.7 percent urban. The major sources of nonpoint source pollution in the watershed are activities associated with these land uses. Of the irrigated lands, the majority are sprinkler irrigated. Additional sediment sources include unstable banks and reentrainment from the streambed itself. However, quantification of these sources has not been completed. As of yet, no confined animal feeding operations (CAFOs) or other point sources are known to exist within the Goose Creek Watersheds above the reservoir.

Conclusions

It appears from the data that suspended sediment, nutrients, DO, and bacteria are within the bounds of water quality determined to be supportive of the designated beneficial uses. Consequently, DEQ will not complete a suspended sediment, nutrient, DO, or bacteria TMDL on the Goose Creek. However, DEQ will complete a TMDL for bedload sediment using the surrogate of percent surface fines and will complete a temperature TMDL using solar pathfinder data.

Trapper Creek

Trapper Creek begins in the south central mountains of Idaho and flows to the confluence with Lower Goose Creek Reservoir. Throughout its 28 km length, it crosses into two ecoregions: the Northern Basin and Range and the Snake River Basin/High Desert. Along this course, several perennial tributaries (e.g., Fall Creek, South Cottonwood Creek, and Trail Creek) enter the system, as do numerous intermittent and ephemeral systems. One USGS gauge location can be found on Trapper Creek approximately 3.36 km from the reservoir (mouth). The gauge has been in operation since May 1911, with a contributing watershed area of 139.08 km^2. Given this size watershed, channel characteristics can be extrapolated from regional curves. These regional curves are in *Applied River Morphology* (Rosgen 1996). Extrapolating from the regional curve, Trapper Creek at this sampling location should have a mean depth of 0.76 m, a bankfull width of 13.91 m, and a cross-sectional area of approximately 11.34 m^2. From the historical gauge data, the period of record average discharge at this location was 0.43 m^3/s. Low discharge typically occurred during the fall quarter with only 0.06 m^3/s on average. Spring discharge averaged 0.65 m^3/s, while winter base discharge averaged 0.34 m^3/s. Summer discharge averaged 0.42 m^3/s.

Physical Characteristics

The §303(d) listed segment of Trapper Creek begins near the Ibex Hollow area. The listed segment is 12.26 km long. The valley through which this segment flows is approximately 11.22 km in length. Over the entire listed segment, the creek has a low slope of 1.3 percent. This slope corresponds to a 12.88 m fall per kilometer. Slopes of this magnitude are usually seen in moderately sinuous streams that contain both depositional and erosional areas. Sinuosity is also classified as low (1.0) for the listed segment. Floodplain materials are composed of fine textured silts derived from weathered basalts, rhyolite, and ash beds. Also contained within the floodplain are larger cobbles and gravel formed from colluvium. Consequently, it would be expected that the percent fines of Trapper Creek should be elevated in the lower portion of the valley. In comparison, the upper portion of the channel would have less percent fines with much higher slopes, low sinuosity, and coarser floodplain materials. The listed segment of Trapper Creek would be more similar to Birch Creek than to Goose Creek. Bankfull measurements near the USGS gauge indicate that Trapper Creek does not fall within the normal expected parameters of a stream within its watershed size. The creek is much more incised in the lower portion of the watershed. In addition, the arid Goose Creek Subbasin may not fit the regional curves developed by Rosgen (1996). The mean bankfull depth was 0.72 m, mean bankfull width was 4.28 m, and bankfull area was 3.09 m^2.

Hydrology

As stated above, a USGS gauge has been in operation since 1911. The average annual hydrograph for the Trapper Creek period of record discharge is shown in Figure 22.

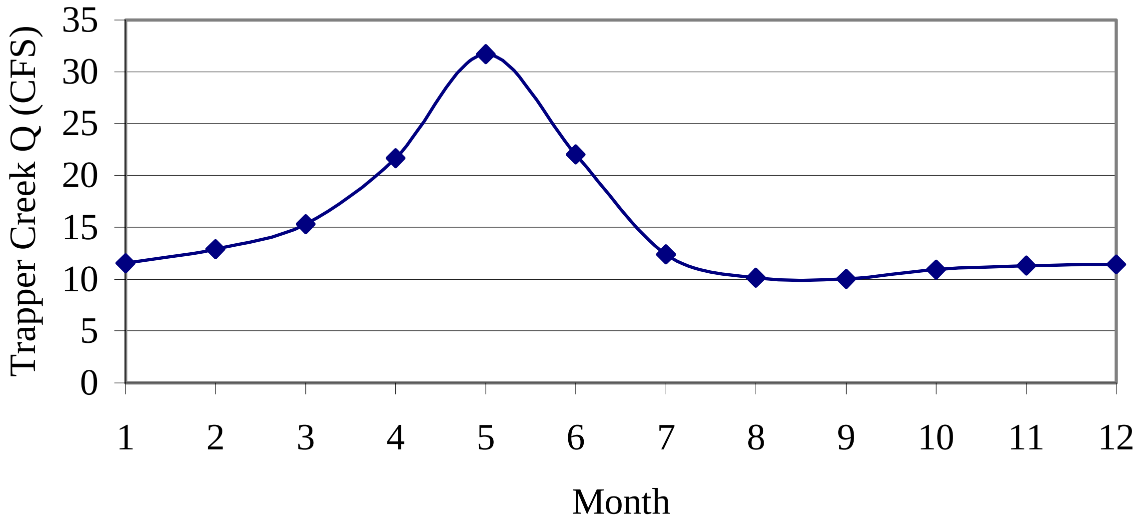


Figure 22. Average annual hydrograph for Trapper Creek.

Fisheries

Idaho Department of Fish and Game stocking records indicate that catchable (6 + inches) rainbow trout have been released into Trapper Creek on an semiannual basis since at least 1995. In addition, Goose Creek Reservoir is stocked with rainbow trout several times each year. It is likely that some of the reservoir stocked fish would migrate upstream into the creek. Therefore, hatchery fish and hybrids should be present throughout Trapper Creek. However, cutthroat trout and brook trout are not stocked. Therefore, DEQ assumes that any rainbow trout found in Trapper Creek is of hatchery origin and any cutthroat or brook trout must be from self-sustaining populations of wild or naturalized fish.

The IDFG conducted fish collections on Trapper Creek in 1979. This collection was in the Cottonwood Creek and Fall Creek area of Trapper Creek. Fall Creek was also sampled at that time. The data indicate that the trout population consists of hatchery rainbow trout with some naturalized or wild rainbows present (IDFG 1980). Density estimates at the locations were not calculated.

DEQ has collected fish information from Trapper Creek as well. DEQ fish collections were made at three locations. The lowermost was just above the reservoir-influenced area. At this location, two rainbow trout were collected. It was not noted if they were hatchery or wild fish. The middle location was near South Cottonwood Creek. At this location, 27 rainbow trout were captured in two passes through the reach. It was noted that eight of these trout were “wild” trout; the remainder were identified as from hatchery origin. The uppermost site was located in the fully supported section of the creek near Badger Gulch. At this location 27 rainbow trout and four brook trout were captured. It was not noted if the rainbow trout were from hatchery origin. However, 19 of the rainbows captured were smaller that the 150 mm catchable trout typically stocked into the stream. Therefore, DEQ assumes that these smaller fish (40-120 mm) were from a wild naturalized population. The brook trout are also from a naturalized wild population, as stocking of this species has not occurred in many years. Thus, it appears that salmonids are spawning in Trapper Creek and that this activity may extend from the headwaters to the South Cottonwood Creek area.

A Brigham Young University (BYU) study aimed at determining the distribution of leatherside chubs (*Gila copei*) in Cassia County also collected fish in the Trapper reek drainage. Four locations were sampled on Trapper Creek in 1994. Three were similar to the DEQ collection points. The additional site was located between the DEQ upper and middle locations, near Birch Spring. At the lowermost BYU site, five rainbow trout were collected. At least one of these was smaller than the stocked hatchery fish, which may indicate that it was a wild fish or a fingerling that had moved up from the reservoir. At the next station upstream, near South Cottonwood Creek, 12 rainbows were captured. All were larger, in the range of stocked fish (162-220 mm). At the third location, near Birch Spring, 11 rainbows were encountered. Some of these were outside of the range (105-162 mm) of stocked fish, indicating a portion of the collection was of wild origin. At the final location, near Rodeo Creek, 13 rainbow trout were collected. This collection also included small, presumably wild, fish.

The BYU study corroborates DEQ findings for both sections of Trapper Creek. In 1997 and 1993, DEQ collected several age classes of wild rainbow and brook trout in the upper reaches of Trapper Creek, indicating a fully supported beneficial use. In the lower section, DEQ collected only hatchery rainbow trout that had immigrated to the stream from the reservoir, which indicates spawning may not be occurring. Additional fishes captured in the lower section included longnose dace, speckled dace, bridgelip sucker (*Catostomus columbianus*), mottled sculpin, and leatherside chub. Most of these fishes are moderately intolerant to organic sediment and thermal pollution (DEQ 1996). This may indicate that the water quality in the lower reach is moderately impaired. However, the lack of wild or naturalized salmonids may indicate periods of poor water quality, thus eliminating these intolerant species from the community.

Macroinvertebrates

DEQ collected macroinvertebrates in the lower, listed segment of Trapper Creek twice. Macroinvertebrates were collected once in 1993 and again in 1997. The macroinvertebrate communities at these two locations and times indicate that water quality is not impairing the beneficial uses. Using both WBAGs' invertebrate tools, the macroinvertebrate indices were well above the 3.5 (MBI full support) and the 2 (condition rating value) scores needed to ascertain full support (average 3.93 and 2.5, respectively). In these locations, the macroinvertebrate communities are healthy and indicate fully supported beneficial uses as seen with SMI scores of 47.43 and 51.15 (1993 and 1997, respectively). However, the fish communities at these locations indicate that some water quality impacts do occur. There is a lack of wild salmonids, and the remainder of the fish community consists of moderately tolerant species. When combined, these data sets indicate that the water quality in the lower section of the creek is moderately impaired with periods of poor water quality. However, the impact appears to be more strongly affecting salmonid spawning than macroinvertebrates and other cold water aquatic life. Moderate levels of nutrients year-round are on the threshold of causing nuisance aquatic plant growths with low DO problems to follow. Sediment concentrations are also elevated during the spring and following runoff events. Furthermore, bacteria levels are elevated in the stream. Although elevated, the bacteria levels are not water quality standard violations in all cases. Combined, these factors of moderate nutrients, seasonal sediment, and occasional bacteria contamination (as a surrogate for other contaminants) may interact synergistically to impair salmonid spawning.

Alternatively, water quality may not be the factor affecting the salmonid spawning, or lack thereof, in the lower segment. Increased competition with the hatchery-reared fish, or higher predation rates from fishermen due to the increase in fish density from stocking, may also result in fewer wild fish. Further water quality investigations may be needed to determine why smaller salmonids do not appear in the lower section of Trapper Creek.

Aquatic Vegetation

The presence of aquatic vegetation was noted in many reaches of the lower segment of Trapper Creek. However, these aquatic plant communities were not excessively abundant. In most cases, the community consisted of periphyton with no long filamentous organisms present. A chlorophyll *a* sample was collected during the peak of the summer growing period to determine if nuisance conditions existed. The sample collected was well below (21 mg/m^2) the 200 mg/m^2 value suggested (see Section 2.2) to indicate nuisance aquatic vegetation growths. This value supports the beneficial use assessment based upon the macroinvertebrate communities. As such, it is unlikely that excessive nutrients are the factor effecting the beneficial uses of Trapper Creek. More likely, sediment or some other constituent such as temperature is to blame. However, more samples may be required to definitively exclude nutrients as a pollutant in Trapper Creek.

Trapper Creek Existing Water Quality Data

Water quality samples containing a full suite of constituents collected within the listed segment of Trapper Creek are rare. According to the EPA's STORET database, a few TP samples were collected from the creek, while many SC measurements were taken. According to STORET, these TP samples (n = 19) were from Trapper Creek near Oakley, Idaho. DEQ assumes that the samples were collected in the lower section of the stream, possibly near the gauge located on Trapper Creek. The data cover a range of years (1971-

1981) and in nearly each month at least one sample was collected. The overall average of the historical data was 0.12 mg/L TP with a standard deviation of 0.12 mg/L. From this data and the fisheries information, a sense of the historical water quality can be gathered. In the decades following these collections many nonpoint source changes have occurred. The USFS and BLM have tightened grazing regulations, land ownership has changed, and our knowledge of water quality and BMPs has increased. These changes are evident in the recent macroinvertebrate data collected on the lower segment of Trapper Creek.

DEQ sampled in the creek over the course of 2001, and additional samples will be collected throughout upcoming phases as budgets and sampling time frames allow. However, due to the limited number of sampling periods in the original 2001 data set, DEQ's confidence in monthly average concentrations is low. The lack of a robust data set was due to limited budgets and, in part, to a limited time frame for collecting data. In most cases one sample was the most collected in any given month. Infrequently, multiple samples were collected in a month. This sampling design was intended to determine annual pollutant loads . The annual load estimated by this type of design would overestimate the annual load by 25 to 50 percent (Robertson and Richards 2000). To assist in the determination of seasonal components and appropriate critical conditions, the data will be presented as monthly averages in the following tables while period of record averages are presented in the text and other tables and used for any future load calculations. For those cases when a parameter was below detection limits, half the detection limit was used to calculate the monthly average and was used as part of the period of record average.

One sample location was set up on Trapper Creek and sampling began in March 2001 (Figure 20). The site was used to determine concentrations and loads for the stream. An additional site in the upstream, full support, segment of the stream should be sampled as well to determine net change. This will be established as budgets and sampling time frames allow. The lower site was used to determine the concentrations and loads due to activities along the listed reach.

At the sampling location, the effects of land uses can be seen in the slightly elevated levels of the measured constituents (Table 16) in comparison to those levels measured at the Goose Creek locations. These increases in most cases are of a small magnitude, indicating similar or slightly higher use and degradation. For example, TSS in Trapper Creek averages 34 mg/L (standard deviation 29 mg/L), which is higher than the combined (both the Nevada and Idaho sites) Goose Creek sites (11 mg/L). These samples were taken the same days as the Goose Creek samples and include the critical periods of springtime high flows and summertime low flows. Total phosphorus increased as well, although less dramatically than did suspended sediments. At Trapper Creek the average TP concentration was 0.108 mg/L (standard deviation 0.07 mg/L), while at the Goose Creek sites the average TP concentration was 0.096 mg/L. The minimum measured TP concentration at Trapper Creek was 0.036 mg/L in early September and the maximum was 0.294 mg/L during the middle of July. Both TP and TSS concentrations fell dramatically as the year progressed. The TSS decreases corresponded to the falling limb of the annual hydrograph. Total phosphorus decreases corresponded to an observed movement of cattle from pastures located adjacent to the stream. At these times, TSS and TP concentrations fell below target levels (50 mg/L and 0.05mg/L, respectively) set in other TMDLs (Lay 2000, Lay 2001).

Monthly concentrations of TP were indicative of excess nutrients that may cause impairment (nuisance aquatic vegetation). Guidelines that DEQ has used in the past are no more than 0.160 mg/L TP in any single sample, 0.100 mg/L TP in any average monthly sample, and 0.100 mg/L TP as a period of record average (Lay 2000, Lay 2001). The guidelines were exceeded in May, June, and July where the monthly average values ranged from 0.118 to 0.176 mg/L (Table 16). For the period of record annual average TP has been 0.108 mg/L. However, a lack of nuisance aquatic vegetation is seen within the system. Further chlorophyll *a* samples are required to determine if these levels of nutrients are impacting water quality. Since those data have not been collected, DEQ will write a TMDL for excess nutrients in Trapper Creek.
Bacteria samples were also collected with the water chemistry samples. A single sample collected at Trapper Creek in early March indicated significant bacteria contamination (1,000 col/100 ml). However, contamination of the sample may have occurred, as previous and follow up samples were considerably lower. At no other time did bacteria exceed state water quality standards. Bacteria concentrations were slightly elevated (125 col/100 ml average) in the spring and decreased dramatically (46 col/100 ml average) as the year progressed. Therefore, DEQ concludes that bacteria do not impair the beneficial uses of the lower segment of Trapper Creek, as seen by the 2001 data set.

From the 2001 data set, TSS also appears to be a non-factor effecting beneficial uses. However, 2001 was a drought year in which water levels were diminished. Consequently, much of the sediment stored in the system was never transported out of the reach as a suspended load. In a higher water year, the data from the suspended fraction may support the contention that a sediment TMDL is required. However, DEQ is constrained by the legal system to complete a TMDL for Trapper Creek with the data at hand.

Due to DEQ's limited sampling for suspended sediments in the Trapper Creek system, additional measures were taken to determine if other forms of sediment were impairing the beneficial uses. From DEQ's sampling regime, it was determined that the suspended fraction of the sediment load was not impairing the beneficial uses. Therefore, a series of Wolman pebble counts were conducted in the lower section of the stream to determine if bedload sediment was impairing beneficial uses. Following BURP protocols, Wolman pebble counts were conducted on riffles in a 3-km reach of Trapper Creek. Counts were conducted from bankfull edge to bankfull edge until at least 50 measurements were taken. Following this the crew traveled upstream approximately 100 m to another riffle. This was repeated until the crew had collected 30 series of Wolman pebble counts (approximately 3.25 km of the creek). A similar system (one where the beneficial uses have been documented as being fully supported) was chosen from the general area of the §303(d) listed water body for comparison with Trapper Creek (DEQ 1998 §303(d) list). In this case, the upper segment of Trapper Creek was chosen. Wolman pebble counts from 30 transects were used to determine the surface fines (DEQ-TFRO's surrogate for bedload sediment) of the upper segment of Trapper Creek. Data concerning the stored fraction of sediment and/or the bedload (surface fines) were collected in the lower segment at the end of the summer of 2002. The percent surface fines for the lower section of Trapper Creek from the USGS gauge downstream was 33.55 percent (fines are particles < 6 mm in median length). Percent fines in the upper fully supported segment were 8.0 percent.

Table 16. Measured water quality constituents in Trapper Creek.

Month	No of Samples	TSS (mg/L)[a]	Total NH_3 as N (mg/L)[b]	Total NO_2 + NO_3 (mg/L) as N[c]	Total P (mg/L)[d]	Temp (°C)	Dissolved Oxygen (mg/L)[e]	Bacteria *E. coli* (Col/100 ml)[f]
January	0							
February	0							
March	1	82	0.041	0.054	0.141	11.41	8.82	NA
April	1	62	0.050	0.034	0.099	13.72	9.80	30
May	2	78	0.051	0.043	0.118	14.50	9.31	240
June	3	33	0.031	0.088	0.144	18.45	8.14	67
July	2	10	0.038	0.171	0.176	18.09	7.99	95
August	2	8	0.015	0.133	0.050	18.66	8.09	48
September	2	17	0.032	0.112	0.054	13.59	8.25	52
October	1	4	0.024	0.033	0.043	4.76	12.58	64
November	0							
December	0							
Annual Average		34	0.034	0.093	0.108	15.34	8.78	90
Standard Deviation		29	0.016	0.063	0.070	4.53	1.28	86

a Total suspended solids in milligrams per liter, TSS detection limit = 1 mg/L.
b Total ammonia as nitrogen in milligrams per liter.
c Nitrite plus nitrate in milligrams per liter, as nitrogen. NO_2+NO_3 detection limit = 0.005mg/L.
d Total phosphorus in milligrams per liter.
e milligrams per liter.
f colonies per 100 milliliters.

To determine if the percent surface fines between the two streams was significantly different, a Chi-squared analysis of the proportions of sediment in each size classification was completed. The Chi-squared analysis was used to test the following hypothesis:

H_o: Trapper Creek lower proportions = Trapper Creek upper proportions.
H_a: Trapper Creek lower proportions ≠ Trapper Creek upper proportions.

The test indicated that the percent surface fines between the fully supported segment and lower Trapper Creek were significantly different ($p < 0.02$). As a result of the differences between the percent fines of the two streams, DEQ has determined that bedload sediment as measured by the percent surface fines surrogate is impairing the lower segment of Trapper Creek. Samples collected in other fully supported streams indicate that percent fines within the wetted width should be 25 percent or less (Lay 2000). Thus it appears that bedload is impairing the beneficial uses of the lower segment of Trapper Creek.

Dissolved oxygen was also monitored throughout 2001. At no time did DO fall below state water quality standards. Dissolved oxygen is often used in conjunction with pH to determine if excess nutrients have caused nuisance aquatic growths. DEQ had determined that excess aquatic growths had not occurred in Trapper Creek during the 2001 sampling period. The DO and pH data support this contention. Therefore, DEQ finds that the lower segment of Trapper Creek is not polluted with oxygen demanding materials.

Instantaneous temperature measures were also collected in Trapper Creek. A slight exceedance occurred in early June (22.67 °C). It is unknown why this exceedance occurred. At other locations, on this same day, temperatures were below state standards (22 °C). In the warmer months of July and August no temperature exceedances occurred. Temperature is likely not an issue in Trapper Creek due to the numerous cold water springs that feed the system. These springs would act as a temperature buffer for the system.

Point and Nonpoint Sources

Trapper Creek flows through fifth field HUC 1704021115. The GIS coverages indicate that 52.2 percent of the watershed is rangeland and 47.8 percent forest. The major sources of nonpoint source pollution in the watershed are from activities associated with these land uses. The listed segment falls mainly within the rangeland area. Additional sediment sources include unstable banks, culverts and associated gullies, and reentrainment from the streambed itself. Data collected for the sediment TMDL indicate that the gullies may contribute as much as half of the sediment load (see Trapper Creek sediment TMDL). As of yet, no CAFOs are known to exist within the watershed. A single, small, fish hatchery is located on the creek. The annual production at the hatchery is small enough that it does not require a National Pollutant Discharge Elimination System (NPDES) permit. Consequently, it is treated as a nonpoint source in upcoming TMDLs, although it will be discussed in sections of this document dealing with point sources.

Conclusions

It appears from the data that suspended sediment, DO, temperature, and bacteria are within the bounds of water quality determined to be supportive of the designated beneficial uses. Consequently, DEQ will not complete a suspended sediment, DO, temperature, or bacteria

TMDL on the creek. However, DEQ will complete a TMDL for bedload sediment using the surrogate of percent surface fines and a nutrient TMDL for excess TP.

Birch Creek

Birch Creek begins in the Albion mountains of south central Idaho. Historically Birch Creek flowed to a confluence with Goose Creek below the town of Oakley. Currently, Birch Creek is diverted approximately 8 km above this confluence and flows into Lower Goose Creek Reservoir. Throughout its 17.24 km length, it flows through narrow basalt canyons and wide alluvial plains. This dichotomy of landscapes can cause dramatic changes in the structure and function of the bankfull and floodplain areas. Along this course, several perennial tributaries (e.g., North and South Carson Creeks and Lake and Fish Creeks) enter the system, as do numerous intermittent and ephemeral systems. One USGS gauge is located on Birch Creek. The gauge is just upstream from the diversion point. The gauge was in operation March through September 1999, with a contributing watershed area of 87.8 km^2. Given this size watershed, channel characteristics can be extrapolated from regional curves. These regional curves are in *Applied River Morphology* (Rosgen 1996). Extrapolating from the regional curve, Birch Creek at this sampling location should have a mean depth of 0.68 m, a bankfull width of 10.51 m, and a cross-sectional area of approximately 7.60 m^2. From the gauge data, the period of record average discharge at this location was 0.41 m^3/s. The low discharge occurred during the fall quarter with only 0.1 m^3/s. The spring discharge was 0.66 m^3/s and the summer discharge was 0.26 m^3/s. The winter base discharge was not recorded.

Physical Characteristics

The §303(d) listed segment of Birch Creek begins in the headwaters at an elevation of 2,280 m. The segment is 24 km long. The valley through which this segment flows is approximately 23 km in length. Over the entire listed segment, the creek has a moderate to steep slope of 4.3 percent. This slope corresponds to a 42.78 m fall per kilometer. Slopes of this magnitude are usually seen in low sinuous streams that are by nature erosional Rosgen type A or B channels. Sinuosity is low (1.1) for the listed segment. Floodplain materials are composed of fine textured silts derived from weathered basalts and rhyolite and larger cobbles and gravel formed from colluvium. Consequently, it would be expected that the percent fines of Birch Creek should be elevated in the lower portion of the valley. In comparison, the upper portion of the channel would have less percent fines with much higher slopes, low sinuosity, and coarser floodplain materials. Birch Creek would be more similar to Trapper Creek than to Goose Creek. Bankfull measurements near the USGS gauge indicate that Birch Creek, like Trapper Creek, does not fall within the normal expected parameters of a stream with its watershed size. The stream is approximately half of the size as would be expected from the Rosgen curves. This is in keeping with other streams in the subbasin and the arid nature of the subbasin. The mean bankfull depth was 0.48 m, mean bankfull width was 5.1 m, and bankfull area was 2.47 m^2.

Hydrology

Due to the lack of a complete historical data set, the natural hydrology of Birch Creek cannot be described on an annual average with USGS gauge data. However, because the some gauge data available correspond with data collected concurrently in Goose Creek, a statistical relationship can be developed. Several assumptions must be made in order to develop this relationship. DEQ assumes that the amount of precipitation and resulting runoff are similar between basins and have been similar throughout the period of record for both the Birch Creek Watershed and the Goose Creek gauged watershed. As Birch Creek is in the same general area of the Goose Creek gauged watershed, this assumption should be met due to their proximity. A second assumption is that a similar amount of development has occurred in the Birch Creek drainage as in the Goose Creek drainage. As development increases, so do impervious surfaces which could change the rate of discharge in a system following a precipitation event. In general, the development in the Goose Creek Subbasin has occurred in the lower portion of the subbasin and not in the different watersheds, so DEQ is confidant that this assumption can also be safely made. Consequently, linear regression was performed on the partial year data collected in Birch Creek and the data from the Goose Creek gauge. The regression was highly significant ($p = 0.000$), and the model ($y = 0.1645x + 1.8322$) (Figure 23) was able to describe 82.6 percent of the variation between the Birch Creek discharge and the discharge at Goose Creek. Therefore, DEQ will use the model to describe the annual hydrograph for Birch Creek. Figure 24 estimates the average annual hydrograph for Birch Creek based upon the linear regression model and the Goose Creek period of record discharge.

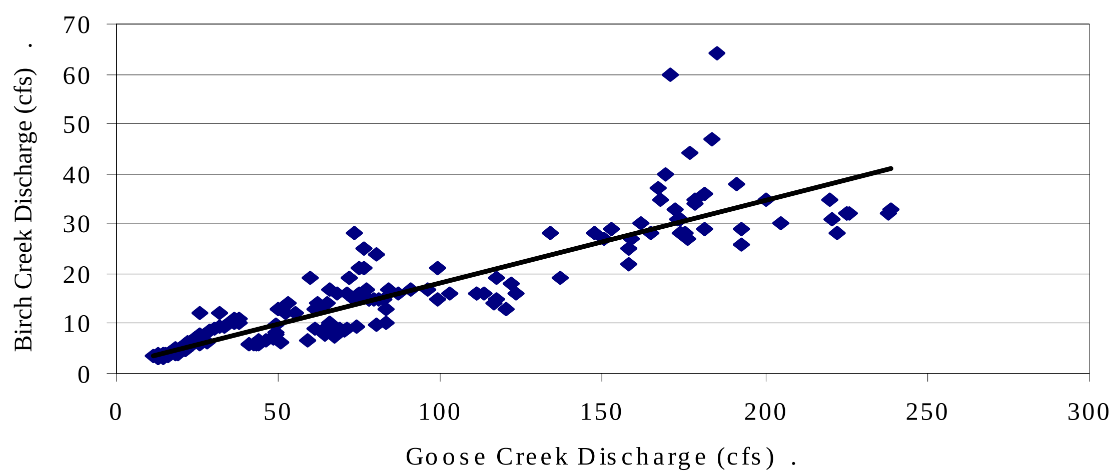


Figure 23. Linear regression model used to predict Birch Creek discharge.

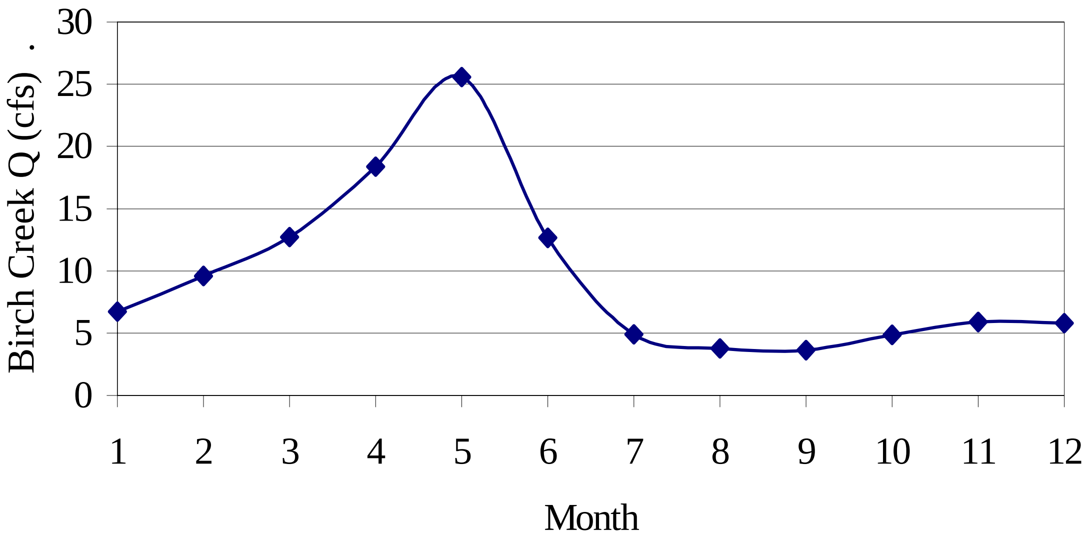


Figure 24. Predicted annual average hydrograph for Birch Creek.

From the predicted annual hydrograph, annual average discharge was 0.270 m^3/s, first quarter discharge was 0.209 m^3/s, second quarter discharge was 0.539 m^3/s, third quarter discharge was predicted at 0.201 m^3/s, and fourth quarter discharge was predicted to be 0.136 m^3/s. In subsequent discussion this predictive model will be used to determine flows during critical periods. Such as the critical period for nutrients which is typically June through September. The discharge from Birch Creek during this period averaged 0.177 m^3/s.

Fisheries

Idaho Department of Fish and Game stocking records indicate that trout have not been stocked in Birch Creek since 1967. The IDFG has also not surveyed the fishery in Birch Creek. Therefore, DEQ assumes that any salmonids captured in Birch Creek are from wild or naturalized populations. The naturalized populations may be from rogue stockings that have occurred throughout the west.

DEQ electrofished Birch Creek once in the past (July 1994) as part of a BURP site. At that time, DEQ collected several age classes of rainbow trout, including young-of-year. Approximately 30 trout were collected in two passes through a 100 m reach. It is unclear where the trout originated. It is likely that they are from a non-governmental stocking sometime in the past. In addition, it was noted on the field form that these fish were cutthroat/rainbow hybrids. DEQ found no unhybridized cutthroat trout. Regardless of origin, there appears to be a self-sustaining population of salmonids in Birch Creek. The size and range of the population is unknown at this time. The BURP site was located in the lower half of the stream segment.

Macroinvertebrates

DEQ collected macroinvertebrates in Birch Creek twice. Macroinvertebrates were collected once in 1994 and again in 1995. The macroinvertebrate community at the lower location, approximately 2 km upstream from the USGS gauge, indicates that water quality is not impairing the beneficial uses. Using both WBAGs macroinvertebrate tools, the macroinvertebrate index was well above the 3.5 (MBI full support) and 51 (SMI full support) scores needed to ascertain full support (3.77 and 52.94, respectively). In this location the macroinvertebrate community is healthy and indicates fully supported beneficial uses. In addition, the fish community at this location indicates that water quality is also fully supported. When combined, these data sets indicate that the water quality in the lower section of the creek is not impaired.

However, there appears to be an impact to beneficial uses in the upper segment of the stream. Macroinvertebrates collected in the upper 5 km (near Walters Creek) appear to be impacted. The SMI score for this area was 48.91 resulting in a condition rating score of 2 (a score of 2 or more indicates full support). The 1996 MBI score for this site was 2.63, which is just above the 2.5 level indicating impaired beneficial uses. Therefore, the stream was retained on the 1998 §303(d) list as needing more verification. However, under the WBAG II SMI, the macroinvertebrate data would not have been cause to retain the stream on the list. This is not to say that another community or index used in WBAG II wouldn't have indicated that the stream needed to remain.

Aquatic Vegetation

The presence of aquatic vegetation was noted in many reaches of the lower segment of Birch Creek. However, estimations of the coverage of aquatic vegetation were limited due to poor access to the creek. At those locations where the creek could be accessed, aquatic plant communities bordered on excessively abundant. In some cases, the community consisted of periphyton with long filamentous organisms present. A chlorophyll *a* sample was collected during the peak of the summer growing period to determine if nuisance conditions existed. The sample collected was well below (14 mg/m^2) the 200 mg/m^2 value suggested (Section 2.2) to indicate nuisance aquatic vegetation growths. This apparent contradiction is likely the result of the sample being epilithic and mainly composed of diatoms rather than of the patchy filamentous growths seen in the reach. The epilithic sample value confirms the beneficial use assessment based upon the fisheries and macroinvertebrate communities of the lower section. However, due to the presence of a patchy algae community that suggests excessive nutrients and elevated nutrient concentrations (see the following discussion), DEQ feels that the beneficial uses of Birch Creek may be impacted at other locations or during some summer months. Further investigations are needed to determine if the beneficial uses are impaired throughout the segment.

Birch Creek Existing Water Quality Data

Water quality samples containing a full suite of constituents collected within the listed segment of the Birch Creek are rare. According to the EPA's STORET database, no TP samples were collected from the creek, while many SC measurements were taken. According to STORET, these SC samples (n = 39) were from Birch Creek above the feeder canal near Oakley, Idaho. DEQ assumes that the samples were collected in the lower section of the stream, near the gauge located on Birch Creek. The data cover a range of years (1973-1986) and in nearly each month at least one sample was collected. The overall average SC of the historical data was 330 microsiemens per centimeter (µS/cm), with a standard deviation of 55 µS/cm.

DEQ sampled in the creek over the course of 2001, and additional samples will be collected throughout upcoming phases as budgets and sampling time frames allow. However, due to the limited number of sampling periods in the original 2001 data set, DEQ's confidence in monthly average concentrations is low. The lack of a robust data set was due to limited budgets and, in part, to a limited time frame for collecting data. In most cases one sample was the most collected in any given month. Infrequently, multiple samples were collected in a month. This sampling design was intended to determine annual pollutant loads . However, the annual load estimated by this type of design would overestimate annual load by 25 to 50 percent (Robertson and Richards 2000). To assist in the determination of seasonal components and appropriate critical conditions, the data will be presented as monthly averages in the following tables, while period of record averages are presented in the text and other tables and used for any future load calculations. For those cases when a parameter was below detection limits, half the detection limit was used to calculate the monthly average and was used as part of the period of record average.

One sample location was set up on Birch Creek and sampling began in March 2001 (Figure 20). The site was used to determine concentrations and loads for the stream. At the sampling location, the effects of land uses can be seen in the slightly elevated levels of the measured constituents (Table 17) in comparison to those levels measured at the Goose Creek locations. These increases, in most cases, are of a small magnitude, indicating similar or slightly higher use and degradation. For example, TSS in Birch Creek averages 35 mg/L (standard deviation 48 mg/L), which is higher than the Goose Creek sites (11 mg/L). The Birch Creek samples were taken on the same day as the Goose Creek samples and include the critical periods of springtime high flows and summertime low flows. Total phosphorus increased as well, more dramatically than did suspended sediments. At Birch Creek the average TP concentration was 0.117 mg/L (standard deviation 0.087 mg/L), while at the Goose Creek sites the average TP concentration was 0.096 mg/L. The minimum measured TP concentration at Birch Creek was 0.022 mg/L in early June and the maximum was 0.287 mg/L during the middle of March. Both TP and TSS concentrations fluctuated dramatically as the year progressed. Total suspended sediment and TP decreased in one month and increased dramatically the following month. No patterns could be discerned to account for these fluctuations.

Monthly concentrations of TP were indicative of excess nutrients that may cause impairment (nuisance aquatic vegetation). The guidelines that DEQ has used in the past are not to exceed 0.160 mg/L TP in any single sample, 0.100 mg/L TP in any average monthly sample, and 0.100 mg/L TP as a period of record average. The guidelines were exceeded in March, July, and September where the monthly values were 0.287, 0.124, and 0.243 mg/L, respectively (Table 17). Annual average for the period of record was 0.117 mg/L. Further chlorophyll *a* samples are required to determine if these levels of nutrients are impacting water quality. Since those data have not been collected, DEQ wrote a TMDL for excess nutrients in Birch Creek.

Table 17. Measured water quality constituents in Birch Creek.

Month	No of Samples	TSS (mg/L)[a]	Total NH_3 as N (mg/L)[b]	Total NO_2 + NO_3 (mg/L) as N[c]	Total P (mg/L)[d]	Temp (°C)	Dissolved Oxygen (mg/L)[e]	Bacteria *E. coli* (Col/100 ml)[f]
January	0							
February	0							
March	1	188	0.041	0.475	0.287	6.60	10.13	86
April	1	17	0.017	0.235	0.062	9.41	10.73	12
May	3	40	0.031	0.129	0.100	12.59	9.29	128
June	3	8	0.007	0.126	0.053	16.66	8.31	219
July	2	38	0.029	0.167	0.124	20.02	8.01	910
August	2	1	0.017	0.121	0.059	17.59	8.68	195
September	2	32	0.073	0.247	0.243	13.46	8.20	25,500
October	1	4	0.014	0.062	0.038	7.26	11.26	300
November	0							
December	0							
Annual Average		35	0.029	0.177	0.117	14.21	8.98	3,643
Standard Deviation		48	0.024	0.113	0.087	4.74	1.23	9,577

a Total suspended solids in milligrams per liter, TSS detection limit = 1 mg/L.
b Total ammonia as nitrogen in milligrams per liter.
c Nitrite plus nitrate in milligrams per liter, as nitrogen. NO_2+NO_3 detection limit = 0.005mg/L.
d Total phosphorus in milligrams per liter.
e milligrams per liter.
f colonies per 100 milliliters.

Annual weighted average bacteria concentrations were also highly elevated (3,643 col/100 ml). Bacteria levels increased throughout the year. In the spring, March through early June, *E. coli* levels averaged less than 100 col/100 ml. The low levels were soon surpassed, as during the summer *E. coli* levels rose to an average of 7,680 col/100 ml from late June through September.

From the 2001 data set, TSS appears to be a non-factor effecting beneficial uses. However, 2001 was a drought year in which water levels were diminished. Consequently, much of the sediment stored in the system was never transported out of the reach as a suspended load. In a higher water year, the data from the suspended fraction may support the contention that a sediment TMDL is required. However, DEQ is constrained by the legal system to complete a TMDL for Birch Creek with the data at hand.

Due to DEQ's limited sampling for suspended sediments in the Birch Creek system, additional measures were taken to determine if other forms of sediment were impairing the beneficial uses. From DEQ's sampling regime, it was determined that the suspended fraction of the sediment load was not impairing the uses. Therefore, a series of Wolman pebble counts were conducted at the lower section of the stream. These Wolman pebble counts were conducted to determine if bedload sediment was impairing beneficial uses. Following the BURP protocols, Wolman pebble counts were conducted on riffles in a 3-km reach of Birch Creek. Counts were conducted from bankfull edge to bankfull edge until at least 50 measurements were taken. Following this the crew traveled upstream approximately 100 m to another riffle. This was repeated until the crew had collected 30 series of Wolman pebble counts (approximately 3.25 km of the creek). A similar system (one where the beneficial uses have been documented as being fully supported) was chosen from the general area of the §303(d) listed water body for comparison with Birch Creek. In this case the upper segment of Trapper Creek was chosen. The upper segment of Trapper Creek was determined to be fully supporting its beneficial uses (see the 1998 §303(d) list chapter 2.5). Wolman pebble counts from 30 transects were used to determine the surface fines (DEQ-TFRO's surrogate for bedload) of the upper segment of Trapper Creek. Data concerning the stored fraction of sediment and/or bedload (surface fines) were collected in the segment at the end of the summer of 2002. The percent surface fines for Birch Creek from the USGS gauge upstream were 19.56 percent (fines are particles < 6 mm in median length). Percent fines in the fully supported Trapper Creek segment were 8.0 percent.

To determine if the percent surface fines between the two stream segments were significantly different, a Chi-squared analysis was completed on the proportions of each size class. The Chi-squared analysis was used to test the following hypothesis:

H_o: Birch Creek proportions = Trapper Creek upper proportions.
H_a: Birch Creek lower proportions ≠ Trapper Creek upper proportions.

The test indicated that the proportion of surface fines between the fully supported segment of Trapper Creek and Birch Creek were not significantly different ($p > 0.15$). As a result of the similarities between the percent fines of the two streams, DEQ has determined that bedload sediment as measured by the percent surface fines surrogate is not impairing Birch Creek. Samples collected in other fully supported streams indicate that percent fines within the wetted width should be 25 percent or less (Lay 2000). Since the percent fines in Birch Creek is 19.56 percent and is similar to the reference system, it appears that bedload is not impairing the beneficial uses of Birch Creek.

Dissolved oxygen was also monitored throughout 2001. At no time did DO fall below state water quality standards. Dissolved oxygen is often used in conjunction with pH to determine if excess nutrients have caused nuisance aquatic growths. DEQ has determined that excess aquatic growths may have existed in Birch Creek during the 2001 sampling period. However, the DO and pH data do not reflect this condition. The high DO levels may be an artifact of daytime sampling. The current data set does not indicate that DO is a problem in the watershed. Therefore, DEQ finds that Birch Creek is not polluted with oxygen demanding materials. Further DO and biochemical oxygen demand (BOD) samples should be collected to confirm the current data. Although, as a nutrient TMDL is proposed, the diel and BOD deficiency in the DO analysis will be moot following implementation of the nutrient TMDL.

Instantaneous temperature measures were also collected in Birch Creek. Temperature exceedances did not occur in Birch Creek. This was even true in the warmer months of July and August (average temperature 15.52 °C). Instantaneous temperature standards for cold water aquatic life are no more than 22 °C.

Point and Nonpoint Sources

Birch Creek flows through fifth field HUC 1704021104. The GIS coverages indicate that 72.5 percent of the watershed is rangeland, 18.9 percent sprinkler irrigated, 5.1 percent forest, and 3.5 percent urban. The major sources of nonpoint source pollution are activities associated with these land uses. The listed segment falls mainly within the rangeland. Additional sediment sources include unstable banks and reentrainment from the streambed itself. However, quantification of these sources has not been completed. As of yet, no CAFOs or other point sources are known to exist within the watershed.

Conclusions

It appears from the data that suspended sediment, DO, and temperature are within the bounds of water quality determined to be supportive of the designated beneficial uses. Consequently, DEQ will not complete a suspended sediment, DO, or temperature TMDL on Birch Creek. However, DEQ will complete a nutrient TMDL for excess TP and a bacteria TMDL.

Cold Creek

Cold Creek begins in the south central mountains of Idaho in an area called Middle Mountain and flows 13.49 km to the confluence with Goose Creek. Along this course, one unnamed perennial tributary enters the system, as do approximately five intermittent or ephemeral systems. The USGS has not had a gauge located on Cold Creek in Idaho. The Cold Creek Watershed is an area of approximately 33.81 km^2. Given this size watershed, channel characteristics were extrapolated from regional curves. These regional curves are in *Applied*

River Morphology (Rosgen 1996). Extrapolating from the regional curve, Cold Creek near the mouth should have a mean bankfull depth of 0.59 m, a bankfull width of 7.42 m, and a bankfull cross-sectional area of approximately 4.46 m^2. Because no historical gauge data exist, a statistical interpretation of hydrological events will be provided based upon Goose Creek gauge data. The predicted period of record average discharge at this location is 0.087 m^3/s. The predicted low discharge occurs during the fall quarter with an average discharge of 0.035 m^3/s. The average predicted spring discharge is 0.189 m^3/s, while winter base discharge was predicted to average 0.063 m^3/s. The average summer discharge was estimated at 0.061m^3/s.

Physical Characteristics

The §303(d) listed segment of Cold Creek encompasses the entire length of the creek. This creek is 13.49 km long. The valley through which this segment flows is approximately 12.04 km in length. Over the entire listed segment, the creek has a moderately steep slope of 5.88 percent. This slope corresponds to a 58.76 m fall per kilometer. Streams with slopes of this magnitude are usually not sinuous and are erosional by nature. Sinuosity is low (1.1) for the entire stream. Floodplain materials are composed of coarse textured sands and gravel derived from colluvium and glacial till. Consequently, it would be expected that the percent fines of Cold Creek would be very low in comparison to a channel with much lower slopes, higher sinuosity, and finer floodplain materials such as Goose Creek. Bankfull measurements near the mouth indicate that Cold Creek does not fall within the normal expected parameters of a stream within its watershed size. Most likely, this is the result of incisement from past erosional events and the arid nature of the Goose Creek Subbasin. The mean bankfull depth was 0.33 m, mean bankfull width was 3.34 m, and bankfull area was 1.09 m^2.

Hydrology

Due to the lack of historical data, the natural hydrology of Cold Creek cannot be described with USGS gauge data. However, because some flow data available (collected by DEQ staff [DEQ 2001b]) correspond with data collected concurrently in Goose Creek, a statistical relationship can be developed. Several assumptions must be made in order to develop this relationship. DEQ assumes that the amount of precipitation and resulting runoff is similar between basins and has been similar throughout the period of record for both the Cold Creek Watershed and Goose Creek gauged watershed. As Cold Creek is in the same general area of the Goose Creek gauged watershed this assumption should be met due to their proximity. A second assumption is that a similar amount of development has occurred in the Cold Creek drainage as in the Goose Creek drainage. As development increases, so do impervious surfaces which could change the rate of discharge in a system following a precipitation event. In general, the development in the Goose Creek Subbasin has occurred in the lower portion of the subbasin and not in the different watersheds, so DEQ is confidant that this assumption can also be safely made. Consequently, linear regression was performed on the partial year data collected in Cold Creek and the data from the Goose Creek gauge. The regression was highly significant ($p = 0.000$), and the model (Figure 25) was able to describe 91.4 percent of the variation between the Cold Creek discharge and the discharge at Goose Creek.

Therefore, DEQ will use the model to describe the annual hydrograph for Cold Creek (Figure 26).

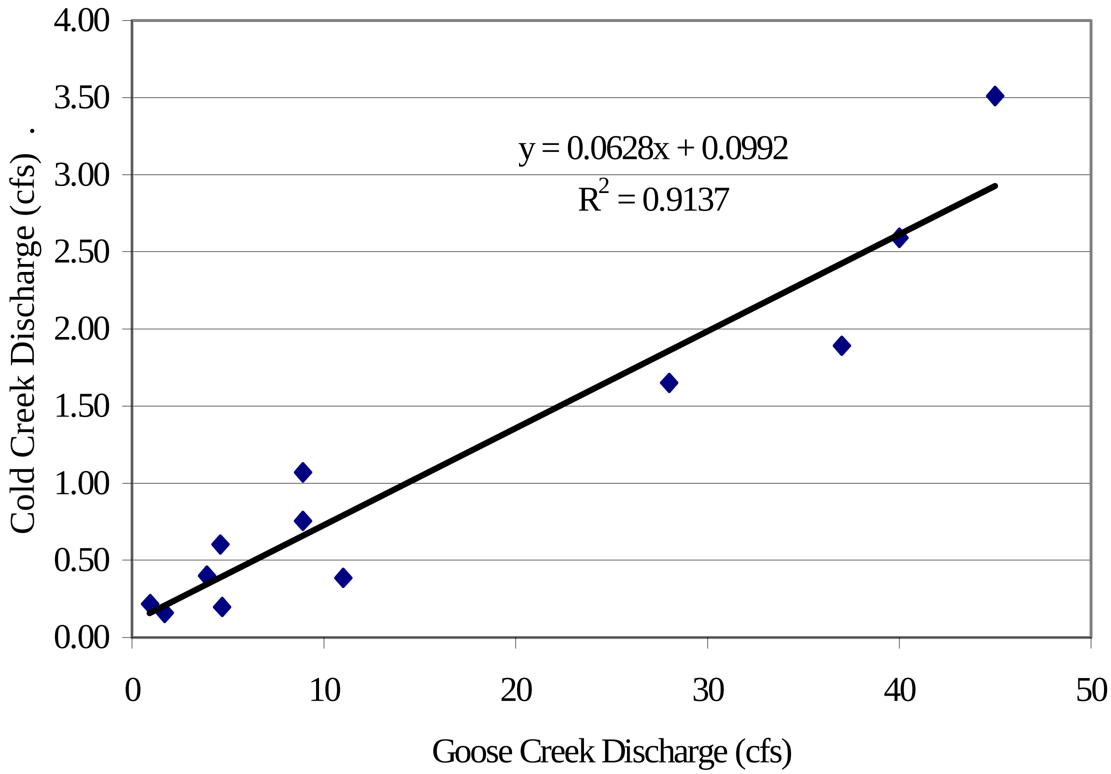


Figure 25. Linear regression model used to predict Cold Creek discharge.

The average annual hydrograph for Cold Creek was based upon the above model and the Goose Creek period of record discharge from the USGS gauge and is shown in the following figure (Figure 26). As can be see by the predicted hydrograph, Cold Creek has the potential to go dry during the summer. Indeed, this has been the case at least once in the past five years.

Fisheries

Idaho Department of Fish and Game stocking records indicate that trout have not been stocked in Cold Creek since 1967. Therefore, DEQ assumes that any salmonids captured in Cold Creek are from wild or naturalized populations. The naturalized populations may be from rogue stockings that have occurred throughout the west or from fish that have moved upstream from Goose Creek. The IDFG has surveyed the fishery in Cold Creek twice, one in 1987 and again in 1994. In 1987, it was determined that a wild population of cutthroat trout existed in the system (Grunder et al. 1989). The purity of these fish, however, was questioned as some hybridization may have occurred with rainbows from Goose Creek.

Additionally, spawning areas were assessed as marginal due to encroachment of fine sediment (Grunder et al. 1989). Other factors discussed as limiting salmonid production included loss of riparian vegetation from road building activities, grazing, flooding, and habitat changes due to fire.

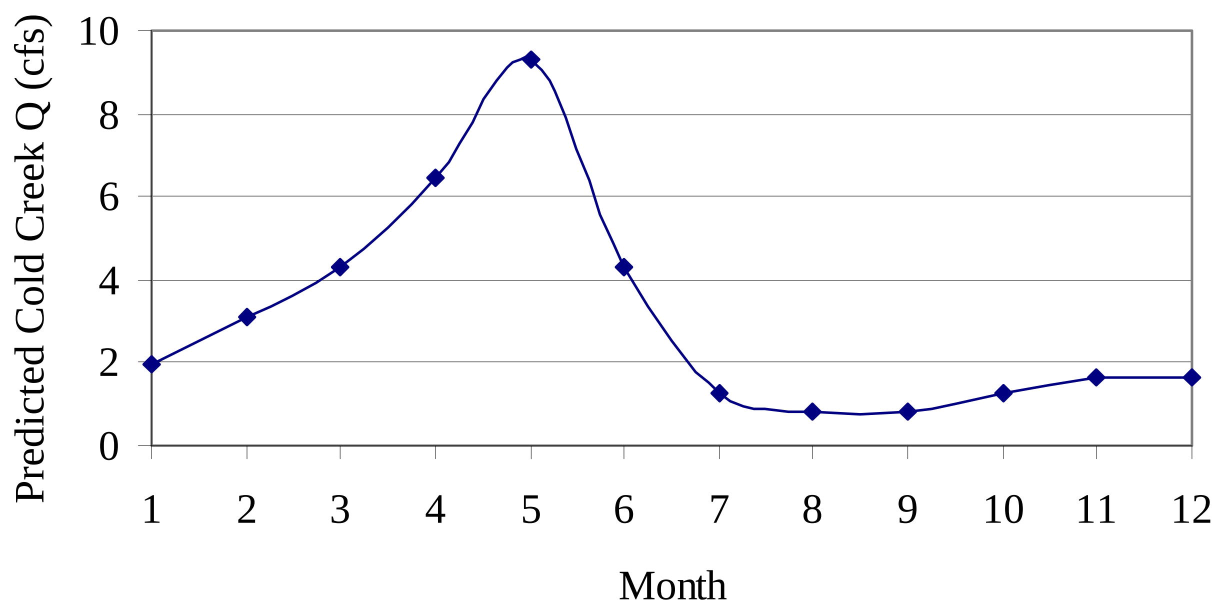


Figure 26. Predicted annual average hydrograph for Cold Creek.

In 1994, IDFG returned to Cold Creek with the BLM to gather base line information for future BLM projects (Partridge and Warren 1995). Sampling was conducted approximately 1 km downstream from the 1987 location. In 1994, brook trout were the only salmonids captured. At least three size classes (age classes) of brook trout were captured indicating some recruitment was occurring.

DEQ has electrofished Cold Creek three times (four locations) in the past (1997 and 1999). The first of these was in 1997, near the bottom of the creek, several hundred yards up from Goose Creek Road. At that time, DEQ collected five brook trout, one rainbow trout, and one cutthroat trout. DEQ returned in June 1999 near the same location. At that time 17 rainbow trout were collected, 15 of which were smaller than 150 mm stocked size. This may indicate that rainbow trout have naturalized in Cold Creek. Later that summer a controlled burn escaped control and swept through the Cold Creek area. DEQ returned (September 1999) to investigate the effects of the fire on water quality and the aquatic biota.

Two locations were electrofished following the burn, one in the burned area near the June sampling site and another upstream of the burned area. Three rainbow trout were collected from the burned area; two of these fish were smaller than the 150 mm. At the upper location, 36 rainbow trout were collected; 28 of these were identified as young-of-year. In addition, 13 brook trout were collected; five of these were identified as young-of-year. In the short term, it appears that the fish had moved out of or were killed in the burned area as the densities were different between the two collection dates and between the two locations. However, in the long term, the upstream population will serve as replacement stock as the area recovers from the fire.

DEQ concludes that there appears to be self-sustaining populations of salmonids in Cold Creek. Over time, the populations have shifted from cutthroat to rainbow trout. It is unknown if water quality has played a role in this shift.

Macroinvertebrates

DEQ collected macroinvertebrates in Cold Creek six times. Macroinvertebrates were collected in two general locations, lower Cold Creek just above Goose Creek Road and upper Cold Creek near the forks. The macroinvertebrate communities at both locations are indicative of moderate water quality. Under the 1996 WBAG, the macroinvertebrate index at both locations averaged less than the 3.5 score needed to ascertain full support (average 3.37 and 3.43). The SMI scores for these same locations were highly variable. At the lower location, SMI scores ranged from approximately 17 to 61 (Scores greater than 41 indicate "passing" values for the northern Basin and range ecoregion). In the upper reaches the community was just as variable, with SMI scores ranging from 29 to 71. This indicates that some disturbances are occurring that are of a magnitude to impair beneficial uses. However, because EPA added Cold Creek to the §303(d) list in 1992, the few good scores are not enough to remove the creek from the §303(d) list coupled with a few poor scores. In order to determine the beneficial use status other data sets must be analyzed. The fish data sets indicate that the water quality in the creek is not impaired. However, the shifts from cutthroat to rainbow trout coupled with the highly variable macroinvertebrate community indices lend support to the assertion that water quality is degraded. Although the fish community shift could be the result of several factor not associated with water quality. These include but are not limited to: a competitive advantage for rainbow and brook trout over cutthroat trout; the removal of cutthroat trout from the system by drought while only rainbow and brook trout were available from colonizing populations and stockings. The fish data do not provide a clear linkage with the macroinvertebrate data to beneficial use impairment.

Aquatic Vegetation

The presence of aquatic vegetation was noted in many reaches of the lower segment of Cold Creek. However, these aquatic plant communities were not excessively abundant. In most cases, the community consisted of periphyton with some long filamentous organisms present. A chlorophyll *a* sample was collected during the peak of the summer growing period to determine if nuisance conditions existed. The sample collected was well below (10 mg/m^2) the 200 mg/m^2 value suggested (see section 2.2) to indicate nuisance aquatic vegetation growths. This value indicates that the degradation to the beneficial uses is from some source other than nuisance aquatic growths. As such, it is unlikely that excessive nutrients are the factor effecting the beneficial uses of Cold Creek.

Cold Creek Existing Water Quality Data

The quantity of water quality samples collected by entities other than DEQ within Cold Creek is unknown. The EPA's STORET database contains no samples collected from the creek. Data queries to other agencies have yielded no water chemistry data. Therefore, DEQ data are the only readily available data for Cold Creek.

DEQ sampled in the creek over the course of 2001, and additional samples will be collected throughout various phases as budgets and sampling time frames allow. However, due to the limited number of sampling periods in the original 2001 data set, DEQ's confidence in monthly average concentrations is low. The lack of a robust data set was due to limited budgets and, in part, to a limited time frame for collecting data. In most cases one sample was the most collected in any given month. Infrequently, multiple samples were collected in a month. This sampling design was intended to determine the annual load. However, the annual load estimated by this type of design would overestimate annual load by 25 to 50 percent (Robertson and Richards 2000). To assist in the determination of seasonal components and appropriate critical conditions, the data will be presented as monthly averages in the following tables while, period of record averages are presented in the text and other tables and used for any future load calculations. For those cases when a parameter was below detection limits, half the detection limit was used to calculate the monthly average and was used as part of the period of record average.

One sample location was set up on Cold Creek with sampling beginning in March 2001 (Figure 20). The site was used to determine concentrations and loads for the stream.

Another sampling location in the lowermost portion of the creek was established in June 2001 due to some concerns about the effects of the old burned area on the water chemistry. This location was approximately 1 km downstream from the lower Cold Creek site, on the Double Diamond Ranch. The Double Diamond Ranch location is representative of the creek pre-fire, as the Goose Creek Road acted as a fire break and the riparian zone below the road did not burn. Additionally, significant efforts to improve water quality in Cold Creek on the ranch have occurred (see Appendix B).

The chemical constituents at both sites seemed to be very similar throughout the sampling period. In order to determine if this was the case, a two-sample t-test was conducted to test the null hypothesis.

H_o: Cold Creek Lower Mean = Cold Creek Upper Mean.
H_a: Cold Creek Lower Mean $\neq$ Cold Creek Upper Mean.

Each constituent sampled at the two locations was tested using Systat 7.0. For most constituents the null hypothesis was not rejected ($p > 0.05$). However, bacteria colonies were significantly different from upstream to downstream ($p = 0.033$). Therefore, for bacteria the null hypothesis was rejected. The change in bacteria is likely due to a one time event of several head of cattle escaping from adjacent pastures and were in the riparian buffer established by the ranch for a few days. Fecal material remained in the creek channel and contributed to the higher counts. This elevated the bacteria counts at the lower site for several sampling events. In addition, cattle from other operations frequented the area between Goose Creek Road and the Double Diamond Ranch throughout the summer. The statistical analysis indicates that the remainder of the data from the two locations can be pooled together for analysis.

The levels of the measured constituents (Table 18) in Cold Creek are much lower in comparison to levels measured at other locations within the subbasin (Goose Creek, Trapper Creek, and Birch Creek). These levels in most all cases indicate lower use and lower degradation. For example, TSS averaged 12 mg/L (standard deviation 19 mg/L), which is similar to the Goose Creek sites (11 mg/L average and 17 mg/L standard deviation.). The Cold Creek samples were taken the same day as the Goose Creek samples and include the critical periods of springtime high flows and summertime low flows. On the other hand, TP differed dramatically between creeks. At Cold Creek the average TP concentration was 0.037 mg/L (standard deviation 0.035 mg/L), while at the Goose Creek sites the average TP concentration was 0.096 mg/L. The minimum measured TP concentration at Cold Creek was 0.007 mg/L in September and the maximum was 0.139 mg/L during the middle of April. Neither TP nor TSS showed large fluctuations through the year. Both constituents remain relatively constant as seen in the small standard deviations.

Monthly concentrations of TP were never indicative of excess nutrients that may cause impairment (nuisance aquatic vegetation). The guidelines that DEQ has used in the past are not to exceed 0.160 mg/L TP in any single sample, 0.100 mg/L TP in any average monthly sample, and 0.100 mg/L TP as a annual weighted average. These guidelines were never exceeded.

Bacteria concentrations were elevated (371 col/100 ml) as an annual weighted average at the lower location, while at the upper location it averaged 29 col/100 ml. Bacteria levels increased following the escape of some of the Double Diamond Ranch cattle and fell appreciably after their capture. Bacteria at the lower site, however, was always slightly higher (25 col/100 ml on average) than the upper location. This may be due, in part, to the occasional presence of cattle between the two sample locations. However, it should be noted that at neither location did water quality standards violations occur based on the geometric mean standard (126 col/100 ml).

From the 2001 data set, TSS also appears to be a non-factor effecting beneficial uses. However, 2001 was a drought year in which water levels were diminished. Consequently, much of the sediment stored in the system was never transported out of the reach as a suspended load. In a higher water year, the data from the suspended fraction may support the contention that a sediment TMDL is required. However, DEQ is constrained by the legal system to complete a TMDL for Cold Creek with the data at hand.

Table 18. Measured water quality constituents in Cold Creek.

Month	No of Samples	TSS (mg/L)[a]	Total NH_3 as N (mg/L)[b]	Total NO_2 + NO_3 (mg/L) as N[c]	Total P (mg/L)[d]	Temp (°C)	Dissolved Oxygen (mg/L)[e]	Bacteria *E. coli* (Col/100 ml)[f]	
								Low	up
January	0								
February	0								
March	1	14	0.011	<0.005*	0.042	8.20	9.66	NA	2
April	1	82	0.022	0.143	0.139	6.89	11.12	NA	11
May	2	25	0.01	0.005	0.054	11.34	9.92	NA	29
June	6	15	0.008	0.005	0.044	15.34	8.79	55	68
July	4	10	0.010	<0.005*	0.045	22.14***	8.04	97	29
August	2	<1*	<0.005*	0.007	0.023	17.12	9.08	118 5	15
September	4	<1*	0.008	<0.005*	0.010	14.04	8.45	469	18
October	2	1	0.018	0.005	0.008	6.22	10.90	47	3
November	0								
December	0								
Annual Average		12	0.010	0.011	0.037	14.60	9.10	371	29
Standard Deviation		19	0.007	0.030	0.035	5.87	1.25	543	34

a Total suspended solids in milligrams per liter, TSS detection limit = 1 mg/L.
b Total ammonia as nitrogen in milligrams per liter.
c Nitrite plus nitrate in milligrams per liter, as nitrogen. NO_2+NO_3 detection limit = 0.005mg/L.
d Total phosphorus in milligrams per liter.
e milligrams per liter.
f colonies per 100 milliliters.

Due to DEQ's limited sampling for suspended sediment in the Cold Creek system, additional measures were taken to determine if other forms of sediment were impairing the beneficial uses. From DEQ's sampling regime, it was determined that the suspended fraction of the sediment load was not impairing the uses. Therefore, a series of Wolman pebble counts were conducted in the lower section of the stream. These Wolman pebble counts were conducted to determine if bedload sediment was impairing beneficial uses. Following the BURP protocols, Wolman pebble counts were conducted in riffles in a 3-km reach of Cold Creek. Counts were conducted from bankfull edge to bankfull edge until at least 50 measurements were taken. Following this the crew traveled upstream approximately 100 m to another riffle. This was repeated until the crew had collected 30 series of Wolman pebble counts (approximately 3.25 km of the creek). A similar system (one where the beneficial uses have been documented as being fully supported) was chosen from the general area of the §303(d) listed water body for comparison with Cold Creek. In this case the upper segment of Trapper Creek was chosen. The upper segment of Trapper Creek was determined to be fully supporting its beneficial uses (see the 1998 §303(d) list chapter 2.5). Wolman pebble counts from 30 transects were used to determine the surface fines (DEQ-TFRO's surrogate for bedload) of the upper segment of Trapper Creek. Data concerning the stored fraction of sediment and/or the bedload (surface fines) was collected in the lower segment of Cold Creek during the summer of 2001. The percent surface fines for the lower section of Cold Creek from the Goose Creek Road upstream was 13.67 percent (fines are particles < 6 mm in median length). Percent fines in the fully supported Trapper Creek segment were 8.0 percent.

To determine if the percent surface fines between the two streams were significantly different, a Chi-squared analysis was completed on the proportions of each size class. The Chi-squared analysis was used to test the following hypothesis:

H_o: Cold Creek proportions = Trapper Creek upper proportions.
H_a: Cold Creek proportions ≠ Trapper Creek upper proportions.

The test indicated that the percent surface fines between the fully supported segment and lower Cold Creek were not significantly different ($p > 0.25$). As a result of the similarity between the percent fines of the two streams, DEQ has determined that sediment as measured by the percent bedload surrogate is not impairing Cold Creek and that the suspended load is also not impairing the beneficial uses. Samples collected in other fully supported streams indicate that percent fines within the wetted width should be 25 percent or less (Lay 2000). Since the percent fines for the lower segment of Cold Creek were 13.67 percent, it appears that bedload is not impairing the beneficial uses of Cold Creek and that a TMDL for bedload is not required.

Dissolved oxygen was also monitored throughout 2001. At no time did DO fall below state water quality standards. Dissolved oxygen is often used in conjunction with pH to determine if excess nutrients have caused nuisance aquatic growths. DEQ determined that excess aquatic growths did not occur in Cold Creek during the 2001 sampling period. The DO and pH data support this contention. Therefore, DEQ finds that Cold Creek is not polluted with oxygen demanding materials.

Instantaneous temperature measurements were also collected in Cold Creek. Temperature exceedances did not occur at the lower Cold Creek location. However, in the upper burned area, several temperature exceedances occurred (22.83 °C and 25.64 °C). Instantaneous temperatures at the lower location were measured shortly after or before measurements at the upper location were taken. On those days in which temperatures exceeded water quality standards at the upper location, they did not at the lower location just 1 km downstream. This 1 km is heavily shaded. Through this riparian area, stream temperatures typically drop an average of 3.05 °C. Shade may decrease the temperature fluctuations in the reach, but ground water influx is the likely reason temperatures are lower in the lower section. Specific conductivity and total dissolved solids (TDS) are higher at the lower location. Both of these factors increase with the presence of ground water. Additionally, when the upper location is near 15 °C (typical ground water temperature) the temperature differences between the two locations is the smallest (0.78 °C). Thus it appears that the segment below Goose Creek Road is a gaining reach, and ground water protects the lower segment from the effects of shade loss in the upper segments due to the fire and past management activities. Potentially this area could serve as a temperature refugia for the local salmonids in the hotter months of the year.

The upstream location does exceed temperature standards and does not appear to have the buffering of cold ground water. Consequently, it must rely on shading to provide temperature relief. Until sufficient shade is fully is restored, Cold Creek will likely continue to exceed state water temperature standards. Therefore, a temperature TMDL will be required to set load allocations for the different landowners/land uses in the watershed.

Point and Nonpoint Sources

Cold Creek is one of three §303(d)-listed streams that flow through fifth field HUC 1704021106. In order to determine what point and nonpoint sources contribute to Cold Creek, a 1.6 km (1 mile) buffer on each side of the stream was calculated from GIS coverages. The land uses within this critical zone are considered to contribute to the specific water body if more than one water body exists within a watershed or if the water body is not the pour point of the watershed. The land uses (from GIS) critical area buffer are 75.3 percent forest, 22.5 percent rangeland, and 2.2 is urban. Most nonpoint source pollution in the watershed comes from activities associated with these land uses. Rangeland activities predominate both the forest and rangeland areas. Additional sediment sources include unstable banks and reentrainment from the streambed itself. However, quantification of these sources has not been completed. As of yet, no CAFOs or other point sources are known to exist within the watershed.

Conclusions

It appears from the data that suspended sediment, bedload sediment, DO, and nutrients are within the bounds of water quality determined to be supportive of the designated beneficial uses. Consequently, DEQ will not complete a sediment, DO, or nutrient TMDL on Cold Creek. However, DEQ will complete a TMDL for temperature.

Blue Hill Creek

Blue Hill Creek begins in the south central mountains of Idaho in an area called Middle Mountain and flows 9.93 km to the confluence with Goose Creek. Along this course, no perennial tributaries enter the system, although approximately four intermittent or ephemeral systems do. The USGS has not had a gauge located in Blue Hill Creek in Idaho. The Blue Hill Creek Watershed is an area of approximately 63.07 km^2. Given this size watershed, channel characteristics were extrapolated from regional curves. These regional curves are in *Applied River Morphology* (Rosgen 1996). Extrapolating from the regional curve, Blue Hill Creek near the mouth should have a mean bankfull depth of 0.66 m, a bankfull width of 9.70 m, and a bankfull cross-sectional area of approximately 6.78 m^2. Because no historical gauge data exist, a statistical interpretation of hydrological events will be provided based upon Goose Creek gauge data. The predicted period of record average discharge at this location was 0.009 m^3/s. The predicted low discharge occurs during the fall quarter with an average discharge of 0.005 m^3/s predicted. Spring discharge was predicted at 0.017 m^3/s, while winter base discharge was predicted at 0.007 m^3/s. Summer discharge was also estimated at 0.007 m^3/s.

Physical Characteristics

The entire length of Blue Hill Creek is §303(d) listed. This creek is 9.93 km long. The valley through which the creek flows is approximately 8.93 km in length. The creek has a moderately steep slope of 6.57 percent. This slope corresponds to a 65.67 m fall per kilometer. Streams with slopes of this magnitude are usually not sinuous and are by nature erosional. Sinuosity is low (1.1) for the entire stream. Floodplain materials are composed of coarse textured sands and gravel derived from colluvium and glacial till. Consequently, it would be expected that the percent fines of Blue Hill Creek would be very low in comparison to a channel with much lower slopes, higher sinuosity, and finer floodplain materials such as Goose Creek. Percent fines in Blue Hill Creek should be similar to those in Cold Creek. Bankfull measurements near the mouth indicate that Blue Hill Creek also does not fall within the normal expected parameters of a stream within its watershed size if calculated using the regional curves found in Rosgen (1996). However, it has been within the same percentage difference as other streams in this arid watershed. The mean bankfull depth was 0.283 m, mean bankfull width was 1.58 m, and bankfull area was 0.45 m^2.

Hydrology

Due to the lack of historical data, the natural hydrology of Blue Hill Creek cannot be described with USGS gauge data. However, because some flow data available (collected by DEQ in 2001) correspond with data collected concurrently in Goose Creek, a statistical relationship can be developed. Several assumptions must be made in order to develop this relationship. DEQ assumes that the amount of precipitation and resulting runoff is similar between basins and has been similar throughout the period of record for both the Blue Hill Creek Watershed and Goose Creek gauged watershed. As Blue Hill Creek is in the same general area of the Goose Creek gauged watershed this assumption should be met due to their proximity. A second assumption is that a similar amount of development has occurred in the Blue Hill Creek drainage as in the Goose Creek drainages. As development increases, so do impervious surfaces which could change the rate of discharge in a system following a precipitation event. In general, the development in the Goose Creek Subbasin has occurred in the lower portion of the subbasin and not in the different watersheds, so DEQ is confidant that this assumption can also be safely made. Consequently, linear regression was performed on the data collected in Blue Hill Creek and the data from the Goose Creek gauge. The regression was significant ($p = 0.033$), and the model (Figure 27) was able to describe 82.1

percent of the variation between the Blue Hill Creek discharge and the discharge at Goose Creek. Therefore, DEQ will use the model to describe the annual hydrograph for Blue Hill Creek.

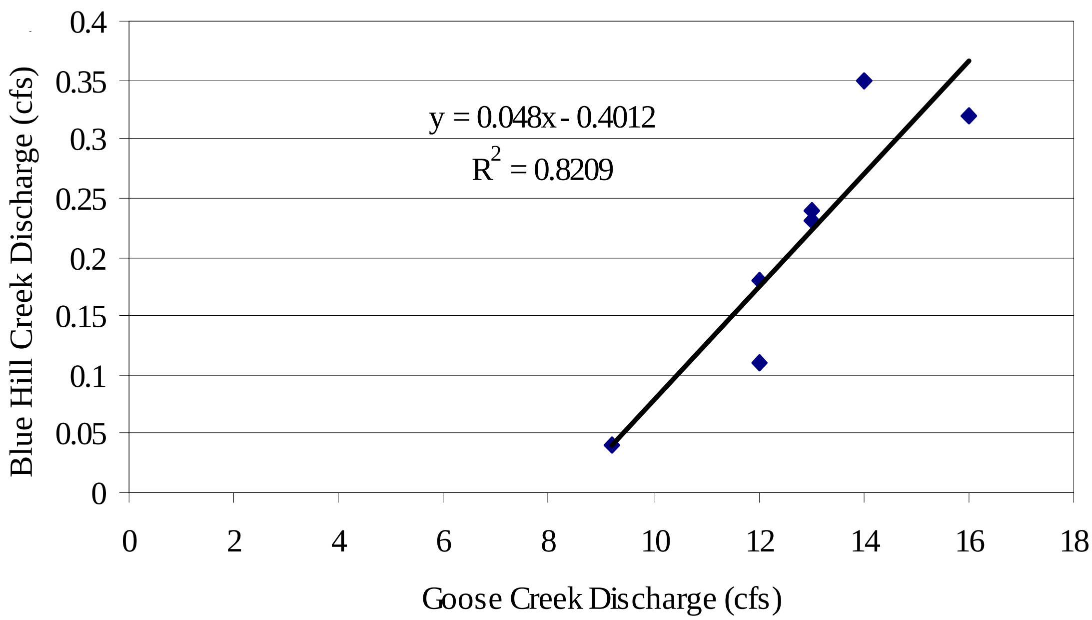


Figure 27. Linear regression model used to predict Blue Hill Creek discharge.

The average annual hydrograph for Blue Hill Creek was based upon the above model and the Goose Creek period of record discharge from the USGS gauge and is shown in Figure 28.

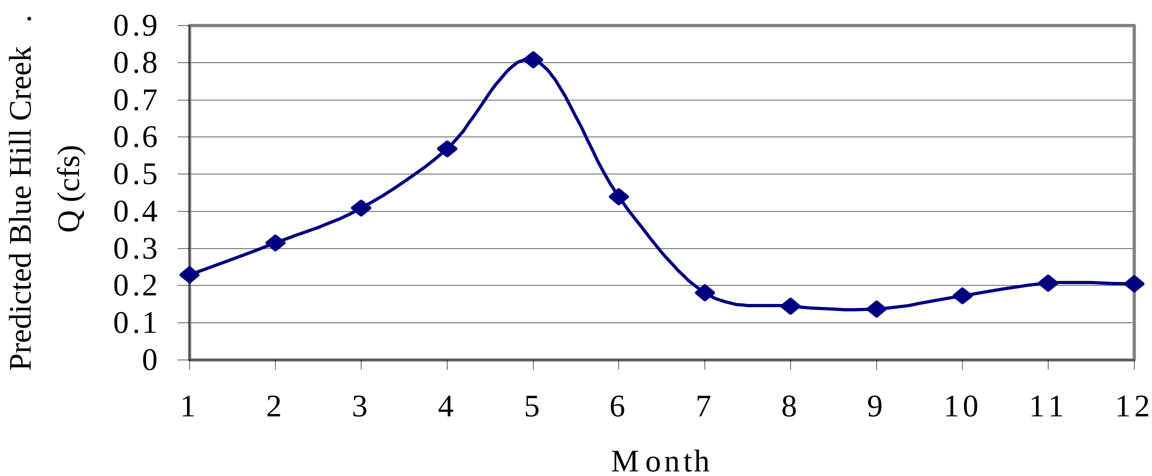


Figure 28. Predicted annual average hydrograph for Blue Hill Creek.

As seen in Figure 28, Blue Hill Creek never discharges more that 1 cubic feet per second (cfs) (monthly average) and is near 0.2 cfs discharge for much of the summer and winter. Hydrologically, this means that Blue Hill Creek is likely an intermittent stream in all but the wettest of years. In normal water years Blue Hill Creek is likely to experience periods of zero discharge throughout the summer. In dry years, this intermittence could extend from the late spring throughout much of the winter.

Fisheries

Idaho Department of Fish and Game stocking records indicate that trout have not been stocked into Blue Hill Creek. Therefore, DEQ assumes that any salmonids captured in Blue Hill Creek are from wild or naturalized populations. The naturalized populations may be from rogue stockings that have occurred throughout the west or from fish that have moved upstream from Goose Creek. The IDFG surveyed the fishery in Blue Hill Creek in 1987. The site IDFG sampled was near the middle of the creek. In 1987 it was determined that a wild population of brook trout existed in the system (Grunder et al. 1989). Additionally, spawning areas were assessed as good, reproductive success was excellent, and sedimentation was minimal (Grunder et al. 1989). No other factors were discussed that could limit salmonid production. The IDFG sampled a very small section of Blue Hill Creek (21 m). In that reach, they captured 81 brook trout (presumably of various age and size classes). Of the creeks discussed so far in this SBA Blue Hill Creek has the highest density of trout.

DEQ electrofished Blue Hill Creek in 1997, near the bottom of the creek, several hundred yards up from Goose Creek Road. At that time, DEQ did not collect any fish. However, one small fish was seen during the electrofishing effort.

DEQ concludes that there may be self-sustaining populations of salmonids in the middle reaches of Blue Hill Creek during wet years. However, Blue Hill Creek is intermittent and, in drought years, will likely not support a fishery. DEQ site visits throughout the summers of 2001, 2002, and 2003 confirm the intermittent status of the creek for approximately 5-7 creek kilometers upstream from the Goose Creek Road. Several small seeps or springs do occur in the lower segments and provide some water to the lower segment early in the summer. These seeps and springs dry as the summer progresses until later in the summer when they simply become damp areas within the creek channel (DEQ 2001b, DEQ 2002, and DEQ 2003). Further investigations are required as to the extent of the intermittent area of the creek.

Macroinvertebrates

DEQ has collected macroinvertebrates five times in Blue Hill Creek. Macroinvertebrates were collected in two general locations, lower Blue Hill Creek just above Goose Creek Road and upper Blue Hill Creek near the upper Cold Creek road. The macroinvertebrate communities at both locations are indicative of moderate to poor water quality. The average condition rating, using the SMI, for Blue Hill Creek is 0.75. Four of the five scores were below the minimum threshold. Under the1996 WBAG, the macroinvertebrate index at both locations averaged less than the 3.5 score needed to ascertain full support (3.27 and 3.18). The SMI indicates that disturbances are common and are of a magnitude to impair beneficial uses. However, the poor scores are likely the result of Blue Hill Creek's intermittent nature and not water quality degradation due to a specific pollutant.

Although it is likely that the low SMI scores are the result of persistent low water and the intermittent nature of Blue Hill Creek, the presence of multiple age classes of brook trout indicates that some perennial water exists. However, the macroinvertebrate community does not support the hypothesis that some perennial waters exist within the watershed. The SMI scores are typical of what would be expected in a stream that goes dry completely year in and year out.

Aquatic Vegetation

The presence of aquatic vegetation was noted in the lower segment of Blue Hill Creek. However, these aquatic plant communities were not excessively abundant. In most cases, the community consisted of periphyton with no long filamentous organisms present. A chlorophyll *a* sample could not be collected during the peak of the summer growing period because the creek went dry. As such, it is unlikely that excessive nutrients are the factor effecting the beneficial uses of Blue Hill Creek.

Blue Hill Creek Existing Water Quality Data

Water quality samples containing a full suite of constituents collected within the listed segment of the Blue Hill Creek are rare. No results for Blue Hill Creek could be found in the STORET database.

DEQ sampled in the creek over the course of 2001, and additional samples will be collected throughout the various phases of the TMDL process as budgets and sampling time frames allow. However, due to the limited number of sampling periods in the original 2001 data set, DEQ's confidence in the monthly average concentrations is low. The lack of a robust data set was due to limited budgets and, in part, to a limited time frame for collecting data. In most cases one sample was the most collected in any given month. Infrequently, multiple samples were collected in a month. This sampling design was intended to determine annual pollutant loads . However, the annual load estimated by this type of design would overestimate annual load by 25 to 50 percent (Robertson and Richards 2000). To assist in the determination of seasonal components and appropriate critical conditions, the data will be presented as monthly averages in the following tables while period of record averages are presented in the text and other tables and used for any future load calculations. For those cases when a parameter was below detection limits, half the detection limit was used to calculate the monthly average and was used as part of the period of record average.

One sample location was set up in Blue Hill Creek with sampling beginning in March 2001 (Figure 20). The site was used to determine pollutant concentrations and loads for the stream. An alternative site was planned in 2002 in the upstream segment of the stream. However, the upper location also went dry as the summer progressed. Therefore, the lower, more complete data set, was used to assess the stream and to determine the pollutant concentrations and loads due to activities along the reach.

At the lower sampling location, the measured constituents (Table 19) are at or near reference conditions. For example, TSS in Blue Hill Creek averages 5 mg/L (standard deviation 6 mg/L). Total phosphorus was very low as well. At Blue Hill Creek the average TP concentration was 0.028 mg/L (standard deviation 0.027 mg/L), in comparison with the Goose Creek sites, which averaged 0.096 mg/L. The minimum measured TP concentration at Blue Hill Creek was 0.011 mg/L in early June and the maximum was 0.287 mg/L during the middle of March. All samples include the critical periods of springtime high flows and summertime low flows.

Monthly concentrations of TP were not indicative of excess nutrients that may cause impairment (nuisance aquatic vegetation). The guidelines that DEQ has used in the past are no more than 0.160 mg/L TP in any single sample, 0.100mg/L TP in any average monthly sample, and 0.100 mg/L TP period of record average. The guidelines were never exceeded in Blue Hill Creek (Table 19).

Bacteria concentrations were also near reference conditions (0-1 col/100 ml) as an annual average. Only two samples were collected with bacteria concentrations greater than zero. Each sample contained 1 col./ 100 ml.

From the 2001 data set, TSS also appears to be a non-factor effecting beneficial uses. However, 2001 was a drought year in which water levels were diminished. Consequently, much of the sediment stored in the system was never transported out of the reach as a suspended load. In a higher water year, the data from the suspended fraction may support the contention that a sediment TMDL is required. However, DEQ is constrained by the legal system to complete a TMDL for Blue Hill Creek with the data at hand.

Dissolved oxygen was also monitored throughout 2001. At no time did DO fall below state water quality standards. Dissolved oxygen is often used in conjunction with pH to determine if excess nutrients have caused nuisance aquatic growths. DEQ determined that excess aquatic growths had not occurred in Blue Hill Creek during the 2001 sampling period. The DO and pH data support this contention. Therefore, DEQ finds that Blue Hill Creek is not polluted with oxygen demanding materials.

Instantaneous temperature measurements were also collected in Blue Hill Creek. Temperature exceedances did not occur in Blue Hill Creek. This was even true while the creek was drying up. For the month of June, while flows were diminishing rapidly, temperatures would be expected to exceed state standards (22 °C). In Blue Hill Creek during the month of June, the maximum instantaneous temperature measured was 20.46 °C. Subsequent samples during the month were much lower.

Table 19. Measured water quality constituents in Blue Hill Creek.

Month	No of Samples	TSS (mg/L)[a]	Total NH_3 as N (mg/L)[b]	Total NO_2 + NO_3 (mg/L) as N[c]	Total P (mg/L)[d]	Temp (°C)	Dissolved Oxygen (mg/L)[e]	Bacteria *E. coli* (Col/100 ml)[f]
January	0							
February	0							
March	1	3	0.016	0.013	0.032	9.55	10.86	0
April	1	4	0.008	<0.005*	0.020	6.81	10.96	1
May	2	2	0.010	0.005	0.014	11.38	10.45	0
June	3	7	0.013	0.056	0.039	18.60	8.61	0
July	dry							
August	dry							
September	dry							
October	dry							
November	0							
December	0							
Annual Average		5	0.012	0.027	0.028	13.56	9.79	0
Standard Deviation		6	0.009	0.059	0.027	6.15	1.68	0

a Total suspended solids in milligrams per liter, TSS detection limit = 1 mg/L.
b Total ammonia as nitrogen in milligrams per liter.
c Nitrite plus nitrate in milligrams per liter, as nitrogen. NO_2+NO_3 detection limit = 0.005mg/L.
d Total phosphorus in milligrams per liter.
e milligrams per liter.
f colonies per 100 milliliters.

Point and Nonpoint Sources

Blue Hill Creek is one of two §303(d)-listed streams that flow through fifth field HUC 1704021107. In order to determine what point and nonpoint sources contribute to Blue Hill Creek, a 1.6 km (1 mile) buffer on each side of the stream was calculated from GIS coverages. The land use within this critical zone is considered to contribute to the specific water body if more than one water body exists within a watershed or if the water body is not the pour point of the watershed. The land uses (from GIS) in the critical buffer indicate that 68.3 percent forest, 24.9 percent rangeland, and 6.8 percent irrigated pastureland. Most nonpoint source pollution in the watershed comes from activities associated with these land uses. Rangeland activities predominate both the forest and rangeland areas. Additional sediment sources include unstable banks and reentrainment from the streambed itself. However, quantification of these sources has not been completed. As of yet, no CAFOs or other point sources are known to exist within the watershed.

Conclusions

It appears from the data that suspended sediment, DO, nutrients, bacteria, and temperature are within the bounds of water quality determined to be supportive of the designated beneficial uses. However, the macroinvertebrate data indicate that water quality degradations are occurring. These degradations are likely the result of the intermittent nature of Blue Hill Creek. Consequently, DEQ will not complete a suspended sediment, DO, nutrient, bacteria, or temperature TMDL on the creek, while retaining the Blue Hill Creek on the §303(d) list for flow alteration. The creek will likely remain listed in this manner until DEQ and EPA develop guidelines for intermittent streams.

Beaverdam Creek

Beaverdam Creek begins in the south central mountains of Idaho on the western side of the subbasin at the confluence of Left Hand Fork Beaverdam Creek and Right Hand Fork Beaverdam Creek. From this point Beaverdam Creek proper begins and flows 9.3 km to the confluence with Goose Creek. Along this course, no perennial tributaries enter the system (Left Hand Fork Beaverdam Creek and Right Hand Fork Beaverdam Creek join to form Beaverdam Creek; although, Right Hand Fork Beaverdam Creek may be intermittent), but approximately seven intermittent or ephemeral systems do enter the system. The USGS has not had a gauge located on Beaverdam Creek in Idaho. The Beaverdam Creek Watershed is an area of approximately 108.08 km^2. Given this size watershed, channel characteristics were extrapolated from regional curves. These regional curves are in *Applied River Morphology* (Rosgen 1996). Extrapolating from the regional curve, Beaverdam Creek near the mouth should have a mean bankfull depth of 0.73 m, a bankfull width of 12.41 m, and a bankfull cross-sectional area of approximately 9.62 m^2. Because no historical gauge data exist, a statistical interpretation of hydrological events will be provided based upon Goose Creek gauge data. The predicted period of record average discharge at this location is 0.009 m^3/s. The predicted low discharge occurs during the fall quarter with 0.005 m^3/s. Spring discharge was predicted at 0.017 m^3/s, while winter base discharge was predicted at 0.007 m^3/s. Summer discharge was also estimated at 0.007 m^3/s. Critical period flows for nutrients (June through September) averaged 0.010 m^3/s.

Physical Characteristics

The §303(d)-listed segment of Beaverdam Creek begins at the confluence of Left Hand Fork Beaverdam Creek and Right Hand Fork Beaverdam Creek. This segment is 9.3 km long. The valley through which this segment flows is approximately 7.6 km in length. Over the entire listed segment, the creek has a very low slope of 1.065 percent. This slope corresponds to a 10.64 m fall per kilometer. Slopes of this magnitude are usually seen in highly sinuous streams that are by nature depositional. Sinuosity, however, is classified as low (1.2) for the listed segment. This is likely due to the historical and present day incisement of the channel. This incisement has confined the channel to a narrow floodplain, which limits the sinuosity of a system. However, over much of Beaverdam Creek the floodplain has been redeveloped allowing over bankfull floods to deposit sediments and reduce stream energy. This situation suggests that Beaverdam Creek has regained equilibrium with the sediment and water delivery from the watershed. Floodplain materials are composed of fine textured sands and silt derived from alluvium and Miocene lake deposits. Consequently, it would be expected that the percent fines of Beaverdam Creek would be elevated in comparison to a channel with much higher slopes, lower sinuosity, and coarser floodplain materials such as Trapper Creek. The mean bankfull depth was 0.39 m, mean bankfull width was 2.10 m, and bankfull area was 0.82 m^2.

Hydrology

Due to the lack of historical data, the natural hydrology of Beaverdam Creek cannot be described with USGS gauge data. However, because some flow data (collected by DEQ in 2001) correspond with data collected concurrently in Goose Creek, a statistical relationship can be developed. Several assumptions must be made in order to develop this relationship. DEQ assumes that the amount of precipitation and resulting runoff is similar between basins and has been similar throughout the period of record for both the Beaverdam Creek Watershed and Goose Creek gauged watershed. As Beaverdam Creek is in the same general area of the Goose Creek gauged watershed this assumption should be met due to their proximity. A second assumption is that a similar amount of development has occurred in the Beaverdam Creek drainage as in the Goose Creek drainages. As development increases, so do impervious surfaces which could change the rate of discharge in a system following a precipitation event. In general, the development in the Goose Creek Subbasin has occurred in the lower portion of the subbasin and not in the different watersheds, so DEQ is confidant that this assumption can also be safely made. Consequently, linear regression was performed on the data collected in Beaverdam Creek and the data from the Goose Creek gauge. The regression was highly significant ($p = 0.000$), and the model (Figure 29) was able to describe 91.9 percent of the variation between the Beaverdam Creek discharge and the discharge at Goose Creek. Therefore, DEQ will use the model to describe the annual hydrograph for Beaverdam Creek.

The average annual hydrograph for Beaverdam Creek (in cfs) based upon the above model and the Goose Creek period of record discharge (cfs) is shown in Figure 30.

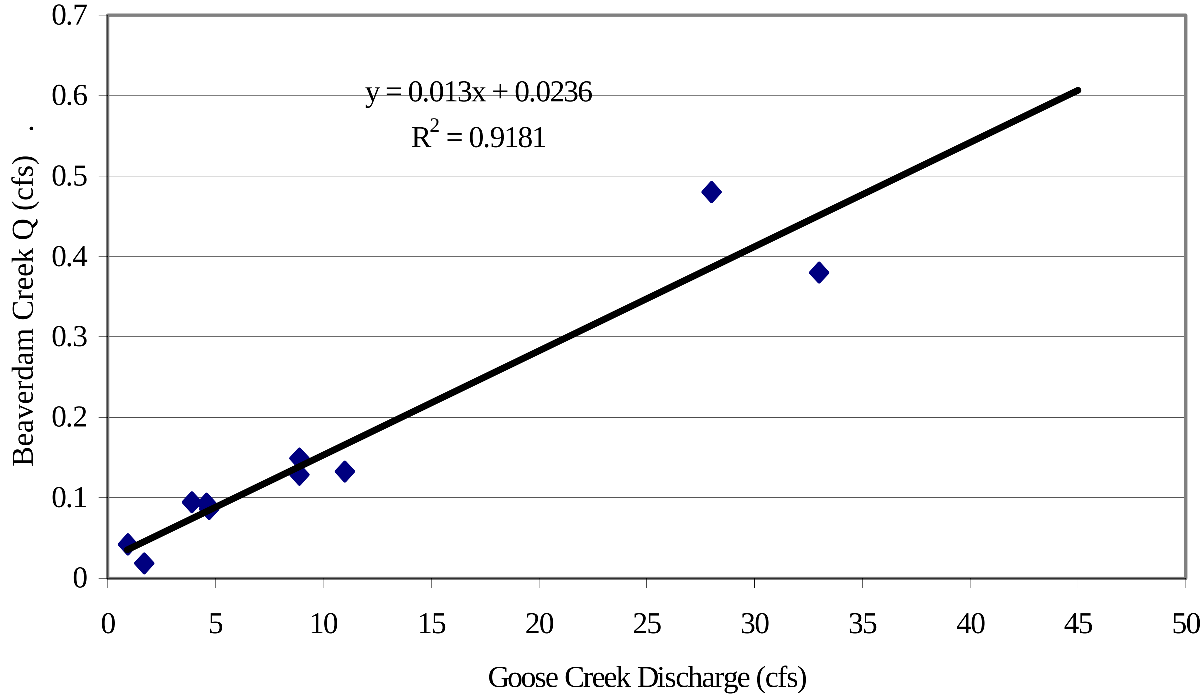


Figure 29. Linear regression model used to predict Beaverdam Creek discharge.

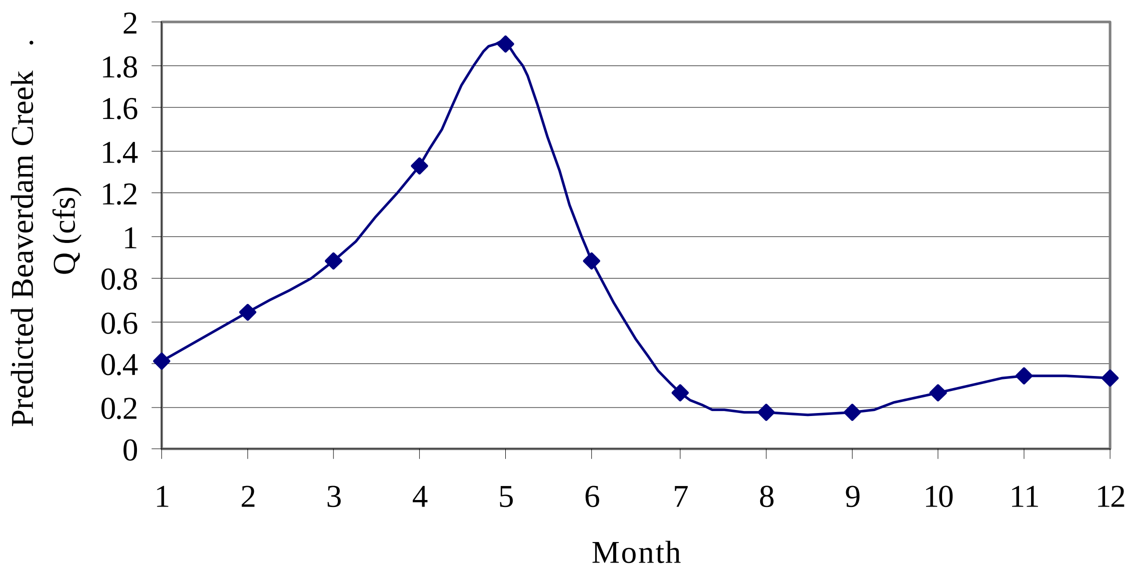


Figure 30. Predicted annual average hydrograph for Beaverdam Creek.

The hydrology of the Beaverdam system, however, is more complex than can be described in a single graph. Beaverdam Creek flows in the upper 3 km because of springs in Left Hand Fork Beaverdam Creek; below this to the Emery Ranch, the stream is dry during most summers. Typically, the stream remains dry until the spring at the old Emery Ranch house. This spring brings water back to the stream for the remainder of the system. However, the spring at the Emery Ranch was not able to provide water to the lower 3-5 km in the summer of 2001, a situation common for dry years. As a result of the above situations, Beaverdam Creek is perennial only in the upper third of the water body and intermittent in the lower two-thirds.

Fisheries

Idaho Department of Fish and Game stocking records indicate that trout have not been stocked in Beaverdam Creek. Therefore, DEQ assumes that any salmonids captured in Beaverdam Creek are from wild or naturalized populations. The naturalized populations may be from rogue stockings that have occurred throughout the west or from fish that have moved upstream from Goose Creek. The IDFG surveyed the fishery in 71 m of Beaverdam Creek in 1987. The site the IDFG sampled was near the bottom of the creek, near the old Emery Ranch. In 1987, no salmonids were captured at the site. However, leatherside chubs, speckled dace, redside shiners, and unknown sucker species were captured. Additionally, bank conditions were assessed as good, although spawning habitat was limited due to sedimentation of the creek bed. Other factors that were discussed that could limit salmonid production included a lack of deep water for cover (Grunder et al. 1989).

DEQ has never electrofished Beaverdam Creek. However, throughout the summer of 2001, several small cutthroat trout were seen in the upper section of Beaverdam Creek by DEQ water quality personnel. Additionally, personal communication with a local landowner indicates that a self-sustaining population of cutthroat trout reside in the lower sections of Left Hand Fork Beaverdam Creek and Beaverdam Creek. Electrofishing efforts should be planned to quantify this population.

DEQ concludes that there may be self-sustaining populations of salmonids in the upper reaches of Beaverdam Creek. The upper reaches may be perennial while the lower reaches below Emery Ranch are likely intermittent and hold only fish that have moved upstream from Goose Creek. Further investigations are required.

Macroinvertebrates

DEQ has collected macroinvertebrates three times in Beaverdam Creek. Macroinvertebrates were collected in two general locations, lower Beaverdam Creek just below the Emery Ranch and upper Beaverdam Creek near the confluence of the forks. The macroinvertebrate communities at the lower location are indicative of poor water quality or intermittence. The SMI scores for this reach were 21.59 and 20.49 (1995 and 1996, respectively). Under WBAG II, the macroinvertebrate index in this reach averaged less than the 2 condition rating score indicative of water quality impacts (average 0). This indicates that major disturbances are common and of a magnitude to impair beneficial uses. However, hydrology information indicates that the lower reach is intermittent. The low scores could be a result of this intermittence. Bank and other habitat scores (from IDFG and DEQ) indicate that the channel is stable and in good condition (Grunder et al. 1989). It is likely that the low SMI scores are the result of persistent low water and the intermittent nature of the lower reach of Beaverdam Creek.

In the upper reach of Beaverdam Creek, above the Emery Ranch, macroinvertebrate community information indicates fully supported beneficial uses. The SMI score, 79.75 (1999), was well above the breakpoint used to determine the condition rating score indicative of full support. In addition, the presence of cutthroat trout cut off from Goose Creek by a section of stream that dries each year indicates that a self-sustaining spawning population exists. This population likely finds refuge from low water in several small ponds and springs located in the lower section of Left Hand Fork Beaverdam Creek.

Aquatic Vegetation

The presence of aquatic vegetation was noted in the upper segment of Beaverdam Creek. However, these aquatic plant communities were not excessively abundant. In most cases, the community consisted of periphyton with no long filamentous organisms present. A chlorophyll *a* sample was collected during the peak of the summer growing period to determine if nuisance conditions existed. The sample collected was well below (12 mg/m^2) the 200 mg/m^2 value suggested (Section 2.2) to indicate nuisance aquatic vegetation growths. This value supports the full support beneficial use assessment based upon the fisheries and macroinvertebrate communities in the upper segment of Beaverdam Creek. As such, it is unlikely that excessive nutrients are the factor effecting the beneficial uses in the upper reach of Beaverdam Creek. Aquatic vegetation was not noted in the lower section of Beaverdam Creek. The lower section was visited in early May. At that time, the channel was clear of any noticeable aquatic vegetation. During subsequent visits in July and August, the creek was dry.

Beaverdam Creek Existing Water Quality Data

Water quality samples containing a full suite of constituents collected within the listed segment of the Beaverdam Creek are rare. No results for Beaverdam Creek could be found in The EPA's STORET database.

DEQ sampled in the creek over the course of 2001, and additional samples will be collected throughout the various phases of the TMDL process as budgets and sampling time frames allow. However, due to the limited number of sampling periods in the original 2001 data set, DEQ's confidence in monthly average concentrations is low. The lack of a robust data set was due to limited budgets and, in part, to a limited time frame for collecting data. In most cases one sample was the most collected in any given month. Infrequently, multiple samples were collected in a month. This sampling design was intended to determine annual pollutant loads . However, the annual load estimated by this type of design would overestimate annual load by 25 to 50 percent (Robertson and Richards 2000). To assist in the determination of seasonal components and appropriate critical conditions, the data will be presented as monthly averages in the following tables while period of record averages are presented in the text and other tables and used for any future load calculations. For those cases when a parameter was below detection limits, half the detection limit was used to calculate the monthly average and was used as part of the period of record average.

One sample location was set up in Beaverdam Creek with sampling beginning in March 2001 (Figure 20). The site was used to determine concentrations and loads for the stream (Table 20). An alternative site in the downstream segment of the stream was sampled occasionally. The upper site will be used to determine the concentrations and loads due to activities along the more perennial reach.

DEQ normally cannot acess the lower portion of the creek on a regular basis. However, one sample was collected in 2001 at a lower sampling location The site was accessed in early May during the end of the runoff period. At that time there was water in the lower section. The measured constituents at that time were well within water quality standards or were near background conditions for the area (see TP discussion for Goose Creek). The lone TSS sample from lower Beaverdam Creek was 3 mg/L. The sample was taken near the peak or during the declining limb of the annual hydrograph (see Figure 30). Total phosphorus was elevated at this time (0.141 mg/L); however, natural deposits of phosphate-rich soils are thought to exist within the watershed. While TP may have been elevated, nitrate and nitrite were near detection limits. Consequently the total nitrogen (TN):TP ratios indicate that the system is nitrogen limited. Concentrations of nitrogen compounds were not indicative of excess nutrients that may cause impairment (nuisance aquatic vegetation). The bacteria concentration at the lower site was also within state water quality standards. Repeat samples for all constituents are needed in the lower segment.

The upper location of Beaverdam Creek was accessible throughout the 2001 monitoring season. Consequently, a fuller data set exists for the upper fully supported reach of the stream. However, the single sample point from the lower site is comparative with the water quality found in the upper site. DEQ therefore believes that the lower site, while not supporting the aquatic life beneficial uses, is impaired by flow alteration (pollution) rather than from a specific pollutant.

Data collected throughout 2001 at the upper location support the aquatic life assessment based on the macroinvertebrates and the potential for a self-sustaining salmonid population throughout most of the year. However, once cattle were shifted into the upper section of the creek, water quality parameters were some of the highest measured in the subbasin. This was likely because water was not available for much of the growing season, which led to poor range conditions. As a result, the cattle congregated near the stream and had a significant impact on water quality. It is unknown if riparian grazing standards and guidelines were exceeded or not.

Table 20. Measured water quality constituents in Beaverdam Creek.

Month	No of Samples	TSS (mg/L)[a]	Total NH_3 as N (mg/L)[b]	Total NO_2 + NO_3 (mg/L) as N[c]	Total P (mg/L)[d]	Temp (°C)	Dissolved Oxygen (mg/L)[e]	Bacteria *E. coli* (Col/100 ml)[f]
January	0							
February	0							
March	0							
April	0							
May	2	7	0.007	<0.005	0.104	15.1	8.71	90
June	3	1	<0.005	<0.005	0.108	13.78	8.56	396
July	2	6	0.015	0.005	0.143	21.75	7.83	335
August	2	24	0.011	<0.005	0.147	19.32	8.62	844
September	2	1,649	0.528	0.033	1.566	14.94	5.75	132,000
October	1	12	0.01	<0.005	0.150	0.16	12.68	5,800
November	0							
December	0							
Annual Average		282	0.095	0.008	0.366	15.62	8.34	18,336
Standard Deviation		817	0.282	0.016	0.698	6.54	1.77	61,629

a Total suspended solids in milligrams per liter, TSS detection limit = 1 mg/L.
b Total ammonia as nitrogen in milligrams per liter.
c Nitrite plus nitrate in milligrams per liter, as nitrogen. NO_2+NO_3 detection limit = 0.005mg/L.
d Total phosphorus in milligrams per liter.
e milligrams per liter.
f colonies per 100 milliliters.

At the upper location, water quality constituents were near background levels measured at other locations throughout the subbasin. For example, prior to August, TSS averaged 4 mg/L, while after August TSS averaged 671 mg/L. Most of the increase is directly attributable to the presence of cattle in and along the stream at the end of August. Other constituents follow the same pattern: low concentrations until the cattle were moved into the area. For example, TP increased from 0.117 mg/L average to 0.715 mg/L average, bacteria from 301 col/100 ml to 45,389 col/100 ml, and ammonia from 0.008mg/L to 0.218 mg/L. In addition, DO fell to 5.28 mg/L during the day while cattle were in the allotment. It is likely that during the night DO fell further below state standards. Furthermore, pH during the period fell to 6.63. Both of these are indicative of large amounts of BOD leading to potential beneficial use impairment by oxygen demanding materials. Again it is unknown if the cattle behavior was anomalous due to the poor range conditions brought about due to the low water year or if this was a normal grazing season. Clearly, the data indicate that the critical period for upper Beaverdam Creek is when the cattle are moved into that section of the allotment.

Instantaneous temperature measurements were collected in upper Beaverdam Creek. Temperature exceedances occurred in Beaverdam Creek periodically. They are likely minimized due to the proximity to the spring sources of the creek. Specific conductivity and TDS are elevated year-round, indicating the predominance of ground water. However, lack of shade in the upper reaches is common, leading to the probability of temperature exceedances on a regular basis during July and August in the lower reaches further from the spring sources. In Beaverdam Creek during the month of July, the maximum instantaneous temperature measured was 22.86 °C. In August, the maximum instantaneous temperature measured was 23.92 °C. Beaverdam Creek has been identified as a stream in need of recording thermographs.

Point and Nonpoint Sources

Beaverdam Creek is one of two water quality limited streams that flow through fifth field HUC 1704021109. In order to determine what point and nonpoint sources contribute to Beaverdam Creek a 1.6 km (1 mile) buffer on each side of the stream was calculated from GIS coverages. The land use within this critical zone is considered to contribute to the specific water body if more than one water body exists within a watershed or if the water body is not the pour point of the watershed. The land uses (from GIS) in the critical buffer indicate that 88.1 percent forest, 11.7 percent irrigated pastureland, and 0.2 percent rangeland. Most nonpoint source pollution in the watershed comes from activities associated with these land uses. Rangeland activities predominate both the forest and rangeland areas. Additional sediment sources include unstable banks and reentrainment from the streambed itself. However, quantification of these sources has not been completed. As of yet, no CAFOs or other point sources are known to exist within the watershed.

Conclusions

In summary, it appears from the data that suspended sediment, DO, nutrients, bacteria, and temperature are at values determined to impair beneficial uses. It is unknown if the concentrations measured during fall 2001 were indicative of water quality during the typical grazing period or if 2001 was abnormal due to the poor water year. Due to limited budgets and court-ordered time frames, DEQ will proceed with TMDL development based upon the data collected to date. Consequently, DEQ will develop TMDLs for suspended sediment, DO, nutrients, bacteria, and temperature for the upper portion of the creek based upon data collected in 2001.

Big Cottonwood Creek

Big Cottonwood Creek begins in the south central mountains of Idaho in an area called the South Hills. The listed section of Big Cottonwood Creek is 21.24 km from Billys Hole

Creek to the mouth. Historically, Big Cottonwood Creek had two channels. One would have flowed to a confluence with Dry Creek and into Murtaugh Lake in HUC 17040212. The other flowed more directly to the Snake River west of Burley (Hedberg 1993). Present day Big Cottonwood Creek discharges to a canal and drain system and is entirely used during the irrigation season. During the nonirrigation season Big Cottonwood Creek drains to this same system and is used for stock water and ground water recharge. In practice, Big Cottonwood Creek no longer exists 13 km downstream of Billys Hole Creek. Therefore, DEQ will assess Big Cottonwood Creek from Billys Hole Creek to the IDFG wildlife management area at the mouth of Big Cottonwood Creek canyon, the beginning of the canal and drain system. The remainder of the system will remain on the §303(d) list for flow alteration. Along the 13 km perennial course, one perennial tributary (Billys Hole Creek) enters the system and approximately 14 intermittent or ephemeral systems do as well. The USGS had a gauge located in Big Cottonwood Creek in Idaho. The Big Cottonwood Creek Watershed is an area of approximately 75 km^2. Given this size watershed, channel characteristics were extrapolated from regional curves. These regional curves are in *Applied River Morphology* (Rosgen 1996). Extrapolating from the regional curve, Big Cottonwood Creek near the mouth should have a mean bankfull depth of 0.70 m, a bankfull width of 11.28 m, and a bankfull cross-sectional area of approximately 8.41 m^2. Historical gauge data exist, from 1909 to 1915. Due to the age of the data, a statistical interpretation of current hydrological events will be provided based upon Trapper Creek gauge data. The predicted period of record average discharge at this location is 0.235 m^3/s. The predicted low discharge occurs during the fall quarter with 0.036 m^3/s. Spring discharge was predicted at 0.823 m^3/s, while winter base discharge was predicted at 0.094 m^3/s. Summer discharge was estimated at 0.361 m^3/s.

Physical Characteristics

The §303(d)-listed segment of Big Cottonwood Creek begins at the confluence of Billys Hole Creek at an elevation of 1,768 m. This segment is 13 km long. The valley through which this segment flows is approximately 11 km in length. Over the entire listed segment, the creek has a low slope of 2.75 percent. This slope corresponds to a 27.46 m fall per kilometer. Slopes of this magnitude are usually seen in moderately to low sinuous streams that are complex depositional and erosional streams. Sinuosity is also classified as low (1.2) for the listed segment. Floodplain materials are composed of coarse textured sands and gravel derived from alluvium and glacial till. Consequently, it would be expected that the percent fines of Big Cottonwood Creek would be lower in comparison to a channel with much lower slopes, higher sinuosity, and finer floodplain materials such as Goose Creek. Bankfull measurements near the USGS gauge indicate that Big Cottonwood Creek falls within the normal expected parameters of a stream within the Goose Creek arid watershed and approximately 50 percent of what would be expected if calculated using the regional curves found in Rosgen (1996) . The mean bankfull depth was 0.47 m, mean bankfull width was 4.02 m, and bankfull area was 1.87 m^2.

Hydrology

Due to the age of the historical data, the natural hydrology of Big Cottonwood Creek cannot be described with USGS gauge data. However, because the gauge data available correspond with data collected concurrently in Trapper Creek, a statistical relationship can be developed. Several assumptions must be made in order to develop this relationship. DEQ assumes that the amount of precipitation and resulting runoff is similar between basins and has been similar throughout the period of record for both the Big Cottonwood Creek Watershed and Trapper Creek gauged watershed. As Big Cottonwood Creek is in the same general area of the Trapper Creek gauged watershed this assumption should be met due to their proximity. A second assumption is that a similar amount of development has occurred in the Big Cottonwood Creek drainage as in the Trapper Creek drainages. As development increases, so do impervious surfaces which could change the rate of discharge in a system following a precipitation event. In general, the development in the Goose Creek Subbasin has occurred in the lower portion of the subbasin and not in the different watersheds, so DEQ is confidant that this assumption can also be safely made. Consequently, linear regression was performed on the data collected in Big Cottonwood Creek and the data from the Trapper Creek gauge. The regression was highly significant (p = 0.000), and the model (Figure 31) was able to describe 82.2 percent of the variation between the Big Cottonwood Creek discharge and the discharge at Trapper Creek. Therefore, DEQ will use the model to describe the annual hydrograph for Big Cottonwood Creek.

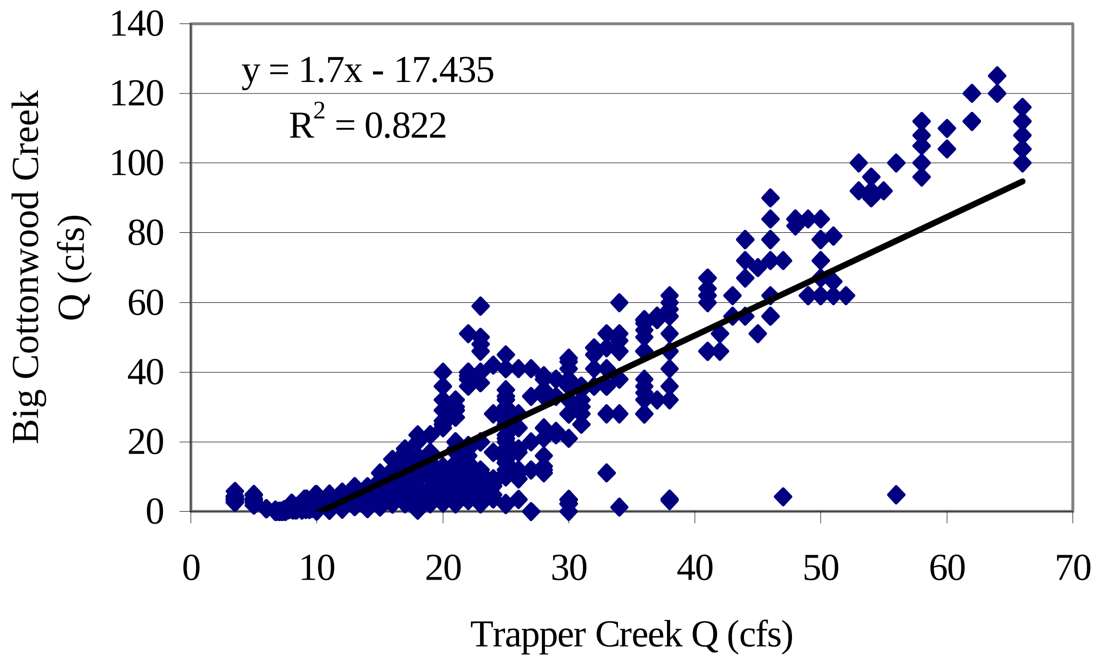


Figure 31. Linear regression model used to predict Big Cottonwood Creek discharge.

The average annual hydrograph for Big Cottonwood Creek based upon the above model and the Trapper Creek period of record discharge is shown in Figure 32.

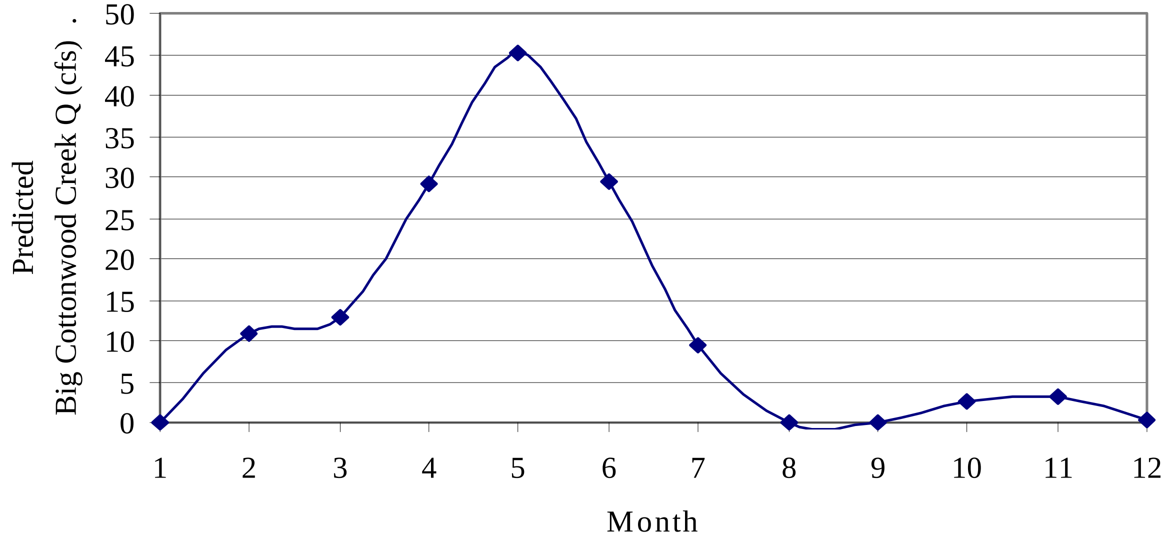


Figure 32. Predicted annual average hydrograph for Big Cottonwood Creek.

Fisheries

Idaho Department of Fish and Game stocking records indicate that trout have not been stocked in Big Cottonwood Creek. Therefore, DEQ assumes that any salmonids captured in Big Cottonwood Creek are from wild or naturalized populations. The naturalized populations may be from rogue stockings that have occurred throughout the west. The IDFG has surveyed the fishery in Big Cottonwood Creek several times beginning in 1978. In 1978, IDFG sampled near the lower bounds of the creek and just below Picket Hollow. It was determined that a wild population of cutthroat trout existed in the reaches downstream from Picket Hollow. These populations were assessed as fair with high quality cutthroat trout. The upper sampling location averaged 41 cutthroat trout per 100 feet of stream (approximately 1.1 per m^2 of stream) while in the lower sites the average was 8.6 rainbow and cutthroat throat trout per 100 feet of stream (approximately 0.2 per m^2) (Bell 1979). In 1986, IDFG returned to the creek. The creek was electrofished upstream from Picket Hollow. Multiple pass electrofishing efforts were undertaken to estimate populations. At that time it was estimated that cutthroat trout densities were 258 ± 356 per kilometer (approximately 0.2 ± 0.3 per m^2). The fishery was summarized as one of the superior cutthroat trout fisheries in Region 4 (Grunder et al. 1987). In addition, it was noted that upper Big Cottonwood Creek was in excellent condition with no single factor limiting fish production. In 1998 the lower end of Big Cottonwood Creek was electrofished to determine the population of cutthroat trout below the diversion structure. Historically the reach below this structure was dewatered during the irrigation season. Additionally, the diversion structure is an upstream migration barrier to the fish population located in the reach. Two sites were fished in the summer of 1998 prior to dewatering. At that time it was estimated that the cutthroat trout population in the lower reach was 6-17 fish per 100 m^2 (0.06-0.17 per m^2) (Warren and Frank 1999). The creek was again sampled by IDFG in 1999. Two locations were sampled during the summer of 1999, one above the diversion and another near the headwaters of Jarvis Spring. The density of trout was estimated for the lower site as 6.25 fish per 100 m^2 (0.06 per m^2). In the upper location, a single pass effort was conducted; consequently, a population estimate could not be made. However, cutthroat trout were present in that sample (Warren 2000). The IDFG also electrofished Big Cottonwood Creek at five locations in 2001. Four of the five sample events were in the upper segment above Billys Hole Creek. The fifth site was near Picket Hollow. The lower site cutthroat trout abundance estimate was 1.7 fish per 100 m^2 (1.2 > 100 mm and 0.5 < 100 mm per m^2). This estimate is much lower than those made in the past. In the upper reaches abundance estimates were much higher (0.2 to 0.70 cutthroat trout per m^2). One possible explanation is the higher angling pressure in the lower reach in comparison with the upper reach. In addition, the diversion structure acts as an upward migration barrier. Any fish that has moved downstream below the diversion is lost from the population, thus increasing the mortality for fishes in the lower reach.

DEQ has also electrofished Big Cottonwood Creek three times in the past. The earliest was in 1994. This was the only one of DEQ's samples that was taken in the §303(d) listed section of the creek. In 1994, DEQ sampled below the diversion structure in the wildlife management area. At that time, DEQ captured two cutthroat trout and numerous sculpin. It was noted that the young-of-year paiute sculpin were very abundant. Sculpin are cold water indicator species for DEQ and are indicative of good water quality because they are intolerant to organic enrichment and temperature pollution (DEQ 1996). The data from electrofishing efforts in the upper segment were all assessed in 1998 as fully supporting salmonid spawning and cold water aquatic life.

DEQ concludes that there are self-sustaining populations of salmonids in the upper reaches of Big Cottonwood Creek as low as the diversion near the wildlife management area. In addition, the water quality in the lower reaches would likely support a self-sustaining population if it were not dewatered on a regular basis. A fish ladder in the lower segment would allow fishes in the lower segment to escape the dewatered area below the diversion structure. Allowing some water to pass through the lower segment would also benefit the fishery.

Macroinvertebrates

DEQ has collected macroinvertebrates four times in Big Cottonwood Creek. Macroinvertebrates were collected in two general locations, lower Big Cottonwood Creek just below the diversion at the wildlife management area and upper Big Cottonwood Creek near the Bostetter campground. The macroinvertebrate communities at the lower location are indicative of good water quality. Under the WBAG II system, the macroinvertebrate index in this reach average more than the 2 condition rating score indicative of no water quality impacts (average 3). The SMI scores were very high at 69.19 and 96.09. However, hydrology information indicates that this lower reach is intermittent. The high scores are in spite of this intermittence. The communities in the lower reach are likely being augmented by drift from the upper perennial reaches.

In the upper reach of Big Cottonwood Creek, above the diversion, macroinvertebrate community information also indicates fully supported beneficial uses. The SMI scores were well above the 51 needed to give condition rating scores of 2.0 or higher, which are indicative of full support. The SMI scores in this reach were 60.54 and 91.52. In addition, the presence of a healthy cutthroat trout population indicates that a self-sustaining spawning population exists. These two communities together indicate that the beneficial uses of Big Cottonwood Creek are not impaired

Aquatic Vegetation

The presence of aquatic vegetation was noted in many reaches of the lower segment of Big Cottonwood Creek. However, these aquatic plant communities were not excessively abundant. In most cases, the community consisted of periphyton with no long filamentous organisms present. A chlorophyll *a* sample was collected during the peak of the summer growing period to determine if nuisance conditions existed. The sample collected was well below (4 mg/m^2) the 200 mg/m^2 value suggested (see section 2.2) to indicate nuisance aquatic vegetation growths. This value supports the beneficial use assessment based upon the fisheries and macroinvertebrate communities. As such, it is unlikely that excessive nutrients are the factor effecting the beneficial uses of Big Cottonwood Creek.

Big Cottonwood Creek Existing Water Quality Data

Water quality samples collected within the listed segment of the Big Cottonwood Creek are rare. According to EPA's STORET database, a few temperature and SC samples were collected from the creek.

DEQ sampled in the creek over the course of 2001 and additional samples will be collected throughout the various phases of the TMDL process as budgets and sampling time frames allow. However, due to the limited number of sampling periods in the original 2001 data set, DEQ's confidence in the monthly average concentrations is low. The lack of a robust data set was due to limited budgets and, in part, to a limited time frame for collecting data. In most cases one sample was the most collected in any given month. Infrequently, multiple samples were collected in a month. This sampling design was intended to determine annual pollutant loads. However, the annual load estimated by this type of design would overestimate annual load by 25 to 50 percent (Robertson and Richards 2000). To assist in the determination of seasonal components and appropriate critical conditions, the data will be presented as monthly averages in the following tables while period of record averages are presented in the text and other tables and used for any future load calculations. For those cases when a parameter was below detection limits, half the detection limit was used to calculate the monthly average and was used as part of the period of record average.

One sample location was set up in Big Cottonwood Creek below the diversion at the wildlife management area. Sampling began in March 2001 (Figure 20). The site will be used to determine the concentrations and loads due to activities along the listed reach.

At the sampling location, the effects of land uses can be seen in the seasonal changes of the measured constituents (Table 21). However, in comparison to those levels measured at the Goose Creek locations, the measured parameters are much lower. These differences in most all cases are of a large magnitude, indicating much lower use and degradation. For example, TSS in Big Cottonwood Creek averages 1.56 mg/L (standard deviation 1.42 mg/L), which is lower than the Goose Creek sites (11 mg/L). These samples were taken the same day as the Goose Creek samples and include the critical periods of springtime high flows and summertime low flows. Total phosphorus differs as well, although less dramatically than did suspended solids. In Big Cottonwood Creek the average TP concentration was 0.042 mg/L (standard deviation 0.011 mg/L), while at the Goose Creek sites the average TP concentration was 0.096 mg/L. The minimum measured TP concentration in Big Cottonwood Creek was 0.028 mg/L in late October and the maximum was 0.069 mg/L during the middle of April.

Monthly concentrations of TP were never indicative of excess nutrients that may cause impairment (nuisance aquatic vegetation). Guidelines that DEQ has used in the past are not to exceed 0.160 mg/L TP in any single sample, 0.100 mg/L TP in any average monthly sample, and 0.100 mg/L as an annual weighted average. The guidelines were never exceeded (Table 21). In addition, a lack of nuisance aquatic vegetation is seen within the system. Further chlorophyll *a* samples are required to determine a subbasin-wide model for nutrient concentration and sestonic chlorophyll *a* concentrations.

Bacteria counts were elevated (256 col/100 ml average) in the summer in comparison with the average annual counts for the creek (148 col/100 ml average). Bacteria counts exceeded state water quality standards once (920 col/100 ml). However, this sample was taken from the canal below the diversion rather than in the stream where the remainder of the samples were drawn. Consequently, it is not representative of the stream and the remainder of the samples. The inferences DEQ draws from this data are that the canal may be more heavily used by cattle and wildlife than the stream as a watering source during the summer and this likely protects the stream from increased bacterial contamination. If the canal data point is excluded, the average bacteria count for Big Cottonwood Creek was 103 col/100 ml.

From the 2001 data set, TSS also appears to be a non-factor effecting beneficial uses. However, 2001 was a drought year in which water levels were diminished. Consequently, much of the sediment stored in the system was never transported out of the reach as a suspended load. In a higher water year, the data from the suspended fraction may support the contention that a sediment TMDL is required. However, DEQ is constrained by the legal system to complete a TMDL for Big Cottonwood Creek with the data at hand.

Table 21. Measured water quality constituents in Big Cottonwood Creek.

Month	No of Samples	TSS (mg/L)[a]	Total NH_3 as N (mg/L)[b]	Total NO_2 + NO_3 (mg/L) as N[c]	Total P (mg/L)[d]	Temp (°C)	Dissolved Oxygen (mg/L)[e]	Bacteria *E. coli* (Col/100 ml)[f]
January	0							
February	0							
March	2	1	0.011	0.005	0.041	10.01	9.75	3
April	2	4	0.019	<0.005	0.068	18.12	7.68	NA
May	2	3	0.009	0.008	0.044	11.58	9.37	24
June	2	1	<0.005	<0.005	0.037	15.28	8.47	145
July	2	1	0.006	<0.005	0.037	13.90	8.14	218
August	1	<1	0.015	0.029	0.034	15.83	7.18	32
September	2	2	0.016	0.112	0.045	12.31	5.04	17
October	1	<1	0.010	0.008	0.028	5.51	10.01	220
November	0							
December	0							
Annual Average		1.6	0.011	0.026	0.043	14.00	7.78	103
Standard Deviation		1.4	0.006	0.040	0.011	4.17	1.65	135

a Total suspended solids in milligrams per liter, TSS detection limit = 1 mg/L.
b Total ammonia as nitrogen in milligrams per liter.
c Nitrite plus nitrate in milligrams per liter, as nitrogen. NO_2+NO_3 detection limit = 0.005mg/L.
d Total phosphorus in milligrams per liter.
e milligrams per liter.
f colonies per 100 milliliters.

Due to DEQ's limited sampling for suspended sediment in the Big Cottonwood Creek system, additional measures were taken to determine if other forms of sediment were impairing the beneficial uses. From DEQ's sampling regime, it was determined that the suspended fraction of the sediment load was not impairing the uses. Therefore, a series of Wolman pebble counts were conducted in the lower section of the stream. These Wolman pebble counts were conducted to determine if bedload sediment was impairing beneficial uses. Following the BURP protocols, Wolman pebble counts were conducted in riffles in a 3-km reach of Big Cottonwood Creek. Counts were conducted from bankfull edge to bankfull edge until at least 50 measurements were taken. Following this the crew traveled upstream approximately 100 m to another riffle. This was repeated until the crew had collected 30 series of Wolman pebble counts (approximately 3.25 km of the creek). A similar system (one where the beneficial uses have been documented as being fully supported) was chosen from the general area of the §303(d) listed water body for comparison with Big Cottonwood Creek. In this case the upper segment of Trapper Creek was chosen. The upper segment of Trapper Creek was determined to be fully supporting its beneficial uses (see the 1998 §303(d) list chapter 2.5). Wolman pebble counts from 30 transects were used to determine the surface fines (DEQ-TFRO's surrogate for bedload) of the upper segment of Trapper Creek. Data concerning the stored fraction of sediment and/or the bedload (surface fines) were collected in the lower segment at the end of July 2001. The percent surface fines for the lower section of Big Cottonwood Creek below the diversion was 11.58 percent (fines are particles < 6 mm in median length). Percent fines in the fully supported segment of Trapper Creek were 8.0 percent.

To determine if the percent surface fines between the two streams were significantly different, a Chi-squared analysis was completed on the proportions of each size class of sediment from each transect. The Chi-squared analysis was used to test the following hypotheses:

H_o: Lower segment Big Cottonwood Creek proportions = Upper segment Trapper Creek proportions.
H_a: Lower segment Big Cottonwood Creek proportions ≠ Upper segment Trapper Creek proportions.

The test indicated that the percent surface fines between the lower segment of Big Cottonwood Creek were not significantly different ($p > 0.25$) from Trapper Creek. As a result of the differences between the percent fines of the two streams, DEQ has determined that sediment as measured by the percent surface fines surrogate is not impairing the lower segment of Big Cottonwood Creek. Samples collected in other fully supported streams indicate that percent fines within the wetted width should be 25 percent or less (Lay 2000). Since the percent fines for the lower segment of Big Cottonwood Creek were 11.58 percent, it appears that bedload is not impairing the beneficial uses of Big Cottonwood Creek and that a TMDL for bedload is not required.

Dissolved oxygen was also monitored throughout 2001. Following the complete diversion of Big Cottonwood Creek, DO occasionally fell below state water quality standards. At that time discharge into the reach below the diversion was from seepage and water leaking through the diversion structure. The fall of DO levels was expected to correspond with a rise in stream temperatures. However, this was not the case. Stream temperatures at that time remained near ground water temperature. A possible explanation for the low DO measurements is that a preponderance of the water in the surface channel was from a ground water source, and ground water is naturally low in DO. Specific conductivity and TDS during this period were slightly higher than the averages for the stream at other times of the year. While DO may have been low several times in the late summer it was more likely linked to the flow diversion than an increase in BOD. Dissolved oxygen is often used in conjunction with pH to determine if excess nutrients have caused nuisance aquatic growths. DEQ determined that excess aquatic growths had not occurred in Big Cottonwood Creek during the 2001 sampling period. The DO and pH data support this contention. Therefore, DEQ finds that the lower segment of Big Cottonwood Creek is not polluted with oxygen demanding materials.

Instantaneous temperature measurements were also collected in Big Cottonwood Creek. In the warmer months of July and August no temperature exceedances occurred. As the creek was diverted, what little water remained in the creek did not exceed instantaneous temperature standards. Again this was likely due to the influence of ground water in the lower reach. Temperature is likely not an issue in Big Cottonwood Creek due to the numerous cold water springs that feed the system. These springs would act as a temperature buffer for the system.

Point and Nonpoint Sources

Big Cottonwood Creek flows through fifth field HUC 1704021118. The GIS coverages indicate that 64.2 percent of the watershed is rangeland, 19.9 percent forest, and 15.9 percent irrigated. Most nonpoint source pollution in the watershed comes from activities associated with these land uses. The listed segment falls mainly within the rangeland and irrigated areas. Additional sediment sources include unstable banks and reentrainment from the streambed itself. However, quantification of these sources has not been completed. As of yet, no CAFOs or other point sources are known to exist within the watershed.

Conclusions

It appears from the data that nutrients, suspended sediment, DO, temperature, and bacteria are within the bounds of water quality determined to be supportive of the designated beneficial uses. If the beneficial uses sustain any impact in the lower segment it is due solely to flow alteration. Consequently, DEQ will not complete a nutrients, suspended sediment, DO, temperature, or bacteria TMDL on Big Cottonwood Creek. However, DEQ will retain Big Cottonwood Creek on the §303(d) list for flow alteration in the lower segment from the diversion to the lower bounds of the creek.

Emery Creek

Emery Creek begins in the south central mountains of Idaho in an area called Middle Mountain and flows 7.44 km to a confluence with Goose Creek. Along this course, no perennial tributaries enter the system, although approximately four intermittent or ephemeral systems do. The USGS has not had a gauge located on Emery Creek in Idaho. The Emery Creek Watershed is an area of approximately 9.17 km^2. Given this size watershed, channel characteristics were extrapolated from regional curves. These regional curves are in *Applied River Morphology* (Rosgen 1996). Extrapolating from the regional curve, Emery Creek near the mouth should have a mean bankfull depth of 0.47 m, a bankfull width of 4.03 m, and a bankfull cross-sectional area of approximately 1.93 m^2. Because no historical gauge data exist, a statistical interpretation of hydrological events will be provided based upon Goose Creek gauge data. The predicted period of record average discharge at this location is 0.009 m^3/s. The predicted low discharge occurs during the fall quarter with only 0.005 m^3/s.

Spring discharge was predicted at 0.017 m^3/s, while winter base discharge was predicted at 0.007 m^3/s. Summer discharge was also estimated at 0.007 m^3/s.

Physical Characteristics

Emery Creek is not §303(d) listed. Data collected in the late summer of 2000 indicate that Emery Creek was not supporting recreational beneficial uses. Therefore, DEQ assessed Emery Creek during the SBA and TMDL writing phase for the Goose Creek Subbasin. The segment of concern covers the entire length of the creek. This creek is 7.44 km long. The valley through which this segment flows is approximately 7.41 km in length. Over the entire segment, the creek has a steep slope of 9.84 percent. This slope corresponds to a 98.39 m fall per kilometer. Streams with slopes of this magnitude are usually not sinuous and are by nature erosional. Sinuosity is very low (1.0) for the entire stream. Floodplain materials are composed of coarse textured sands and gravel derived from colluvium and glacial till. Consequently, it would be expected that the percent fines of Emery Creek should be very low in comparison to a channel with much lower slopes, higher sinuosity, and finer floodplain materials such as Goose Creek. Percent fines in Emery Creek should be similar to those in Cold Creek. Bankfull measurements near the mouth indicate that Emery Creek falls within the normal expected parameters of a stream within the arid Goose Creek Subbasin. The mean bankfull depth was 0.38 m, mean bankfull width was 2.47 m, and bankfull area was 0.95 m^2.

Hydrology

Due to the lack of historical data, the natural hydrology of Emery Creek cannot be described with USGS gauge data. However, because some flow data available (collected by DEQ in 2001) correspond with data collected concurrently in Goose Creek, a statistical relationship can be developed. Several assumptions must be made in order to develop this relationship. DEQ assumes that the amount of precipitation and resulting runoff is similar between basins and has been similar throughout the period of record for both the Emery Creek Watershed and Goose Creek gauged watershed. As Emery Creek is in the same general area of the Goose Creek gauged watershed this assumption should be met due to their proximity. A second assumption is that a similar amount of development has occurred in the Emery Creek drainage as in the Goose Creek drainages. As development increases, so do impervious surfaces which could change the rate of discharge in a system following a precipitation event. In general, the development in the Goose Creek Subbasin has occurred in the lower portion of the subbasin and not in the different watersheds, so DEQ is confidant that this assumption can also be safely made. Consequently, linear regression was performed on the data collected in Emery Creek and the data from the Goose Creek gauge. The regression was significant ($p = 0.032$), and the model (Figure 33) was able to describe 45.9 percent of the variation between the Emery Creek discharge and the discharge at Goose Creek. Therefore, DEQ will use the model to describe the annual hydrograph for Emery Creek.

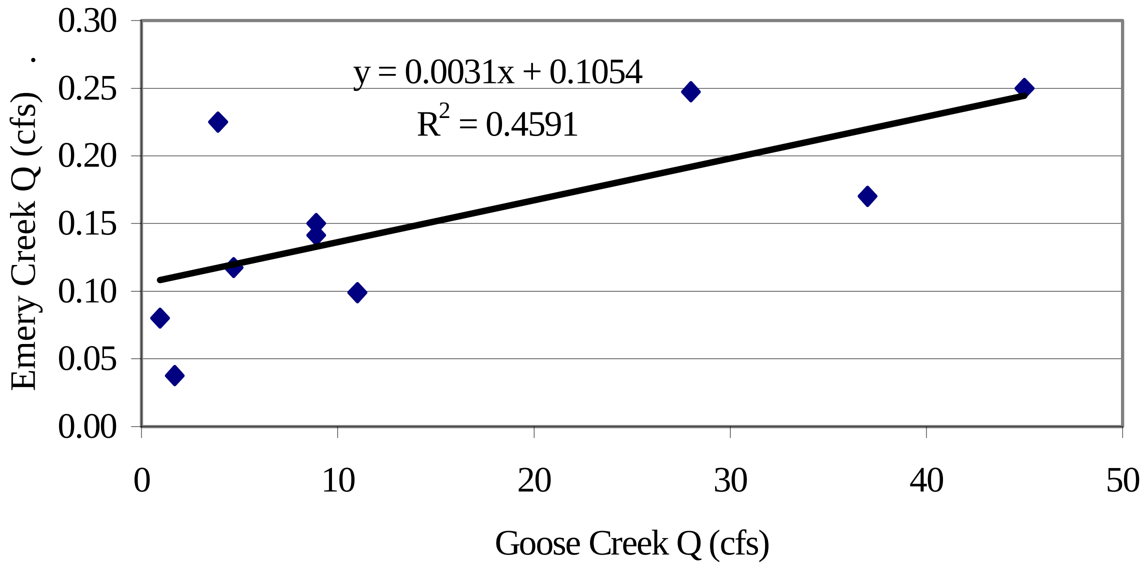


Figure 33. Linear regression model used to predict Emery Creek discharge.

The average annual hydrograph for Emery Creek was based upon the above model and the Goose Creek period of record discharge from the USGS gauge and is shown in the following figure (Figure 34).

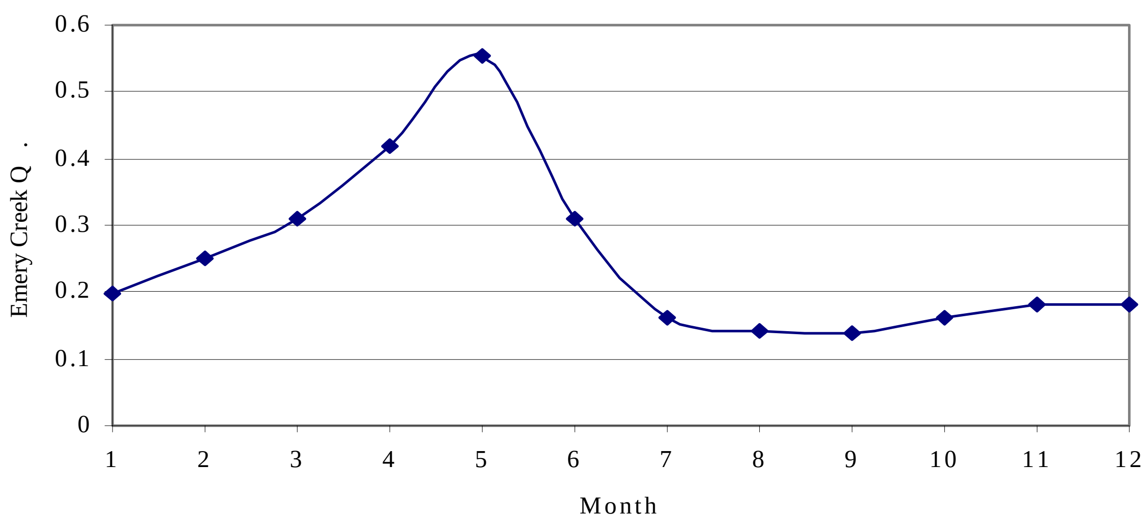


Figure 34. Predicted annual average hydrograph for Emery Creek.

As seen in Figure 34, Emery Creek on average never discharges more that 1 cfs, and is near 0.2 cfs for much of the summer and winter. Hydrologically, this means that Emery Creek is likely an intermittent stream in all but the wettest of years. In normal water years Emery Creek is likely to experience periods of zero discharge throughout the summer. In dry years, this intermittence could extend from the late spring throughout much of the winter.

Fisheries

Stocking records indicate that Emery Creek has never been planted with hatchery fishes. Additionally, Emery Creek has never been electrofished by IDFG agency personnel. DEQ attempted electrofishing efforts in Emery Creek on two occasions. In both instances, no fish were captured. This evidence bolsters the contention that Emery Creek is intermittent.

Macroinvertebrates

DEQ collected macroinvertebrates three times in Emery Creek: once each in 1995, 1997, and 1998. The SMI scores varied dramatically from year to year. The lowest score, 22.1, was calculated from data collected in 1995; the highest (56.7) from 1998. The wettest of the three years, 1997, had a very low score (23.38). However, it should be noted that the scores decreased the later in the season the data were collected. In the year with the highest score, the data were collected in June while in the year with the lowest score, data were collected at the end of August. This corroborates the intermittent nature of Emery Creek. Therefore, DEQ-TFRO feels that biological information such as macroinvertebrates and fishes should not be used to assess the beneficial uses of Emery Creek as Emery Creek is very likely intermittent.

Aquatic Vegetation

The presence of terrestrial vegetation was noted in many reaches of the lower segment of Emery Creek. This indicates that the creek channel is not inundated year-round. In some reaches, aquatic vegetation was present. However, these aquatic plant communities were not excessively abundant. In most cases, the community consisted of periphyton with no long filamentous organisms present. A chlorophyll *a* sample was not collected in Emery Creek due to the presence of terrestrial vegetation within the creek channel.

Emery Creek Existing Water Quality Data

Emery Creek was originally identified as exceeding state water quality standards for recreational beneficial uses. Therefore, DEQ collected bacteria samples from the creek throughout 2001. The data collected do not support the contention that primary or secondary contact recreation in Emery Creek is impaired. The highest sample count collected in the creek was 130 col/100 ml. This was taken at the end of October 2001. Prior samples were much lower. Throughout the summer, bacteria levels averaged 6 col/100 ml (Table 22). Other water quality parameters collected at the same time as the bacteria sampling events were also below any actionable levels (water quality standards or EPA guidelines).

Table 22. Bacteria data collected from Emery Creek.

Month	March	April	May	June	July	August	September	October
Number of Samples	1	1	2	3	2	1	2	1
Average Colonies/ 100 ml	0	0	1	10	2	1	34	130

Point and Nonpoint Sources

Emery Creek is one of three streams assessed at this time that flow through fifth field HUC 1704021106. In order to determine what point and nonpoint sources contribute to Emery Creek a 1.6 km (1 mile) buffer on each side of the stream was calculated from GIS coverages. The land use within this critical zone is considered to contribute to the specific water body if more than one water body exists within a watershed or if the water body is not the pour point of the watershed. The land uses (from GIS) of the critical buffer are 85.1 percent forest, 9.5 is irrigated pastureland, and 5.4 percent rangeland. Most nonpoint source pollution in the watershed comes from activities associated with these land uses. Rangeland activities predominate both the forested and rangeland areas.

Conclusions

DEQ will not proceed with any TMDLs on Emery Creek. Future monitoring of bacteria contamination will be limited in upcoming years. This monitoring will be to ensure that DEQ's assessment remains accurate.

Little Cottonwood Creek

Little Cottonwood Creek begins in the south central mountains of Idaho and flows to the agricultural areas west of Oakley. In flood years, Little Cottonwood Creek may discharge to a canal that feeds Big Cottonwood Creek, which flows into Murtaugh Lake. Throughout its 18.70 km length, it crosses from the Northern Basin and Range Ecoregion into the Snake River Basin High Desert Ecoregion. Land uses along this course remain similar. Grazing activities predominate the land use activities along Little Cottonwood Creek. Along the course of the creek, no perennial tributaries enter the system. Several intermittent and ephemeral systems, as well as several springs (Durfee Meadow, Severe, Little Cottonwood, and Cowboy Springs), feed Little Cottonwood Creek. Little Cottonwood Creek has never been gauged by the USGS. From GIS coverages, the contributing watershed area is estimated as 95.5 km^2. Given this size watershed, channel characteristics can be extrapolated from regional curves. These regional curves can be found in *Applied River Morphology* (Rosgen 1996). Extrapolating from the regional curve, Little Cottonwood Creek near Cowboy Springs should have a mean depth of 0.66 m, a bankfull width of 9.67 m, and a cross-sectional area of approximately 6.75 m^2. Because no historical gauge data exist, a statistical interpretation of hydrological events will be provided based upon Trapper Creek gauge data. The predicted period of record average discharge at this location is 0.015 m^3/s. The predicted low discharge occurs during the fall quarter at 0.009 m^3/s. Spring discharge was predicted at 0.027 m^3/s, while winter base discharge was predicted at 0.011 m^3/s. Summer discharge was estimated at 0.015 m^3/s.

Physical Characteristics

Little Cottonwood Creek is not currently §303(d) listed. However, based upon data collected by DEQ over the past five years, Little Cottonwood Creek will be listed for bacteria impairing the recreational beneficial uses. The segment of concern is the entire water body. The stream is 18.70 km long. The valley through which this creek flows is approximately 17.38 km in length. Over the entire segment, the creek has a moderately steep slope of 4.30 percent. This slope corresponds to a 43.03 m fall per kilometer. Slopes of this magnitude are usually seen in nearly non-sinuous streams that are by nature erosional. Sinuosity is classified as low (1.1) for the creek. Floodplain materials, however, are composed of eroded rhyolite and basalts that degrade to fine textured sand and silts. Consequently, it would be expected that the percent fines of Little Cottonwood Creek would be elevated in comparison to other steep streams with low sinuosity and coarse floodplain materials, such as Blue Hill Creek. Bankfull measurements near the lower bounds indicate that Little Cottonwood Creek falls within the normal expected parameters of a stream within the arid Goose Creek Subbasin. The mean bankfull depth was 0.24 m, mean bankfull width was 1.92 m, and bankfull area was 0.45 m^2.

Hydrology

Due to the lack of historical data, the natural hydrology of Little Cottonwood Creek cannot be described with USGS gauge data. However, because data collected by DEQ corresponds with data collected concurrently in Trapper Creek, a statistical relationship can be developed. Several assumptions must be made in order to develop this relationship. DEQ assumes that the amount of precipitation and resulting runoff is similar between basins and has been similar throughout the period of record for both the Little Cottonwood Creek Watershed and Trapper Creek gauged watershed. As Little Cottonwood Creek is in the same general area of the Trapper Creek gauged watershed this assumption should be met due to their proximity. A second assumption is that a similar amount of development has occurred in the Little Cottonwood Creek drainage as in the Trapper Creek drainages. As development increases, so do impervious surfaces which could change the rate of discharge in a system following a precipitation event. In general, the development in the Goose Creek Subbasin has occurred in the lower portion of the subbasin and not in the different watersheds, so DEQ is confidant that this assumption can also be safely made. Consequently, linear regression was performed on the partial year data collected in Little Cottonwood Creek and the data from the Trapper Creek gauge. The regression was highly significant ($p = 0.008$), and the model (Figure 35) was able to describe 60.19 percent of the variation between the Little Cottonwood Creek discharge and the discharge at Trapper Creek. Therefore, DEQ will use the model to describe the annual hydrograph for Little Cottonwood Creek.

The average annual hydrograph for Little Cottonwood Creek based upon the above model and the Trapper Creek period of record discharge is shown in the following figure (Figure 36).

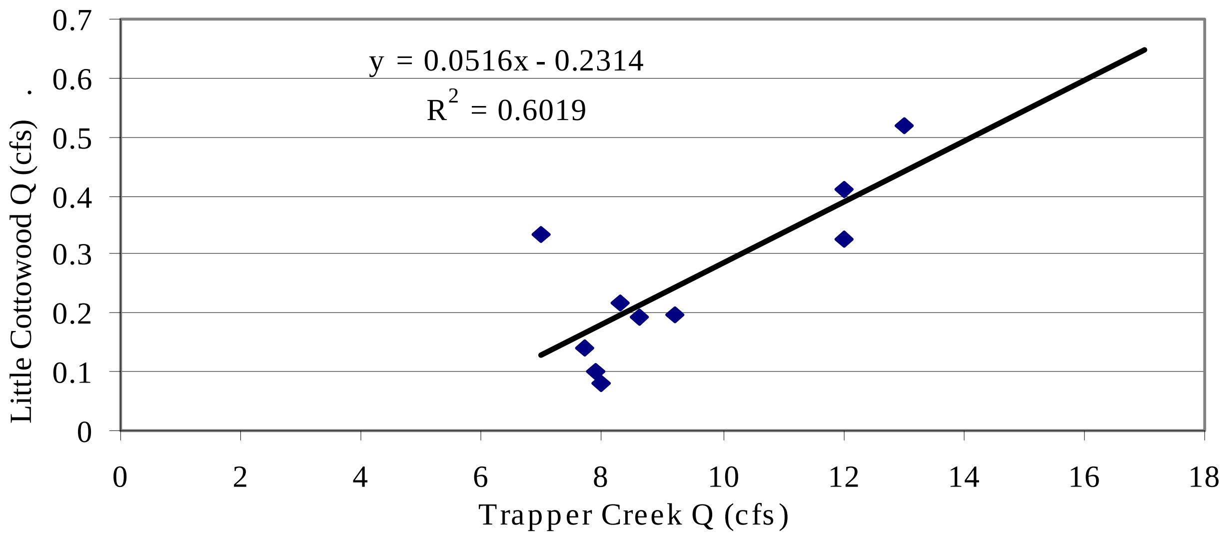


Figure 35. Linear regression model used to predict Little Cottonwood Creek discharge.

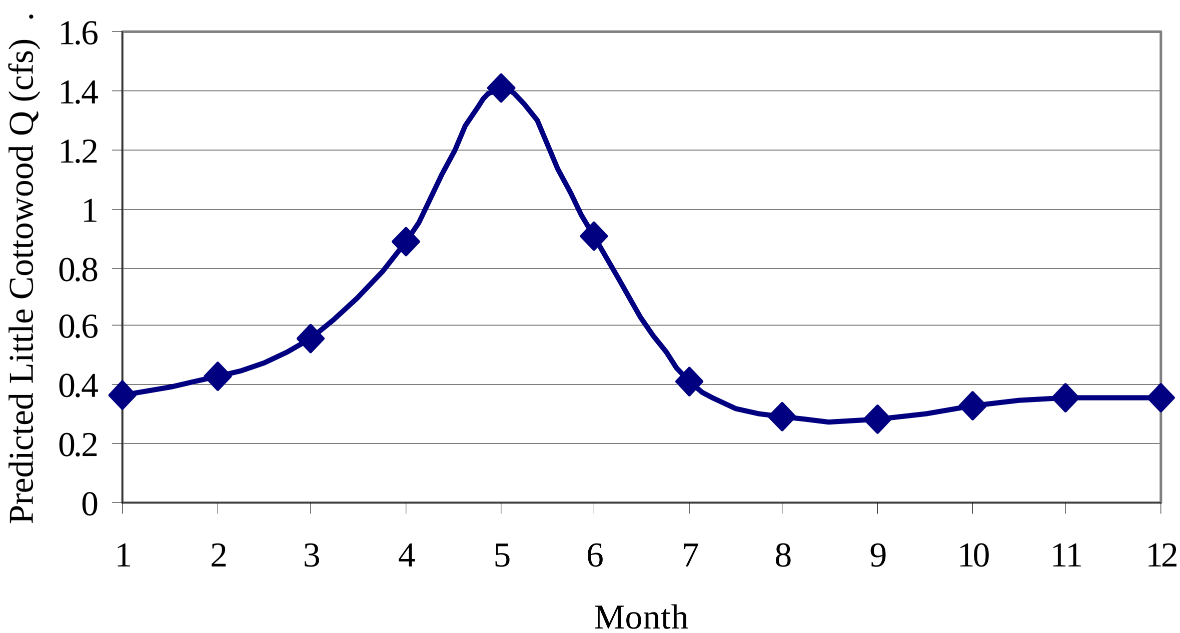


Figure 36. Predicted Little Cottonwood Creek discharge.

Fisheries

Idaho Department of Fish and Game stocking records indicate that trout have not been stocked in Little Cottonwood Creek. Therefore, DEQ assumes that any salmonids captured in Little Cottonwood Creek are from wild or naturalized populations. The naturalized populations may be from rogue stockings that have occurred throughout the west. The IDFG has surveyed the fishery in Little Cottonwood Creek twice, once in 1999 and again in 2001. In 1999, IDFG sampled two locations, one near the lower bounds of the creek and another near the headwaters. In 1999, it was determined that a wild population of rainbow trout existed in the upper portions of the system (Warren 2000). In 2001, IDFG sampled the stream at three locations: upper, middle, and lower. The middle location was dry at the time of the survey. No fish were captured at the other two locations. It is unknown if the conditions between 1999 and 2001 changed to exclude fish from the system. However, it is likely that during the drought years between 1999 and 2001 Little Cottonwood Creek went dry, removing the fishery from the system. Fisheries monitoring is required to determine the presence/absence of the previous salmonid fishery.

DEQ has electrofished Little Cottonwood Creek once in the past. This was in 1999, near the lower bounds of the creek. At that time, DEQ did not collect any fish.

DEQ concludes that the probability of the presence of a self-sustaining population of salmonids in the upper reaches Little Cottonwood Creek is low. The upper reaches may be perennial only in wet years and intermittent in average and dry years. Salmonid spawning and cold water aquatic life would be severely limited due to natural and anthropogenic flow alteration. Therefore, the biological assessment of water quality should not be based upon the fishery due to flow alteration issues. Further investigations are required to determine the status of the fishery.

Macroinvertebrates

DEQ collected macroinvertebrates four times in Little Cottonwood Creek: once in 1994, once in 1995, and twice in 1997. Macroinvertebrates were collected from three general locations. The first of these was a few hundred meters from Little Cottonwood Spring. These macroinvertebrates are not representative of the community in the remainder of the stream due to the proximity of the stream source and the lack of upstream habitats. Abundance of macroinvertebrates was very low in these collections as would be expected in collection made from headwater areas. The second general area macroinvertebrates were collected was approximately 1.6 km downstream from the spring. Invertebrate abundance was much higher in this location than near the springs, as would be expected. There was an even mix of Ephemeroptera and Plecoptera in the sample. However, the caddisfly order (Trichoptera) was under-represented. The total number of taxa collected was more similar to the spring source samples than samples collected further downstream or in other nearby systems. Using the1996 MBI score the site would have been classified as needing verification of the beneficial uses (MBI score = 2.83). Again, this is likely the result of the proximity to the stream source and not water quality degradation per se. The SMI score for this location was 34.92, which would have yielded a condition rating score of 1.

Consequently, a strong fish community would be needed to make the full support determination. Without that information, the stream would likely be assessed as not meeting beneficial uses.

The final location macroinvertebrates were collected was near the lower bounds of the stream near Cowboy Spring. Total abundance was similar here as in the previous upstream location, but total taxa richness was much higher. The increased diversity in invertebrates was associated with a low dominance of the top three taxa. In comparison, the community from the upstream site was highly dominated by a single taxa. As a result, the lower site scored well in the multi-metric analyses (MBI = 4.54, SMI = 68.33). In general, the aquatic life beneficial uses of Little Cottonwood Creek appear to be fully supported throughout the creek if the proximity to spring source effects is taken into account.

In general, the macroinvertebrate community seems to respond to the intermittence of Little Cottonwood Creek better than do the fish populations. The small springs located in Little Cottonwood Creek may act as refugia for the macroinvertebrates yet not provide the same refuge for the salmonids during average or drought affected water-years.

Aquatic Vegetation

The presence of aquatic vegetation was noted in the lower segment of Little Cottonwood Creek. However, these aquatic plant communities were not excessively abundant. In most cases, the community consisted of periphyton with no long filamentous organisms present. A chlorophyll *a* sample was collected during the peak of the summer growing period to determine if nuisance conditions existed. The sample collected was well below (4 mg/m^2) the 200 mg/m^2 value suggested (see Section 2.2) to indicate nuisance aquatic vegetation growths. This value supports the beneficial use assessment based upon the macroinvertebrate communities collected in the lower bounds of the creek. As such, it is unlikely that excessive nutrients are the factor effecting the beneficial uses of Little Cottonwood Creek.

Little Cottonwood Creek Existing Water Quality Data

Little Cottonwood Creek was originally identified as exceeding state water quality standards for bacteria for recreational beneficial uses. Therefore, DEQ collected biweekly bacteria samples from the creek throughout 2001 (Table 23). The data collected support the contention that primary or secondary contact recreation in Little Cottonwood Creek is impaired. The highest sample count collected in the creek was 2,200 col/100 ml. This was taken at the end of June 2001. Prior samples showed similar levels. Throughout the summer bacteria levels averaged 800 col/100 ml. Other water quality parameters collected at the same time as the bacteria sampling events were below any actionable levels (water quality standards or EPA guidelines).

Table 23. Little Cottonwood Creek bacteria data.

Month	March	April	May	June	July	August	Sept	Oct
Number of Samples	1	1	2	5	5	2	2	1
Average Colonies per 100 ml	1	0	0	1,198	760	515	184	4
Geometric mean				708	515			

Point and Nonpoint Sources

Little Cottonwood Creek is the only stream that flows through fifth field HUC 1704021117. Consequently, the point and nonpoint sources of this watershed are considered to contribute pollutants to Little Cottonwood Creek. The land uses, from the GIS coverage of the watershed, indicate that 40.4 percent forest, 42.1 percent rangeland, and 17.5 is irrigated pastureland. Most nonpoint source pollution in the watershed comes from activities associated with these land uses. Rangeland activities predominate both the forested and rangeland land uses. There are no point sources located within the watershed.

Conclusions

DEQ will proceed with a bacteria TMDL on Little Cottonwood Creek. Future monitoring will include other parameters as well as bacteria. This monitoring will be to ensure that DEQ’s assessment remains accurate. It is unlikely that salmonid spawning can be an existing use in Little Cottonwood Creek. However, cold water aquatic life is an existing use and appears fully supported in the lower bounds of Little Cottonwood Creek.

Left Hand Fork Beaverdam Creek

Left Hand Fork Beaverdam Creek begins in the south central mountains of Idaho on the western side of the subbasin and flows to the confluence with the Right Hand Fork Beaverdam Creek. From this point Beaverdam Creek proper begins and flows 9.3 km to the confluence with Goose Creek. Left Hand Fork Beaverdam Creek is 8.74 km in length. Along its course, two perennial tributaries enter the system (Carlson Creek and Right Hand Fork Beaverdam Creek; both may be intermittent). The USGS has not had a gauge located in Left Hand Fork Beaverdam Creek in Idaho. The Left Hand Fork Beaverdam Creek Watershed is an area of approximately 21.24 km^2. Given this size watershed, channel characteristics were extrapolated from regional curves. These regional curves are in *Applied River Morphology* (Rosgen 1996). Extrapolating from the regional curve, Left Hand Fork Beaverdam Creek near the mouth should have a mean bankfull depth of 0.55 m, a bankfull width of 5.91 m, and a bankfull cross-sectional area of approximately 3.34 m^2. Because no historical gauge data exist, a statistical interpretation of hydrological events was attempted based upon Goose Creek gauge data. However, Left Hand Fork Beaverdam Creek is primarily spring fed with a very small watershed. As a result, no relationship between either Goose Creek or Trapper Creek (a heavily spring fed system) could be developed. Therefore, an understanding of the hydrological regime will have to be developed through monitoring. The average measured discharge at this location was 0.005 m^3/s with a standard deviation of 0.002 m^3/s. Discharge was not very variable as can be seen by the low standard deviation.

Physical Characteristics

Left Hand Fork Beaverdam Creek begins at a small spring at the head of Johnny Canyon. The segment is 8.74 km long. The valley through which this creek flows is approximately 8.22 km in length. Over the entire segment, the creek has a very steep slope of 6.82 percent. This slope corresponds to a 68.19 m fall per kilometer. Slopes of this magnitude are usually seen in streams with very low sinuosity that are by nature erosional. Sinuosity is classified as low (1.1) for the segment. Due to the steep slope of the creek, the stream is confined within the channel with a very narrow floodplain; this limits the sinuosity of the system. The floodplain materials are composed of fine textured sands and silt derived from alluvium and Miocene lake deposits. Consequently, it would be expected that the percent fines of Left Hand Fork Beaverdam Creek should be elevated in comparison to other channels with higher slopes, lower sinuosity, and coarser floodplain materials. Bankfull measurements near the lower portion of the creek indicate that Left Hand Fork Beaverdam Creek falls within the normal expected parameters of a stream within the arid Goose Creek Subbasin. The mean bankfull depth was 0.35 m, mean bankfull width was 0.8 m, and bankfull area was 0.28 m^2.

Hydrology

Due to the lack of historical data, the natural hydrology of Left Hand Fork Beaverdam Creek cannot be described with USGS gauge data. Linear regression was performed on the data collected from Left Hand Fork Beaverdam Creek and the data from both the Goose Creek and Trapper Creek gauges. Neither regression was significant ($p = 0.52$ and 0.10, respectively). However, the Trapper Creek data approached a significant relationship at an alpha level of 0.1 rather than 0.05. A model based on Trapper Creek data was able to describe only 24.7 percent of the variation between Left Hand Fork Beaverdam Creek discharge and the discharge at Trapper Creek. In addition, the direction of the slope was in the wrong direction to be meaningful (i.e., negative versus positive slope). Therefore, DEQ cannot use a model to describe the annual hydrograph for Left Hand Fork Beaverdam Creek.

The measured discharge for Left Hand Fork Beaverdam Creek over the period of DEQ data collection in 2001 is shown in Figure 37.

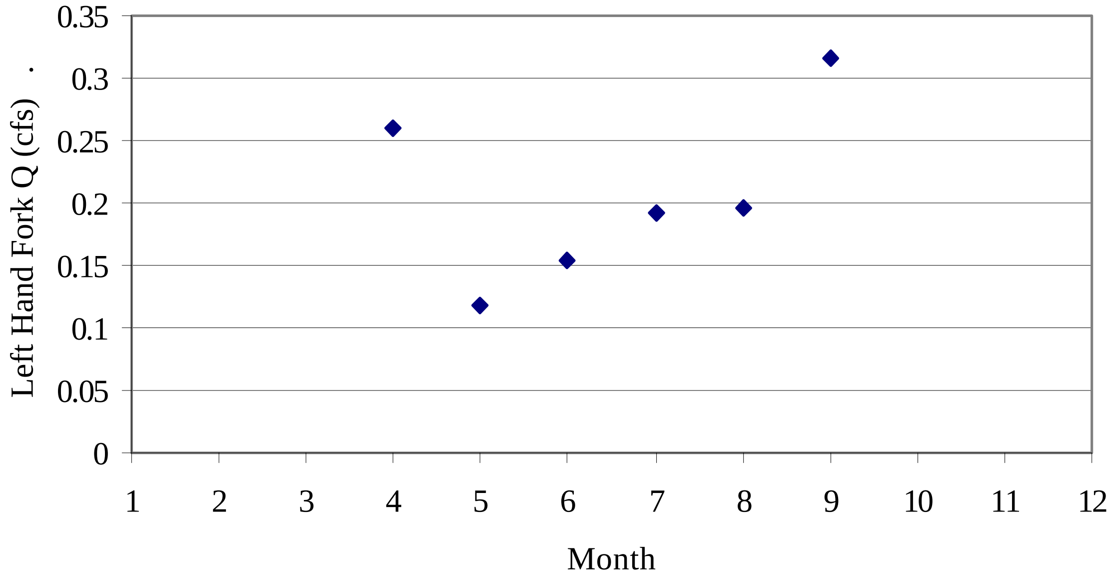


Figure 37. Left Hand Fork Beaverdam Creek monthly measured discharge.

The hydrology of Left Hand Fork Beaverdam Creek system, however, is more complex than can be described in a single graph. Left Hand Fork Beaverdam Creek flows in the upper 3 km because of springs. After the stream leaves Johnny Canyon it flows underground through an approximately 1.5 km long area of unconsolidated channel comprising a sagebrush flat. During spring flows some water moves through this area. However, flows are such that a regular channel has not been established through the flat. Below this area, a series of springs and ponding occur and Left Hand Fork Beaverdam Creek is reborn from ground water. This creek flows through open pastureland (the old Frish Ranch) for approximately 5 km before entering a small canyon and joining Right Hand Fork Beaverdam Creek to become Beaverdam Creek. Irrigation water rights have the potential to dry Left Hand Fork Beaverdam Creek below Johnny Canyon completely throughout the summer months. Left Hand Fork Beaverdam Creek should be considered perennial only in the upper third of the water body, intermittent in the middle third, and perennial again in the lower third.

Fisheries

Idaho Department of Fish and Game stocking records indicate that trout have not been stocked in Left Hand Fork Beaverdam Creek. Therefore, DEQ assumes that any salmonids captured in Left Hand Fork Beaverdam Creek are from wild or naturalized populations. The naturalized populations may be from rogue stockings that have occurred throughout the west or from fish that have moved upstream from Goose Creek. The IDFG has not surveyed the fishery in Left Hand Fork Beaverdam Creek.

DEQ has never electrofished Left Hand Fork Beaverdam Creek. However, throughout the summer of 2001, several small cutthroat trout were seen in the lower section of Left Hand Fork Beaverdam Creek by DEQ water quality personnel. Additionally, personal communications with a local landowner indicate that a self-sustaining population of cutthroat trout resides in the lower sections. Electrofishing efforts are planned to quantify this population.

DEQ concludes that there may be self-sustaining populations of salmonids in the lower reaches Left Hand Fork Beaverdam Creek and that the upper reaches may be perennial, but the middle reaches above the old Frish Ranch are likely intermittent. Further investigations are required.

Macroinvertebrates

DEQ has collected macroinvertebrates three times in Left Hand Fork Beaverdam Creek. Macroinvertebrates were collected in two general locations, lower Left Hand Fork Beaverdam Creek just above Right Hand Fork Beaverdam Creek and upper Left Hand Fork Beaverdam Creek just below Johnny Canyon. The macroinvertebrate samples from the lower location and one sample from the upper location have not yet been analyzed. The community was sampled at the upper location in 1997, and results were indicative of good water quality. Under the 1996 WBAG, the macroinvertebrate index in this reach was more than the 3.5 score indicative of no water quality impacts (4.75). This indicates that minimal disturbances are occurring. Under the new system the SMI score was also very high for a basin desert stream (64.45).

Aquatic Vegetation

The presence of aquatic vegetation was noted in the upper segment of Left Hand Fork Beaverdam Creek. However, these aquatic plant communities were not excessively abundant. In most cases, the community consisted of periphyton with no long filamentous organisms present. A chlorophyll *a* sample was collected during the peak of the summer growing period to determine if nuisance conditions existed. The sample collected was well below (2 mg/m^2) the 200 mg/m^2 value suggested (see Section 2.2) to indicate nuisance aquatic vegetation growths. This value supports the beneficial use assessment based upon the fisheries and macroinvertebrate communities. As such, it is unlikely that excessive nutrients are the factor effecting the beneficial uses of the upper reach of Left Hand Fork Beaverdam Creek. Aquatic vegetation was not noted in the lower section of Left Hand Fork Beaverdam Creek. The lower section was visited throughout the summer of 2001. At that time, the channel was clear of any noticeable aquatic vegetation.

Left Hand Fork Beaverdam Creek Existing Water Quality Data

Water quality samples containing a full suite of constituents collected within the listed segment of Left Hand Fork Beaverdam Creek are rare. No results for Left Hand Fork Beaverdam Creek could be found in EPA's STORET database.

DEQ sampled in the creek over the course of 2001, and additional samples will be collected throughout the various phases of the TMDL process as budgets and sampling time frames allow. However, due to the limited number of sampling periods in the original 2001 data set, DEQ's confidence in the monthly average concentrations is low. The lack of a robust data set was due to limited budgets and, in part, to a limited time frame for collecting data. In most cases one sample was the most collected in any given month. Infrequently, multiple samples were collected in a month. This sampling design was intended to determine annual pollutant loads . However, the annual load estimated by this type of design would overestimate annual load by 25 to 50 percent (Robertson and Richards 2000). To assist in the determination of seasonal components and appropriate critical conditions, the data will be presented as monthly averages in the following tables while period of record averages are presented in the text and other tables and used for any future load calculations. For those cases when a parameter was below detection limits, half the detection limit was used to calculate the monthly average and was used as part of the period of record average.

Two sample locations were set up in Left Hand Fork Beaverdam Creek with sampling beginning in April 2001 (Figure 20) at the upper location and occurring August through October 2001 at the lower. The sites were used to determine concentrations and loads for the stream. The upper site will be used to determine the concentrations and loads due to activities along the perennial reach from the headwaters to the mouth of Johnny Canyon, while the lower site will be used to determine the concentrations and loads in the lower perennial section (through the Old Frish Ranch to the confluence of the forks).

Data collected throughout 2001 at the upper location conflict with the aquatic life assessment based on the macroinvertebrates and the potential for a self-sustaining salmonid population throughout most of the year. Once cattle were shifted into the upper section of the creek, water quality parameters were some of the highest measured in the subbasin. This was likely because water was not available for much of the growing season. Consequently, the range conditions were likely poor. As a result, cattle congregated near the stream and had a significant impact on water quality. It is unknown if riparian grazing standards and guidelines were exceeded.

At the upper location, water quality constituents were near levels measured at other locations throughout the subbasin early in the summer (Table 24). For example, prior to the first half of June, TSS averaged 18 mg/L, while after mid June TSS averaged 69 mg/L. Most of the increase is directly attributable to the presence of cattle in and along the stream throughout July and August. Other constituents follow the same pattern: low concentrations until cattle are moved into the area. For example, TP increased from 0.133 mg/L average (background concentration) to 0.318 mg/L average; bacteria from 77 col/100 ml to 9,101 col/100 ml; and ammonia from 0.009 mg/L to 0.033 mg/L after cattle are moved into the allotment. Again it is unknown if cattle behavior was anomalous due to the poor range conditions brought about due to the low water year or if this was a normal grazing season. Clearly, the data indicate that the critical period for upper Left Hand Fork Beaverdam Creek is when cattle are moved into that section of the allotment.

Instantaneous temperature measurements were also collected in upper Left Hand Fork Beaverdam Creek. Temperature exceedances did not occur in Left Hand Fork Beaverdam Creek. Temperature effects are likely minimized due to the proximity to the spring sources of the creek. Specific conductivity and TDS are elevated year-round, indicating the predominance of ground water.

Table 24. Measured water quality constituents in upper Left Hand Fork Beaverdam Creek.

Month	No of Samples	TSS (mg/L)[a]	Total NH_3 as N (mg/L)[b]	Total NO_2 + NO_3 (mg/L) as N[c]	Total P (mg/L)[d]	Temp (°C)	Dissolved Oxygen (mg/L)[e]	Bacteria *E. coli* (Col/100 ml)[f]
January	0							
February	0							
March	0							
April	1	22	0.007	0.019	0.128	14.94	8.54	78
May	2	18	0.011	0.021	0.109	15.67	8.07	29
June	3	19	0.010	0.031	0.161	15.91	7.87	1,683**
July	2	112	0.067	0.223	0.452	20.01	6.84	9,483*
August	1	84	0.026	0.194	0.345	20.36	7.11	7,500**
September	1	44	0.006	0.019	0.295	8.97	8.87	290
October	1	2	0.016	<0.005	0.078	6.46	10.65	170
November	0							
December	0							
Annual Average		42	0.022	0.071	0.221	16.60	7.84	5,922
Standard Deviation		35	0.020	0.196	0.125	5.27	1.19	7,632

a Total suspended solids in milligrams per liter, TSS detection limit = 1 mg/L.
b Total ammonia as nitrogen in milligrams per liter.
c Nitrite plus nitrate in milligrams per liter, as nitrogen. NO_2+NO_3 detection limit = 0.005mg/L.
d Total phosphorus in milligrams per liter.
e milligrams per liter.
f colonies per 100 milliliters. *geometric mean of five samples ** The average of three samples

At the lower sampling location, the effects of different land use management can be seen in the slightly lower levels of the measured constituents (Table 25) in comparison to those levels measured at other Beaverdam Creek and Left Hand Fork Beaverdam Creek locations.

Table 25. Measured water quality constituents in lower Left Hand Fork Beaverdam Creek.

Month	No of Samples	TSS (mg/L)[a]	Total NH_3 as N (mg/L)[b]	Total NO_2 + NO_3 (mg/L) as N[c]	Total P (mg/L)[d]	Temp (°C)	Dissolved Oxygen (mg/L)[e]	Bacteria *E. coli* (Col/100 ml)[f]
January	0							
February	0							
March	0							
April	1	19	<0.005	<0.005	0.111	11.1	9.42	1
May	0							
June	0							
July	4	NA	NA	NA	NA	NA	NA	350 135*
August	3	15	0.01	0.006	0.151	12.73	8.59	80
September	2	24	0.009	0.007	0.164	9.61	9.09	797
October	1	20	0.007	<0.005	0.140	-0.1	12	16
November	0							
December	0							
Annual Average		20	0.007	0.005	0.146	9.77	9.34	296
Standard Deviation		13	0.009	0.002	0.019	4.79	1.22	422

a Total suspended solids in milligrams per liter, TSS detection limit = 1 mg/L.
b Total ammonia as nitrogen in milligrams per liter.
c Nitrite plus nitrate in milligrams per liter, as nitrogen. NO_2+NO_3 detection limit = 0.005mg/L.
d Total phosphorus in milligrams per liter.
e milligrams per liter.
f colonies per 100 milliliters. *geometric mean of five samples within 30 days.

Total suspended solids at the upper location averages 42 mg/L (standard deviation 39 mg/L), which is higher than the lower site (21 mg/L average, 5 mg/L standard deviation). These samples were taken on the same days and include the critical periods of springtime high flows and summertime low flows. Total phosphorus was lower as well. At the upper location the average TP concentration was 0.221 mg/L (0.136 mg/L standard deviation), while at the lower site the average TP concentration was 0.155 mg/L average (0.022 mg/L standard deviation). At the lower location, TP and TSS concentrations were remarkably stable throughout the year, as evidenced by the very low standard deviations. This may indicate that current land use practices are in equilibrium with the stream system and do not cause the seasonal water quality degradations seen in other systems within the subbasin, such as Beaverdam Creek.

At the upper location, strong correlations between bacteria, TP, and TSS were also evident, while at the lower site no such correlations could be made. This may indicate a strong link between the land use activities degrading the water quality in the upper location and a very weak link between land use activities in the lower reach. As such, ground water quality at the lower location may be a bigger influence on water quality parameters than current land use activities.

Monthly concentrations of TP were indicative of excess nutrients that may cause impairment (nuisance aquatic vegetation) while other nutrient constituents are not indicative of excess nutrients. The guidelines that DEQ has used in the past are 0.160 mg/L TP in any single sample and 0.100 mg/L TP in any average monthly sample. The guidelines were exceeded in September when the monthly average value was 0.164 mg/L TP. However, a lack of nuisance aquatic vegetation is seen within the system. Additionally, background TP levels were determined to be 0.129 mg/L TP in Left Hand Fork Beaverdam Creek area. While TP was elevated NO_x values were near detection limits (0.005 mg/L) throughout most of the year. Further chlorophyll *a* samples are required to determine if these levels of nutrients are impacting water quality.

Bacteria concentrations were also elevated (244 col/100 ml average for the period of record). Bacteria counts were highly variable throughout. Occasional exceedances of the instantaneous state water quality standards occurred, but subsequent samples generally were significantly lower. However, in July and August 2001, five samples were collected, beginning during the middle of July and continuing through the middle of August, which indicate that the geometric mean standards were violated. The land owner was notified and has since split a pasture and changed the grazing management plan to effect a change in the water quality. Follow-up monitoring has determined that a TMDL is not warranted.

From the data set, TSS also appears to be a non-factor effecting beneficial uses. However, the samples were collected during drought years in which water levels were diminished. Consequently, much of the sediment stored in the system was never transported out of the reach as a suspended load. In a higher water year, the data from the suspended fraction may support the contention that a sediment TMDL is required.

The inference DEQ draws from the bacteria, TSS data, and TP information is that the phosphorus is likely coming from a natural source rather than from a sediment associated source or being exacerbated by animal concentrations. This situation is similar to the natural sources in Goose Creek. Further validation of this hypothesis will occur as more data are collected.

Dissolved oxygen was also monitored throughout 2001. At no time did DO fall below state water quality standards. Dissolved oxygen is often used in conjunction with pH to determine if excess nutrients have caused nuisance aquatic growths. DEQ determined that excess aquatic growths did not occurred in Left Hand Fork Beaverdam Creek during the 2001 sampling period. The DO and pH data support this contention. Therefore, DEQ finds that the lower segment of Left Hand Fork Beaverdam Creek is not polluted with oxygen demanding materials.

Instantaneous temperature measurements were also collected in the lower reach of Left Hand Fork Beaverdam Creek. The temperature at the lower location never exceeded 15 °C. This is likely due to the proximity of the spring source. The springs would act as a temperature buffer for the system.

Point and Nonpoint Sources

Left Hand Fork Beaverdam Creek is one of two water quality limited streams that flow through fifth field HUC 1704021109. In order to determine what point and nonpoint sources contribute to Left Hand Fork Beaverdam Creek, a 1.6 km (one mile) buffer on each side of the stream was calculated from GIS coverages. The land use within this critical zone is considered to contribute to the specific water body if more than one water body exists within a watershed or if the water body is not the pour point of the watershed. The land uses (from GIS) in the critical buffer are 71 percent rangeland and 29 percent forest. Most nonpoint source pollution in the watershed comes from activities associated with these land uses. Rangeland activities predominate both the forest and rangeland areas. Additional sediment sources include unstable banks and reentrainment from the streambed itself. However, quantification of these sources has not been completed. As of yet, no CAFOs or other point sources are known to exist within the watershed.

Conclusions

In summary, it appears from the data that suspended sediment, nutrients, and bacteria are at values determined to impair beneficial uses in the upper portion of the creek. It is unknown if the concentrations measured summer/fall 2001were indicative of water quality during the typical grazing period or if 2001 was abnormal due to the poor water year in the area. Consequently, DEQ will continue to monitor Left Hand Fork Beaverdam Creek as monies are available. However, DEQ developed TMDLs for suspended sediment, nutrients, and bacteria for the upper portion of Left Hand Fork Beaverdam Creek based upon data collected in 2001.

Furthermore, it appears from the data that suspended sediment, DO, and temperature are within the bounds of water quality determined to be supportive of the designated beneficial uses in the lower portion of Left Hand Fork Beaverdam Creek. Occasional bacteria elevations occur in the lower portion of Left Hand Fork Beaverdam Creek, but a preemptive management change was done to correct that problem. Due to the cooperation with the landowner, DEQ will continue to monitor bacteria at the lower location to determine if the measures were sufficient to eliminate the need for a TMDL. Consequently, DEQ will not complete a suspended sediment, DO, or bacteria, TMDL on the lower portion. Further investigations will be completed as budgets and monitoring logistics allow.

Mill Creek

Mill Creek begins in the Albion Mountains of Idaho and flows to the lower boundaries of the creek near Basin and Oakley, Idaho. Throughout its approximate 20 km length, it crosses two ecoregions: the Northern Basin and Range and the Snake River Basin/High Desert. Along this course, the perennial tributary Spring Creek enters the system, as do numerous intermittent and ephemeral systems. The lower bound of Mill Creek ends with the East Canal from Goose Creek Reservoir. However, during the irrigation season it is unlikely that Mill Creek empties into the canal, as the creek is 100 percent allocated for irrigation and stock water rights. Much of the lower portion of Mill Creek has been channelized and/or moved from its original course. Currently nearly 2 km of Mill Creek run in a roadside ditch through the town of Basin. The USGS has not had a gauge located in Mill Creek in Idaho. The Mill Creek Watershed is an area of approximately 21.24 km^2. Given this size watershed, channel characteristics were extrapolated from regional curves. These regional curves are in *Applied River Morphology* (Rosgen 1996). Extrapolating from the regional curve, Mill Creek near the mouth should have a mean bankfull depth of 0.55 m, a bankfull width of 5.91 m, and a bankfull cross-sectional area of approximately 3.34 m^2.

Physical Characteristics

The §303(d) listed segment of Mill Creek begins at the headwaters. The segment is 20.20 km long. The valley through which this segment flows is approximately 18.09 km in length. Over the entire listed segment, the creek has a very high slope of 6.15 percent. This slope corresponds to a 61.52 m fall per kilometer. Slopes of this magnitude are usually seen in streams with very low sinuosity that are by nature erosional. Sinuosity is classified as low (1.1) for the listed segment. Floodplain materials are composed of coarse textured sands derived from colluvium and glacial till. Consequently, it would be expected that the percent fines of Mill Creek should be lower in comparison to a channel with lower slopes, higher sinuosity, and finer floodplain materials such as Goose Creek. Bankfull measurements near the mouth indicate that Mill Creek falls within the normal expected parameters of a stream within its watershed size in the arid Goose Creek Subbasin. Typically, in the arid Goose Creek Subbasin, the streams are half of what is predicted by Rosgen extrapolations (Rosgen 1996). The mean bankfull depth was 0.51 m, mean bankfull width was 3.6 m, and bankfull area was 1.84 m^2.

Hydrology

Flow data have not been required to complete the assessment of temperature issues in Mill Creek to date. It should be considered a data gap and be filled as soon budgets and monitoring time frames allow.

Fisheries

Idaho Department of Fish and Game stocking records indicate that trout have not been stocked in Mill Creek. Therefore, DEQ assumes that any salmonids captured in Mill Creek are from wild or naturalized populations. The naturalized populations may be from rogue stockings that have occurred throughout the west. The IDFG has not surveyed the fishery in Mill Creek. Mill Creek is an isolated system within the Goose Creek Subbasin. DEQ has never electrofished Mill Creek. Electrofishing efforts should be undertaken to quantify the fish community. Currently it should be considered a data gap. Because Mill Creek does not connect with other streams containing fishes, DEQ is uncertain if Mill Creek contains salmonids.

Macroinvertebrates

DEQ has collected macroinvertebrates twice in Mill Creek. Macroinvertebrates were collected in two general locations; lower Mill Creek in the narrows just below the town of Basin and upper Mill Creek just onto the USFS managed lands. The macroinvertebrate communities at the lower location and the upper location were analyzed and assessed following the 1996 WBAG protocols. It was determined that Mill Creek was meeting its beneficial uses. However, EPA added Mill Creek to the 1998 §303(d) list for temperature exceedances due to a single instantaneous temperature exceedance. The single temperature measurement at the lower site was 27 °C. However, the macroinvertebrate community at the lower location was still within the “needs verification” range of scores. Temperature could have be the pollutant driving the decrease in macroinvertebrate community health. However, more probable was flow alteration. At the time of the sample collection at the lower location, Mill Creek was flowing at 0.006 m^3/s (0.21 cfs). In the days following the sample collection Mill Creek was dry. The lower bounds of Mill Creek are routinely dry during the irrigation season due to diversion, the fact that the creek has been channelized and removed from the natural channel to facilitate water delivery, and has had most of its natural vegetation removed. In essence, the lower portion of the creek below Basin is a canal.

The macroinvertebrate community was sampled at the upper location in 1996 and results were indicative of good water quality. Under the 1996 WBAG, the macroinvertebrate index in this reach was more than the 3.5 score indicative of no water quality impacts (4.79). This indicates that minimal disturbances are occurring.

The SMI scores for the two sites resulted in a similar interpretation as that generated by the MBI and 1996 WBAG. The SMI score from the upper location was very high, 68.89, while the lower, dewatered segment was 33.67. Condition rating scores for the two locations would be 3 and 1, respectively, indicating full support and not full support of beneficial uses, respectively

Aquatic Vegetation

Only a small amount of aquatic vegetation was noted in Mill Creek. When aquatic plant communities did occur they were not excessively abundant. In most cases, the community consisted of periphyton with no long filamentous organisms present. As such, it is unlikely that excessive nutrients are the factor effecting the beneficial uses of Mill Creek.

Mill Creek Existing Water Quality Data

DEQ placed a temperature data logger near the lower bounds of Mill Creek (above Basin) in the late spring of 2001 to evaluate the cold water aquatic life default beneficial use. It is unknown at this time if other aquatic life uses exist in Mill Creek. Therefore, only cold water aquatic life will be addressed in this assessment.

It appears that there were slight exceedances of the instantaneous maximum temperature standard during one week in mid August 2001. During this week, the average temperature standard was also exceeded. However, for the remainder of the summer neither criterion was exceeded (Figure 38).

DEQ policy concerning §303(d) listing of a water body is that greater than 10 percent of the samples must exceed the criterion in order to add a stream to the list of impaired water bodies. Mill Creek does not meet this policy; and therefore, would not have been listed for temperature by the state of Idaho had the temperature logger data been available at the time of the 1998 §303(d) assessments (Table 26). Other factors that may indicate temperature problems in Mill Creek also do not exist. The stream, in the non-channelized portion, appears to have a healthy and vigorous riparian zone, the macroinvertebrate community meets DEQ criteria for fully supporting cold water aquatic life uses, and the stream is perennial.

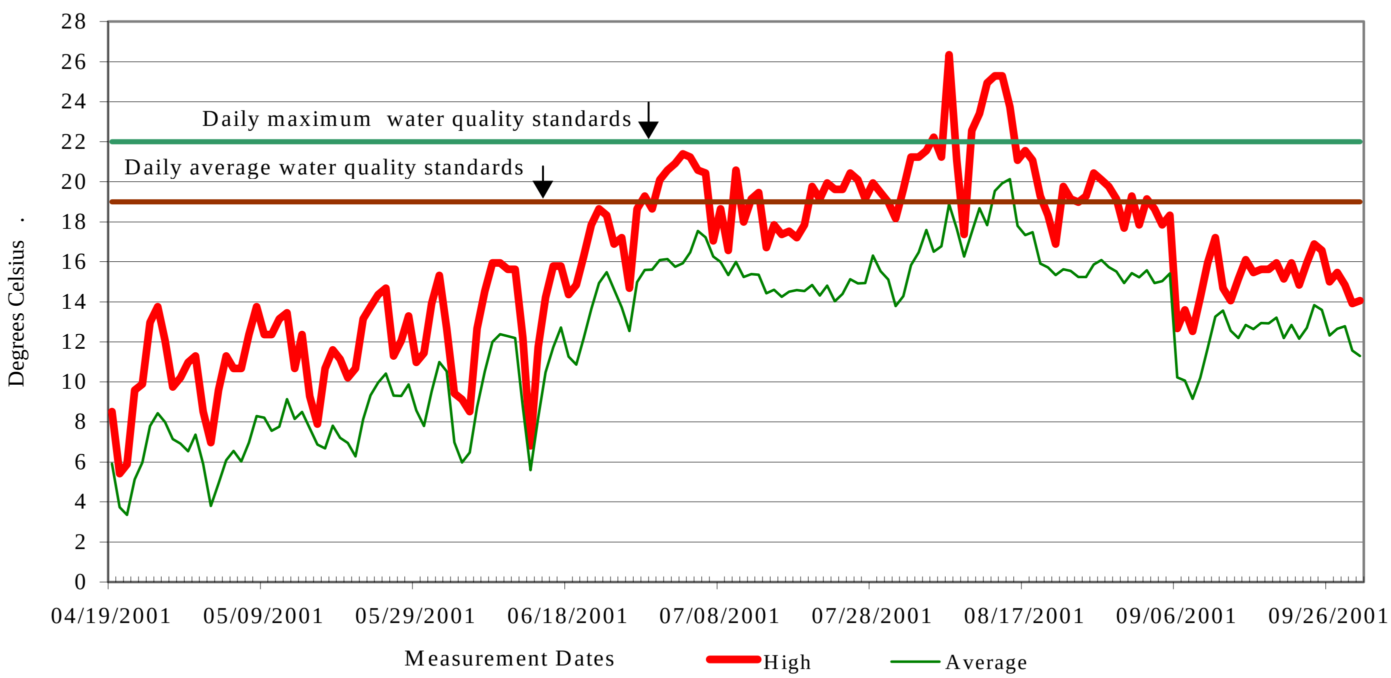


Figure 38. Mill Creek daily water temperatures.

In the lower, channelized portion of Mill Creek, the stream is impaired by flow alteration. The flows in this section of the creek are below what the state water quality standards require for cold water aquatic life.

Point and Nonpoint Sources

Mill Creek is the only water quality limited stream that flows through fifth field HUC 1704021103. Consequently, the point and nonpoint sources of this watershed are those considered to contribute pollutants to Mill Creek. The GIS coverage of the watershed indicate that 48.9 percent rangeland, 47.6 percent irrigated agricultural lands, 1.9 percent urban, and 1.4 percent forest. Most nonpoint source pollution in the watershed comes from activities associated with these land uses. Rangeland activities predominate both the forest and rangeland areas.

Table 26. Mill Creek aquatic life criteria exceedances.

Idaho cold water aquatic life-criteria exceedance summary		
Criteria	**Exceedance Counts**	
	Number of Exceedances	**Percent Exceedance**
22 °C Instantaneous	8	5%
19 °C Average	3	2%
Days Evaluated and Date Range	92	06/22-09/21 2001

Conclusions

DEQ will remove Mill Creek from the §303(d) list for temperature unless other information indicates that temperature is impacting the cold water aquatic life beneficial uses of the creek. Flow alteration will be considered for the lower bounds of Mill Creek below the town of basin.

Goose Creek Reservoir

Goose Creek Reservoir lies within the south central mountains of Idaho in an area south of the town of Oakley. The major sources of water for the reservoir are Trapper Creek, Goose Creek, and Birch Creek. At full pool, the reservoir covers approximately 407 hectares. The Oakley Canal Company operates a nonrecording gauge at the reservoir. Those data are shared with the USGS and are available in the annual water resource reports. The Goose Creek Reservoir watershed covers an area of approximately 1,888 km^2. Usable storage in the reservoir is 77,400 acre-feet. The dam was constructed in 1911, with storage beginning in that year. The crest of the spillway is at 138.4 feet. This was raised from 136.0 feet in 1984, due to potential flooding of the downstream areas. The reservoir has spilled only twice since its initial construction. The first was in 1921, prior to the removal of the natural Goose Creek drainage to the Snake River through Burley; the second time was in 1984. A massive community effort was required to construct a canal to the Snake River following the old Big Cottonwood Creek drainage (Hedberg 1993). Through water management, the reservoir has filled several more times but did not require spilling water through any water conveyance system other than the current canal system. Historically Goose Creek Reservoir has underfilled in most years. This factor led to the reduction of water project lands from 43,893 acres to 21,000 acres shortly after the reservoir was completed (Hedberg 1993).

Physical Characteristics

The reservoir has an overall length of 7.89 km and an effective length of 5.23 km through the Goose Creek arm. The maximum width is 1.69 km, while the average width is 0.78 km. The shoreline development (or shoreline area) is moderate at 2.97 (a perfectly round lake would have a shoreline development of 1.0, while a highly dendritic lake would have much higher shoreline development). For comparison, Lake Mead has a shoreline development of 9.72, Salmon Falls Reservoir has a shoreline development of 5.32, and the third lake of the Independence Lakes has a shoreline development of 1.03. The maximum depth in water year 2001 was 27 m, with a mean depth of 13.61 m (volume/surface area). See Figure 39 for the relationship between depth and volume.

Hydrology

The amount of water that enters Goose Creek Reservoir can best be described by a summation of Trapper Creek and Goose Creek USGS gauge data. In addition, there are several decrees that allow for the diversion of excess water from Birch Creek into the reservoir. The summation of these decrees equals the excess of approximately 750 miner's inches of water (15 cfs) in Birch Creek. Therefore, any water in excess of 15 cfs is available to be diverted into the reservoir. In many years, this is only a few days of diversion at best, while in flood years, such as 1997, it may mean several months of diverted water flowing into the reservoir.

To estimate how much water enters the reservoir DEQ summed the Trapper Creek and Goose Creek discharge data from the USGS gauges. From the relationship with Birch Creek and Goose Creek (see Birch Creek hydrology in proceeding sections), discharge from Birch Creek in excess of 15 cfs was added to the summation. However, it is likely that this will overestimate the contribution of Birch Creek. Any time Birch Creek was over 15 cfs regardless of time of year, or number of days the excess water existed, the additional amount was added into the reservoir input. In reality, the excess above 15 cfs would likely only be diverted to the reservoir following several days of excess flow and likely only in the spring. However, for ease of summation of several decades of data, any event in the Birch Creek system above 15 cfs was added to the reservoir input. Annual average input ranged from nearly 200 cfs in May to a low of approximately 25 cfs throughout the summer (Figure 40). See Figure 41 for a depiction of the net volume change based on the values in Figure 40.

Fisheries

Idaho Department of Fish and Game stocking records indicate that numerous species of fish have been stocked in Goose Creek Reservoir since 1967. Predominantly rainbow trout are placed in the water body. Fish and Game records indicate that several species of salmon were stocked in the early 1970s. Channel catfish were also stocked several times since 1974 (the earliest event for catfish). Walleye were stocked nearly every year from 1989 to 1998. Typically, one strain or another of rainbow trout are stocked each year (up to several times per year) and range from fingerlings to catchable sizes. Therefore, DEQ assumes that any salmonids captured in Goose Creek Reservoir are from stocked populations. In addition, IDFG has planted spottail shiner (*Notropis hudsonius*) as a forage fish for the walleye population. The IDFG surveys the spottail population though beach seines on an annual basis. From that information, it appears that the forage fish are thriving in the reservoir. However, no information was available concerning the population of game fishes. Idaho Department of Fish and Game management strategies for the reservoir over the past 10 years have fallen in the general fishery category. Therefore, no special regulations, such as slot limits, are in place.

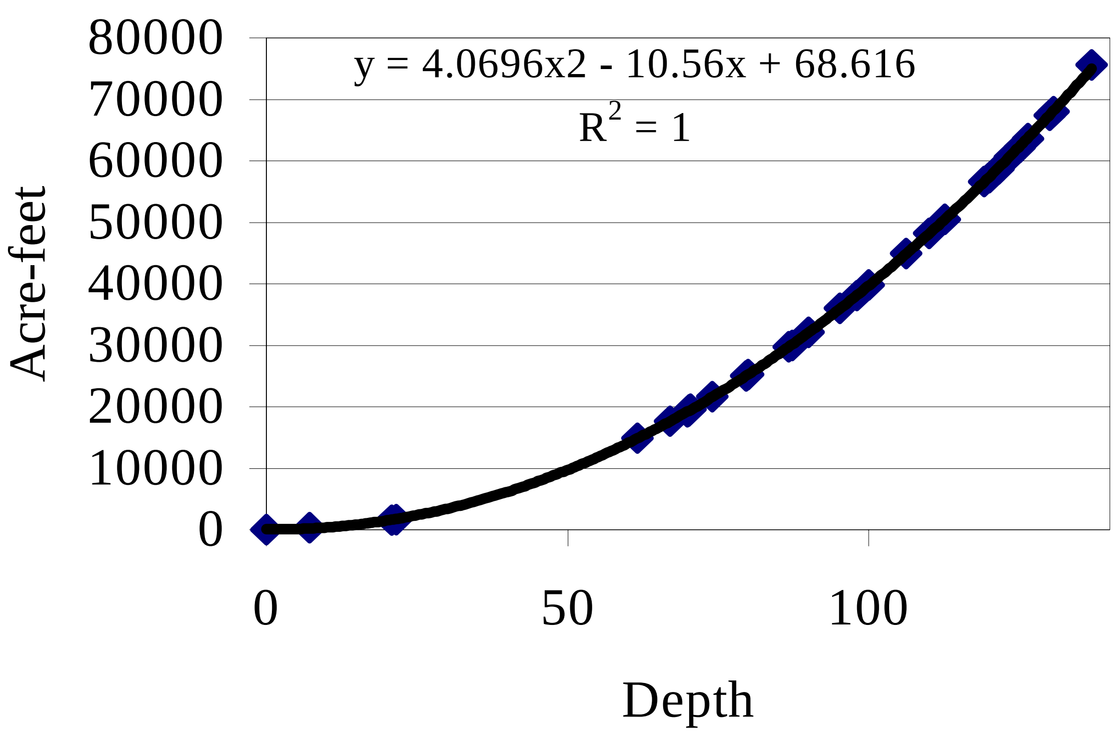


Figure 39. Depth to volume relationship for Goose Creek Reservoir.

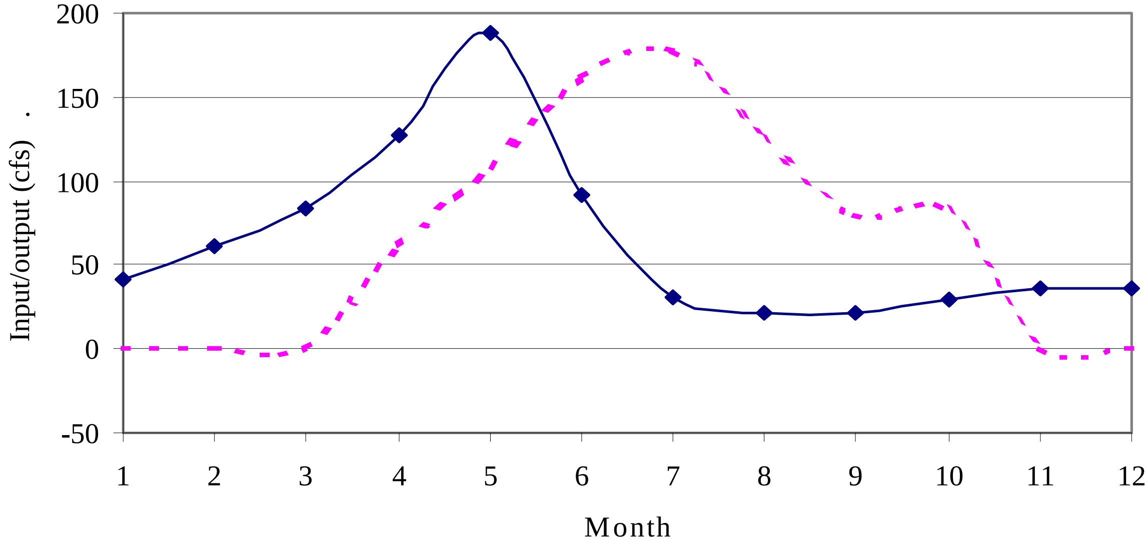


Figure 40. Annual average hydrograph for the reservoir input (solid line) and output (dashed line).

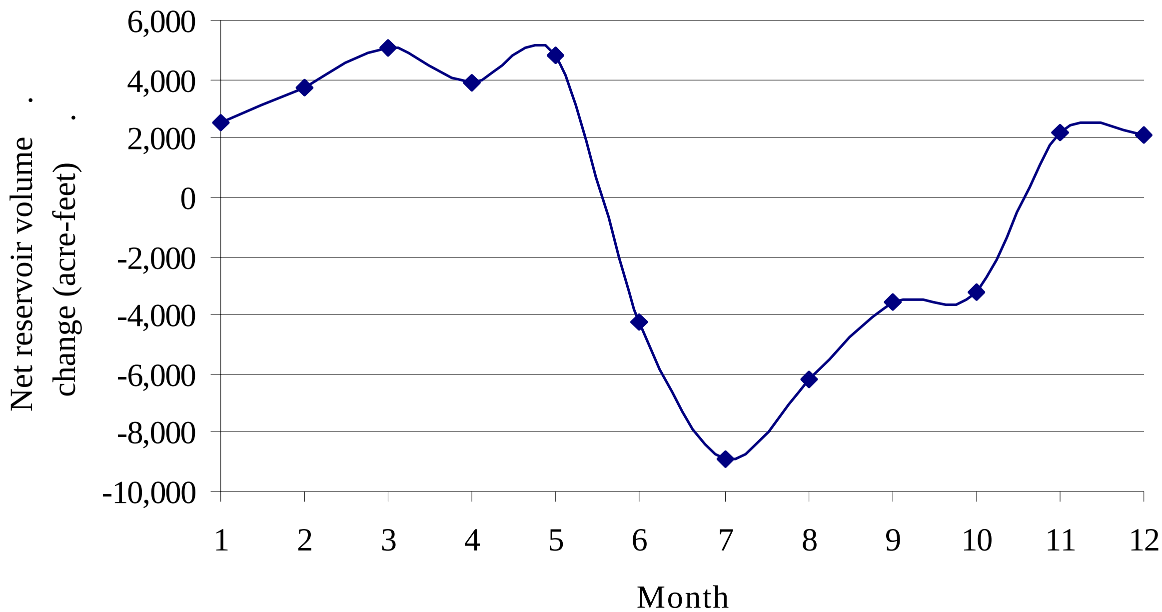


Figure 41. Annual reservoir net volume change.

Macroinvertebrates

DEQ collected macroinvertebrates in Goose Creek Reservoir one time in 1997. Macroinvertebrates were collected in three general locations and pooled for analysis. The first location was near the boat launching area near the Trapper Creek inlet. The second was in the Goose Creek inlet, and the third was near the dam. Few macroinvertebrates were collected in the pooled samples. Overall, the community consisted of chironomids and oligochaet worms. An assessment of the water quality based on the macroinvertebrate community will not be completed. Statewide, there is a limited number of limnetic benthic samples, a lack of a reference community for comparison, and a general shift towards lower trophic level analysis using Carlson's trophic state index (TSI). However, the macroinvertebrate community in Goose Creek Reservoir appears similar in density and community composition to other oligotrophic lakes and reservoirs (Wurtsbaugh and Hawkins 1990, Wurtsbaugh and Lay 1998).

Aquatic Vegetation

Emergent aquatic vegetation such as water smartweed (*Polygonum amphibium)* and pondweed (*Potomogeton amplifolius)* is noticeably lacking within the reservoir. It appears that the most significant primary production comes from algal cells within the reservoir. DEQ collected phytoplankton in 1997 to determine the composition of the algae in the reservoir. At that time, the phytoplankton community consisted of four groups, green algae, diatoms, cryptophyts, and blue-green algae. Typically, blue-green algae dominate highly eutrophic systems. In Goose Creek Reservoir, the blue-greens made up only 0.76 percent of the biovolume, while diatoms and green algae made up 79.34 percent of the biovolume. As another indicator of trophic state, chlorophyll *a* samples were collected throughout the year to determine if nuisance conditions existed. For lakes, Carlson's TSI can be used to determine if a lake is undergoing cultural eutrophication (Carlson 1977). The Utah Department of Environmental Quality has used a TSI score of 50 as a threshold value to indicate impaired water quality in many of the TMDLs completed for excess nutrients in lakes (UDEQ 2000). In order to reach a TSI of 50 for chlorophyll *a* the concentration of chlorophyll *a* has to be higher that 7.22 μg/L. The samples collected from Goose Creek Reservoir throughout the summer were below (mean 3.60 μg/L) the value suggested, indicating nuisance aquatic vegetation growths. As such, it is unlikely that excessive nutrients are the factor effecting the beneficial uses of Goose Creek Reservoir.

Goose Creek Reservoir Existing Water Quality Data

The EPA's STORET database contains no samples collected from the reservoir. Data queries from other agencies have yielded no water chemistry data. Therefore, DEQ data are the only readily available data for Goose Creek Reservoir.

DEQ sampled in the reservoir over the course of 2001 and additional samples will be collected throughout the various phases of the TMDL process as budgets and time frames allow. However, due to the limited number of sampling periods in the original data set, DEQ's confidence in the monthly average concentrations is low. The lack of a robust data set was due to limited budgets and, in part, to a limited time frame for collecting data. In most cases one sample was the most collected in any given month. Infrequently, multiple samples were collected in a month. This sampling design was intended to determine annual pollutant loads . However, the annual load estimated by this type of design would overestimate annual load by 25 to 50 percent (Robertson and Richards 2000). To assist in the determination of seasonal components and appropriate critical conditions, the data will be presented as monthly averages in the following tables while period of record averages are presented in the text and other tables and used for any future load calculations. For those cases when a parameter was below detection limits, half the detection limit was used to calculate the monthly average and was used as part of the period of record average.

Three sample locations were set up in Goose Creek Reservoir, with sampling beginning in April of 2001 (Figure 20). The first sampling site was set up near the dam in the area of the deepest part of the reservoir or "Zmax". The Zmax site was used to determine the average concentrations for the water body. At this location, the reservoir waters have had a chance to equilibrate and begin to function as a lake rather than as a stream. Two additional sampling locations were established in each arm of the reservoir. These locations were used to understand the relative contribution from the two major inputs. The chemical constituents within each site seemed to be very similar throughout the sampling period. However, there seemed to be some differences among sites. In order to determine if this was the case, analysis of variance was conducted to test the null hypothesis.

H_o: Goose Creek arm = Trapper Creek arm = Zmax
H_a: Goose Creek arm ≠ Trapper Creek arm ≠ Zmax

Each constituent sampled at the three locations was tested using Systat 7.0. For most constituents (TP, (NH_3, temperature, DO, and TSS) the null hypothesis was not rejected ($p > 0.05$). These constituents can be pooled for discussion. However, nitrogen and secchi depth (a measurement of water clarity) differed significantly among sample sites ($p < 0.05$). In order to determine which location was different, a Tukeys post hoc test was performed. Nitrogen in the Trapper Creek arm was significantly different from nitrogen concentrations in both the Goose Creek arm ($p = 0.028$) and Zmax ($p = 0.043$). Similarly, secchi was significantly different among all locations ($p = 0.007$). Upon completion of the Tukeys post hoc test, it was determined that the Zmax was significantly different from both the Trapper Creek and Goose Creek arms. Although nitrogen is significantly different between the Trapper Creek arm and the other sites it should be recognized that the difference is between non detection (0.005 mg/L) at the other sites and 0.006 mg/L at the Trapper Creek site. The relationship between sites for transparency (secchi depth) is as expected. Transparency should increase further from the sediment sources (the streams) as the solids drop out of suspension.

The levels of the measured constituents (Table 27) in Goose Creek Reservoir are very low. These levels in most all cases indicate the higher assimilative capacity of the reservoir compared to Goose Creek and Trapper Creek, as well as lower use and lower degradation. For example, TSS at Zmax averaged 3 mg/L; at the Goose Creek arm, 5 mg/L; and at the Trapper Creek arm, 3 mg/L (Trapper Creek had a wind event coupled with extremely low water which yielded a 350 mg/L data point that was excluded from the mean). The average TP was 0.035 mg/L at Zmax. The average TP in both the Goose Creek and Trapper Creek arms (0.067 mg/L and 0.076 mg/L, respectively) was elevated due to the proximity to the sources. DEQ collected one sample from near the discharge point in 1998. This bottom sample was 0.18 mg/L. Phosphorus is typically elevated in the hypolimnetic waters of a lake or reservoir. It is likely that during the irrigation season the bottom withdrawal leads to an overall export of TP from the system. Further investigations are needed.

Carlson's TSI can also be used to determine if nutrients are in excess. Again, a TSI for TP score above 50 has been used in other states as a threshold for excess nutrients. A TSI of 50 corresponds with 0.025 mg/L of TP, 1 m secchi, and 7.25 µg/L chlorophyll *a*. Based upon these numbers, Goose Creek Reservoir exceeded the threshold value for TP once at the Trapper Creek arm location as the summer progressed. Both the tributary bays exceeded the secchi depth threshold several times throughout the summer. Chlorophyll *a* was sampled only at Zmax. At that location, the TSI of 50 was never exceeded for that parameter. Likely causes of the decreased transparency in the tributary bays are increased sediment load from the streams, increased chlorophyll *a* due to the higher nutrient concentrations, or a combination of the two. Because chlorophyll *a* was not available from the bays, caution should be exercised in determining the root of the decreased transparency. Overall, the average TSI scores for all three locations were well below the 50 TSI threshold, as seen in Figure 42.

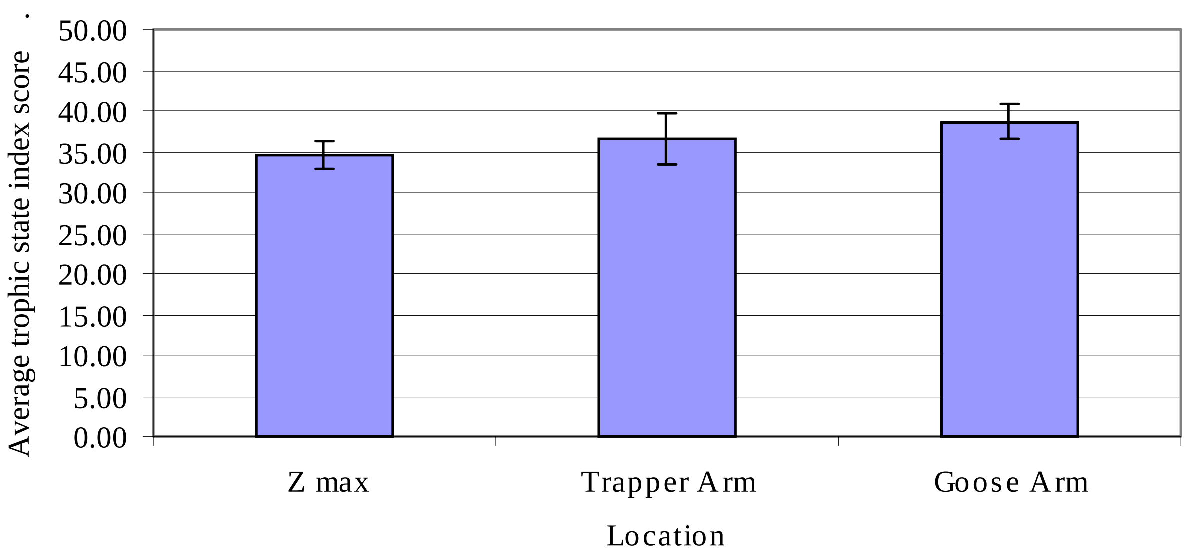


Figure 42. Mean Goose Creek Reservoir trophic state index scores (with standard error).

The TSI scores in a reservoir can be very complicated under severe draw-down events such as occurred in the summer of 2001. Phosphorus can be mobilized from the sediments in the deeper portions of the lake due to natural processes. When a lake is drawn down, this layer of water becomes mixed with the epilimnetic (and low TP) waters, enriching the system later in the year when it is typically poor in nutrients (Wetzel 1983). In addition, sediments rich in adsorbed TP can be remobilized as the waters recede (Wetzel 1983). Both of these situations likely occurred in Goose Creek Reservoir throughout the summer of 2001. Further investigations are required to determine if there is a significant trend in TSI scores. However, it appears from TSI scores for TN and TP that the reservoir is nutrient limited as the TSI scores were typically in the mid 30s, while secchi scores were near 50. Thus, it is not likely that nutrients are impairing the beneficial uses of the reservoir.

Bacteria samples were collected near the more heavily used Trapper Creek arm. This area is in close proximity to the boat ramp and one of the few access points to the water. Colonies of *E. coli* were seldom present in the samples, and when they were in very low numbers (2 col/100 ml).

Temperature profiles were also collected throughout 2001 (Zmax data presented in Figures 43 and 44) at the three reservoir locations. At the end of April, the reservoir appears isothermal, although water was only sampled to 10 m. A weak stratification began to set up in May with the thermocline near 20 m in depth. As the epilimnion warmed throughout May and early June the stratification became more pronounced. At that time, the thermocline was near 13 m. The stratification began to break down in late June and the lake was isothermal from late June throughout the remainder of the summer. This was likely due to strong wind events driving the epilimnion deeper and the bottom withdrawals removing the colder hypolimnetic water from the reservoir. Coincidentally, this time corresponds with the increase in TP throughout the epilimnion, supporting the hypothesis that the increased TP levels are from stored phosphorus released from the sediments and hypolimnion and mixed with the epilimnetic waters as the reservoir is drawn down.

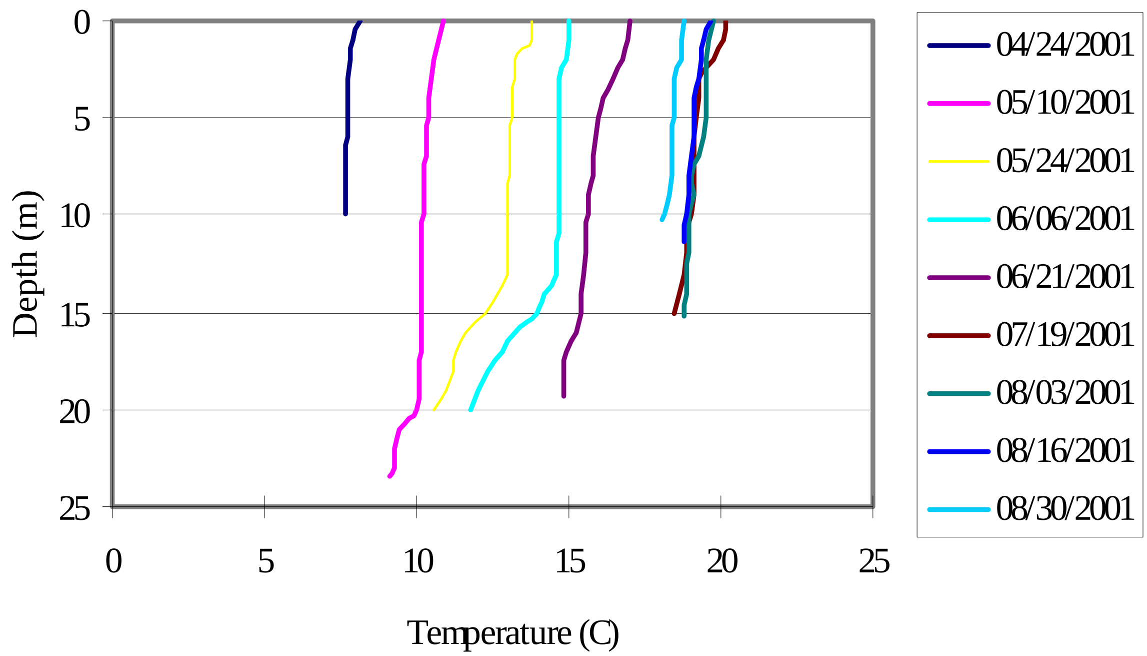


Figure 43. Temperature-depth profiles.

Dissolved oxygen profiles were also collected along with the temperature profiles. Similar situations were observed. Prior to stratification, DO levels were relatively high throughout the water column. Although some oxygen depletion was noted near the sediment interface even while the lake was isothermal. The oxygen depletion became more evident and extended higher into the water column as the year progressed. However, the waters near the sediment interface never became anoxic. DEQ had already determined that excess aquatic growths had not occurred in Goose Creek Reservoir during the sampling period. The DO and pH data support this contention. In addition, in lakes and reservoirs with significant primary production (or nuisance aquatic growths) the hypolimnetic waters will often become anoxic. In lakes that are isothermal, this situation rarely happens (Wetzel 1983). However, oxygen can become depleted in the lower bounds of some lakes and a chemocline can be established. Following the weak stratification in Goose Creek Reservoir, slight DO depletion began to occur in the hypolimnion. However, DO levels remained above state water quality standards near the sediment water interface. Therefore, DEQ finds that Goose Creek Reservoir is not polluted with oxygen demanding materials.

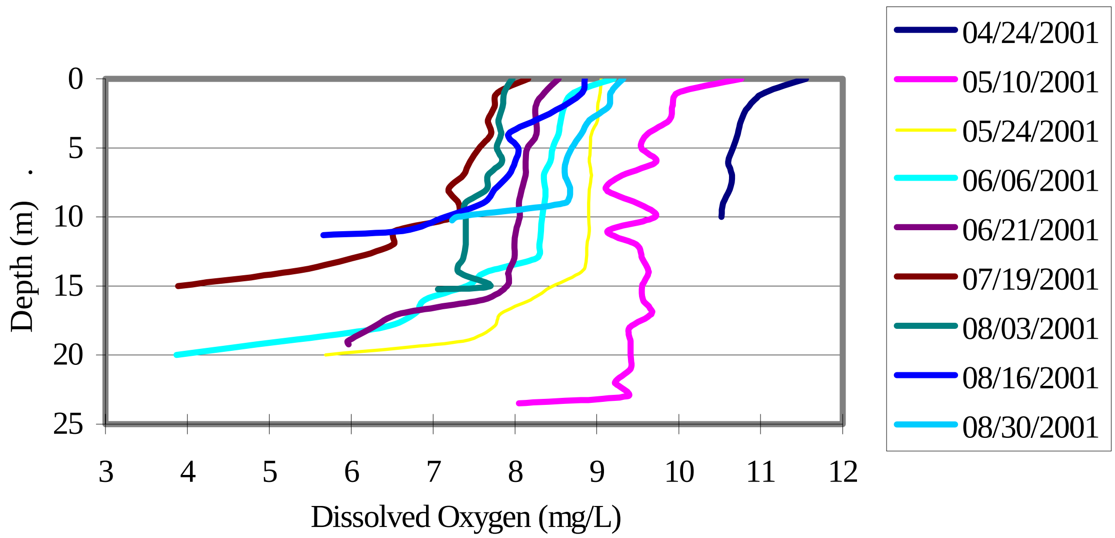


Figure 44. Dissolved oxygen-depth profiles.

Individually, TSI scores can give additional information when interpreting single constituents. However, the determination of the overall trophic state should not be based upon a single component of the index. To better understand what is occurring within Goose Creek Reservoir the individual components will be presented here. It should be recognized that the overall score is the basis for the water quality assessment. Individually the components of the overall TSI score make it appear that Goose Creek is a slightly eutrophic reservoir (Figure 45). Much of the weight is placed on the secchi values near the tributaries. However, the average chlorophyll *a* TSI score (40.95) does not reflect this trophic state. Likewise, the TSI based upon secchi is also much lower (43.61) in the main area of the lake. In addition, TP values at all three sampling locations are much lower (36.33). Thus, it appears that TP may not influence the aquatic vegetation in Goose Creek Reservoir. Furthermore, TN also appears to be well below the eutrophic threshold of 50 (TN TSI averages 32.26). The average TSI score for all components for the sampling period of 2001 increased along the same trend as TSI-TP. Thus, it can be seen the weight TSI-TP has in the overall average. However, overall TSI indicates that Goose Creek Reservoir is a mesotrophic reservoir. Reservoirs of this type are well balanced in terms of fish production and water quality. In more oligotrophic lakes, fish production is less while water quality is higher. The same trade-off exists for eutrophic waters with higher fish production and lower water quality. Therefore, mesotrophic lakes are viewed by many as the ideal target; hence, the many states and entities use a TSI target of 50 as their management goal.

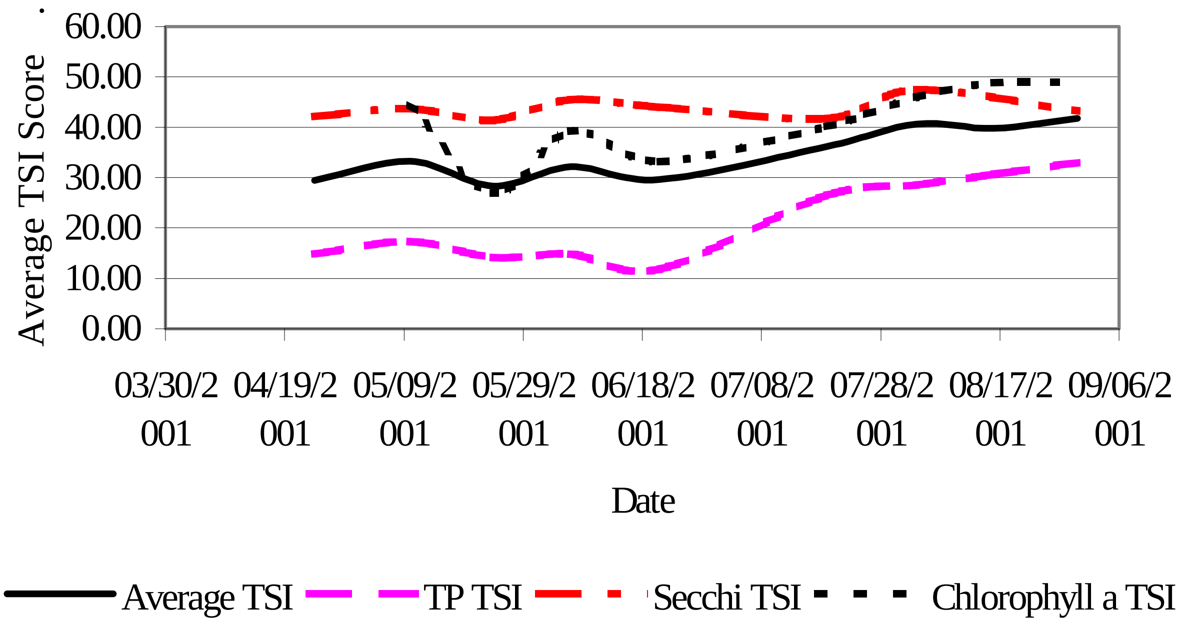


Figure 45. Trophic state index scores from Zmax throughout the 2001 sampling season.

Table 27. Measured water quality constituents in Goose Creek Reservoir

Month	No of Samples	TSS (mg/L)[a]	Total NH_3 as N (mg/L)[b]	Total NO_2 + NO_3 (mg/L) as N[c]	Total P (mg/L)[d]	Temp (°C)	Dissolved Oxygen (mg/L)[e]	Bacteria *E. coli* (Col/100 ml)[f]
April	3	2	0.007	<0.005	0.026	7.95	11.06	0
May	6	4	0.010	0.005	0.026	12.09	9.49	0
June	6	2	0.008	<0.005	0.022	16.01	8.48	0
July	5	3	0.012	<0.005	0.077	19.88	7.57	0
August	9	6	0.027	0.006	0.065	19.15	8.18	1
Average		17	0.017	0.004	0.058	15.72	8.79	NA
Standard Deviation		67	0.019	0.003	0.079	4.13	1.09	NA

a Total suspended solids in milligrams per liter, TSS detection limit = 1 mg/L.
b Total ammonia as nitrogen in milligrams per liter.
c Nitrite plus nitrate in milligrams per liter, as nitrogen. NO_2+NO_3 detection limit = 0.005mg/L.
d Total phosphorus in milligrams per liter.
e milligrams per liter.
f colonies per 100 milliliters.

Point And Nonpoint Sources

Goose Creek Reservoir is one of three §303(d)-listed water bodies in fifth field HUC 1704021106. In order to determine what point and nonpoint sources contribute to Goose Creek Reservoir, a 1.6 km (one mile) buffer on each side of the reservoir was calculated from GIS coverages. The land use within this critical zone is considered to contribute to the specific water body if more than one water body exists within a watershed or if the water body is not the pour point of the watershed. The land uses (from GIS) for the critical buffer are 75.3 percent forest, 22.5 percent rangeland, and 2.2 percent urban. Most nonpoint source pollution in the watershed comes from activities associated with these land uses. Rangeland activities predominate both the forested and rangeland areas. Additional sediment sources include unstable banks and reentrainment from the lakebed itself. However, quantification of these sources has not been completed. As of yet, no CAFOs or other point sources are known to exist within the watershed.

Conclusions

It appears from the TSI data that suspended sediment, DO, and nutrients are within the bounds of water quality determined to be supportive of the designated beneficial uses. Consequently, DEQ will not complete a suspended sediment, DO, or nutrient TMDL for the reservoir.

2.4 Data Gaps

This section contains a description of the informational gaps concerning pollution sources and transport as well as physical data gaps. The informational and data gaps will be identified for the subbasin rather than for individual water bodies.

Due to the brevity of the assessment period and drought situations, sources and transport mechanisms are weakly understood. Previous TMDLs have simply used land use as the tool to allocate loads. This approach relies heavily on post-TMDL monitoring and adaptive management to refine the load allocations once better information, such as pollutant transport mechanisms, is developed. Adaptive management is necessary in the Goose Creek Subbasin because little is known concerning the relative yield of pollutants from identified sources (by source type and/or subwatershed). An equivalent percentage has been applied in past TMDLs. Post-TMDL refinement will allow us to better understand the seasonality of pollutant loads. Currently, little is known about seasonal pollutant delivery from identified sources. It is assumed that the seasonal component corresponds with the critical periods identified in the stream assessments. Adaptive management will also allow us to define the relationships between pollutants specific to identified sources (i.e., physical or chemical associations). One of the final informational gaps in the Goose Creek SBA concerns the specific stream reaches within a water body most sensitive to impairment. The overall conceptual goal of adaptive management and refinement of the assessments and TMDLs is a further refinement and identification of critical areas.

Relative to specific data gaps, a limited amount of data was collected in the Goose Creek Subbasin. Therefore, physical data gaps abound. The most significant of these is the overall lack of data in wet or even normal water years. Consequently, any conclusions drawn from the current data set could be viewed as incomplete. However, a lack of data has not been viewed as a legal reason not to proceed with TMDL development. In addition, fires in the Goose Creek Subbasin in the recent past have altered the grazing rotations along some, if not most, of the water quality limited water bodies. As a result, some creeks have shown dramatic improvements in water quality within the assessment period. However, this situation may revert to conditions seen before once grazing is resumed in the burned areas. Further, monitoring in these systems is required to assure DEQ that the preliminary conclusions drawn based on the current management holds true under different management schemes.

Excess nutrients are a listed pollutant in many of the streams within the subbasin. However, current water quality data do not support the listing of most streams for excess nutrients. Chlorophyll *a* information also supports the contention that nutrients are not degrading the water quality in most streams in the subbasin. However, the chlorophyll *a* data were very limited (a single sample in a single year); a fuller collection of both sestonic and benthic chlorophyll *a* is needed to make the SBA conclusions more robust.

Hydrological information was limited throughout the subbasin. DEQ relied heavily on statistical interpretations of limited monitoring data and relationships with gauged locations. In some cases, such as Mill Creek hydrological information was not collected. Throughout the implementation phases, collection of hydrological information should be considered a priority. Those data then would make the statistical relationships with the gauge data more robust.

A final data gap concerning biological communities exists. Fisheries information is very weak within the subbasin. It is unclear if some streams contain, or ever contained, salmonids. Current fisheries information needs to be collected to determine if salmonid spawning is indeed an existing use.

3. Subbasin Assessment – Pollutant Source Inventory

There are three categories of potential pollution inputs to the waters of the Goose Creek Subbasin: point sources, nonpoint sources, and background.

There is one small point source in the basin. The point source is a small fish hatchery, which discharges to Trapper Creek. The fish hatchery is small enough to not require a NPDES permit and hence will be treated as a nonpoint source until such time that it is permitted. A*s of the summer of 2003 the fish hatchery was no longer operational. However the fish hatchery discussions will be retained in this document so that the SBA remains valid if the hatchery should again begin fish production.*

Confined animal feeding operations (for dairy and meat production), septic systems, and activities such as farming and grazing have the potential to produce pollutants in the watershed. Total surface discharges from these activities are minimal (with the exception of the growing season return flows from irrigated agriculture) and have relatively minor impacts in the streams. It is unknown at this time how many sources within the subbasin land-apply their waste. Although the total discharges are minimal, the high concentrations of pollutants can make the loadings significant, particularly at lower flows. The region is arid, and most surface flow is intercepted and consumed in the agricultural process, evapotranspired, or infiltrated to the subsurface.

The contributions of the nonpoint source impacts; however, are often integrated from the many entry sites into the larger discrete flows of the tributaries and drains. This integration often hides the magnitude of the impacts of single activities or sources. For example, home sewer systems and animal feedlots are legally forbidden to produce direct surface discharges. However, manure from the latter is eventually spread on agricultural lands as fertilizer and becomes inseparable from other nutrient production that results from application of chemical fertilizer in the agricultural process. The great majority of lands used exclusively for grazing in this arid area produce no surface runoff at all, although rangeland comprise approximately 67 percent of the land use of the subbasin. Where grazing (post-harvest) occurs in combination with agriculture, the effects of manure and trampling of riparian areas may be inseparable from, and concurrent with, the effects of fertilizer application and plowing up to the stream sides.

Natural erosive processes by the streams in the subbasin include scouring stream banks and beds, overland sediment transport, and mass wasting (earth movement down-gradient). The natural introduction of nutrients and sediment into the watershed includes nutrients and sediment transported by precipitation, wind, and ground water (in the case of nutrients). Most of these natural processes are also, to some respect, enhanced or accelerated by human alterations of the landscape (e.g., grazing and farming operations that effect riparian growth and streamside cover), often making specific attribution of pollutant production difficult.

3.1 Sources of Pollutants of Concern

The following sections will discuss the point sources and major nonpoint sources of the Goose Creek Subbasin. These sources or land uses will serve as the basis for the load allocations in the required TMDLs.

Point Sources

As stated previously, there is one known point source within the subbasin. The source is a small fish hatchery. Typical pollutants from this type of operation include TSS, nutrients, and BOD. The hatchery is located midway through the listed segment of Trapper Creek. In addition to acting as a point source, the hatchery may also serve as a sediment removal system. The raceways are periodically cleaned and any accumulated sediment from upstream sources is removed from the ponds and quiescent zones. Currently the hatchery has too low a production rate to fall under the general aquaculture NPDES permit, and therefore is considered a nonpoint source.

Nonpoint Sources

Nonpoint pollution in the Goose Creek Subbasin has not been clearly identified. Rather it is assumed to be coming from the different land uses at equal rates. Therefore, any load allocations can be made based on the percentage of differing land uses within a watershed (See Figure 18 for the location of watersheds within the Goose Creek Subbasin). In some cases, the watershed area contains several water quality limited water bodies. In other cases, the water quality limited water body is not the mainstem of the watershed. In these instances, it was more appropriate to determine the land use breakdown from a set buffer or critical area. In this manner, the most probably areas contributing nonpoint sources pollution to the stream are captured rather than large tracts of land uses that may not influence the particular listed stream or segment. In other TMDLs, this buffer zone was set at 1.6 km on either side of the stream in question. This buffer zone would incorporate those areas most likely to influence the water quality of the particular stream. The following table (Table 28) describes the land use breakdown of each watershed or buffer zone that contains a water quality limited water body within the Goose Creek Subbasin.

Table 28. Percent land use for load allocation purposes.

Water body	Percent Forest	Percent Range	Percent Urban	Percent Irrigated Sprinkler	Percent Irrigated Gravity
Goose Creek	70.1	0.0	1.7	0.3	27.9
Trapper Creek	47.8	52.2	0.0	0.0	0.0
Birch Creek	5.1	72.5	3.5	18.9	0.0
Cold Creek	75.3	22.5	2.2	0.0	0.0
Blue Hill Creek	68.3	24.9	0.0	0.0	6.8
Beaverdam Creek	53.1	37.4	0.0	0.0	9.5
Big Cottonwood Creek	19.9	64.2	0.0	7.7	8.2
Emery Creek	85.1	5.4	0.0	0.8	8.7
Little Cottonwood Creek	40.4	42.1	0.7	16.8	0.0
Left Hand Fork Beaverdam Creek	29.0	71.0	0.0	0.0	0.0
Goose Creek Reservoir	See Goose Creek and Trapper Creek distributions.				
Mill Creek	1.4	48.9	1.9	42.7	5.1

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

Past and present pollution control activities in the Goose Creek Subbasin have involved both public and private entities. Some of the activities have included changes in grazing management regimes, building off-creek water troughs, fencing, and reducing numbers of animals or time spent on the range. The next several pages contain information on pollution control efforts submitted by the Double Diamond Ranch, USFS and BLM. These write-ups explain the efforts these land managers have taken to improve water quality in the Goose Creek Subbasin.

DOUBLE DIAMOND RANCH EFFORTS TO IMPROVE WATER QUALITY

By Carl Austin.

Double Diamond Ranch has a lengthy segment of Goose Creek, plus a segment of Cold Creek. Both are 303-d listed streams. This short report presents what has been done in the past few years to improve the quality of these streams as they pass through land the ranch controls or leases.

1. Livestock impacts on creek banks and in creeks have been reduced significantly in the following ways.

    A. Cold Creek – we have permanently excluded livestock from all but a very short segment of the creek. This has resulted in a flourishing riparian system. The short stretch where livestock still access Cold Creek is a crossing and a stock-water point. It is our intent in the near future to convert this to a protected crossing by installing a culvert, fences, and water trough.

    B. Main Goose Creek – through a HIP [Habitat Improvement Program] Project with Idaho Department of Fish and Game we have fenced the entire riparian zone of Goose Creek on both our private land and on our state lease. We briefly graze inside the fences in the late summer to assist with weed control. Except for this, cattle are normally excluded from the creek and its banks.

    C. Irrigation Cross Ditches – we have two cross ditches that extend from the west side of our meadows to Goose Creek. We have now fenced cattle out of the main cross ditch totally and plan to do the same on the shorter cross ditch near the main house. This shorter ditch has been protected most of the time by a temporary electric fence. These fences keep the cattle out of the water, keep them from breaking down the ditch banks, and keep the water free of manure and mud. From a cattleman’s perspective, it is worth noting that fencing riparian and ditch banks also greatly reduces the exposure of our cattle to liver flukes.

2. Erosion and sedimentation impacts have been historically severe on the ranch. In a land of periodic flashfloods, gully formation is extensive. We have done the following to control or at least reduce these problems.

   A. Filter strips – by fencing off the main creek banks we now have the beginning of effective filter strips for the entire length of Goose and Cold Creeks on the ranch.

   B. Plantings – we have planted thousands of willows, birch, cottonwood, dogwood and some conifers along main Goose Creek. Initial success was low due to pervasive Tordon residue in the creek banks from prior owner's efforts to kill willows, but with the passage of time, over 7 years required, the plantings are beginning to take hold and flourish. Obviously, we have a collateral spurge problem to deal with so as to not kill the riparian we are trying to establish.

   C. Check-dams – we build large numbers of small check-dams, both ourselves and as youth group environmental activities. These small rock dams are proving very successful with many already silt filled and showing grass establishment on the new stable surface.

   D. EQUIP PROJECT – we have established an EQUIP [Environmental Quality Incentive Program] Project on the Cave Gulch side of the ranch. This project includes protective fencing, plantings, and the construction of large erosion control structures in both Cave Gulch and Owens Corral Creek. This will reduce the vast amounts of mud being washed down canyon into Goose Creek and the Oakley Reservoir.

   E. Natural Beaverdams – The ranch has allowed three natural beaverdams to become established on Goose Creek. These dams have raised the water table and have provided an extensive sediment trap.

3. Bacterial contamination of a non-livestock source was of concern to us when we purchased the ranch several years ago. We have taken the following steps to mitigate this potential problem.

   A. Cold Creek House – this house had a septic tank and drain field excessively close to Cold Creek. We have had an entirely new septic system installed, which now protects Cold Creek from this pollution source.

   B. Homestead House – this house used a pit privy. Although not too close to Cold Creek, it still offered a possible source of pollution. We replaced the privy with indoor plumbing and a new up to code septic system. This potential source of pollution has been eliminated.

   C. Main Ranch House – the septic system for the main ranch house was totally inadequate. The shallow leach field would flood out when irrigating the meadows, with leachate spreading on the surface with the potential to flow into

Goose Creek. The leach field was moved to a proper location free of flooding and a new leach field up to code standards built, eliminating this problem.

4. Nutrient management – fields are routinely analyzed prior to fertilizing, so that excess fertilizing is not a problem

5. Runoff – to protect the quality of Goose Creek and to capture and use scarce and expensive irrigation water, we are now in the process of excavating large tail water ponds. These will capture tail water before it can get into Goose Creek and enable us to pump the water on to a formerly dry farmed area. Our biggest concern with doing this is not to create a trace element and salts build up as a result of controlling runoff. We have no desire to create a Kesterson type of situation.

6. Junk in the Creek – we have removed large amounts of just plain junk from Goose Creek and a surprising amount from Cold Creek. Largely an issue of aesthetics, we feel this is worth doing. We have removed appliances, vast amounts of baler twine, tires, old machinery, oil cans, tangles of old fencing, scrap lumber, etc. and more junk comes in with every spring flood. We fish it out of the creek and haul it to the dump routinely.

7. We hope that this short presentation is of interest. It shows what can be done, not so much as a burst of effort, but rather as a steady continuous striving to improve the ranch and also to improve the public's perception of cattle ranching.

UNITED STATES FOREST SERVICE EFFORTS TO IMPROVE WATER QUALITY

The following pages concerning the USFS pollution control activities were taken from a document prepared by Trudy Flock of the USFS Burley Ranger District for the TFRO-DEQ.

Project Name	**USFS Division**	**Document &/or year**	**Allotment**	**Pollution Control Measure**	**Location**	**Subbasin**
Projects files-Structural, Non-Structural, and Water						
Lower Fish Creek Spring Developm ent	Albion	1997	Fish Creek C&H	One trough and one headbox with approximately 50 yards of buried pipeline to protect the spring source by providing water away from the source and by providing a water source away from fish creek drainage …to keep livestock more evenly distributed on the lower portion of the allotment and to keep livestock from lingering along Fish Creek	T15S R23 E Section 10	Goose Creek
From Allotment Files						
Goose Creek Allotment File	Cassia	12/20/91	Goose Creek C&H	Exclosure with water gaps on the lower three miles of Trout Creek (below narrows). 200 acre exclosure at the head of Right Hand Fork Beaverdam Creek to protect watershed above active gullies in that area.	T16S R19E Sections 24 and 25	Goose Creek
Oakley Valley Allotment File	Cassia	1995-2002 Annual Operating Instructions	Oakley Valley C&H	Riparian area utilization managed so that the residual stubble height at the end of the growing season or grazing season is at least four inches. Salt not placed within .25 miles of water		Goose Creek
Goose	Cassia	1997-1998	Goose	Utilization of riparian species will be managed so the residual		Goose

Project Name	USFS Division	Document &/or year	Allotment	Pollution Control Measure	Location	Subbasin
Creek Allotment File		Annual Operating Instructions	Creek C&H	herbage stubble height at the end of the growing or grazing season is at least 4-6 inches.		Creek
Goose Creek Allotment File	Cassia	1996 Annual Operating Instructions	Goose Creek C&H	Rest upper Beaverdam Unit for two growing season due to a 1995 fall wild land fire. Salt not place within .25 miles of water		Goose Creek
Goose Creek Allotment File	Cassia	1992	Goose Creek C&H	Dry Gulch riparian exclosure: 2 mile	T16S R20E Sections 1 and 2	Goose Creek?
Goose Creek Allotment File	Cassia	About 1992	Goose Creek C&H	Trapper Creek Pasture – approximately a 60 acre exclosure. Provides unit integrity for a portion of the riparian corridor, Squaw Creek and Rodeo Creek Units		Goose Creek
Goose Creek Allotment File	Cassia	1994-1995 Annual Operating Instructions	Goose Creek C&H	Salt not placed within .25 miles of water		Goose Creek
Trapper Creek S&G Trout Creek S&G Badger Mt. S&G	Cassia	1997 Annual Operating Instructions	Trapper Creek S&G Trout Creek S&G Badger Mt. S&G	Specific Instructions to follow: -Sheep should not be bed down, day or night, within 200 yards of any running stream or spring. -Sheep should come in to drink and move away from water as soon as finished. -every effort should be made to avoid trampling and other impacts to waterway. -Dead sheep within 300 ft. of a stream must be promptly removed and disposed of.		Goose Creek

Project Name	USFS Division	Document &/or year	Allotment	Pollution Control Measure	Location	Subbasin
Little Fork S&G? Falls/Swanty C&H			Little Fork S&G? Falls/Swanty C&H	General Instructions: -Salt not placed within .25 miles of water		
Fish Creek Allotment File	Albion	1991 Fish Creek C&H Allotment Grazing Management Revision	Fish Creek C&H	See Attachment D for "Forest Wide Standards and Guides for Riparian Areas"		Goose Creek
Fish Creek Allotment File	Albion	1997-2002 Annual Operating Plan	Fish Creek C&H	Riparian Sites, Fish Creek: Sedge Communities (wet sites) -5 in. stubble height (20-35% utilization) -Bluegrass meadow communities -4 in. stubble height (30-40% utilization) -Stream banks -20% stream bank trampling Compliance with the stubble height standards listed above should ensure that stream bank trampling does not exceed 20% for these sites. However, if stream bank trampling exceeds 20% before stubble heights are achieved, livestock must be removed.		Goose Creek

Project Name	USFS Division	Document &/or year	Allotment	Pollution Control Measure	Location	Subbasin
Basin Allotment File	Albion	2000-2002 Annual Operating Plan	Basin C&H	Allowable use levels for riparian vegetation associated with these streams is 30% (This equates to about a 4-6 inch stubble height). All stream banks no greater than 20% stream bank trampling (noted in 200&2001) Compliance with the stubble height standards listed above should ensure that stream bank trampling does not exceed 20% for these sites. However, if stream bank trampling exceeds 20% before stubble heights are achieved, livestock must be removed.		Goose Creek
Basin Allotment File	Albion	1997 - 1999 Annual Operating Plan	Basin C&H	Riparian Areas: Lake Creek, Summit Creek, Mill Creek Units 30% use of all species. The objective is to maintain or improve the long-term ecological condition of these areas, so it is necessary to adjust the level of allowable use by livestock. As a result, the allowable use levels for riparian vegetation associated with these streams is 30% (This equates to about 4-6 inch stubble height (6 inches-1998, 4 inches-1997)) All stream banks no greater than 20% stream bank trampling		Goose Creek

Project Name	**USFS Division**	**Document &/or year**	**Allotment**	**Pollution Control Measure**	**Location**	**Subbasin**
				Compliance with the stubble height standards listed above should ensure that stream bank trampling does not exceed 20% for these sites. However, if stream bank trampling exceeds 20% before stubble heights are achieved, livestock must be removed.		
Basin Allotment File	Albion	1996Annual Operating Plan	Basin C&H	Riparian Areas: Lake Creek, Summit Creek, Mill Creek Units 45% use of all species. The objective is to maintain or improve the long-term ecological condition of these areas, so it is necessary to adjust the level of allowable use by livestock. As a result, the allowable use levels for riparian vegetation associated with these streams is 30% (This equates to about 4 inch stubble height)		
Land Creek Allotment File	Albion	1991 Addendum #1 to the 1978 Approved AMP on the Land Creek C&H Allotment	Land Creek C&H	See Attachment E for “Standards and Guides for Riparian Areas”		Goose Creek
Willow Creek Allotment	Albion	1991 Addendum #1 to the 1981	Willow Creek C&H	See Attachment F for “Standards and Guides for Riparian Areas”		

Project Name	USFS Division	Document &/or year	Allotment	Pollution Control Measure	Location	Subbasin
File		Approved AMP on the Willow Creek C&H Allotment				
Willow Creek Allotment File	Albion	1997-2002 Annual Operating Plan	Willow Creek C&H	Riparian Sites, Smith Creek, Robinson Creek and Willow Creek: Sedge Communities (wet sites) -5 in. stubble height (30-35% utilization) -Bluegrass meadow communities -4 in. stubble height (30-40% utilization) -Stream banks -20% stream bank trampling Compliance with the stubble height standards listed above should ensure that stream bank trampling does not exceed 20% for these sites. However, if stream bank trampling exceeds 20% before stubble heights are achieved, livestock must be removed.		
From Timber/Silviculture Files						
Post and Poles		1995 Permit: District wide for dead poles only		-No skidding across live streams. -If skidding with equipment or horses and a skid trail develops, it must be properly water-barred	District-wide	Raft River and Goose Creek

Project Name	USFS Division	Document &/or year	Allotment	Pollution Control Measure	Location	Subbasin
Post, Poles and Ornamentals		1993		Roads will not be traveled when wet and damage may occur.	Designated post and pole areas	
Burned Area Emergency Rehabiliatation (BAER)						
Worthington Fire Baer Project	Cassia	2001 Worthington Fire- Baer Burned Area Report (Interim)		555 NFS Acres Burned -Limit erosion by providing adequate road drainage and by seeding where no regrowth or seed source is expected, and to be sure that the burn will not allow more encroachment of noxious weeds. Land Treatments – helicopter seed 200 acres of burned land with little or no grass, with 3 native grass species in a previous juniper monoculture Roads and Trail Treatments- One mile of low standard roads over the 2.5 miles need water bars and other drainage to limit erosion associated with roads. 7 Structures: two miles of temporaray fence will be installed to protect the burned area from grazing for three growing seasons. Livestock needed to be removed as soon as possible, to protect beginning sprouts of grass, etc. In the burned area.		Goose Creek
West	Cassia	2000 West		Fire Suppression Damages Repaired:		Goose

Project Name	USFS Division	Document &/or year	Allotment	Pollution Control Measure	Location	Subbasin
Basin Fire Baer Project		Basin Fire – Bare Burned Area Report (Initial Request		15 miles of fireline water bars repair 4 water catchments in system roads to provide drainage. These were excavated during suppression activities.		Creek
West Basin Fire Baer Project	Cassia	2000 West Basin Fire – BAER Burned Area Report (Initial Request		16,392 Idaho NFS Acres In both Goose Creek and Salmon Falls Creek– Goose Creek acres unknown. Land Treament : Aerial seed 900 acres of Wyoming sagebrush to expedite the re-establishment of this key sage grouse and sharp tail grouse component.. Cattle will be rested a minimum of three growing season.. Immediate replacement of 12 miles of fence destroyed by the fire will be necessary to keep the re-seeded area protected from livestock grazing. Aerial seed all dozer lines (23 miles). Construct water bars and close off access points after re-seeding efforts are completed. Road Treatment: Repair four water bars that were dug too deep and without proper drainage.		Goose Creek
Coal Banks Fire Baer Project		2000 Coal Banks Fire – BAER Burned Area Report (Initial Request)		Fire Suppression Damages Repaired: 8.5 miles of fireline water bars Dry Gulch exclosure Fence – about .25 mile		Goose Creek
Coal		2000 Coal		1965 NFS acres burned		Goose

Project Name	USFS Division	Document &/or year	Allotment	Pollution Control Measure	Location	Subbasin
Banks Fire Baer Project		Banks Fire – BAER Burned Area Report (Initial Request)		Road Treatment: Dozer lines on Forest Service lands have been stabilized and seeded with native grasses as part of the suppression damage control. Structures: Four miles of temporary fence will be installed to protect the burned area from grazing for three growing seasons.		Creek

The following is a list of provisions that would have been included in most timber sale contracts.

WO-CT6.34 – Sanitation and Servicing (12/00). Purchaser shall take all reasonable precautions to prevent pollution of air, soil, and water by Purchaser's Operations. If facilities for employees are established on Sale Area, they shall be operated in a sanitary manner. Purchaser shall not service tractors, trucks, or other equipment on National Forest lands where servicing is likely to result in pollution to soil or water. Purchaser shall remove from National Forest lands all refuse resulting from use, servicing, repair, or abandonment of equipment. In the event that Purchaser's Operations or servicing of equipment result in pollution to soil or water, Purchaser shall conduct cleanup to restore the polluted site to the satisfaction of Forest Service.

WO-CT6.342 – Hazardous Substances (5/01). Purchaser shall notify Forest Service, in an annual Operating Schedule, of any hazardous substances, as defined in 29 CFR 1910.120, to be used on Sale Area and will have Material Safety Data Sheets for those materials available at the landing and any road construction site. All such materials shall be labeled in accordance with Federal and State regulations.

Before commencing operations Purchaser shall provide a Hazardous Substances Plan. The Plan must include, but is not limited to, hazardous substances to be used in the Sale Area and identification of Purchaser's representatives responsible for supervising initial containment action for releases and subsequent cleanup.

Purchaser shall not release abnormal quantities of petroleum products or other hazardous substances on land or into rivers, streams, or impoundments or into natural or man-made channels leading thereto. Purchaser will take whatever initial action may be safely accomplished to contain all abnormal releases. Purchaser shall conduct cleanup, to the satisfaction of Forest Service, to restore the site polluted by the abnormal release of petroleum products or other hazardous substances resulting from Purchaser's Operations, including releases caused by Purchaser's employees and contractors. Purchaser shall pay all damages and costs incurred by the Government.

Purchaser shall immediately notify appropriate agencies, including Contracting Officer or designated representative, of all abnormal spills or leaks or other releases of petroleum products or other hazardous substances on or in the vicinity of National Forest land that are caused by Purchaser's employees, directly or indirectly, as a result of Purchaser's Operations.

Purchaser shall maintain all equipment operating on Sale Area in good repair and free of abnormal leakage of lubricants, fuel, coolants, and hydraulic fluid. Purchaser shall properly dispose of all contaminated soil, vegetation, debris, vehicle oil filters (drained of free-flowing oil), oily rags, and waste oil in accordance with local, State, and Federal regulations off of Government property and shall transport such substances in accordance with State and Federal regulations.

Purchaser shall furnish oil-absorbing mats, approved by Forest Service, for use under all stationary landing equipment or equipment being serviced to prevent leaking or spilled petroleum-based products from contaminating soil and water resources.

RO-CT6.344 - Prevention of Oil Spills (Idaho Forests) (1/01). If Purchaser maintains storage facilities for petroleum or petroleum products on Sale Area, Purchaser shall take appropriate preventive measures to ensure that any spill of such petroleum or petroleum products does not enter any stream or other waters of the United States or any of the individual States.

Petroleum or petroleum product storage containers with capacities of more than 200 gallons, but less than 1,320 gallons, stationary or mobile, shall be located no closer than 100 feet from stream, watercourse, or area of open water. Dikes, berms, or embankments shall be constructed to contain the volume of petroleum products stored within the tanks. Diked areas shall be sufficiently impervious and of adequate capacity to contain spilled petroleum products.

If the total petroleum or petroleum products storage exceeds 1,320 gallons, or if any single container exceeds a capacity of 660 gallons, Purchaser shall prepare a Spill Prevention Control and Countermeasures (SPCC) Plan. Such plan shall meet applicable EPA requirements (40CFR 112), including certification by a registered professional engineer.

RO-CT6.50# - Streamside Management Zones (11/98). A Streamside Management Zone (SMZ) is a zone that contains riparian vegetation and other special characteristics. Areas identified as Streamside Management Zones (SMZ's) are shown on the Sale Area Map and designated Timber designation, conduct of logging, and/or slash treatment may differ in the SMZ from the rest of the unit. Unless otherwise agreed to in writing and notwithstanding the contract requirements otherwise applicable to each cutting unit, the following special requirements apply to the SMZ of the cutting units specified below:

Streamside Management	Cutting Unit(s)	Zone Requirements

RO-CT6.6# - Erosion Prevention and Control (11/98).

A. Purchaser shall locate Temporary Roads on locations approved by the Forest Service. Such location shall include the marking of road centerline or grade-line and the setting of such construction stakes as are necessary to provide a suitable basis for economical construction and the protection of National Forest lands.

B. Skidding with tractors within __________ feet of live streams shall not be permitted except in places designated in advance by Forest Service, and in no event shall skid roads be located in live or intermittent streamcourses. Skid trails shall be located high enough out of draws, swales, and valley bottoms to permit diversion of runoff water to natural undisturbed forest ground cover.

C. Prior to periods of accelerated water runoff, especially during the spring runoff and periods of heavy rainfall, Purchaser shall inspect and open culverts and drainage structures, construct special cross ditches for road runoff, and take other reasonable measures needed to prevent soil erosion and siltation of streams.

D. Temporary Road surface width shall be limited to truck bunk width plus four (4) feet, except for needed turnouts which shall not exceed two (2) times the bunk width plus four (4) feet. If shovels or cranes with revolving carriage are used to skid or load, Temporary Road surface width equal to track width plus tail swing shall be permitted.

E. Unless otherwise agreed in writing, Purchaser shall keep erosion control work current with his operations under the sale and in any case not later than 15 days after completion of skidding on each payment unit or cutting unit.

RO-CT6.601# - Erosion Control Seeding (11/98). Following completion of skidding and yarding operations in an area, Purchaser shall seed and fertilize all exposed areas of raw soil as designated by the Forest Service on skid trails, landings, firebreaks, slides, slumps, Temporary Roads and traveled ways of Specified Roads following closure specified in CT5.51#. Soil on areas to be seeded shall be left in a roughened condition favorable to the retention and germination of the seed. Scarification of traveled ways on Specified Roads listed above shall be to a minimum depth of ______ inches and a maximum depth of _______ inches. Seed and fertilizer shall be spread evenly at the rate of______ pounds of seed and _______ pounds of fertilizer per acre. When fertilizer and seed are applied in separate operations, the second operation shall be carried out within 72 hours of the first. Seeding shall be done during the period _________ to __________ and under the above specified conditions unless otherwise approved. The kinds and amounts of seed to be sown in terms of pure live seed (PLS) shall be: ________ Species of Seed PLS Pounds Per Acre

All seed purchased will be certified to be free of the noxious weed seeds from weeds listed on the current "All States Noxious Weeds List." Test results from a certified seed analyst and seed analysis labels attached to the bags will be provided to the Forest Service. The following kinds and amounts of standard commercial fertilizer shall be used with guaranteed analysis of contents clearly marked on containers: Type of Fertilizer Pounds Per Acre.

Road provisions; the specific restrictions vary by sale. (Note: CT5.12# has been used frequently to control use on roads in meadows or other wet areas).

WO-CT5.12# - Use of Roads by Purchaser (6/99). Purchaser's use of existing roads identified on Sale Area Map by the following codes is prohibited or subject to restrictive limitations, unless agreed otherwise:

Code	Use Limitations
X	Hauling prohibited
R	Hauling restricted
U	Unsuitable for hauling prior to completion of agreed reconstruction
P	Use prohibited
A	Public use restriction
W	Regulation waiver

Roads coded A will be signed by the Forest Service to inform the public of use restrictions. Purchaser's use of roads coded R, A, or W shall be in accordance with the following restrictions:

RO-CT5.124 - Existing Roads (11/98). Notwithstanding BT5.12, existing roads not shown on Sale Area Map may be used upon written agreement of use restrictions and closure requirements following completion of use.

RO-CT5.44# - Obliteration of Temporary Roads (11/98). Unless otherwise agreed in writing, temporary roads constructed to access units(s) _________, as shown on the Sale Area Map, shall be restored to original contour. This work shall include but not be limited to, ripping the surface for seeding, pulling material from the fill slope and brow of the cut slope on to the running surface of the road, removal of drainage structures, and placing slash, stumps, or cull logs on the road surface.

RO-CT5.45# - Closure of Temporary Roads (11/98). Unless otherwise agreed to in writing, temporary roads associated with the cutting unit(s) listed in the following table shall be closed using the closure method described.

Unit	Closure Method

RO-CT5.46# - Snow Removal (11/98). Snow removal shall be done in a manner to preserve and protect the roads to insure safe and efficient transportation and to prevent unacceptable erosion damage to roads, streams, and adjacent lands.

A. Description. Snow removal work by Purchaser shall include:

1. Removal of snow from entire road surface width including turnouts.

2. Removal of snow slides, minor earth slides, fallen timber and boulders that obstruct normal road surface width including turnouts.

3. Maintain drainage so that the drainage system will function efficiently.

B. Performance. All items of snow removal shall be done currently as necessary to insure safe, efficient transportation. Work shall be done in accordance with the following minimum standards of performance.

1. Removal of material. All debris, except snow and ice, that is removed from the road surface and ditches shall be deposited away from stream channels at agreed locations.

2. During snow removal operations, banks shall not be undercut nor shall gravel or other selected surfacing material be bladed off the roadway surface.

3. Ditches and culverts shall be kept functional during and following roadway use.

4. Snow berms shall not be left on the road surface. Berms left on the shoulder of road shall be removed and/or drainage holes shall be opened and maintained. Drainage holes shall be spaced as required to obtain satisfactory

surface drainage without discharge on erodible fills.

5. Dozers and skidders shall not be used to plow snow on system roads without written approval of Forest Service. Upon approval, dozers and skidders must be equipped with shoes or runners to keep the plow blade a minimum of ________ inches above the road surface unless specifically removed from the requirements in writing.

6. Snow must not be removed to the road surface. A minimum
inch depth must be left to protect the roadway.

7. Purchaser's damage from, or as a result of, snow removal shall be restored in a timely manner.

T.S. Contract – Division CT – Special provisions for: South Heglar Salvage Timber Sale: 1993-1994 – HUC - Raft River

Temp Roads:

Temporary roads maximum ruling grade shall not exceed 8% except short pitches for not more than 200 feet in length.
In no case shall grades be such to cause accelerated soil erosion or damage to the NFC and values.

Side ditch and/or cross drainage structures shall bee proved for permanent seeps.

Road Maintenance:

Removal of earth and debris from ditches and culverts so that the drainage systems will function efficiently at all times.
Restoration of eroded fills and repair and protection of should berms, berm outlets, stabilized waterways, vegetated slopes and other erosion control features.

Removal of Material – Maintenance Performance:

Earth, rocks, trees, brush and debris removed from Roadways and ditches shall not be deposited in stream channels or upon slope stabilization and erosion control features.

Ditches, culverts, drop inlets, trash rocks, downspouts and splatter structures shall be kept clear of earth, slash and other debris so that drainage systems will function efficiently during and immediately following periods of road use by purchases. This includes correcting and eliminating causes of erosion or plugging of the structure and actual repair of the structure and riprap if damaged.

Any washing or settling of roadway fills will be corrected promptly to prevent additional soil erosion or roadway damage should berms, berm outlets, and stabilized waterways shall be protected during road maintenance operations and if damage such structure shall be promptly restored to their original condition, including repairs and reseeding of vegetation established to control slope erosion. No earth, rocks, or other debris shall be deposited upon any roadside slope stabilization structure or feature.

Prevention of Oil Spills:

If purchaser maintains storage facilities for oil or oil products on sale area, purchaser shall take appropriate preventative measures to ensure that any spill of such oil or oil product does not enter any stream or other waters of the US or State.

If oil/oil product >320 gallons or single container exceeds 660 gallons, the purchaser shall prepare a spill prevention and control and counter measures plan and it shall meet applicable EPA requirements.

Erosion Prevention and Control:

Forest Service shall designate and Purchaser shall construct erosion control structures in accordance with the follow items:

Specification for outsloping and Berm Removal; Equipment blade used for removing berm and cutting roadbed to form required outsloping shall be so angled that material resulting from such work will be moved toward the inside of the road. The bladed material shall then be spread over the surface of the road which will result in uniformly sloping the entire width of the road to the outside to divert water from the road surface. Where road compaction prevents equipment blades from cutting into the road, ripping shall be performed prior to blade work.

Erosion Control seed: Purchaser shall furnish and sow suitable seed where staked or otherwise marked on skid trails, firelines, landings and roadways, embankments, and fill sections of Temporary roads. Such seed composition shall be evenly spread at the rate of 10 lbs per acre in the early spring when moisture conditions are favorable, or in the early fall.

UNITED STATES BUREAU OF LAND MANAGMENT EFFORTS TO IMPROVE WATER QUALITY

The following was given to DEQ during a grazing allotment review. It was prepared by Ken Knowles of the BLM and is an example of the water quality efforts that have been undertaken by the BLM on some allotments. More information was made available through hard copy and will be included during the implementation phase.

Brief Goose Creek History

1. Historic livestock grazing usually began about April 1 and continued into late fall. The Goose Creek Unit range survey was completed in 1953. It consisted of about 70,000 acres of public lands. The results of the range survey recommended an 82% reduction of the historic grazing use.

2. The Goose Creek Unit was fenced and separated into individual or community allotments and an agreement signed regarding allotment boundaries in 1963. The Goose Creek Group allotment was established at that time and amounted to about 30,000 acres of public land. At time of this final adjudication, the unit took a 60% reduction in grazing use. The difference between the recommendation in 1953 (82%) and 1963 was due to the establishment of several seedings within the allotment. The grazing season was establish as May 1 to October 15.

3. In 1970 an Allotment Management Plan [AMP] was written for the allotment. It was a rest-rotation grazing system whereby one of the four native pastures would be completely rested each year and the seedings would be used on a deferred rotation system, using some in the spring and some in the fall. Upon completion of the AMP a 20% increase in grazing use was approved to begin the following grazing season (1971). The new grazing season was from May to October 31. Consequently, the 20% increase amounted to about a 10% increase in time and about 10% in numbers.

4. In 1975 it was determined by the permittees and the BLM that the rest rotation-grazing season on the native range was not working as well as had been expected, nor were the seedings responding well. Consequently, a revision of the AMP was incorporated to allow a deferred rotation grazing system on the 4 native pastures and a rest rotation grazing system on the seedings, although light use could be made in the rested seeding in the fall.

Some of the reasons for the changes included:

a. There was a large difference in the grazing capacities of the pastures, some pastures had four times as [much] forage, which didn't lend itself well to a rest-rotation grazing system.

b. There is an elevation difference in the pastures that caused cattle to be moved from a higher elevation to a lower elevation and then back to a higher elevation, or vice versa.

c. Cattle were allowed in the native pastures for 4-5 months at a time. The amended grazing system was followed from 1975 until 1990 with yearly modifications made, especially during the drought conditions of the late 1980s.

5. In 1990 an allotment evaluation was completed. In essence, this evaluation cited four problems: 1) The allotment was over-allocated and a 20% reduction was needed, 2) The riparian zones were being overused and needed rehabilitation, 3) The seedings were in a declining trend and needed immediate rest, and 4) Livestock were not being moved from pasture to pasture in an expedient manner.

Consequently, a new grazing season was established as May 15 to October 20 (about 14% of the reduction) and cattle numbers were reduced (about 6% of the reduction). The seedings were all rested from grazing during 1991 and 1992 by putting them in the Dale Pierce allotment. Each of the seedings have also had at least one additional year of complete rest since 1992. The use in the native range pastures have been reduced over the past 10 years by completely resting 3 of the 4 pastures in different years. The Cold Creek pasture is the only pasture that has not had at least 2 years of complete rest from cattle grazing since 1990, although it had minimal use (5%) in 1998.

Since 1990 grazing management on the allotment has been on a yearly schedule, and has needed to be modified due to fires, drought, and implementation of rangeland improvement projects.

6. In 1998, an allotment evaluation under the “Idaho Standards and Guidelines” format was begun. After three years of fieldwork and public participation, the evaluation was finalized last August. This evaluation noted that the riparian-wetland areas have improved since 1990. Approximately 24% of the sampled areas were in Proper Functioning Condition (PFC) vegetation-wise. About 76% is Functioning-at-Risk, but is making significant progress towards PFC.

There are, however, some issues that need to be resolved:

a. The majority of the riparian areas are not yet in PFC, which is the BLM’s targeted goal.

b. The current AMP and grazing system is not adequate to significantly improve the riparian areas and needs to be updated.

5. Total Maximum Daily Loads

A TMDL prescribes an upper limit on discharge of a pollutant from all sources 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 waste load 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 (40 CFR part 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 Instream Water Quality Targets

Instream water quality targets are the basis for load calculations. From these targets, loads for the various water bodies are calculated. Although TMDLs are expressed in a mass per unit time, as required by the CWA and EPA, the instream targets are typically what the local stakeholders look to when they assess data collected on their streams of concern. As a result, instream water quality targets should be something understandable such as water quality standards or other straightforward targets. Complex targets can be just as confusing and as unworkable as load calculations and should be avoided.

Instream water quality targets for the Goose Creek Subbasin were chosen from a variety of sources. Principally, the Idaho Water Quality Standards were used to set instream targets. The water quality standards related beneficial use impairment to a narrative standard; however (e.g., IDAPA 58.01.02.200.03 "...surface waters shall be free from deleterious materials in concentrations that impair beneficial uses."), other sources were consulted to determine appropriate instream water quality targets. Other sources used to determine appropriate instream water quality targets were the Clean Water Act, the Code of Federal Regulations, EPA technical support documents and guidelines, other states' water quality standards, other TMDLs written by the state of Idaho and submitted to or approved by EPA, and scientific papers from refereed journals. Instream water quality targets developed from sources other than the state of Idaho's water quality standards will be reviewed at such time that numeric standards are adopted and codified by the state of Idaho following negotiated rule making. Targets were developed for four pollutants found to be impairing the beneficial uses of the listed water bodies identified in previous sections of the SBA. These pollutants are nutrients, bacteria, sediment, and temperature. Other pollutants have been demonstrated to be not degrading the beneficial uses in the various listed water bodies. 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 specific pollutants as "pollution." TMDLs are not required for water bodies impaired by pollution, but not specific pollutants.

Design Conditions

Typically, design conditions are based upon the critical periods for specific beneficial uses respective of the pollutants and water bodies or upon some reference system within the subbasin or creek. Design conditions often vary from stream to stream for various pollutants. One of the reasons for such variability is the different land use practices along each stream. Other factors also increase loadings at different times of the year from pollutant to pollutant. For example, TP and sediment may impair a beneficial use on a stream at different times of the year. Typically, sediment is more likely to impact a system in the spring runoff during higher flow, while TP will impact a stream during summer growing seasons. Therefore, the critical periods for each stream and each pollutant will be discussed separately. In addition, much of the sediment design was based upon reference reaches within each creek. In some cases prototypical reference conditions for stream bank erosion were used. These conditions will be outlined in the following sections.

Goose Creek

Goose Creek is a relatively homogeneous stream from a morphological standpoint. However, politically it appears that Goose Creek is very complex. It runs from Idaho, into Nevada, then into Utah, and back into Idaho. In the process it changes EPA jurisdiction three times and has three different state agencies involved in water quality. Currently Goose Creek is only on the Idaho §303(d) list. The other states' 2002 lists can be found at http://www.waterquality.utah.gov/documents/2002303final08-30-02.pdf (Utah) and at http://ndep.nv.gov/bwqp/303list.pdf (Nevada). It is very likely that Goose Creek should be listed by the other states. However, due to the remoteness, relative to the other states population centers, and limited miles within the other states it may have "fallen through a crack" in respect to §303(d) assessment and listing. Due to the relative homogeneous morphology of the creek the design conditions applicable in Idaho can be extrapolated into the other states and the loads and load allocations can be made for the other two states as well. These, however, would be purely informational as it would be up to the other states and EPA to determine if the stream should be §303(d) listed in the first place and the different states would have to develop their own loadings.

In the case of Goose Creek temperature issues, cold water aquatic life and salmonid spawning are the designated beneficial uses affected by increased temperature. The salmonid population consists or consisted of stocked and naturalized populations of rainbow trout, as well as native populations of cutthroat trout. Currently it is unknown if cutthroat trout inhabit the lower reaches of Goose Creek. It is likely that naturalized rainbows exist within the water body. The spawning and incubation periods of these salmonids range from early spring to the middle of the summer. These times should be considered the critical period for the beneficial uses of the stream. Temperature exceedances, of both the cold water aquatic life use and salmonid spawning, typically occur throughout the summer months. This period also corresponds with the end of the spawning and incubation periods of the rainbow and cutthroat trout. Discharge during the critical months of June and July averages 1.19 m^3/s. This value will be used in the following temperature TMDLs for Goose Creek.

The land use practices along the reach may have long term effects on the ability of Goose Creek to meet state water quality standards. Agricultural practices have removed significant portions of the riparian vegetation (both grazing and farming practices), changing the current shade of the stream. These land use practices do not necessarily occur only during the critical period but have occurred throughout the year and over the past several decades. As a result, the land use practices may only allow short pasture grasses and rangeland communities rather than a taller willow dominated riparian community to exist along the stream corridor. The temperature target selection will need to reflect this historic change in the riparian community and how it is applied with the solar pathfinder data.

Sediment also impairs the beneficial uses of Goose Creek. The elevated suspended load that occurs during the high spring flows impairs the uses. These flows also redistribute the bedload stored within the system throughout the year. Much of this load is coming from bank erosion of Goose Creek Load allocations will be developed using bank erosion rates developed by the NRCS and refined for TMDL use by the Idaho Falls Regional Office staff. The loads to the creek are derived from high flow events eroding unstable banks throughout the system. These loads can be estimated from bank heights and the percent unstable bank length within a system. The loads would then be reflective of average peak flow from the annual average hydrograph calculated from USGS data. For Goose Creek, this equates to a discharge of approximately 8.58 m^3/s and a recurrence interval of once every three years. Bankfull events (or recurrence intervals of 1.5 years) average 4.04 m^3/s.

Trapper Creek

It has been determined that nutrients and sediment impair the listed portion of Trapper Creek. Typically, sediments are more likely to impair the beneficial uses at higher flows while nutrients are more likely to impair a system during lower flows. Lower summer base flows in Trapper Creek range from 0.284 to 0.623 m^3/s (June through September) with an average of 0.386 m^3/s. The load capacity of nutrients will be based upon this average summer time flow.

Sediment also impairs the beneficial uses of the lower portions of Trapper Creek. The elevated suspended load that occurs during the high spring flows impairs these uses. These flows also redistribute the bedload stored within the system throughout the year. Much of this load is coming from bank erosion of Trapper Creek and from gullies and other ephemeral channels. Load allocations will be developed using bank erosion rates developed by the NRCS and refined for TMDL use by the Idaho Falls Regional Office staff. The loads to the creek are derived from high flow events eroding unstable banks throughout the system. These loads can be estimated from bank heights and the percent unstable bank length within a system. The loads would then be reflective of the average peak flow from the annual hydrograph calculated from USGS data. For Trapper Creek, this equates to a discharge of approximately 1.24 m^3/s and a recurrence interval of once every 2.4 years. Bank full events (or recurrence intervals of 1.5 years) average 0.82 m^3/s.

Birch Creek

It has been determined that the Birch Creek is impaired by nutrients and bacteria. Typically, sediments are more likely to impair the beneficial uses at higher flows while nutrients are more likely to impair a system during lower flows. Lower summer flows in Birch Creek range from 0.358 to 0.103 m^3/s with an average of 0.177 m^3/s. The load capacity of nutrients will be based upon the average flow during June through September.

Bacteria also impair the creek. Bacteria seem to impact the creek throughout the summer months into the fall. The critical period for the recreational beneficial uses is within May to October. Recreation activities occurring within the watershed during this period include hiking, biking, fishing, and hunting. It is equally likely that water would be ingested at any time during this period, but the highest concentrations of bacteria typically occur later in the season. This may be because of a change in land use practices, when the cattle are returned to pastures along the creek in the late summer through fall. At earlier times in the season, the cattle are located on rangeland further away from the stream. Therefore, to be protective of the beneficial use the design conditions should fall within the critical period when the bacteria contamination is most likely to occur. In Birch Creek this appears to be during the months of August and September. The design flow for the TMDL will be the average discharge from the fall or 0.136 m^3/s.

Cold Creek

The data collected and presented by DEQ in this report indicate that temperature impairs the beneficial uses of Cold Creek. The salmonid population consists or consisted of stocked and naturalized populations of rainbow and brook trout, as well as native populations of cutthroat trout. Currently it is unknown if cutthroat trout inhabit the lower reaches of Cold Creek. It is likely that naturalized rainbows exist within the entire water body. The spawning and incubation periods of these salmonids range from early spring to the middle of the summer for the trout and the fall through the winter for the char. The typical period for cutthroat trout (April 1 to July 1) should be considered the critical period for the beneficial uses of the stream as these fish meet the desired management goals of the IDFG. Temperature exceedances, of both the cold water aquatic life use and salmonid spawning, typically occur throughout the summer months. This period also corresponds with the end of spawning and incubation period of the cutthroat trout. Therefore, the design conditions for Cold Creek will be based upon the average flow conditions during the spawning and incubation period of the cutthroat trout. The average discharge during this period is 0.19 m^3/s.

Beaverdam Creek

It has been determined that Beaverdam Creek is impaired by nutrients, temperature, bacteria, sediment, and DO. Typically, sediments are more likely to impair the beneficial uses at higher flows while nutrients are more likely to impair a system during lower flows. Lower summer base flows in Beaverdam Creek range from 0.007 to 0.005 m^3/s. Assigning a load capacity for such a small stream often becomes pointless when flows are less than 0.007 m^3/s (or 0.25 cfs). At this point the question must be if the beneficial uses are actually impaired by flow rather than another constituent. Therefore, design flows less than 0.007 m^3/s will not be used. The lowest flows for which water quality standards apply to intermittent streams, 0.142 m^3/s for recreational uses and 0.028 m^3/s for aquatic life uses (IDAPA 58.01.02.070.06), will be used to determine meaningful load capacities in such small perennial streams. Load capacity will be developed using background concentrations determined from sample data corresponding with detection limits of nitrate plus nitrite within the Beaverdam Creek Watershed, or 0.129 mg/L TP.

The data collected and presented by DEQ in this report indicates that temperature also impairs the beneficial uses of Beaverdam Creek. The salmonid population consists or consisted of stocked and naturalized populations of rainbow trout, as well as native populations of cutthroat trout. Currently it is unknown if cutthroat trout inhabit Beaverdam Creek. It is likely that naturalized rainbows exist within the water body. The spawning and incubation periods of these salmonids range from early spring to the middle of the summer. The typical period for cutthroat trout (April 1 to July 1) should be considered the critical period for the beneficial uses of the stream as these fish meet the desired management goals of the IDFG. Temperature exceedances, of both the cold water aquatic life use and salmonid spawning, typically occur throughout the summer months. This period also corresponds with the end of the spawning and incubation period of the cutthroat trout. Therefore, the design conditions for Beaverdam Creek will be based upon the average flow conditions during the spawning and incubation period of the cutthroat trout (April thought June). The average discharge during this period is 0.039 m^3/s.

Bacteria also impair the creek. Bacteria seem to impact the creek throughout the summer months into the fall. The critical period for the recreational beneficial uses is May to October. Recreation activities occurring within the watershed during this period include hiking, biking, fishing, and hunting. It is equally likely that water would be ingested at any time during this period, but the highest concentrations of bacteria typically occur later in the season. However, the exceedances may depend on when in the rotation the Beaverdam pastures are used. Therefore, to be protective of the beneficial use the design conditions should fall within the critical period when the bacteria contamination is most likely to occur. In Beaverdam Creek this could be anytime during the grazing season (again depending on rotation pattern). The design flow for the TMDL will be the lowest flow that is meaningful to the users and the beneficial uses, which is 0.142 m^3/s for recreational beneficial uses (IDAPA 58.01.02.070.07).

Sediment also impairs the beneficial uses of Beaverdam Creek. The beneficial uses are impaired by elevated suspended load that occurs during the high spring flows and high use times of the year. These flows also redistribute the bedload stored within the system throughout the year. Load allocations will be developed using sediment rating curves and targets implemented in other TMDLs such as the Bruneau Subbasin Assessment and TMDL (Lay 2001) and the Middle Snake River Watershed Management Plan (Buhidar 1997). The loads to the creek are derived from high flow events eroding unstable banks throughout the system and mechanical erosion of the banks during high use periods as is seen in the water chemistry data. The suspended load can be estimated from average TSS concentrations and critical period flow. Load capacity will be derived from target concentration of 50 mg/L TSS and average peak flow. Average peak flow (0.054 m^3/s) will be used as this is typically the period in which the mechanical redistribution of suspended load occurs. Furthermore, this would be protective of early season salmonid spawning and cold water aquatic life.

Low DO impairs the beneficial uses of Beaverdam Creek. The design conditions for low DO will be based upon the TMDLs developed for temperature and nutrients. For further explanation, see Low Dissolved Oxygen target selection in this document.

Little Cottonwood

Bacteria impair the beneficial uses of Little Cottonwood Creek. Bacteria seem to impact the creek throughout the summer months into the fall. The critical period for the recreational beneficial uses is May to October. Recreation activities occurring within the watershed during this period include hiking, biking, fishing, and hunting. It is equally likely that water would be ingested at any time during this period, but the highest concentrations of bacteria typically occur later in the season. However, the exceedances may depend on when in the rotation the pastures are used. Therefore, to be protective of the beneficial use the design conditions should fall within the critical period when the bacteria contamination is most likely to occur. In Little Cottonwood Creek this could be anytime during the grazing season (again depending on rotation pattern). The design flow for the TMDL will be the lowest flow that water quality standards apply, which is 0.142 m^3/s for recreational uses (IDAPA 58.01.02.070.07).

Left Hand Fork Beaverdam Creek

It has been determined that Left Hand Fork Beaverdam Creek is impaired by nutrients, bacteria, and sediment. Typically, sediments are more likely to impair the beneficial uses at higher flows while nutrients are more likely to impair a system during lower flows. Lower summer base flows in Left Hand Fork Beaverdam Creek range from 0.007 to 0.005 m^3/s. Assigning load capacity for such a small stream often becomes pointless when flows are less than 0.007 m^3/s (or 0.25 cfs). At this point the question must be if the beneficial uses are actually impaired by water quantity or flow alteration rather than another constituent. Therefore, design flows less than 0.007 m^3/s will not be used. The load capacity of nutrients will be based upon the lowest flow to which water quality standards apply to intermittent streams, which is 0.142 m^3/s for recreational uses and 0.028 m^3/s for aquatic life uses (IDAPA 58.01.02.070.07).

Bacteria impair the beneficial uses of Left Hand Fork Beaverdam Creek. Bacteria seem to impact the creek throughout the summer months into the fall. The critical period for the recreational beneficial uses is May to October. Recreation activities occurring in the watershed during this period include hiking, biking, fishing, and hunting. It is equally likely that water would be ingested at any time during this period, but the highest concentrations of bacteria typically occur later in the season. Although the exceedances may depend on when in the rotation the pastures are used. Therefore, to be protective of the beneficial use, the design conditions should fall within the critical period and when the bacteria contamination is most likely to occur. In Left Hand Fork Beaverdam Creek this could be anytime during the grazing season (again depending on rotation pattern). The design flow for the TMDL will be the lowest flow for which water quality standards apply, which is 0.142 m^3/s for recreational uses (IDAPA 58.01.02.070.07).

Sediment also impairs the beneficial uses of Left Hand Fork Beaverdam Creek. The elevated suspended load that occurs during the high spring flows impairs these uses. These flows also redistribute the bedload stored within the system throughout the year. Much of this load is coming from bank erosion of Left Hand Fork Beaverdam Creek and from gullies and other ephemeral channels. Load allocations will be developed using sediment rating curves and targets implemented in other TMDLs such as the Bruneau Subbasin Assessment and TMDL (Lay 2001) and the Middle Snake River Watershed Management Plan (Buhidar 1997). The loads to the creek are derived from high flow events eroding unstable banks throughout the system and mechanical erosion of the banks during high use periods as is seen in the water chemistry data. The suspended load can be estimated from average TSS concentrations and critical period flow. Load capacity will be derived from a target concentration of 50 mg/L TSS and summer peak flow. Summer peak flow (0.04 m^3/s) will be used, as this is typically the period in which the mechanical redistribution of suspended load occurs. Furthermore, this would be protective of late season salmonid spawning and cold water aquatic life.

Target Selection

Target selection will be based upon water quality standards if appropriate numeric standards exist. For those water quality parameters, which fall under narrative standards, target selection will be based upon current usage within the DEQ TMDL program and TFRO-DEQ. For example: EPA nutrient guidelines are commonly used as nutrient targets; sediment targets are based upon European inland fisheries investigations, other DEQ TMDLs, or bank erosion inventory work done in other DEQ regions. In some cases target selection is based upon the statistical relationship between one pollutant and another pollutant. This approach to target selection was used for low DO TMDLs. Load calculations for low DO does not lend themselves to mass-per-unit-time computations. The Statistical approach was first explored in the Bruneau Subbasin Assessment and TMDL (Lay 2001) following discussions with EPA Idaho Operations Staff. Consequently, the same or similar approach was used in the Goose Creek SBA TMDLs.

Nutrients

Four water bodies within the Goose Creek Subbasin do not meet the narrative standard for nutrients. Therefore, these segments will be considered for application of a TMDL for restoration and protection of designated beneficial uses. Water quality will be restored through the TMDL process and the subsequent implementation plans developed by the land management agencies. The TMDLs will establish a limit on the quantity of nutrients that may enter the segments from sources in the local watersheds. The nutrient limits will be set at levels such that the segments will not exceed the estimated load capacities supportive of a good to excellent fisheries and will allow the water quality to improve to restore degraded beneficial uses. The TP targets for Trapper Creek shall be a monthly average of 0.05 mg/L of TP with a daily maximum of 0.08 mg/L to allow for natural variability. The average monthly target is within the range identified by EPA as supporting beneficial uses of water flowing into lakes and reservoirs. This will restore the beneficial uses of Trapper Creek and be protective of the reservoir as well. Total phosphorus targets for Birch Creek shall be set at 0.100 mg/L of TP with a daily maximum of 0.160 mg/L of TP to allow for natural variability in those streams. The average monthly target is within the range identified by EPA as supporting beneficial uses of free flowing streams and rivers. The TP targets for Beaverdam Creek and Left Hand Fork Beaverdam Creek shall be set at a daily maximum of 0.129 mg/L TP each. This level has been determined to be the average natural background levels from data collections made from spring sources and from within the watershed when other constituents are below detection limits and anthropogenic factors are limited within the watershed.

Total phosphorus target values do not imply that degradation by TP may occur up to the target value. Rather, TP values should be less than the respective targets on an average monthly basis and daily maximum, which will allow for some exceedances of the instream standards to account for seasonal and daily variation. However, it is DEQ’s administrative policy under IDAPA 58.01.02.050.01 that 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 of in the future, in the utilization of the water appropriations which have been granted to them under the statutory procedure. IDAPA 58.01.02.50.02.a states: "Wherever attainable, surface waters of the state shall be protected for beneficial uses which for surface waters includes all recreational use in and on the water surface and the preservation and propagation of desirable species of aquatic biota." The existing and designated beneficial uses of these segments will be protected through the TMDL process as legally described. Acts of God and or uncontrollable flood/drought events will be exempt during the period of impact until such time that the impact is stabilized and the "imminent and substantial danger to the public health or environment" (IDAPA 58.01.02.350.02.a) is minimized so that the activity may be conducted in compliance with approved BMPs…to fully protect the beneficial uses (IDAPA 58.01.02.350.02.b.ii. (2)). Other activities that may cause degradation, but which are outside the scope of IDAPA 58.01.02.050.01 and which there is foreknowledge of the event's occurrence, will require a formal written letter from the individual, organization, or agency to DEQ-TFRO about the nature of the potential event. If the activity violates IDAPA 58.01.02.350.02.b.i, such that it will occur in a manner not in accordance with approved BMPs, or in a manner that does not demonstrate a knowledgeable and reasonable effort to minimize the resulting adverse water quality impacts, then DEQ-TFRO will seek intervention by the Director of DEQ for preparation of a compliance schedule (as provided in Idaho Code 39-116). DEQ may also institute administrative or civil proceedings including injunctive relief as provided in Idaho Code 39-108.

Beneficial uses may be fully supported at higher rates of nutrient loading. The implementation strategy for the nutrient impaired streams is to establish a declining trend in nutrient load indicator targets (chlorophyll *a* and TP) and to regularly monitor water quality and beneficial uses support status. If it is established that fully supported uses are achieved at intermediate nutrient loads above natural background levels, and that the narrative nutrient standards are being met, the TMDL will be revised accordingly.

Temperature

Goose Creek, Cold Creek, and Beaverdam Creek exceed the temperature water quality standards for their designated beneficial uses of cold water aquatic life and salmonid spawning. State water quality temperature standards for cold water aquatic life are 22 °C or less with a daily average of no greater than 19 °C. Those standards established for salmonid spawning are water temperatures no greater than 13 °C and a maximum daily average no greater than 9 °C during the spawning and incubation period of the particular salmonid community within the water body.

In addition to the state water quality standards, a solar pathfinder based data will be used to determine instream temperatures based on reference location average shade. The numeric standards do not apply in all cases because they realistically cannot be met throughout the reach, even under ideal shading. In these cases, the "best achievable thermal load" is used as the target. The best achievable thermal load is based on the practical amount of shading possible as defined in the TMDL by shade and solar pathfinder data collected on reference streams within the region. This data was collected from ten transects space approximately 500 meters apart on each stream. The shade from each transect was used to determine the stream average shade and the over all average shade.

Site potential shading characteristics are derived from similar riparian communities within the Goose Creek, Raft River, and Upper Snake-Rock Subbasins. Site potential shading is not an estimate of presettlement conditions. These subbasins have seen changes because of anthropogenic impacts (e.g. channel armoring, straightening, entrenchment, and farming practices) and the historic condition is no longer attainable or attainable in the very long term. Thus, site potential shading is based upon maximum vegetation heights, maximum density, and optimal vegetative offset of the riparian community based upon a group of streams with fully supported beneficial uses, located within south central Idaho. These factors also influence the bank stability of a system. Potential changes in width/depth ratios are also taken into account for the particular channel type, but changes in the existing channel type are not modeled. The Goose Creek Subbasin temperature TMDLs will be based upon the site potential shading or thermal load from five streams with fully supported beneficial uses. These streams are examples of high quality waters that are available to develop the maximum thermal load target for south central Idaho. Extrapolation outside of this area should be undertaken with some reservations until reference shade can be determined for a greater area. The first of these five reference streams was the upper fully supporting segment of Trapper Creek. The percent shade, as determined from solar pathfinder data, indicates that Trapper creek averages 28 percent shade during June through August. The second site was the fully supporting segments of Stinson Creek, which is in the Raft River Subbasin. Stinson Creek is 34 percent shaded. Cross Creek was the third stream used, as it was another fully supporting stream within the Raft River Subbasin. It was determined that Cross Creek is also 28 percent shaded. Two Streams were selected in the Upper Snake-Rock subbasin, The upper portions of Rock Creek and North Cottonwood Creek were the fourth and fifth sites. Both have been assessed using WBAG II and within the Upper Snake Rock TMDL and have been determined to meet beneficial uses and have no temperature related impacts to the beneficial uses. It was determined that Rock Creek is 64 percent shaded while North Cottonwood Creek is 55 percent shaded. As other streams are located within the general area the maximum thermal load will become more robust as the values from those streams are incorporated into the average of the reference streams. The current reference stream average is 42 percent shade during the months June, July, and August.

The Goose Creek Subbasin has always had high summer temperatures, high solar radiation, and low summer flows. Temperatures are exacerbated by certain land use practices including flow diversion, but water temperatures have most likely never been cold during the hottest part of the year. Native fishes have either physiologically adapted to the high temperatures or have take thermal refuge in and near the spring sources located throughout the various creeks. Factoring in these natural conditions, these temperature targets are based upon the temperature decrease expected under optimal habitat conditions, which, while potentially above the state numeric criteria, are protective of the native fish community and their reproduction.

Bacteria

The state of Idaho has a water quality standard for *E. coli* that covers both primary and secondary contact recreation. All of the systems in the subbasin are undesignated water bodies except Goose Creek and Goose Creek Reservoir. The undesignated water bodies are afforded protection for primary and secondary contact recreation according to IDAPA

58.01.02.101.01.a. After a review of the physical properties of the listed systems, DEQ-TFRO has determined that likely recreational activities include fishing, wading, and infrequent swimming. These recreational activities are descriptive of the existing uses consistent with secondary contact recreation. As a result, the water quality bacteria targets will be those water quality criteria for secondary contact recreation. Thus, the number of colonies of *E. coli* shall not exceed a single instantaneous sample of 576 col/100 ml and the geometric mean of five samples collected in a 30 day period of 126 col/100 ml.

Additionally, the target bacteria load (576 col/100 ml) will be segregated into percentages based on land uses. Thus, if 40 percent of the land use is attributable to agriculture, then 230 col/100 ml of the target will be distributed to agriculture. The remainder (576 - 230 = 346 col/100 ml) will be distributed to the other land uses where appropriate. An essential assumption in this method of distribution is that the water quality standard is the load capacity of a system. By using a percentage of the target or "load capacity," the calculations become unitless percentages, which overcomes the inherent problem of calculating loads from a parameter that does not lend itself to loading calculations. Allocations can then be made from this percentage of the load according to land use in the watershed. The MOS (10 percent in all cases) would be used to hold back a percent of the load from the load capacity.

Compliance with the water quality target and the TMDL will be based on the geometric mean (126 col/100 ml) for secondary contact recreation as described in the IDAPA regulations. Because the major exceedances occur primarily during the grazing season (April through September), monitoring of the water bodies will occur primarily during the grazing season, although year-round monitoring may be developed so that comparisons between the grazed and nongrazed seasons can be assessed. It is recognized that bacteria are a singular parameter that has a statistically significant linkage to TSS. (see Upper Snake Rock TMDL [Buhidar 1999] for review of surrogate use of TSS for bacteria reductions.) During the implementation phase of this TMDL, land management agencies will provide guidance as to site-specific BMPs that will effectively reduce *E. coli*, such that conjunction with TSS reductions will yield *E. coli* reductions and eventually meet beneficial uses and/or state water quality standards.

Sediment

The antidegradation policy for the state of Idaho (IDAPA 58.01.02.051(01)) indicates that the existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected. Most of the listed segments (listed for sediments in the 1998 §303(d) list) in the Goose Creek Subbasin appear to be meeting the narrative standard for suspended sediment, although they are not meeting the assessment criteria (percent surface fines) for bedload sediments. Because of this, water quality degradation due to suspended sediment beyond these conditions shall not occur, but shall be maintained at or below these levels throughout the implementation of the TMDL.

The sediment limit, in the listed segments of the subbasin, will be set at a level such that the rivers and streams will not exceed the estimated load capacity supportive of a good fishery and will not allow the water quality to degrade worse than current levels. This target shall be a monthly average of less than 50 mg/L of TSS with a daily maximum of 83 mg/L to allow for natural variability. The average monthly target is within the range identified by the European Inland Fisheries Advisory Commission (EIFAC 1965) and the Committee on Water Quality Criteria from the Environmental Studies Board of the National Academy of Science and National Academy of Engineers (NAS/NAE 1973) as supporting a moderate fishery.

Total suspended sediment values of less than 50 mg/L do not imply that degradation by TSS may occur up to 50 mg/L. Rather, TSS values should be less than 50 mg/L on an average monthly basis, which will allow for some exceedances of the in-stream standard to account for seasonal and daily variation. However, it is DEQ's administrative policy under IDAPA 58.01.02.050.01 that 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 of in the future, in the utilization of the water appropriations which have been granted to them under the statutory procedure. IDAPA 58.01.02.50.02.a states "Wherever attainable, surface waters of the state shall be protected for beneficial uses which for surface waters includes all recreational use in and on the water surface and the preservation and propagation of desirable species of aquatic biota." The existing and designated beneficial uses of the subbasin will be protected through the antidegradation as previously described. Acts of God and or uncontrollable flood/drought events will be exempt during the period of impact until such time that the impact is stabilized and the imminent and substantial danger to the public health or environment (IDAPA 58.01.02.350.02.a) is minimized so that the activity may be conducted in compliance with approved BMPs…to fully protect the beneficial uses (IDAPA 58.01.02.350.02.b.ii. (2)).

Other activities that may cause degradation, but which are outside the scope of IDAPA 58.01.02.050.01 and which there is foreknowledge of the event's occurrence will require a formal written letter from the individual, organization, or agency to DEQ-TFRO about the nature of the potential event. If the activity violates IDAPA 58.01.02.350.02.b.i, such that it will occur in a manner not in accordance with approved BMPs, or in a manner which does not demonstrate a knowledgeable and reasonable effort to minimize the resulting adverse water quality impacts, then DEQ-TFRO will seek intervention by the Director of DEQ for preparation of a compliance schedule (as provided in Idaho Code 39-116). DEQ may also institute administrative or civil proceedings including injunctive relief as provided in Idaho Code 39-108.

Loads for the bedload fraction of sediment will be developed to meet the beneficial uses of the streams and maintain the above TSS targets using a stream bank erosion estimate developed by the NRCS and refined for TMDLs by the Idaho Falls Regional Office. The current state of science does not allow specification of a sediment load or load capacity to meet the narrative criteria for sediment to fully support beneficial uses for cold water aquatic life and salmonid spawning. All that can be said is that the load capacity lies somewhere between current loading and levels that relate to natural stream bank erosion levels. It is assumed that beneficial uses were or would be fully supported at natural background sediment loading rates. These rates were assumed to equate to the 80 percent bank stability regimes required to meet state water quality standards.

Beneficial uses may be fully supported at higher rates of sediment loading. The strategy is to establish a declining trend in sediment load indicator targets (TSS and percent surface fines) and to regularly monitor water quality and beneficial uses support status. If it is established that fully supported uses are achieved at intermediate sediment loads above natural background levels, and that the narrative sediment standards are being met the TMDL will be revised accordingly.

Dissolved Oxygen

Beaverdam Creek exceeds the DO water quality standard for its designated beneficial use of cold water aquatic life. The state water quality standard for cold water aquatic life requires that DO be greater than 6 mg/L at all times. Daytime levels of DO less than this standard occur occasionally, indicating that nighttime DO levels will often decrease below state water quality standards regularly. However, DEQ has not collected diel water quality data concerning DO in Beaverdam Creek nor has it collected, BOD data to determine an appropriate target to use to reduce the organic enrichment of Beaverdam Creek. Therefore a surrogate for BOD and low DO was devised. In other TMDLs (Lay 2000), TP was used as a surrogate for organic enrichment and low DO. A similar approach was taken to determine an appropriate surrogate target for Beaverdam Creek. Our assumptions were that DO would vary in relationship to temperature, nutrients, and solids entering the stream. It is well known that as temperature increases DO decreases. Other relationships between nutrients, DO, and TSS are not as well known. In the Jacks Creek Watershed of the Bruneau Subbasin a strong correlation existed between TP and DO. The likely explanation would be that as nutrients increase so does plant material and; therefore, BOD would increase (the decaying plants would increase oxygen consumption). Biochemical oxygen demand would have been a direct measurement; however, DEQ did not collected BOD on either creek. Secondly it was assumed that as suspended solids (allochonthonus organic material) increase, so too would BOD and therefore DO would decrease. To test these assumptions simple linear regression was performed with DO as the dependant variable in each case. As expected DO and temperature had a significant relationship ($p = 0.034$). However, the amount of variation described by the model was low ($R^2 = 0.375$). This indicated that another variable was possibly effecting DO concentrations. Similar tests with TSS and TP showed no significant relationship singularly with DO ($P = 0.145$ and 0.130 respectively). To determine if the original hypothesis was correct (that DO would vary in concert with temperature, TSS, or TP), backwards, step-wise, multiple regression was used to build the best predictive model for DO. The model determined from the statistical test (DO = Constant + TP + Temperature) was highly significant ($P= 0.002$) and accounted for a great deal of the variation ($R^2 = 0.757$). Therefore, DEQ shall use, as the surrogate for the DO TMDL, temperature and TP concentrations in the equation:

$$DO = 12.137 + (-1.679 * TP) + (-0.206 * Temperature).$$

Based upon the above equation, predicted DO levels would be well above the state water quality standards if TP concentrations were at nutrient target levels (0.129 mg/L) and temperature was not more than 29 °C. Therefore, the DO targets are those same targets determined to restore the beneficial uses of Beaverdam Creek in the nutrient TMDL.

Monitoring Points

The following are the compliance points to be used to determine if the various load allocations and waste load allocations are being met following implementation of the TMDLs.

Goose Creek

Goose Creek will be monitored near the bottom by the USGS gauge for compliance with the temperature TMDL. At this location HOBO loggers will be placed annually to determine if temperature targets are being met. Different monitoring locations may be required for the bedload TMDL. The locations will be used to determine if bank stability is increasing throughout the reach. These values will be used to extrapolate bank stability conditions to the remainder of the creek. These locations are yet to be determined. Local input via the Goose Creek group will play a major factor in the location of these monitoring points.

Trapper Creek

Trapper Creek will be monitored at two locations for compliance with the TMDLs. The first of these will near the USGS gauge. This location will serve as the compliance point for the nutrient TMDL. This was near the DEQ monitoring location for the SBA. Different monitoring locations may be required for the bedload TMDL. The locations will be used to determine if bank stability is increasing throughout the reach. These values will be used to extrapolate bank stability conditions to the remainder of the creek. These locations are yet to be determined. Local input via the Goose Creek WAG group will play a major factor in the location of these monitoring points.

Birch Creek

Birch Creek will be monitored for *E. coli* bacteria and TP near the old USGS gauge for compliance with the nutrient and bacteria TMDLs.

Cold Creek

Cold creek will be monitored near Goose Creek Road for compliance with the temperature TMDL. At this location HOBO loggers will be placed annually to determine if temperature targets are being met.

Beaverdam Creek

Beaverdam Creek is complex hydrologically speaking (see hydrology section of SBA). In effect, Beaverdam Creek is two water bodies: the upper water body from the confluence of the forks down to where subsurface flow begins above the old Emery Ranch and the lower water body below the springs at the Emery Ranch. Therefore, two compliance points will be required. The lower, below Emery Ranch will be used to determine the water quality of the lower segment and the upper will be used to determine compliance with the various TMDLs. The upper location should be located nearer the bottom of the upper reach possibly near 42°

1’ 0” N 114° 2’ 48” W. This would be several miles below the current monitoring point. However, the location will be moved upstream as needed into the perennial reach should the original location prove to be in the area that the creek dries out each year.

Little Cottonwood Creek

Little Cottonwood Creek will be monitored at one location to determine the compliance with the bacteria TMDL. This location shall be in the perennial reach of water upstream from Cowboy Spring at 42° 12’ 50” N 113° 59’ 17” W.

Left Hand Fork Beaverdam Creek

Left Hand Fork Beaverdam Creek will be monitored above the road crossing near the mouth of Johnny’s Canyon for compliance with the sediment, nutrient, and bacteria TMDLs. The area below the road crossing has been determined to meet the targets and is meeting the beneficial uses at this time.

5.2 Load Capacity

The CWA requires that a TMDL be developed from a load capacity. A load capacity is the greatest amount of load that a water body can carry without violating water quality standards. In those instances where there are numeric water quality standards, the load capacity of a water body for different pollutants can be very straightforward. Most of the pollutants in the Goose Creek TMDL; however, do not have numeric water quality standards; rather they have narrative standards (e.g., IDAPA 58.01.02.200.03 “...surface waters shall be free from deleterious materials in concentrations that impair beneficial uses”), as referenced in this document. As a result, the load capacities of the various segments and tributaries in the Goose Creek Subbasin (Table 26) were estimated from extrapolations from the flow records available from USGS or DEQ and a variety of sources relating concentrations of pollutant to effects on “beneficial uses” or aquatic communities. Other sources used for concentrations were the CWA, the Code of Federal Regulations, EPA recommendations and guidelines, other states’ water quality standards, other TMDLs written by the state of Idaho and submitted to or approved by EPA, and scientific papers from refereed journals. Load capacities developed from sources other than the state of Idaho’s water quality standards will be reviewed at such time that numeric standards are adopted and codified by the state of Idaho following negotiated rule making. Additionally, load capacities were developed from flow regimes identified as critical periods. In some cases, these critical periods were low flow conditions during a particular season. In other cases, the flow regime during the critical period was determined to be at or near zero for several very small intermittent streams. In these cases, the lowest flow that water quality standards apply, which is 0.142 m^3/s for recreational uses and 0.028 m^3/s for aquatic life uses (IDAPA 58.01.02.070.07), was used to determine load capacity.

The load capacity and loading analysis models for the various streams and pollutants were derived from a mass balance approach of monitoring data, upstream monitoring, downstream monitoring, source monitoring, and estimations of loads from that data. Links to the water quality targets and beneficial uses were drawn from other TMDLs completed by the state of Idaho, EPA guidelines and recommendations, and scientific literature sources.

Nutrients

The LC for nutrients was determined by calculation using the target of 0.1 mg/L TP for free flowing streams or natural background concentrations and critical period flow values (calculated from predicted annual hydrographs). For streams flowing into reservoirs the LC was determined using the 0.05 mg/L TP target and critical period flow values (calculated from predicted annual hydrographs).

The phosphorus LC is identified for an average summer flow scenario (june through september). While these values are helpful in giving a relative understanding of the reductions required, and will apply reasonably over most water years, it should be noted that the absolute level of reduction required will depend on flow and concentration values specific to a given water year. The target shown to result in attainment of water quality standards and support of designated uses in the reach is an instream concentration of less than or equal to 0.1 mg/L TP. Transport and deposition of phosphorus, and the resulting algal growth within the reach, is seasonal in nature. Therefore, application of the 0.1 mg/L, 0.05 mg/L, or 0.129 TP targets are also seasonal in nature, extending from the beginning of June through the end of September. The length of this period was also determined by when BMPs would be most effective.

Due to water column nutrients, particularly TP, being more abundant than plant uptake rates, responses by plant communities to management efforts will take time. As TP inputs are reduced, plants that obtain nutrients from the water column (such as algae, epiphytes, and *Cerratophyllum sp.*) will likely be the first to decline. Because nutrients persist longer in sediments, plants that obtain nutrients from the sediments will persist longer. Nevertheless, as reductions in TP (and sediment) continue, sediment bound nutrients will gradually be depleted as plant uptake outpaces recharge rates.

Temperature

The primary source of temperature increases under anthropogenic control are those that increase the amount of solar radiation reaching the stream surface. Thus, the load of this resultant excess “heat” is calculated in kilowatts per hour per square meter per day (kwh/m^2/day). The LC is the amount of heat in the stream when the criteria or the best achievable temperature are met.

Based upon solar table and the reference streams’ average shade conditions, the annual average thermal load capacity for streams in the Goose Creek Subbasin is estimated to be 2.1 kwh/m^2/day. During the critical period of June, July, and August the average load capacity is 4.1 kwh/m^2/day.

Bacteria

The LC for bacteria is based on the state water quality standard for *E. coli*. The bacteria LC is expressed in terms of percent of colony forming units. However, this is simply an accounting mechanism to convert a unit of measurement (colony forming units per 100 ml) to a unitless measurement because of the impracticality of converting to a mass per unit time measurement.

Sediment

The LC for sediment was determined based on the origin of the sediment. In those instances where the sediment generated from stream bank erosion, the LC is based on the load generated from banks that are greater than 70% stable. This load defines the LC for the remaining segments of the stream. In instances where a numeric water column target is defined, the LC is based on the instream load that would be present when the target is met. For example, the instream TSS target for Beaverdam Creek and Left Hand Fork of Beaverdam Creek is 50 mg/L. The LC for these creeks is based on maintaining 50 mg/L TSS throughout the streams during the critical flow period.

Dissolved Oxygen

The LC for DO will be based upon those developed for TP (see Table 29 for TP load capacity for Beaverdam Creek).

Table 29. Load capacities and critical periods.

Stream Name	Parameter	Critical Period	Load capacity[a]
Goose Creek	Temperature	June through July	4.1 kwh/m^2/day
Goose Creek	Sediment	March through May	1,294,371 kg/year
Trapper Creek	Nutrients	June through September	1.67 kg/day
Trapper Creek	Sediment	March through May	108,590 kg/year
Birch Creek	Nutrients	June through September	1.53 kg/day
Birch Creek	Bacteria	June through August	576 col/100 ml
Cold Creek	Temperature	June through July	4.1 kwh/m^2/day
Beaverdam Creek	Nutrients	June through September	0.32 kg/year
Beaverdam Creek	Temperature	June through July	4.1 kwh/m^2/day
Beaverdam Creek	Bacteria	June through August	576 col/100 ml

Stream Name	Parameter	Critical Period	Load capacity[a]
Beaverdam Creek	Sediment	March through May	232.26 kg/day
Beaverdam Creek	Dissolved oxygen	June through August	0.32 kg/year TP
Little Cottonwood Creek	Bacteria	June through August	576 col/100 ml
Left Hand Fork Beaverdam Creek	Nutrients	June through September	0.33 kg/day
Left Hand Fork Beaverdam Creek	Bacteria	June through August	576 col/100 ml
Left Hand Fork Beaverdam Creek	Sediment	March through May	31.78 kg/day

[a] kwh/m^2/day = kilowatt hours per square meter per day, kg/year = kilograms per year, col/100ml = colonies of *E. coli* per 100 ml of water.

5.3 Estimates of Existing Pollutant Loads

Regulations allow that loadings "...may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading," (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. In the Goose Creek Subbasin, data available to distinguish between nonpoint sources and background are very limited. In most cases, the anthropogenic stresses are applicable from the headwaters of a stream to its mouth. In these cases, it is assumed that the background levels of the various parameters are similar to other streams in south central Idaho. As such, background will be estimated for some streams until a better estimation or scientific evaluation can be made for each streams background load.

There are no point sources located within the Goose Creek Subbasin which discharge to any receiving water body regulated under the NPDES permit process. However, there are several CAFOs in the northern segment of the subbasin, below Lower Goose Creek Reservoir, that have NPDES permits. These facilities are allowed zero discharge and therefore would have a 0 kg per day WLA. It is uncertain at this time if there are any land application sites in the subbasin as well. These permitted facilities would also be allowed 0 kg per day discharge to the surface waters under their governing permits. Consequently, CAFOs and land application sites will not be addressed in the wasteload allocations.

Nutrients

In those streams determined to need nutrient TMDLs, natural background was assumed to be similar to that of the major drainages nearby. These drainages contain significant natural phosphorus deposits as well as some anthropogenic stresses. The background concentration of TP has been determined to be very low (0.02 mg/L). Nutrient background determinations will be discussed in greater depth in following sections. The nonpoint source load was assumed to be the difference between the existing load and natural background. The existing load was calculated from the critical flow and the average annual concentration of TP in the different streams. In Trapper Creek this was 0.108 mg/L, in Birch Creek this was 0.117 mg/L, in Beaverdam Creek this was 0.366 mg/L while in Left Hand Fork of Beaver Dam this was 0.221 mg/L.

The Beaverdam Creek Watershed required a different approach to determine natural background. Through discussion with local geological experts and observations during monitoring it was determined that the watershed contained natural deposits of phosphorus. The location of this source is unknown at this time. To determine background concentrations, samples were collected from the various spring sources within the Beaverdam Creek Watershed. These samples were inconclusive due in part to the heavy use of the springs in recent drought years. It was difficult to obtain samples that were not contaminated by sediment and other material. To test for contamination *E. coli* tests were run on the different springs concurrent with the TP collections. Although below state water quality standards, the tests indicated that the water collected from the springs was compromised. Therefore, DEQ returned to the original data set. During seasons of non or limited use, other measured constituents were often below detection limits. Therefore, DEQ assumed that during these times TP was also at or near background levels. The background concentration in the Beaverdam Creek Watershed was determined to be 0.129 mg/L when nitrite and nitrate were below detection limits. A similar analysis was completed in the other watersheds within the Goose Creek Subbasin and background levels ranged from 0.013 to 0.049 mg/L, which supports the natural background assumptions made about the nearby major drainanges.

Temperature

Existing temperature loads were estimated from the solar pathfinder model run with current vegetation cover, or percent solar time exposed (Table 30), to determine current kilowatt hours per square meter per day (Table 31). Natural background was considered the system potential load derived from the solar pathfinder model run with system potential cover.

Table 30. Stream potential and existing percent exposed solar time.

Month	Percent Potential Exposed Solar Time	Goose Creek Percent Exposed	Cold Creek Percent Exposed	Beaverdam Creek Percent Exposed
January	15	93	26	30
February	29	94	41	47
March	46	96	57	65
April	61	96	68	72
May	58	96	67	78
June	61	97	67	80
July	59	96	68	78
August	54	96	66	72
September	45	96	62	69
October	33	96	53	54
November	18	95	34	36
December	15	93	19	31

Bacteria

Little Cottonwood Creek provides the clearest methods for estimating bacteria loads. Natural background was estimated from average bacteria counts collected during the noncritical period (months April through May and October through November). The nonpoint source load was estimated from the difference in the previous number and average bacteria counts collected during the critical period (months June through September). The other three creeks' sampling regimes were very similar. Therefore, a similar approach was used to determine natural background levels and existing loads (Table 32). It should be noted that in other streams in south central Idaho (and the Goose Creek Subbasin) natural background counts of bacteria are near zero. Therefore, the additional background counts used in these TMDLs should be considered part of the implicit MOS.

Table 31. Potential and existing monthly solar load.

Month	Potential Solar Load[a]	Goose Creek Solar Load	Cold Creek Solar Load	Beaverdam Creek Solar Load
January	0.3	1.5	0.4	0.5
February	0.7	2.4	1.0	1.2
March	1.7	3.5	2.1	2.4
April	3.2	5.0	3.5	3.8
May	3.7	6.1	4.2	5.0
June	4.3	6.9	4.8	5.7
July	4.4	7.2	5.1	5.8
August	3.5	6.2	4.3	4.7
September	2.3	4.9	3.2	3.5
October	1.1	3.3	1.8	1.9
November	0.3	1.8	0.7	0.7
December	0.2	1.3	0.3	0.4

a Units in this table are kwh/m^2/day

Sediment

In Goose Creek the primary source of sediment is bank erosion. Existing sediment loads were determined using the bank erosion inventory process. This method provides an estimation of erosion rates within the sampling reaches. The erosion rate was then used to calculate the current instream delivery of sediment within the system. In other TMDLs, the background load was assumed to be similar to that from streams or reaches with slight to moderate bank erosion rates and 80 percent stable banks. Background loads developed for the suspended fraction of the sediment load were derived in a similar fashion as the bacteria and TP loads. Existing loads were determined from the average concentration of TSS during the anthropogenically elevated period (July through September) and average peak discharge. For Beaverdam Creek this was 560 mg/L TSS and for Left Hand Fork of Beaver Dam creek this was 78 mg/L

Dissolved Oxygen

Dissolved oxygen loads were developed from the required nutrient loads.

Table 32. Background and existing nonpoint source loads in the Goose Creek Subbasin.

Stream name	Pollutant	Natural Background[a]	Existing Load[a]	Existing wasteload[a]
Goose Creek	Temperature	4.1 kwh/m^2/day	6.7 kwh/m^2/day	0 kwh/m^2/day
Goose Creek	Sediment	1,294,371 kg/year	9,681,656 kg/year	0 kg/year
Trapper Creek	Nutrients	0.67 kg/day	3.60 kg/day	0.00 kg/day
Trapper Creek	Sediment	108,590 kg/year	1,526,157kg/year	0 kg/year
Birch Creek	Nutrients	0.31 kg/day	1.78 kg/day	0.00 kg/day
Birch Creek	Bacteria	98 col 100/ml	4872 col/100 ml	0 col/100 ml
Cold Creek	Temperature	4.1 kwh/m^2/day	4.7 kwh/m^2/day	0 kwh/m^2/day
Beaverdam Creek	Nutrients	0.117 kg/day	0.73 kg/day	0.00 kg/day
Beaverdam Creek	Temperature	4.1 kwh/m^2/day	5.4 kwh/m^2/day	0 kwh/m^2/day
Beaverdam Creek	Bacteria	351 col/100 ml	22,071 col	0 col/100 ml
Beaverdam Creek	Sediment	19 kg/day	2,601 kg/day	0 kg/day
Beaverdam Creek	Dissolved Oxygen	0.08 kg/day	0.83 kg/day	0.00 kg/day
Little Cottonwood Creek	Bacteria	7 col/100 ml	758 col/100 ml	0 col/100 ml
Left Hand Fork Beaverdam Creek	Nutrients	0.06 kg/day	0.58 kg/day	0.00 kg/day
Left Hand Fork Beaverdam Creek	Bacteria	55 col/100 ml	7,170 col/100 ml	0 col/100 ml
Left Hand Fork Beaverdam Creek	Sediment	2.54 kg/day	49.58 kg/day	0 kg/day

[a] kwh/m^2/day = kilowatt hours per square meter per day, kg/year = kilograms per year, col/100ml = colonies of *E. coli* per 100 ml of water.

5.4 Load Allocation

The total allocations must include a MOS to take into account seasonal variability and uncertainty. Uncertainty arises in selection of water quality targets, load capacity, and estimates of existing loads, and may be attributed to incomplete knowledge or understanding of the system, such as assimilation not well known, sketchy data, or variability in data. The MOS is effectively a reduction in loading capacity that “comes off the top” (i.e., before any allocation to sources). Second in line is the background load, a further reduction in loading capacity available for allocation. It is also prudent to allow for growth by reserving a portion of the remaining available load for future sources.

The load capacity is apportioned among existing and future pollutant sources. Allocations may take into account equitable cost, cost effectiveness, and credit for prior efforts, but all within the ceiling of remaining available load. These allocations may take the form of percent reductions rather than actual loads. Each point source must receive a waste load allocation (In the Goose Creek Subbasin this is zero see Table 32). Nonpoint sources may be allocated by subwatershed, land use, responsibility for actions, or a combination. It is not necessary to allocate a reduction in load for all nonpoint sources so long as water quality targets can be met with the reductions that are specified. In the Goose Creek Subbasin all load allocations are made using watershed area, if finer resolution is needed the load allocations can be made on land use within each watershed.

Margin of Safety

In addition to estimating a load capacity a given water body can carry, the Clean Water Act includes statutory requirements for a MOS in a TMDL. The MOS is intended to account for uncertainties in available data or in the actual effect controls will have on load reductions and the receiving water body's water quality. The MOS may be implicit, such as conservative assumptions used in various calculations, specifically those of natural background, loading capacity, wasteload allocations, and load allocations. Otherwise, a MOS must be clearly defined. For the Goose Creek Subbasin TMDLs, an explicit MOS will be set at 10 percent for all pollutant water body combinations. In addition, any conservative approaches used in the various calculations required by a TMDL will be included as an implicit component of the MOS. The implicit MOS; however, will not be clarified further. Rather, it will be assumed that conservative approaches taken throughout the document will have been sufficiently identified in appropriate sections.

Seasonal Variation

A TMDL must be established with consideration of seasonal variation. In the Goose Creek Subbasin there are seasonal influences on nearly every pollutant addressed. The summer growing season is when concentrations of bacteria and nutrients are the highest. This is also when water temperatures are elevated. The increase in temperature is due to a combination of agricultural diversion/return flow, warmer air temperatures, and a lack of stream shading. Seasonal variation as it relates to development of these TMDLs is addressed simply by ensuring that loads are reduced during the critical period (when beneficial uses are impaired and loads are controllable). Thus, the effects of seasonal variation are built into the load allocations.

Critical Period

The critical period for each water body is based on the time when beneficial uses must be protected and when pollutant loads or the stress on the beneficial uses are the highest. Each TMDL was developed such that the water quality standards will be achieved year around, yet the critical period defines when loading reductions must occur (see Table 29 for the critical period for each water body).

Background

Several recent Idaho TMDLs have discussed background levels for the various constituents. Much of that information is applicable to the Goose Creek Subbasin as well. Therefore the information was used in whole or in part *from The Big Wood River Watershed Management Plan* (Buhidar 2001)TMDL, the *Mid Snake Succor Creek TMDL* (Horsburgh 2003*), Snake River Hells Canyon TMDL* (Idaho DEQ and Oregon DEQ 2003) or *the Pahsimeroir River Subbasin Assessment and Total Maximum Daily Load* (Shumar and Reaney 2001) for the Goose Creek Subbasin TMDLs.

Nutrients

The following discussion comes from the *Snake River Hells Canyon TMDL* (SR-HC TMDL) (Oregon DEQ and Idaho DEQ 2003). The SR-HC TMDL assessed natural phosphorus conditions in the mainstem Snake River by looking at concentrations in the Blackfoot and Portneuf watersheds where there are high naturally occurring concentrations of phosphorus. Natural sources of nutrients include erosion of phosphorus-containing rock and soils through wind, precipitation, temperature extremes, and other weathering events.

“Natural deposits of phosphorus (Hovland and Moore 1987) have been identified in the Snake River drainage near Pocatello, Idaho (RM 731.2). Geological deposits in the Blackfoot River watershed (inflow at river mile [RM] 750.6) contain phosphorus in sufficient concentrations that they have been mined. The Snake River flows through this area some distance upstream of the SR-HC TMDL reach.

In an effort to assess the potential magnitude of natural phosphorus concentrations in the mainstem Snake River due to these geological deposits, total phosphorus concentrations occurring in the mainstem near the Blackfoot and Portneuf River inflows (RMs 750.6 and 731.2, respectively) were evaluated. Data were available for the Snake River near Blackfoot, Idaho (USGS gauge No. 13069500, RM 750.1) and for the Blackfoot and Portneuf Rivers (USGS 2001a). The mainstem Snake River and these tributary river systems, where they flow through the natural mineral deposits, represent a worst-case scenario for evaluation of natural phosphorus loading and were identified as potential sources of naturally-occurring phosphorus to the SR-HC reach. The USGS gauged flow data and water quality data from the 1970s to the late 1990s is available for the Blackfoot and Portneuf Rivers (USGS gauge No. 13068500 and No. 13075500, respectively). Because both the mainstem and tributary watersheds have been settled for some time, and land and water management has occurred extensively, the data compiled represent both natural and anthropogenic loading.

Total phosphorus concentrations in the Snake River mainstem, measured near Blackfoot, Idaho (RM 750.1), from 1990 to 1998 averaged 0.035 mg/L (range ≤ 0.01 to 0.11 mg/L, median = 0.03 mg/L, mode = 0.02 mg/L) (USGS 2001a). Nearly 40 percent (23 samples) of the total data set showed total phosphorus concentrations less than or equal to 0.02 mg/L. The data represent year-round sampling. Winter sampling was slightly less frequent (approximately 19% of the total) than spring, summer, or fall sampling.

Natural phosphorus concentrations were not assessed as part of the Blackfoot River TMDL (DEQ 2001b). Total phosphorus concentrations in the Blackfoot River, measured near the mouth, from 1990 to 1999 averaged 0.069 mg/L (range ≤ 0.01 to 0.43 mg/L, median = 0.04 mg/L, mode = 0.03 mg/L) (USGS 2001a). Nearly 23 percent (12 samples) of the total data set showed total phosphorus concentrations less than or equal to 0.02 mg/L. The data represent year-round sampling. Winter sampling was less frequent (approximately 13% of the total) than spring, summer, or fall sampling.

Natural phosphorus concentrations were not assessed for the Portneuf River TMDL (DEQ, 1999d). Total phosphorus concentrations in the Portneuf River, measured near the mouth, from 1990 to 1998 averaged 0.085 mg/L (range = <0.01 to 0.28 mg/L, median = 0.069 mg/L, mode = 0.03 mg/L) (USGS, 2001a). Nearly 21 percent (6 samples) of the total data set showed total phosphorus concentrations less than or equal to 0.02 mg/L. Data represents year-round sampling. Winter sampling represented approximately 22 percent of the total.

The fact that very low total phosphorus concentrations were observed routinely (more than 20% of the time) in the mainstem Snake River, the Blackfoot River and the Portneuf River, all watersheds with a high level of use and management show that the natural loading levels are likely below detection limit concentrations. The additional fact that these low concentrations were observed in watersheds in much closer proximity to the rich geological phosphorus deposits than the Goose Creek Subbasin indicates that these deposits likely do not represent a significant source of high, natural loading to the Goose Creek TMDL reaches.

Given the above discussion, the natural background concentration for TP in the mainstem Snake River has been estimated as at or below 0.02 mg/L for both the Mid Snake River/Succor Creek and SR-HC TMDL reaches. This value is based on the available data set. Data from the Snake River upstream of RM 409 were included in this data set to address the concern of enrichment of surface waters by the phosphoric deposits located in central and eastern Idaho (Hovland and Moore 1987). Due to the fact that there are substantial anthropogenic influences in Snake River Basin, the lower 15^{th} percentile value for total phosphorus concentration was selected as a conservative estimate of the natural phosphorus concentration. In this manner, natural concentration levels for the mainstem Snake River were calculated conservatively. This initial estimate will be reviewed as additional data become available and revisions will be made as appropriate.

The estimated natural background loading concentration for the mainstem Snake River (0.02 mg/L) is most likely an overestimation of the natural loading but represents a conservative estimate for the purposes of load calculation. In addition, this concentration correlates well with other studies that have been completed and closely approximates the TP concentration identified for a reference system (relatively unimpacted) by the US EPA (US EPA 2000d, Dunne and Leopold 1978). Because phosphorus concentrations had dropped to below the detection limit in the Blackfoot watershed after implementation of BMPs, background was assessed at 0.02 mg/L based on the lowest 15^{th} percentile value for phosphorus. This choice of percentile addressed bias introduced by using a lower percentile that contained values below the detection limit and lack of data located directly below the natural source of phosphorus."

Based upon this information, natural background will be assumed to be 0.02 mg/L in the Goose Creek Subbasin unless otherwise noted as in the Beaverdam Creek Watershed.

Temperature

Background for temperature is considered to be the amount of heat in the water when the maximum riparian potential is met. Thus, the background temperature is the same as the loading capacity.

Bacteria

Background bacteria colonies enter the stream from many sources not controllable through the TMDL process. Generally, these sources are from the wildlife that use the stream. In some cases, waterfowl have been shown to be a significant contributor of *E. coli* (Campbell 2001). Other studies have indicated that skunks, ground squirrels, and other small mammals may be significant contributors. No work has been done in the Goose Creek Subbasin to partition these sources from the overall counts. This would entail genetic differentiation of the *E. coli* found within each watershed. Rather than a detailed genetic study of the *E. coli*, DEQ opted to make some simple assumptions about the sources. The first of these is that the contributions from wildlife sources of *E. coli* are similar throughout the year. The second is that anthropogenic sources are more heavily concentrated during the summer. These sources may include recreation as well as grazing. If these two assumptions are met then the uncontrollable portion, that from the wildlife sources, could be identified as the average counts for the period when anthropogenic sources are minimized. This count would vary from watershed to watershed depending on the utilization of the watershed by the local wildlife population.

Sediment

Background sediment production from stream banks equates to the load at 80 percent stream bank stability as described in Overton et al. (1995), where stable banks are expressed as a percentage of the total estimated bank length. The natural condition stream bank stability potential is generally at 80 percent or greater for A, B, and C channel types in plutonic, volcanic, metamorphic, and sedimentary geology types.

Suspended sediment production is assumed to follow a similar pattern as bacterial contamination, although this production should also include the spring runoff period as well. In order to determine the natural background concentration of TSS for the Goose Creek Subbasin the average concentration for the month of October subbasin wide was determined. This early fall sampling data would fall within the time frame when most anthropogenic stresses were minimized throughout the subbasin. Additionally the flow regime would be minimized so that redistribution of sediment via hydrological parameters would also be minimized. As a result the results should give yield a subbasin wide average background concentration of TSS. The value will be reassessed once a more complete data set exist. Currently Background TSS for load calculations will be 4 mg/L or the average concentration collected to date in the month of October.

Dissolved Oxygen

The DO TMDL was developed from an empirically derived equation relating DO levels to temperature and nutrient concentrations. The other aspects of the TMDL, such as background, are the same as those derived for TP and temperature. Therefore, the background load for DO is the same as the TP TMDL or 0.08 kg/day TP.

Reserve

An allowance in the TMDL for a portion of the loading capacity to be set aside for future growth is permissible and encouraged. Careful documentation of the decision making process must accompany the TMDL. This allowance for future growth must be based on existing or readily available data at the time of the TMDL development if it is to be applicable to the assumptions and calculations used to develop the TMDL loads. In the Goose Creek Subbasin, little discussion with the local stakeholders has occurred in regards to a reserve load. In fact, the Lake Walcott WAG has historically chosen to forgo the use of a reserve. Further discussions with the Goose Creek stakeholders are required. If it is deemed feasible a reserve may be developed in a similar fashion as the Wood River WAG used; the reserve will be developed during the implementation of the TMDL. Nevertheless, it should be noted that developing a reserve post hoc will result in more stringent load reductions than presented in the various TMDLs.

Remaining Available Load

The following should be considered the tabular summarization of the SBA and TMDL processes (Table 33). The information also the meets the legal definition of a TMDL such that:

$$TMDL = LC = NB + MOS + LA + WLA$$

Additionally, there are no point sources within the watersheds. Therefore, no wasteload allocations were made. Nonpoint sources were allocated by subwatershed. It is incumbent upon the land management agencies and private individuals to develop the appropriate BMPs to meet the nonpoint source load allocations during the implementation plan development. A finer allocation based upon land ownership, land use, or other mechanism is not needed so long as water quality targets can be met by the aggregate reductions of those sources that are prescribed a reduction in load through the implementation plan. Reach level allocations based upon the stream bank erosion process are presented in Table 34 for Trapper Creek and Table 35 for Goose Creek.

Table 33. Goose Creek Subbasin TMDLs.

Creek	Pollutants[a]	Target[b]	critical period	Critical flow (m^3/s)[c]	load capacity	Back Ground	Total load	MOS[d]	LA[e]	Load Reduction	Percent reduction	Units[f]
Goose Creek	Temp	4.1	June through July	1.19	4.1	4.1	6.7	0.4	3.7	3.0	44.78	Kwh/m^2/ day
Goose Creek	Sed.	70% B.S.	March through May	8.58	1,294	1,294	10,976	Imp.	1,294	9,682	88.21	Mg/year
Trapper Creek	Nut.	0.050 mg/L	June through Sept	0.386	1.67	0.67	3.60	0.17	0.83	2.77	76.94	kg/day
Trapper Creek	Sed.	70% B.S.	March through May	1.24	152	152	3,567	Imp.	152	3,415	95.73	Mg/year
Birch Creek	Nut.	0.100 mg/L	June through Sept	0.177	1.53	0.31	1.78	0.15	1.02	0.76	42.69	kg/day
Birch Creek	Bact.	576	June through August	0.142	576	98 col	4872	58	420	4,452	91.38	col/100 ml
Cold Creek	Temp	4.1	June through July	0.19	4.1	4.1	4.7	0.4	3.7	1.0	21.28	Kwh/m^2/ day
Beaverdam Creek	Nut.	0.129 mg/L	June through Sept	0.01	0.315	0.117	0.331	0.03	0.168	0.163	49.82	kg/day
Beaverdam Creek	Temp	4.1	June through July	0.04	4.1	4.1	5.4	0.4	3.7	1.7	31.48	Kwh/m^2/ day
Beaverdam Creek	Bact.	576	June through August	0.142	576	351	22,071	58	167	21,904	99.24	col/100 ml
Beaverdam Creek	Sed.	50 mg/L	March through May	0.054	232.3	19	2,601	23	190.3	2,410	92.68	kg/day
Beaverdam Creek	DO	0.129 mg/L	June through August	0.01	0.315	0.117	0.331	0.03	0.168	0.163	49.82	kg/day

Creek	Pollutants[a]	Target[b]	critical period	Critical flow (m^3/s)[c]	load capacity	Back Ground	Total load	MOS[d]	LA[e]	Load Reduction	Percent reduction	Units[f]
Little Cottonwood Creek	Bact.	576	June through August	0.142	576	7	758	58	511	247	32.59	col/100 ml
Left Hand Fork Beaverdam Creek	Nut.	0.129 mg/L	June through Sept	0.007	0.33	0.06	0.58	0.03	0.24	0.34	58.66	kg/day
Left Hand Fork Beaverdam Creek	Bact.	576	June through August	0.142	576	55	7,170	58	463	6,707	93.54	col/100 ml
Left Hand Fork Beaverdam Creek	Sed.	50 mg/L	March through May	0.007	31.	2.54	49.58	3	25.46	24.12	48.65	kg/day
Temp. = Temperature, Sed. = Sediment, Nut. = nutrients (TP), Bact. = Bacteria, B.S. = Bank Stability, DO = Dissolved Oxygen, and Imp. = Implicit.												

[a] Temp. = temperature, Sed. = sediment, Nut.= nutrients, Bact. = bacteria, DO = low dissolved oxygen.
[b] B.S. = Bank Stability, mg/L = milligrams per liter.
[c] m^3/s = cubic meters per second
[d] Imp. = Implicit margin of safety
[e] LA = Load Allocation
[f] $kwh/m^2/day$ = kilowatt hours per square meter per day, Mg/year = Megagram per year, kg/day = kilogram per day, col/100ml = colonies per 100 milliliters of water

Table 34. Trapper Creek bank erosion load reductions.

Reach	Existing		Proposed			
	Erosion Rate (Mg/mi/y)[a]	Total Erosion (Mg/y)[b]	Erosion Rate (Mg/mi/y)[a]	Total Erosion (Mg/y)[b]	Erosion Rate Percent Reduction	Percent of Existing Total Load
Headwaters	11.79	6.35	9.98	5.17	15.38	0.18
Middle Reach	44.45	230.42	11.79	61.42	73.47	6.46
Pasture Reach	227.70	445.43	12.70	25.31	94.42	12.49
Lower Reach	1,060.50	952.54	19.05	16.69	98.20	26.70
Gullies	1,653.80	1,932.30	37.19	43.91	97.75	54.17
Total Erosion (Mg/y)		3,567.05		152.50	95.72	100.00

[a] Megagram per mile per year
[b] Megagram per year

Table 35. Goose Creek bank erosion load reductions.

Reach	Existing		Proposed			
	Erosion Rate (Mg/mi/y)[a]	Total Erosion (Mg/y)[b]	Erosion Rate (Mg/mi/y)[a]	Total Erosion (Mg/y)[b]	Erosion Rate Percent Reduction	Percent of Existing Total Load
Upper Idaho	0.9	15.4	7.3	103.1	0	0.14
Nevada Reference	15.4	164.2	15.4	164.2	0	1.50
Nevada from wine cup to Utah	198.7	4,583.1	17.2	402.4	91	41.76
Utah to Idaho	291.2	2,263.4	21.8	165.6	93	20.62
Idaho border to Coal Banks	432.7	3,178.8	27.2	199.3	94	28.96
Coal Banks to Cave Gulch	88.9	764.8	25.4	221.5	71	6.97
Cave Gulch to Reservoir	2.7	6.4	16.3	38.2	0	0.06
Total Erosion (Mg/y)		10,976.0		1,294.4	88.21	100.00

[a] Megagram per mile per year
[b] Megagram per year

5.5 Implementation Strategies

The purpose of this implementation strategy is to outline the pathway by which a larger, more comprehensive, implementation plan will be developed 18 months after TMDL approval. The comprehensive implementation plan will provide details of the actions needed to achieve load reductions (set forth in a TMDL), provide a schedule of those actions, and specify monitoring needed to document actions and progress toward meeting state water quality standards. These details are typically set forth in the plan that follows approval of the TMDL. In the meantime, a cursory implementation strategy is developed to identify the general issues such as responsible parties, a time line, and a monitoring strategy for determining progress toward meeting the TMDL goals outlined in this document.

Overview

The objective of the Goose Creek Subbasin TMDLs is to allocate allowable loads among different pollutant sources so that the appropriate control actions can be taken and water quality standards achieved. The total pollutant loads on these water bodies are derived from nonpoint and background sources. The Goose Creek Subbasin TMDLs have attempted to consider the effect of all activities or processes that cause or contribute to the water quality limited conditions of not just the water bodies listed on the 1998 §303(d) list, but rather all potential sources. Control measures to implement this TMDL do not contain NPDES authorities, but are based on the reasonable assurance that state, federal, and local authorities will ensure that actions to reduce nonpoint source pollution will occur. "There must be assurances that nonpoint source control measures will achieve expected load reductions in order to allocate a wasteload to a point source with a TMDL that also allocates expected nonpoint source load reductions" (EPA 1991). The Goose Creek TMDLs have load allocations calculated with margins of safety to meet water quality standards. The allocations; however, are based on estimates that have used available data and information. Therefore, monitoring for the collection of new data is necessary and required. For the Goose Creek TMDLs the reasonable assurance that it will meet its goal of water quality standards is based on two components: 1) nonpoint source implementation of BMPs based on land management agencies' assurance that reductions will occur, and 2) trend monitoring that will be used to document relative changes in various aquatic organism populations and in physical and chemical water quality parameters over a 10-year period in conjunction with data from various agencies, organizations, and water user industries that will assess overall progress towards attainment of water quality standards and related beneficial uses.

Responsible Parties

Development of the final implementation plan for the Goose Creek Subbasin TMDLs will proceed under the existing practice established for the state of Idaho. The plan will be cooperatively developed by DEQ, the Goose Creek committee of the Lake Walcott WAG, the affected private landowners, and other "designated agencies" with input from the established public process. Of the four entities, the WAG committee will act as the integral part of the implementation planning process to identify appropriate implementation measures. Other individuals may also be identified to assist in the development of the site-specific implementation plans as their areas of expertise are identified as beneficial to the process.

Designated state agencies are responsible for assisting with preparation of specific implementation plans, particularly for those sources for which they have regulatory authority or programmatic responsibilities. Idaho's designated state management agencies are:

- Idaho Department of Lands (IDL): timber harvest, oil and gas exploration and development, mining.
- Idaho Soil Conservation Commission (ISCC): grazing and agriculture.
- Idaho Department of Transportation (IDT): public roads.
- Idaho Department of Agriculture (IDA): aquaculture, animal feeding operations (AFOs), CAFOs.
- Department of Environmental Quality: all other activities.

To the maximum extent possible, the implementation plan will be developed with the participation of federal partners and land management agencies (i.e., NRCS, USFS, BLM, U.S. Bureau of Reclamation, etc.). In Idaho, these agencies, and their federal and state partners, are charged by the CWA to lend available technical assistance and other appropriate support to local efforts/projects for water quality improvements.
All stakeholders in the Goose Creek Subbasin have a responsibility for implementing the TMDL. DEQ and the "designated agencies" in Idaho have primary responsibility for

overseeing implementation in cooperation with landowners and managers. Their general responsibilities are outlined below.

- DEQ will oversee and track overall progress on the specific implementation plan and monitor the watershed response. DEQ will also work with local governments on urban/suburban issues.
- IDL will maintain and update approved BMPs for forest practices and mining. IDL is responsible for ensuring use of appropriate BMPs on state and private lands.
- ISCC, working in cooperation with local Soil and Water Conservation Districts, IDA, and the NRCS, will provide technical assistance to agricultural landowners. These agencies will help landowners design BMP systems appropriate for their properties, and identify and seek appropriate cost-share funds. They also will provide periodic project reviews to ensure BMPs are working effectively.
- IDT will be responsible for ensuring appropriate BMPs are used for construction and maintenance of public roads.
- IDA will be responsible for working with aquaculture to install appropriate pollutant control measures. Under a memorandum of understanding with EPA and DEQ, IDA also inspects AFOs, CAFOs, and dairies to ensure compliance with NPDES requirements.

The designated agencies, WAG, and other appropriate public process participants are expected to:

- Develop BMPs to achieve Las.
- Give reasonable assurance that management measures will meet LAs through both quantitative and qualitative analyses of management measures.
- Adhere to measurable milestones for progress.
- Develop a timeline for implementation, with reference to costs and funding.
- Develop a monitoring plan to determine if BMPs are being implemented, individual BMPs are effective, LA and WLA are being met, and water quality standards are being met.

In addition to the designated agencies, the public, through the WAG and other equivalent processes, will be provided with opportunities to be involved in developing the implementation plan to the maximum extent practical. Public participation will significantly affect public acceptance of the document and the proposed control actions. Stakeholders (landowners, local governing authorities, taxpayers, industries, and land managers) are the most educated regarding the pollutant sources and will be called upon to help identify the most appropriate control actions for each area. Experience has shown that the best and most effective implementation plans are those that are developed with substantial public cooperation and involvement.

Feedback Loop and Adaptive Management

The feedback loop is a component of the Goose Creek Subbasin TMDL strategy that provides for accountability of plan goals for various pollutants. As part of the TMDL process, the Goose Creek TMDLs will use adaptive management as a style and process whereby management of the watershed is initiated by the state, federal agencies, and the water user industries, then, an evaluation process will ascertain the direction in which the reductions are progressing, and, based on monitoring information collected from various agencies, organizations, and water users refine the goals, targets, and BMPs based on short-term and long-term objectives for ecosystem management of the Goose Creek watershed. Past management experiences may be used to evaluate both success and failure and to explore new management options where necessary. By learning from both successes and failures, the Goose Creek TMDL will be iterative to allow implementation of those techniques which may be most useful and helpful, as well as gain insights into which practices best promote recovery for restoration of beneficial uses and state water quality standards (Williams et al. 1997).

For the Goose Creek Subbasin the main goal is to reach the preliminary in-stream water quality target of 576 col/100 ml *E. coli* for all tributaries and to maintain the low TSS annual mean value already existing in most of the other systems. Additionally, for the Goose Creek Subbasin an additional main goal is to reach the preliminary in-stream water quality target of 0.05 mg/L TP for the stream systems feeding Goose Creek Reservoir. These preliminary targets are set up in this way to allow for modifications in the targets over the next 10-15 years to attain beneficial uses and meet state water quality standards.

In order for the feedback loop to be successful in the Goose Creek TMDLs, a concrete mechanism has to be designed with short-term and long-term goals for DEQ, other agencies, and the Goose Creek citizen groups. These entities must regularly review the implementation progress and monitoring results and evaluate plan effectiveness. Sufficient flexibility in management plans must be incorporated to allow for corrections in management strategies that may not be effective in achieving beneficial uses or state water quality standards. Nonpoint source industries will follow the feedback loop by: 1) identifying critical water quality parameter(s), 2) developing site-specific BMPs, 3) applying and monitoring BMPs, and 4) evaluating effectiveness of BMPs by comparing established water quality standards, and 5) modifying the BMPs where needed to achieve water quality goals.

DEQ will review all monitoring results and will provide an opportunity for the Goose Creek residents and EPA to review and comment on them. Each industry should provide summary review/reports to DEQ on its monitoring efforts, strategies, and on-going reduction mechanisms. Each industry should provide its own data in its reports. Based on these reports and other data, the Goose Creek Subbasin TMDL will be revised accordingly as an iterative plan. All industry plans will also be iterative and further developed through adaptive management as new knowledge and technology are discovered for pollution reduction efforts.

Additionally, because of the diverse nature of the partnerships and commitments within the Goose Creek Subbasin citizen groups from various agencies, organizations, and water users, both restoration and education efforts will be guided by DEQ via the Soil Conservation Districts. The citizen groups will take advantage of partner technical knowledge, experience, existing management plans, and resources in determining which types of activities are appropriate for continued implementation of the Goose Creek Subbasin TMDL. The Goose

Creek committee of the Lake Walcott WAG will continue to meet as needed. If needed, a technical advisory committee may be developed through the Soil Conservation District and DEQ. As a result, the citizen groups will have available to them the technical expertise of biologists, hydrologists, range conservationists, foresters, and other water quality and watershed specialists. Monitoring done by the various agencies, organizations, and water users will be evaluated by DEQ, the technical advisory committee, and citizen groups as a feedback mechanism. This will provide he citizens of the Goose Creek Subbasin an evaluation that is scientifically based with an understanding of local constraints. Through such adaptive management, scientific knowledge will be adapted to the task of watershed restoration by the residents of the subbasin almost immediately.

Monitoring and Evaluation

The objectives of a monitoring effort are to demonstrate long-term recovery, better understand natural variability, track implementation of projects and BMPs, and track effectiveness of TMDL implementation. This monitoring and feedback mechanism is a major component of the “reasonable assurance of implementation” for the TMDL implementation plan.

The implementation plan will be tracked by accounting for the numbers, types, and locations of projects, BMPs, educational activities, or other actions taken to improve or protect water quality. The mechanism for tracking specific implementation efforts will be reports to be submitted to DEQ.

The “monitoring and evaluation” component has two basic categories:

- Tracking the implementation progress of specific implementation plans; and
- Tracking the progress of improving water quality through monitoring physical, chemical, and biological parameters.

Monitoring plans will provide information on progress being made toward achieving TMDL allocations and achieving water quality standards and will help in the interim evaluation of progress as described under the adaptive management approach.

Implementation plan monitoring has two major components:

- Watershed monitoring and
- BMP monitoring.

While DEQ has the primary responsibility for watershed monitoring, other agencies and entities have shown an interest in such monitoring. In these instances, data sharing is encouraged. The designated agencies have primary responsibility for BMP monitoring.

Watershed Monitoring

Watershed monitoring measures the success of the implementation measures in accomplishing the overall TMDL goals and includes both in-stream and in-river monitoring. Monitoring of BMPs measures the success of individual pollutant reduction projects.

Implementation plan monitoring will also supplement the watershed information available during the development of associated TMDLs and will fill data gaps.

In the Goose Creek Subbasin TMDLs, watershed monitoring has the following objectives:

- Evaluate watershed pollutant sources,
- Refine baseline conditions and pollutant loading,
- Evaluate trends in water quality data,
- Evaluate the collective effectiveness of implementation actions in reducing pollutant loadings, and
- Gather information and fill data gaps to more accurately determine pollutant loading.

BMP/Project Effectiveness Monitoring

Site or BMP-specific monitoring may be included as part of specific treatment projects if determined appropriate and justified and will be the responsibility of the designated project manager or grant recipient. The objective of an individual project monitoring plan is to verify that BMPs are properly used and maintained and are working as designed. Monitoring for pollutant reductions at individual projects typically consists of spot checks, annual reviews, and evaluation of advancement toward reduction goals. The results of these reviews can be used to recommend or discourage similar projects in the future and to identify specific watersheds or reaches that are particularly ripe for improvement.

Evaluation of Efforts over Time

Reports on progress toward TMDL implementation will be prepared to provide the basis for the assessment and evaluation of progress. Documentation of TMDL implementation activities, actual pollutant reduction effectiveness, and projected load reductions for planned actions will be included. If water quality goals are being met, or if trend analyses show that implementation activities are resulting in benefits that indicate that water quality objectives will be met in a reasonable period of time, then implementation of the plan will continue. If monitoring or analyses show that water quality goals are not being met, the TMDL implementation plan will be revised to include modified objectives and a new strategy for implementation activities.

Implementation Time Frame

The implementation plan must demonstrate a strategy (Table 36) for implementing and maintaining the plan and the resulting water quality improvements over the long term. The timeline should be as specific as possible and should include a schedule for BMP use and/or evaluation, monitoring, reporting dates, and milestones for evaluating progress. There may be disparity in timelines for different subwatersheds. This is acceptable as long as there is reasonable assurance that milestones will be achieved.

The implementation plan will be designed to reduce pollutant loads from sources to meet TMDLs and water quality standards. DEQ recognizes that where implementation involves significant restoration, water quality standards may not be met for quite some time. In addition, DEQ recognizes that technology for controlling nonpoint source pollution is, in some cases, in the development stages and will likely take one or more iterations to develop effective techniques.

A definitive timeline for implementing the TMDL and the associated allocations will be developed as part of the implementation plan. In the meantime a compliance timeframe (Table 36) will be developed in this document as part of the implementation strategy. The implementation plan timeline will be developed in consultation with the WAG, the designated agencies, and other interested publics as the implementation plan is developed. In the interim, the timeframe outlined here will be used.

Table 36. Implementation strategy goals and time frame for nonpoint sources.

Industry	Year 1.5	Year 3	Year 10	Year 15	Year 25
Agriculture	Develop implementation plan for private lands	Begin BMP[a] implementation	Document BMP implementation progress for DEQ database	Reevaluate targets and reductions	Meet reviewed TMDL targets; beneficial uses fully supported
Grazing	Federal agencies review allotment management plans	Begin allotment management adjustments as necessary	Document BMP implementation progress for DEQ database	Reevaluate targets and reductions	Meet reviewed TMDL targets; beneficial uses fully supported
DEQ	Maintain database; review nonpoint source efficacy data; seek funding	Collect data to determine water quality trends	Collect data to determine water quality trend, BMP effectiveness, and beneficial use support	Reevaluate targets and reductions, assess beneficial uses	Collect data to determine water quality trend, BMP effectiveness, and beneficial use support

[a] BMP = Best management practice.

5.6 Conclusions

The Goose Creek SBA and TMDL analysis has been developed to comply with Idaho's TMDL schedule. The SBA describes the physical, biological, and cultural setting; water quality status; pollutant sources; and recent pollution control actions in the Goose Creek Subbasin located in south central Idaho. The first part of this document, the SBA, is an important first step in leading to the actual development of TMDLs or pollution budgets for the water quality limited streams of the subbasin. The starting point for this assessment was Idaho's current 1998 §303(d) list of water quality limited water bodies. Nine segments in the Goose Creek Subbasin were on this list. However, there were 22 water body pollutant combinations. In addition, three additional water bodies were assessed due to bacterial contamination data collected in the past. These water bodies were Emery Creek, Little

Cottonwood Creek, and Left Hand Fork Beaverdam Creek. The total number of potential TMDLs was 25. The SBA portion of this document examined the current status of all of these waters, and defined the extent of impairment and causes of water quality limitation throughout the subbasin. Sediment, nutrients, temperature, and bacteria are the listed pollutants in the subbasin. These pollutants were listed on the 1996 §303(d) listed water bodies within the subbasin. Other listed pollutants and stressors include habitat, flow, and unknown. By far the most influential stressor, as noted by the SBA, was flow alteration. In general, the impacts to the beneficial uses were determined by assessing the biological communities and the limited water chemistry data available. When these two data sets were in agreement with one another, appropriate actions, such as completing a TMDL or delisting the stream, were undertaken.

To this end, it was determined that 16 different TMDLs should be completed. Of the original listed water bodies DEQ proposes to delist four of the nine. These include Lower Goose Creek Reservoir, Mill Creek, Blue Hill Creek, and Big Cottonwood Creek. Of the three additional streams assessed it was determined that Emery Creek was not impaired by bacterial contamination and that all other parameters studied were of exceptional quality during the assessment phase.

Often times the beneficial uses were impacted by flow alteration, which obscured the impacts, if any, of the other pollutants on the beneficial uses. Flow and habitat alteration issues were not discussed at great length in the assessment portion due to current DEQ policy. It is DEQ policy that flow and habitat alterations are pollution, but not pollutants for receiving TMDLs. These forms of pollution will remain on the §303(d) list; however, TMDLs for these two parameters will not be completed on segments listed with altered flow or habitat as pollutants at this time.

The next phase was the development of the loading analysis or pollution budgets for the 16 different water body pollutant combinations. 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. In addition, the pollution budgets must contain discussions of background levels, MOS, and seasonallity.

The load capacity for each water body/pollutant combination was developed using the information gathered during the assessment phase. The most important part of this information was the hydrography of the stream and time of the year in which the various beneficial uses were likely to be impaired by specific pollutants. Only three streams in the subbasin have USGS gauge information available. For the remaining streams a relationship with this gauged data was developed to predict the hydrology. In all but one case the relationship was significant and included much of the variability of the data.

Another component of load capacity included targets for the different pollutants. In general, DEQ adopted targets developed in other TMDLs. For example, the Goose Creek sediment targets include percent bank stability which was presented in TMDLs from the Idaho Falls Regional Office and suspended sediment targets of 50 mg/L TSS as presented in TMDLs developed from the Twin Falls region. In addition to these sediment targets, DEQ adopted nutrient targets from guidelines and recommendations from EPA. These targets are 0.100

mg/L TP for free flowing streams and 0.050 mg/L for streams entering into a lake or reservoir. However, in the Beaverdam Creek Watershed these targets were in appropriate. Therefore an alternative target was developed specifically for the Beaverdam Creek area. Much of this development revolved around determining background in a watershed with naturally elevated TP. It was determined that the target in the Beaverdam Creek Watershed be set at 0.129 mg/L TP which is the natural background level. To many local stakeholders this may appear overly conservative. However, through the adaptive management loop the target will be reevaluated. It is likely that beneficial uses may be fully supported at concentrations greater than 0.129 mg/L. In the meantime, as we reduce from current levels, with unsupported beneficial uses, towards fully supported beneficial uses the target will be reassessed. Once beneficial uses are restored the targets will be adjusted to that value which should be at some level greater than background.

Seasonality plays a strong role in the Goose Creek Subbasin. In most cases the beneficial uses are impacted during the summer months. The pollutants typically causing the impairments are sediment, nutrients, and bacteria. The change in pollutants has a strong correlation to grazing activities in the different watersheds; although, no statistical interpretation of this correlation was made. In general, the rise in pollutants also coincided with summer base flow conditions. Therefore the load capacity and other subsequent calculations were made using summer base flow or other appropriate design flows as indicated in the state water quality standards, such as greater than 1 cfs for cold water aquatic life.

A MOS is required in the TMDL regulations of the CWA. This is to account for uncertainty in the TMDL and how that budget restores beneficial uses. In the Goose Creek Subbasin TMDLs two types of MOS were used. The first of these was an explicit margin of 10 percent. The explicit margin allows DEQ greater freedom in other aspects of the TMDL process in that the explicit MOS can be assumed rather than arduously explained at every turn. That being said, the Goose Creek Subbasin TMDLs include an implicit MOS as well. The best example of this may lie in the bacteria TMDLs' determination of background. The background levels used in these TMDLs may be slightly higher than actual background levels, as determined from other watersheds. These elevated levels reduce the available load for waste load allocations and load allocations thereby providing an implicit margin for each watershed. In future studies the actual background level may be determined, which in turn would reduce the implicit MOS.

As we move forward with implementation of the Goose Creek Subbasin TMDLs, local stakeholders and concerned publics should see the value of adaptive management. As our understanding of the water quality issues grows so should our ability to change the current TMDLs. This is especially important as the current TMDLs were based upon a limited amount of data collected in a short amount of time.

Future iterations of the Goose Creek SBA and TMDLs will include newly listed §303(d) listed water bodies. These will be added as addendum.

References Cited

33 USC §1251.101. Federal Water Pollution Control Act. (Clean Water Act).

40 CFR Part130.

Alt, D.D. and D.W. Hyndman. 1989. Roadside geology of Idaho. Missoula, MT: Mountain Press Publishing Co.

American Geological Institute. 1962. Dictionary of geological terms. Garden City, NY: Doubleday and Company. 545 p.

Armantrout, N.B., compiler. 1998. Glossary of aquatic habitat inventory terminology. Bethesda, MD: American Fisheries Society. 136 p.

Batt, P.E. 1996. Governor Philip E. Batt's Idaho bull trout conservation plan. Boise, ID: State of Idaho, Office of the Governor. 20 p + appendices.

Bell, R.J. 1979. 1978 Annual performance report. Fisheries management F-71-R-4. Jerome, ID: Idaho Fish and Game.

Borchardt, M.A. 1996. Nutrients. In Stevensen R.J., M.L. Bothwell, and R.L. Lowe editors. 1996. Algal Ecology: freshwater benthic ecosystems. San Diego CA: Academic Press, Inc.

Buhidar, B.B. 1999. The Upper Snake Rock SBA. Boise, ID: Idaho Department of Environmental Quality. 154 pp.

Buhidar, B.B. 2001. The Big Wood River Watershed management Plan. Boise, ID: Idaho Department of Environmental Quality. 200 pp.

Campbell, K. 2001. Idaho Department of Agriculture Bacteria study on the Boise River and Jacks Creek. Boise, ID: Department of Agriculture.

Carlson, R.E. 1977. A trophic state index for lakes. Limnology and Oceanography, 19, 767-773.

Clean Water Act (Federal water pollution control act), U.S.C. § 1251-1387 (1972).

DEQ. 1994. 1994 §303(d) list. Boise ID: Division of Environmental Quality.

DEQ. 1996. Water body assessment guidance, a stream to standard process. Boise, ID: Division of Environmental Quality.

DEQ. 2001a. 1998 §303(d) list. Boise ID: Department of Environmental Quality.

DEQ. 2001b. Personnel observation. Clyde Lay. Twin Falls Regional Office: Department of Environmental Quality.

DEQ. 2002. Personnel observation. Clyde Lay. Twin Falls Regional Office: Department of Environmental Quality.

DEQ. 2003. Personnel observation. Clyde Lay. Twin Falls Regional Office: Department of Environmental Quality.

Dodds, W.K., J.R. Jones, and E.B. Welch. 1998. Suggested classification of stream trophic state: distributions of temperate stream types by chlorophyll, total nitrogen and phosphorus. Water Resources 32, No 5 1455-1462 p.

EPA. 1975. Water quality criteria, 1972. EPA R3 73 033. Washington, DC: U.S. Environmental Protection Agency. 594 p.

EPA. 1977. Basic water monitoring program. EPA-440/9-76-025. Washington, D.C: U.S. Environmental Protection Agency. 51 P.

EPA. 1986. Quality criteria for water, 1986. EPA 440/5-86-001. Washington, D.C.: U.S. Environmental Protection Agency.

EPA. 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. 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. 1999. Protocol for developing nutirent TMDLs. EPA 841-B-99-007. Washington, D.C.: U.S. Environmental Protection Agency, Office of Water. 135 p.

Garabedian, S.P. 1992. Hydrology and digital simulation of the regional aquifer system, Eastern Snake River Plain, Idaho. U.S. Geological Survey Professional Paper 1408-F. Boise ID: U.S. Geological Survey. 102 p.

Grafe C.S., C.A. Mebane, M.J. McIntyre, D.A. Essig, D.H. Brandt, and D.T. Mosier. 2002. The Department of Environmental Quality water body assessment guidance, second edition-final. Boise, ID: Department of Environmental Quality. 114 p.

Greenborg A.E., L.S. Clescevi, and A.D. Eaton, editors. 1992. Standard methods for the examination of water and wastewater, 18th edition. Washington, DC: American Public Health Association. 900 p.

Grunder, S.A, L. Barret, and R.J. Bell. 1987. 1986 annual performance report. Fisheries management F-71-R-11. Jerome, Idaho: Idaho Department of Fish and Game. 136 p.

Grunder, S.A., S.C. Elm, and R.J. Bell. 1989. 1988 annual performance report. Fisheries management F-71-R-12. Jerome, Idaho: Idaho Department of Fish and Game. 129 p.

Hansen, H. 1975. Soil survey of Minidoka area, Idaho: Parts of Minidoka, Blaine, and Lincoln Counties. U.S. Department of Agriculture (Soil Conservation Service), in cooperation with U of I College of Agriculture, Idaho Agriculture Experimental Station.

Hedberg, K. 1993. A flood cannot happen here. Burley, ID: Magic Valley Publishers. 298 p.

Horner, R.R., E.B. Welch and R.B. Veenstra. 1983. Development of nuisance periphytic algae in laboratory streams in relation to enrichment and velocity. In Periphyton of freshwater ecosystems. Wetzel, R.G., editor), Dr. W. The Hague. Netherlands: Junk Pubishers.

Horsburgh, B. 2003 The Mid Snake Succor Creek TMDL. Boise, ID: Idaho Department of Environmental Quality. 417 pp.

Hughes R.M. 1995. Defining acceptable biological status by comparing with reference condition. In: Davis W.S., and T.P.Simon, editors. Biological assessment and criteria: tools for water resource planning. Boca Raton, FL: CRC Press. p 31-48.

Idaho Association of Soil Conservation Districts. 1998. Lake Walcott TMDL

Idaho Code § 39.3611. Development and implementation of total maximum daily load or equivalent processes.

Idaho Code § 3615. Creation of watershed advisory groups.

Idaho Department of Environmental Quality, and Oregon Department of Environmental Quality. 2002. Draft Snake River Hells Canyon Total Maximum Daily Load. Boise, ID: Idaho Department of Environmental Quality.

IDAPA 58.01.02. Idaho water quality standards and wastewater treatment requirements.

IDFG. 1980. 1979 annual performance report. Regional Fisheries management Investigations F-71-R-5. Boise, ID: Idaho Department of Fish and Game

IDHW. 1991. Upper Snake River Basin status report: an interagency summary for the basin area meeting implementing the antidegradation agreement. Boise ID; Idaho Division of Environmental Quality.

IDHW. 1989. Idaho water quality status report and non-point assessment. Boise ID: Office of Administrative Rules. *www2.state.id.us/adm.adminrules/index.htm*

Karr JR. 1991. Biological integrity: a long-neglected aspect of water resource management. Ecological Applications 1:66-84.

Lay, C.H. 2000. The Lake Walcott subbasin assessment and TMDLs. Twin Falls, ID: Department of Environmental Quality.

Lay, C.H. 2001. The Bruneau SBA and TMDLs. Twin Falls, Idaho: Department of Environmental Quality.

Omernik, J.M. 1986. Ecoregions of the United States. Supplement (map) to the Annals of the Association of American Geographers, Volume 77, Number 1. Corvallis, OR; Corvallis Environmental Research Center. U.S. Environmental Protection Agency.

Omernik, J.M. and A.L. Gallant. 1986. Ecoregions of the Pacific Northwest. USEPA/600/3-86/033. Washington, D.C.: U.S. Environmental Protection Agency.

Omernik, J.M. 1993. Ecoregions of the United States. ArcView shapefile.

Overton. C.K., J.D. Mcintyre, R. Armstrong, S.L. Whitwell, and K.A Duncan. 1995 User's guide to fish habitat; descriptions that represent natural conditions in the Salmon River Basin Idaho. General Technical Report INT-GTR 322. Ogden UT: US Forest Service Intermountain Research Service.

Partridge, F.E., and C.E. Corsi. 1993. 1990 annual performance report. Regional Fisheries Management Investigations F-71-R-15. Jerome, ID: Idaho Department of Fish and Game. 89 p.

Partridge, F.E., and C.D. Warren. 1995. 1993 Annual Performance report. Regional Fisheries Management Investigations F-71-R-18. Jerome, ID: Idaho Department of Fish and Game. 127 p.

Rand G.W., editor. 1995. Fundamentals of aquatic toxicology: effects, environmental fate, and risk assessment, second edition. Washington, DC: Taylor and Francis. 1125 p.

Robertson, D.M. and K.D. Richards. 2000. Influence of different temporal sampling strategies on estimating loads and maximum concentrations in small streams. Proceedings of the 2000 conference of the National Water Quality Council, US (http://204.87.241.11/2000proceeding/papers/pap_robertson.pdf).

Rosgen, D. 1996. Applied river morphology. Pagosa Springs, Co: Wildland Hydrology.

Schanz, F. and H. Juon. 1983. Two different methods of evaluating nutrient limitation of periphyton bioassays using water from the River Rhine and eight of its tributaries. Hydroboilogia 102, 187-195.

Shumar, M.L. and D. Reaney. 2001. Pahsimeroi River subbasin assessment and total maximum daily load. Boise, ID: Department of Environmental Quality. 120 p.

Stebbins, R.C. 1985. A field guide to western reptiles and amphibians. Second Edition, Revised. Boston, MA: Houghton Mifflin Company. 336 p.

Strahler A.N. 1957. Quantitative analysis of watershed geomorphology. American Geophysical Union Transactions 38:913-920.

Thurston R.V., R.C. Russo, C.M. Fetterolf, T.A. Edsall, and Y.M. Barber Jr., editors. 1979. Review of the USEPA red book: quality criteria for water. Bethesda, MD: Water Quality Section, American Fisheries Society.

USFS. 1990. Salmonid-habitat relationships in the Western United States: a review and indexed bibliography. USDA Forest Service. General Technical Report RM-188. Fort Collins, CO: Rocky Mountain Forest and Range Experiment Station, U.S. Department of Agriculture Forest Service.

USFS. 2001. U.S.Fish and Wildlife Service Bi-annual Forest-wide Species List, Sawtooth National Forest, September 2001

USGS. 1987. Hydrologic unit maps Water supply paper 2294. Denver, CO: United States Geological Survey. 63 p.

UDEQ. 2000. Mantua Reservoir TMDL. Salt Lake City, UT: Utah Department of Environmental Quality, Division of Water Quality, TMDL Section. 12 p.

Warren, C.D. and K.A. Frank. 1999. 1998 annual performance report. Fisheries management F-71-R-23. Jerome, ID: Idaho Department of Fish and Game. 22 p.

Warren, C.D. 2000. 1999 Annual performance report. Fisheries management F-71-R-24. Jerome, ID: Idaho Department of Fish and Game. 38 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 planning and management, 40 CFR 130.

Watson, V. and B. Gestring. 1996. Monitoring algae levels in the clark Fork River. Intermountain Journal of Sciences 2, No 2, pp. 17-26.

Welch, E.B., J.M. Jacoby, R.R. Horner, and M.S. Seeley. 1988. Nuisance biomass levels of periphytic algae in streams. Hydrobiologia 157, pp 161-166.

Welch, E.B., R.R. Horner, and C.R. Patmont. 1989. Prediction of nuisance periphytic biomass: a management approach. Water resources 23, No 4, pp. 401-405.

Wetzel, R.G., editor. 1975. Limnology. Philadelphia, PA: W.B. Saunders Company.

Wetzel R.G. 1983. Limnology, second edition. Orlando, FL: Saunders College Publishing. 767 p.

Wischmeier, W.H. and D.D. Smith. 1965. Predicting rainfall erosion losses from cropland east of the Rocky Mountains: Agriculture Handbook No. 282. Washington D.C.: U.S. Department of Agriculture.

Wurtsbaugh W.A. and C. Hawkins. 1990. Trophic interactions between fish and invertebrates in bear Lake Utah-Idaho. Logan UT: Utah State University. 167 p.

Wurtsbaugh W.A. and C. H. Lay. 1998. Influence of food resources and temperature on the distribution and energy balance of Bear Lake sculpin, *Cottus extensus*. Project F-47-R Study 5. Logan UT: Utah State University. 50 p.

Young, H.W. and R.L. Whitehead. 1974. Geothermal investigations in Idaho. Part 2, An evaluation of thermal water in the Bruneau-Grand View area, southwest Idaho U.S. Geological Survey Open-File Report 74-221. Boise, Idaho: U.S. Geological Survey. 147 p.

Young, H.W. and G.D. Newton. 1989. Hydrology of the Oakley Fan area, south-central Idaho. U.S. Geological Survey Water-Resources Investigations Report 88-4065. Boise, Idaho: U.S. Geological Survey. 73 p.

GIS Coverages:

Restriction of liability: Neither the state of Idaho nor the Department of Environmental Quality, nor any of their employees make any warranty, express or implied, or assume any legal liability or responsibility for the accuracy, completeness or usefulness of any information or data provided. Metadata is provided for all data sets, and no data should be used without first reading and understanding its limitations. The data could include technical inaccuracies or typographical errors. The Department of Environmental Quality may update, modify, or revise the data used at any time, without notice.

EPA Reach File Version 3 (Basins 2.01 2000)

White Horse Associates 1999. Report to DEQ.

Other Related Documents:

Cassia County population information: www.idoc.state.id.us

EPA Basins information: http://www.epa.gov/OST/BASINS/

Idaho Department of Fish and Game's species of special concern:
www2.state.id.us/fishgame/info/nongame/ngconcern.htm

Mantua Reservoir TMDL. http://www.deq.state.ut.us/EQWQ/TMDL/mantua_tmdl_f.pdf.

The USFWS threatened and endangered species lists: (*http://ecos.fws.gov/webpage/webpage_region_lists.html?lead_region=1*).

Western Regional Climate Center: www.wrcc.dri.edu.

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. Section 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	Describeas 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 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. The U.S. Environmental Protection Agency develops criteria guidance; states establish criteria.
Cubic Feet per Second	A unit of measure for the rate of flow or discharge of water. One cubic foot per second is the rate of flow of a stream with a cross-section of one square foot flowing at a mean velocity of one foot per second. At a steady rate, once cubic foot per second is equal to 448.8 gallons per minute and 10,984 acre-feet per day.
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. coli	Short for *Escherichia Coli*, *E. coli* are a group of bacteria that are a subspecies of coliform bacteria. Most *E. coli* are essential to the healthy life of all warm-blooded animals, including humans. Their presence is often indicative of fecal contamination.
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).
Million Gallons per Day (MGD)	A unit of measure for the rate of discharge of water, often used to measure flow at wastewater treatment plants. One MGD is equal to 1.547 cubic feet per second.
Miocene	Of, relating to, or being an epoch of, the Tertiary between the Pliocene and the Oligocene periods, or the corresponding system of rocks.
Monitoring	A periodic or continuous measurement of the properties or conditions of some medium of interest, such as monitoring a 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.

Riparian Habitat Conservation Area (RHCA) A U.S. Forest Service description of land within the following number of feet up-slope of each of the banks of streams:

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

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 4th field hydrologic units (also see Hydrologic Unit).
SBA (SBA)	A watershed-based problem assessment that is the first step in developing a total maximum daily load in Idaho.
Subwatershed	A smaller watershed area delineated within a larger watershed, often for purposes of describing and managing localized conditions. Also proposed for adoption as the formal name for 6th field hydrologic units.
Surface Fines	Sediments of small size deposited on the surface of a streambed or lake bottom. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 605 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 1992) call for using a filter of 2.0 micron or smaller; a 0.45 micron filter is also often used. This method calls for drying at a temperature of 103-105 °C.

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.

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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 Limited Segment (WQLS)	Any segment placed on a state's §303(d) list for failure to meet applicable water quality standards, and/or is not expected to meet applicable water quality standards in the period prior to the next list. These segments are also referred to as "§303(d) listed."
Water Quality Management Plan	A state or area-wide waste treatment management plan developed and updated in accordance with the provisions of the Clean Water Act.
Water Quality 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 U.S. Environmental Protection Agency-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.
Water Table	The upper surface of ground water; below this point, the soil is saturated with water.

Watershed	1) All the land which contributes runoff to a common point in a drainage network, or to a lake outlet. Watersheds are infinitely nested, and any large watershed is composed of smaller "subwatersheds." 2) The whole geographic region which contributes water to a point of interest in a water body.
Water Body Identification Number (WBID)	A number that uniquely identifies a water body in Idaho and ties in to the Idaho Water Quality Standards and GIS information.
Wetland	An area that is at least some of the time saturated by surface or ground water so as to support 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 A. Unit Conversion Chart

Table A-1. Metric - English unit conversions.

	English Units	Metric Units	To Convert	Example
Distance	Miles (mi)	Kilometers (km)	1 mi = 1.61 km 1 km = 0.62 mi	3 mi = 4.83 km 3 km = 1.86 mi
Length	Inches (in) Feet (ft)	Centimeters (cm) Meters (m)	1 in = 2.54 cm 1 cm = 0.39 in 1 ft = 0.30 m 1 m = 3.28 ft	3 in = 7.62 cm 3 cm = 1.18 in 3 ft = 0.91 m 3 m = 9.84 ft
Area	Acres (ac) Square Feet (ft^2) Square Miles (mi^2)	Hectares (ha) Square Meters (m^2) Square Kilometers (km^2)	1 ac = 0.40 ha 1 ha = 2.47 ac 1 ft^2 = 0.09 m^2 1 m^2 = 10.76 ft^2 1 mi^2 = 2.59 km^2 1 km^2 = 0.39 mi^2	3 ac = 1.20 ha 3 ha = 7.41 ac 3 ft^2 = 0.28 m^2 3 m^2 = 32.29 ft^2 3 mi^2 = 7.77 km^2 3 km^2 = 1.16 mi^2
Volume	Gallons (gal) Cubic Feet (ft^3)	Liters (L) Cubic Meters (m^3)	1 gal = 3.78 L 1 L= 0.26 gal 1 ft^3 = 0.03 m^3 1 m^3 = 35.32 ft^3	3 gal = 11.35 L 3 L = 0.79 gal 3 ft^3 = 0.09 m^3 3 m^3 = 105.94 ft^3
Flow Rate	Cubic Feet per Second (cfs)[1]	Cubic Meters per Second (m^3/sec)	1 cfs = 0.03 m^3/sec 1 m^3/sec = 35.31cfs	3 ft^3/sec = 0.09 m^3/sec 3 m^3/sec = 105.94 ft^3/sec
Concentration	Parts per Million (ppm)	Milligrams per Liter (mg/L)	1 ppm = 1 mg/L	3 ppm = 3 mg/L
Weight	Pounds (lbs)	Kilograms (kg)	1 lb = 0.45 kg 1 kg = 2.20 lbs	3 lb = 1.36 kg 3 kg = 6.61 lb
Temperature	Fahrenheit (°F)	Celsius (°C)	°C = 0.55 (F - 32) °F = (C x 1.8) + 32	3 °F = -15.95 °C 3 °C = 37.4 °F

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

Appendix B. Geology of the Goose Creek Subbasin

GEOLOGY OF THE GOOSE CREEK BASIN

By

Carl F. Austin, Ph.D.

This short summary of the geology of the Goose Creek basin is based on published reports by Bowen (1911), Butler et al. (1920), Piper (1923), Anderson (1931), Youngquist and Haegele (1956), Mapel and Hail (1959), and an unpublished thesis by Hildebrand (1984) plus field work by the author and unpublished photogeologic studies by W.H. Austin Jr.

The Goose Creek drainage basin consists of approximately 1200 square miles and includes considerable area below the Oakley Reservoir. This geologic summary is restricted to the area from Goose Creek Reservoir south, the area popularly known as the Goose Creek Basin. It should be noted that the geology of the basin is not well established and little has been published on the parts of the basin in Utah and Nevada. Approximately 105 square miles of the basin is in Box Elder County, Utah and 320 square miles in Elko County, Nevada. Some 12 square miles of the basin are in Twin Falls County, Idaho, and the remainder in Cassia County, Idaho.

The basin consists of the east side and south end of the heavily faulted anticline that makes up the Cassia Mountains, locally known as the South Hills, is bounded on the south by fault block mountains and stacked thrust sheets and is bordered on the east by the stacked thrust sheets of what in the literature is called South Mountain. The ages of the rocks making up the basin perimeter range from pre-Cambrian through Paleozoic with the lower parts of the basin margins and the bulk of the basin floor being mostly Miocene volcanics with interbedded sediments. The area exhibits extensive folding ranging from the very large anticline of the South Hills to small local folds in the volcanics. The area has undergone extensive and complex faulting. Indeed, long straight-line creeks such as Hardesty Creek clearly are fault controlled and hot springs traces in some fields clearly mark conjugate shear sets.

Goose Creek itself flows across what are at present believed to late Miocene volcanics and sediments. In contrast Cold Creek starts in a granodiorite intrusive, flows mostly across pre-Cambrian Harrison series metamorphics, and then across a short stretch of Miocene volcanics to enter Goose Creek. In total contrast, Jay Creek and almost all of Trout Creek flow across Paleozoic marine sediments consisting of limestone, quartzite, and some shale believed to be phosphatic. Both Beaverdam and Trapper Creeks flow almost exclusively across volcanics and their intercalated sediments.

The thick volcanic sequence of the basin, possibly an equivalent to the Miocene Idavada, consists of over 3000 feet of rhyolitic vitric ash fall and ash flow tuffs with interbedded pebble conglomerates, sandstones, siltstones, carbonaceous shales, lignite coal beds, diatomite and marl.

Goose Creek drains a number of mineral deposits. A wide band of mineralization extends along the east side of the basin from Cold Creek to Little Birch Creek. The largest and most heavily exploited deposits are the silver-gold deposits of Vipont, which went into production in 189l and had sporadic activity up through the 1980's. This mining district drains into Goose Creek via Little Birch Creek. This same zone of mineralization embraces an epithermal hotsprings type gold deposit in upper Blue Hill Creek and also a similar deposit in upper Cold Creek. Both deposits have seen exploration drilling in the past few years and are actively under claim. Other deposits are the lignite coal beds, which have had considerable production from the early 1900's to World War II. These beds are widely marked by brilliant red-orange burned outcrops. The basin has undeveloped uranium ores both as roll front type and dispersals in the lignites. There are undeveloped diatomite beds, bentonite beds and extensive zeolite deposits. Building stone has been long produced, with the thin quartzites of Oakley having a worldwide reputation for fine quality. Some of the quartzites are mined in the upper Cold Creek drainage. There are widespread perlites in the basin but none have been produced, nor have any of the rather pure illite beds been produced.

The Goose Creek basin is a pressurized hot water system, with surface flows today from old wildcat oil wells and as leakage along fault zones. A major hot springs silica mound is present at Niles Spring which attests to the fact that there is a geothermal potential in the south-central part of the basin, separate from that of the South Hills Anticline.

Oil and gas drilling dates back to the 1920's but the wells produce only hot water plus a small amount of what is presumed to be coal bed methane.

The margins of the basin have undergone very extensive rather recent mountain type glaciation. Creeks such as Cold Creek, Emery Creek, and especially Blue Hill Creek have excellent morrainal features. Because of traces of wave cut terraces, it is probable that the rather extensive flat meadows of the basin represent lake-bed tills. These are now being somewhat dissected as Goose Creek attempts to recover from the dramatic climate changes of the last few hundred years.

The trace element chemistry of each creek should reflect the rocks across which it flows, and the springs and seeps feeding these often intermittent streams will be strongly affected by their host rock types and by the amount of geothermal fluid leaking locally.

REFERENCES

Bowen "Lignite in the Goose Creek District, Cassia County, Idaho" U.S.G.S. Bull. 531, 1911.

Butler "The Ore Deposits of Utah" U.S.G.S. Prof. Paper 111, 1920

Piper "Geology and Water Resources of the Goose Creek Basin, Cassia County, Idaho" Idaho Bureau of Mines and Geology, 1923

Anderson "Geology and Mineral Resources of Eastern Cassia County, Idaho" Idaho Bureau of Mines and Geology, Bu ll. 14, 1931

Youngquist and Haegele "Geological Reconnaissance of the Cassia Mountain Region, Twin Falls and Cassia Counties, Idaho" Idaho Bureau of Mines and Geology, Pamphlet No 110, 1956

Mapel and Hail "Tertiary Geology of the Goose Creek District, Cassia County, Idaho, Box Elder County, Utah, and Elko County, Nevada" U.S.G.S. Bull. 1055 H, 1959

Hildebrand "Geology and Mineral Deposits of Miocene Tuffaceous Rocks, Goose Creek Basin, Cassia County, Idaho" Masters Thesis, Colorado School of Mines, 1984

Appendix C. Distribution List

Amy Luft. Idaho Department of Environmental Quality. Technical Editor. 10/02/2003.

Marti Bridges. Idaho Department of Environmental Quality. TMDL Program Manager. 10/02/2003.

Balthasar Buhidar. Idaho Department of Environmental Quality. Regional Manager. 10/02/2003.

Mike Etcheverry. Idaho Department of Environmental Quality. Implementation specialist. 10/02/2003.

Jennifer Claire. Idaho Department of Environmental Quality. TMDL Writer. 10/02/2003.

Sean Woodhead. Idaho Department of Environmental Quality. BURP Coordinator. Idaho Department of Environmental Quality. 10/02/2003.

Richard Garrard. University of Idaho. Cassia County Extension. Burley Idaho. 10/14/2003.

Scott Nannega. United States Forest Service. Sawtooth National Forest–Burley Ranger District. 3650 South Overland Ave. Burley, ID 83318. 11/12/2003.

Valdon Hancock. United States Forest Service. Sawtooth National Forest–Supervisor's Office. 2647 Kimberly Rd E. Twin Falls, ID 83301. 11/12/2003.

Trudy Flock. United States Forest Service. Sawtooth National Forest–Burley Ranger District. 3650 South Overland Ave. Burley, ID 83318. 11/12/2003.

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Katie Fite. Committee for Idaho's High Desert. P.O. Box 2863, Boise, ID 83701. 11/12/2003.

Bill Sedivy. Idaho Rivers United. P.O. Box 633, Boise, ID 83701. 11/12/2003.

Chuck Pentzer. Idaho Soil Conservation Commission. 20 W. 100 S. Jerome, ID 83338. 11/12/2003.

Appendix D. Public Comments

The 30-day public comment period closed on December 12, 2003 at 5:00 p.m. During that period comments were received from the US BLM and the US Forest Service. Several of the US BLM and US Forest Service comments were editorial in nature and those changes were incorporated into the document. An electronic copy of the US BLM technical comments was provided and is included here. DEQ's responses follow in italics.

BLM BURLEY FIELD OFFICE COMMENTS CONCERNING THE DRAFT FOR THE "GOOSE CREEK SUBBASIN ASSESSMENT AND TOTAL MAXIMUM DAILY LOADS"

In reference to temperature TMDL's, shade components, solar load and reference streams on pages XX, 49, 180 and 184:

DEQ should strive to locate streams with the same potential vegetation and channel characteristics when determining how much shade any particular stream can achieve. While many of the smaller streams such as Cold Creek may fit into DEQ's formula, it does not appear that any of the reference streams are similar to much of lower Goose Creek with regards to potential natural vegetation and potential shading. The 42% shade determined by averaging shade on fully supported streams will likely never be reached on a stream like Goose Creek. This stream is simply too wide to allow willow or other potential natural vegetation to provide a high level of shade in the lower portions of the stream. Small, rocky systems have segments along them with the potential for nearly 100% shading in contrast to wide meandering streams with fine substrate, such as the meadows along lower Goose Creek, which do not have such potential. In essence, it appears that the formula may underestimate potential shade along some streams and overestimate potential in others. Due to this variability in potential, it is unlikely that these streams all have the same potential solar load as indicated in Table 31 on page 184. In reference to the review of temperature criteria stated on page 49, BLM strongly encourages DEQ to consider not only outdated understanding of cold water aquatic life's temperature requirements but also the likelihood that statewide temperature standards violations are due not only to geothermal springs but to a variety of reasons including regional climates, drought, flow regimes, and the variability in potential natural vegetation communities and stream types.

It is DEQ goal that during the implementation phase for the Goose Creek Subbasin and for other TMDLs that additional solar pathfinder data be collected on reference streams and rivers, such that a stratification of streams could occur. Currently we are limited to the data at hand and as more data is collected the percent shade targets will become more robust and we will be able to address the differences in widths more appropriately.

In reference to the last two sentences of the first paragraph on page 24:

There is only one threatened species (bald eagle), no endangered species, and only one candidate species (yellow-billed cuckoo), that need to be considered in any planning efforts and management decisions by the BLM Burley Field Office. This is in accordance with the most recent official species list (1-4-03-SP-283) received from the U. S. Fish and Wildlife Service on June 3, 2003.

This was incorporated into the document.

In reference to the species list and pollution tolerance levels from page 26:

On page 26, Table 9 lists fish species and pollution tolerance in the Goose Creek Subbasin. Fish species missing from the table include walleye and spottail shiner, which were introduced to Oakley Reservoir as a prey base for the game fishes. Fish included in the list but not likely found in the Goose Creek drainage include brown trout, kokanee salmon, and arctic grayling.

Walleye and spottail shiner were added to the table, while the reference to arctic grayling was removed.

In reference to the designation of all stream segments as coldwater fisheries, as on page 50:

DEQ provides a table of designated and existing beneficial uses for each stream segment in the Goose Creek watershed on page 50. All of the segments are listed COLD, presumably for cold water aquatic life, as described on page 38. However, page 38 also provides criteria for seasonal cold water aquatic life. Although there is no accompanying description of the biotic community that would be expected to inhabit this type of system, Steven P. Canton, in a proposal to modify Colorado's stream classification system (Canton 2003) describes the expected condition of "Aquatic life cool" streams:

> "These are the transition streams—the bridge between the cold and warm water streams and biota. While cold and warmwater biota may be present, these streams often have their own cool water fish and invertebrates. As might be expected, coolwater streams would have more fish than coldwater streams—perhaps 5-9 fish species at a site. These streams are often dominated by "rough fish" (e.g., suckers), with minnows and dace often occurring. Trout may be present, but may not be reproducing. Warmwater fish, like sunfish, may be found, but again may not be reproducing in these stream segments."

A designation similar to this would be more appropriate for some of the Goose Creek stream segments. Goose Creek from Beaverdam Creek to Lower Goose Creek Reservoir and Beaverdam Creek exhibit different characteristics than the headwater streams in this system. They are flatter, lower gradient, valley floor streams. They achieve warmer temperatures due in part to their width and depth, and contain fish communities more reflective of coolwater systems.

Canton, Steven P. 2003. Proposed changes to Colorado's aquatic life classification system using findings of the arid west habitat characterization study. Arid West "Habitat Characterization Study" Symposium Proceedings. Februrary 24, 2003. Colorado Water Quality Control Division.

At this time, DEQ is not proposing to designate any stream within the state as seasonal cold water aquatic life. EPA has yet to approve those standards. Following approval by EPA, DEQ will collect the necessary information to make appropriate designations. Cool water or seasonal cold water aquatic life may be an appropriate designation for many streams throughout southern Idaho. However, the lower segments of Goose Creek have designated beneficial uses. These beneficial uses cannot be changed easily. A use attainability analysis would have to be completed in order to do so. The conditions of the use attainability analyses would not be met for the lower segments of Goose Creek. Therefore EPA would, likely not accept the analysis, and beneficial use designation change.

Beaverdam Creek is an undesignated water body. Default designations are cold water aquatic life and secondary contact recreation. Until designations are made the water quality standards for these designations need to be met on this system.

In reference to the hypothesis on page 82 dealing with the possibility that degradation in water quality over the past decade is the reason for a shift from cutthroat to rainbow trout:

It is BLM's opinion that this shift occurred before 1994. Fish sampling in 1994 yielded no cutthroat trout (only brook trout) and these fish were confined to one location (remainder of the creek was nearly dry). Further sampling by BLM in 1998 also revealed no cutthroat trout but did indicate that rainbow trout had entered the system and were populating the stream. The presence of one cutthroat trout in 1997 may indicate that a few cutthroat persisted in the system for several years while other species were colonizing. However it is probably an indication that these fish are present during some portion of the year in lower Goose Creek and attempt to populate cold creek. Due to the strong presence of rainbow and brook trout, this attempt will undoubtedly be precluded. It is BLM's opinion that cutthroat trout will not repopulate Cold Creek in the presence of rainbow and brook trout. Furthermore, the attached pictures are a good indication that conditions along cold creek have not deteriorated during the past decade but have improved substantially beginning in the early 1990's as is further substantiated in the Standards for Rangeland Health document which was finalized in 2000. Conditions, however, prior to the early 90's were quite degraded.


Lower Cold Creek 1983 (riparian area dominated by grass)


Lower Cold Creek 1998 (riparian area dominated by willow)


Lower Cold Creek 2001 (dominated by willow after only 2 years of recovery after fire)

DEQ postulated that the shift in fish community may have been the result of habitat degradation over the past decade. Photo documentation provided by the BLM refute this hypothesis. Other factors that could have caused this shift include competition between species and drought excluding cutthroat trout from Cold Creek or a synergistic effect of *the two. Currently DEQ is unable to determine the cause of the species shift, however; data provided by the BLM indicates that habitat alteration and water quality degradation over the past decade may not be the significant factor as presented in the document. As a result changes to this effect were made in the discussion.*

In reference to the Cold Creek bacteria discussion on page 84:

It is highly unlikely that a few cattle occasionally loafing along cold creek above the lower monitoring site is causing the higher bacteria counts at this site. The upper site is located within the area where these livestock occasionally loaf as well and where livestock are periodically trailed but the counts are lower. Since these counts are not in exceedance of water quality standards, this discussion should not be included in the document as it seems mute.

Statistical tests were completed to determine if the differences between sites existed, for bacteria these differences were real (p = 0.033) see page 83. However, the hypothesized reasons for this difference were not empirically derived. DEQ may have overstated the continual presence of loafing cattle between the sites as a significant cause to the elevated bacteria. However, cattle were occasionally seen within the area. Changes to this effect were made to the document.

In reference to the temperature, shade and groundwater influence issues regarding Cold Creek on page 85 and 86:

There are several losing and gaining reaches along cold creek. The upper monitoring site is known to be losing reach since this location has gone dry in the past. This will greatly influence water temperature, particularly during drought cycles. There are a variety of other locations where data should be gathered when comparing the lower site to other portions of cold creek. Furthermore, the upper monitoring site is located within or very near where livestock are trailed along Goose Creek road. Due to this, measurements of solar input are probably atypical of much of the creek above this point where livestock are not trailed.

The implication that there may not have been any shading vegetation and that if it was present prior to the prescribed burn it needs to be restored is incorrect. Most of cold creek above the upper monitoring site has seen a dramatic increase in woody cover as is evidenced in the attached photos. The prescribed burn did temporarily remove much of this cover but as can also be seen in the photos, after only two years of recovery, woody canopy cover had already nearly recovered to pre-fire conditions.

Solar pathfinder data were collected over ten transects spaced approximately 500 meters apart. As a result, the average shade was derived from locations that span nearly a mile of Cold Creek. More extensive solar pathfinder data collections can be made during the implementation phase of the TMDL with the assistance of the land management agencies. Clarification of the monitoring protocol was added to the document.

In reference to the Bluehill Creek fishery discussion on page 90:

There are no known fish species present in bluehill creek in the upper reaches. The upper portions of the creek are mainly intermittent although there are perennial reaches. The only location that fish have ever been found is within approximately 1 mile of the mouth of the system where the most consistent higher flows occur in association with a spring area. This reach, during drought periods, also appears to suffer from a lack of sufficient flow to sustain a fishery.

DEQ has made changes to this effect in the document.

In reference to Table 28 on page 142:

It is unclear how these land uses are going to be used for allocation purposes. Depending upon how the percent forest and percent range will affect load allocation for BLM, we would appreciate the opportunity to refine the numbers in the table.

Gross load allocations were made based upon watershed only. It has yet to be determined how load allocations will be made on a finer resolution. The information provided in Table 28 is one allocation method available. Another method includes allocation based on land ownership. These decisions will be made during the implementation planning process. DEQ encourages BLM's participation in that process so that final allocations can be based on acceptable methods to all land management agencies

In reference to BLM's efforts to improve water quality on pages 162-164, BLM would like to add several other items:

The BLM portion of Little Cottonwood Creek, above what is considered a ditch, was fenced into a riparian pasture in 1999 in order to improve riparian area conditions. This applies to the first mile of stream immediately downstream from the USFS/BLM boundary.

The BLM portion of trapper creek above the high water mark in Oakley reservoir was fenced in 1989 to allow for riparian area improvement and recreational opportunities. Livestock are allowed to trail through the area.

The BLM manages approximately 1.7 miles of Goose Creek of which 1.2 miles has been excluded from livestock beginning in approximately 1987. One portion that has not been fenced lies directly below the USGS gauge and above the high water mark of Oakley reservoir. This segment was assessed in 2000 and was found to be in proper functioning condition. Livestock management here consists of two years of spring use followed by two years of fall use, which appears to be adequate for this system to function properly.

These and other past pollution control activities and efforts will be incorporated into the implementation plan. The implementation coordinator of the Twin Falls Regional Office of DEQ has been informed of the extensive hard copy list provided by the US BLM.

In reference to the discussion of potential vegetation along Goose Creek on page 167:

BLM encourages DEQ to visit the BLM portions of Goose Creek to examine what is capable of growing along the creek. Much of these portions of the creek are growing willow communities although it does appear that the finer substrate portions of the creek will take longer time frames for this to occur.

DEQ has used the term "potential vegetation" in this document to describe land use potential vegetation rather than ecological potential. The two are dissimilar in that the Goose Creek Subbasin has the ecological potential to contain large communities of willows while the land use potential is such that haying and farming practices have excluded these from the landscape. Use of the term has been clarified.

In reference to the statement in the middle of page 169 regarding the lowest flows for which water quality standards apply:

There needs to be more clarification about these lowest flows of 0.142 cubic meters/second (recreational uses) and 0.028 cubic meters/second (aquatic life). For instance, does this mean that measurements for bacteria or temperature should not be taken when flows are less than this or that TMDL's should not be set for streams which flow less than this? Are the minimum flows a yearly average?

These flows were the design flows upon which the load capacities were developed for Beaverdam Creek and Left Hand Fork Beaverdam Creek. The TMDL then sets the compliance targets and allocations for the watershed based upon this load capacity. Compliance would be based upon current flow and concentration taken during compliance monitoring. These streams are perennial water bodies. Consequently measurements of bacteria and temperature can occur at any flow level. Idaho's water quality standards contain flow criteria for intermittent water bodies and when the water quality standards apply. These, however; have not been approved by EPA and should be used cautiously on other systems.

In reference to the discussion of site potential shading at the bottom of page 173:

BLM strongly disagrees with the assumption that prescribed fire has changed the potential natural communities along streams in this subbasin. Fire is a natural part of these areas and generally does not kill the underground portions of most riparian species. Numerous natural fires (both pre and postsettlement) have occurred throughout the subbasins mentioned in this discussion and there is no indication that there is any difference between that response and the response after prescribed fire. Post fire response along Cold Creek following the 1999 fire illustrates this. Although the height of riparian shrubs was temporarily reduced, no shifts in riparian potential occurred. Willows and other woody riparian vegetation has rebounded dramatically in the four years since the fire. Prescribed or natural fire should not be lumped with channel armoring, straightening and entrenchment in this discussion.

DEQ agrees with the US BLM that fire should not be included with other factors such as channel armoring, straightening, and entrenchment. Moreover, farming and ranching activities have had a longer-term effect on the vegetative ecology of the streams of Goose Creek than fire. Clarifications to this point were made due to previous comments about potential vegetation.

In reference to the discussion of bank stability monitoring on Goose Creek at the top of page 178 and in reference to the cold creek monitoring site at the bottom of this same page:

The low end of Goose Creek below the USGS gauge on BLM managed land (near the low monitoring site) is not a good place to monitor bank stability changes as this reach is atypical of the majority of the creek above this point. This BLM reach is quite rocky and was determined to be properly functioning with good bank stability already.

Bank stability monitoring occurred at several locations throughout the Goose Creek drainage. These included sites in Nevada, Utah, the unlisted portion of Goose Creek in Idaho, and several locations in the lower listed portion. The lower BLM reach was not included in this monitoring as it was atypical with the remainder of the system.

The Cold Creek monitoring site near Goose Creek road needs to be placed far enough above the road crossing so as to be representative of this reach. Immediately at and near the road crossing is a zone where livestock are allowed to trail up and down Goose Creek road which will likely influence the degree of shade which can be attained here. It would be desirable to locate other monitoring locations farther upstream in order to get a better handle on how drought is affecting the temperature in Cold Creek (the current monitoring site is at the low end of a losing reach which will warm rapidly during low flow periods such as have occurred beginning in 2000).

The compliance monitoring location can be adjusted to better reflect current conditions along the creek if it is determined that a more representative location is available. Discussion of compliance point locations will be made with the stakeholders and land management agencies during the implementation planning process.

In reference to DEQ's method for the creation of hydrographs and use of Rosgen regional curves:

We understand that it is not possible to collect flow data for each and every tributary for a system such as Goose Creek and that flows must be assumed to calculate a TMDL. However, we would like to stress the importance of understanding that many of these streams are extremely variable. Hydrographs were created by establishing a correlation with a reference stream, such as Goose Creek or Trapper Creek, and adjusting the larger stream's hydrograph to correspond to a small number of points in a smaller stream or tributary. While it is reasonable to assume that the overall shape of these hydrographs is likely quite similar to that of the smaller streams, our confidence in their ability to predict average flows is very low. For example, page 169 gives the average discharge during the April 1-July 1 period as .019 m^3/s (6.7 cfs). BLM records indicate that for the period 1982-1987 flows in Cold Creek varied from 2.2 cfs to 107.2 cfs. Although we are also lacking comprehensive flow data, our field observations have also recorded portions of this creek dry in drought years (e.g., 1994). Our belief is that the use of DEQ's method may underestimate flows in the spring runoff period, and overestimates flows throughout the drier months of July and August.

DEQ also agrees that the average hydrographs do not reflect the actual variability seen within these systems. However, in many instances the shape of the curve and an indication of when critical periods with diminished flows occur is needed to complete the TMDL calculations. Rather than relying on incomplete data, a statistical approach was taken to determine these flows and time periods.

Regarding the use of Rosgen's regional curves, we agree with the statement on page 64 that the "arid Goose Creek Subbasin may not fit the regional curves developed by Rosgen" and would like to request that this statement be added to each stream reach.

DEQ agrees that this statement is appropriate for each of the listed and assessed water bodies within the Goose Creek Subbasin.

In reference to conflicts between macroinvertebrate data and fish data:

In cases in which macroinvertebrate collection data and fish data are in seeming conflict, such as in Trapper Creek (page 66), DEQ's conclusions regarding water quality are likely inappropriate. Macroinvertebrates tend to be fairly site-specific organisms, without movement over large distances compared to fishes. In cases like Trapper Creek, where macroinvertebrate indices are indicative of good water quality, the presence of some moderately intolerant fishes is not an indicator of impaired water quality. It is the absence of intolerant species, rather than the presence of moderately intolerant species that indicates water quality impairment. BLM strongly agrees with DEQ that the apparent lack of salmonid spawning in the lower segment is not necessarily due to impaired water quality (page 67). And DEQ's statement on the same page concerning competition with hatchery fish or fishing pressure is a highly probable explanation for the apparent lack of "wild fish".

DEQ agrees that if macroinvertebrates and fish community information was the only information relied upon in an assessment of Trapper Creek the outcome would be much different. However, other factors precluded that outcome such as nuisance aquatic vegetation, seasonally high sediment concentrations, and poor bank stability.

In reference to the "measured water quality constituents" tables for each stream:

Please highlight or bold the instances where there is an exceedance. This would make it much easier to track water quality violations.

DEQ agrees that this would make each table easier to read. However, the footnote requirements for doing so would make the tables more unwieldy an diminish the utility of making the change.

In reference to sediment TMDL's:

The lack of high flows throughout the past several years has led to an accumulation of sediment in many of the Goose Creek Basin streams. It may be important to note this in the first few years of the TMDL implementation as high flows are likely to wash out these stored sediments and may result in high sediments levels downstream.

DEQ agrees with this statement. It should also be noted that until bankfull flood events occur the predicted sediment loads from the bank stability assessments will not occur and that this sediment will be stored within the unstable banks and along the streambeds.

In reference to data limitations:

Understanding that DEQ has been limited as far as time and funding, we appreciate the opportunities that will be available in the future to further review and refine these TMDL's as more data becomes available.

The first opportunity to refine the TMDL will occur during the implementation phase. It is strongly encouraged that all interested parties and land management agencies participate in the implementation-planning phase of the TMDL. Following implementation planning the adaptive management loops provide for continued refinement of the TMDL as our knowledge and data within the systems increases.