South Fork Palouse River
Watershed Assessment and TMDLs

Idaho Department of Environmental Quality

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Acknowledgments

The Idaho Department of Environmental Quality extends our sincere gratitude to the South Fork Palouse River Watershed Advisory Group. Their participation was critical to the completion of this document. The result is a water quality improvement plan that allows for a focused and achievable cooperative implementation approach to meeting the goals and requirements of the Idaho State Water Quality Standards and the Federal Clean Water Act.

The Idaho Department of Environmental Quality would also like to thank the Idaho Association of Soil Conservation District staff for data collection efforts used in the development of the TMDLs, and the Washington State Department of Ecology staff who participated in Watershed Advisory Group meetings to provide downstream perspectives.

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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

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

ADB assessment database

AU assessment unit

AWS agricultural water supply

BAG Basin Advisory Group

BMP best management practice

Btu British thermal unit

BURP Beneficial Use Reconnaissance Program

C Celsius

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

cfs cubic feet per second

cm centimeters

CWA Clean Water Act

CWAL cold water aquatic life

DEQ Department of Environmental Quality

DO dissolved oxygen

DWS domestic water supply

EPA United States Environmental Protection Agency

HUC Hydrologic Unit Code

I.C. Idaho Code

IDAPA Refers to citations of Idaho administrative rules

IDFG Idaho Department of Fish and Game

IDL Idaho Department of Lands

km kilometer

km^2 square kilometer

LA load allocation

LC load capacity

m meter

m^3 cubic meter

mi mile

mi^2 square miles

MBI Macroinvertebrate Biotic Index

MGD million gallons per day

mg/L milligrams per liter

mm millimeter

MOS margin of safety

MWMT maximum weekly maximum temperature

NA not assessed

NFS not fully supporting

NPDES National Pollutant Discharge Elimination System

NTU nephelometric turbidity unit

PCR primary contact recreation

ppm part(s) per million

QA quality assurance

QC quality control

SBA subbasin assessment

SCR secondary contact recreation

SS salmonid spawning

TDS total dissolved solids

TIN total inorganic nitrogen

TMDL total maximum daily load

TP total phosphorus

TS total solids

TSS total suspended solids

t/y tons per year

U.S. United States

U.S.C. United States Code

USDA United States Department of Agriculture

WAG Watershed Advisory Group

WBAG *Water Body Assessment Guidance*

WBID water body identification number

WLA wasteload allocation

WQLS water quality limited segment

WQS water quality standard

Executive Summary

The federal Clean Water Act requires that Idaho restore and maintain the chemical, physical, and biological integrity of state waters. Idaho, pursuant to Section 303 of the Clean Water Act, is to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. Section 305 of the Clean Water Act requires Idaho to monitor water quality conditions of State waters. Idaho must identify, prioritize, and report water bodies that do not meet water quality standards. Idaho must develop a total maximum daily load plan for waters reported as not meeting water quality standards, to restore the water body to water quality standards. An Integrated Report is periodically published by Idaho to meet the integrated requirements of Section 303 and 305 of the Clean Water Act.

This Watershed Assessment and Total Maximum Daily Load (TMDL) addresses the water bodies in the South Fork Palouse River watershed that were listed as not meeting Idaho's water quality standards in Idaho's 2002 Integrated Report. The watershed assessment and TMDL analysis have been developed to comply with Idaho law and the federal Clean Water Act. The TMDL describes the water quality data used to develop estimated loads, and identifies estimates for existing loads, allowable loads, and load reductions needed to meet Idaho water quality standards. The South Fork Palouse River TMDL follows other TMDLs developed for Hydrologic Unit Code 17060108: Paradise Creek, the Palouse River Tributaries, and Cow Creek.

Subbasin at a Glance

The Idaho portion of the South Fork of the Palouse River watershed lies within Hydrologic Unit Code 17060108. The South Fork Palouse River drains from the southern slope of Moscow Mountain, skirts the south side of the City of Moscow, and enters Washington State upstream of the City of Pullman.

The general geographic location of the South Fork Palouse River watershed is displayed in Figure A. Elevations in the watershed range from approximately 4,900 feet on Moscow Mountain to 2,550 feet at the state line. Palouse Loess covers most of the topography of the watershed, especially at elevations at or below 3,000 feet. For elevations below 3,000 feet the north slopes are of moderate to steep rolling hills, while the south slopes are more moderate.

Most of the wetlands and flood plains in the Palouse have been eliminated by modern land use, urbanization, and transportation infrastructure. These activities have affected instream flows, channel sinuosity, and habitat diversity. The topography, soils, and climate make the Palouse watershed very susceptible to erosion. Land uses that contribute excess sediment, nutrients, and bacteria to the river can degrade water quality.

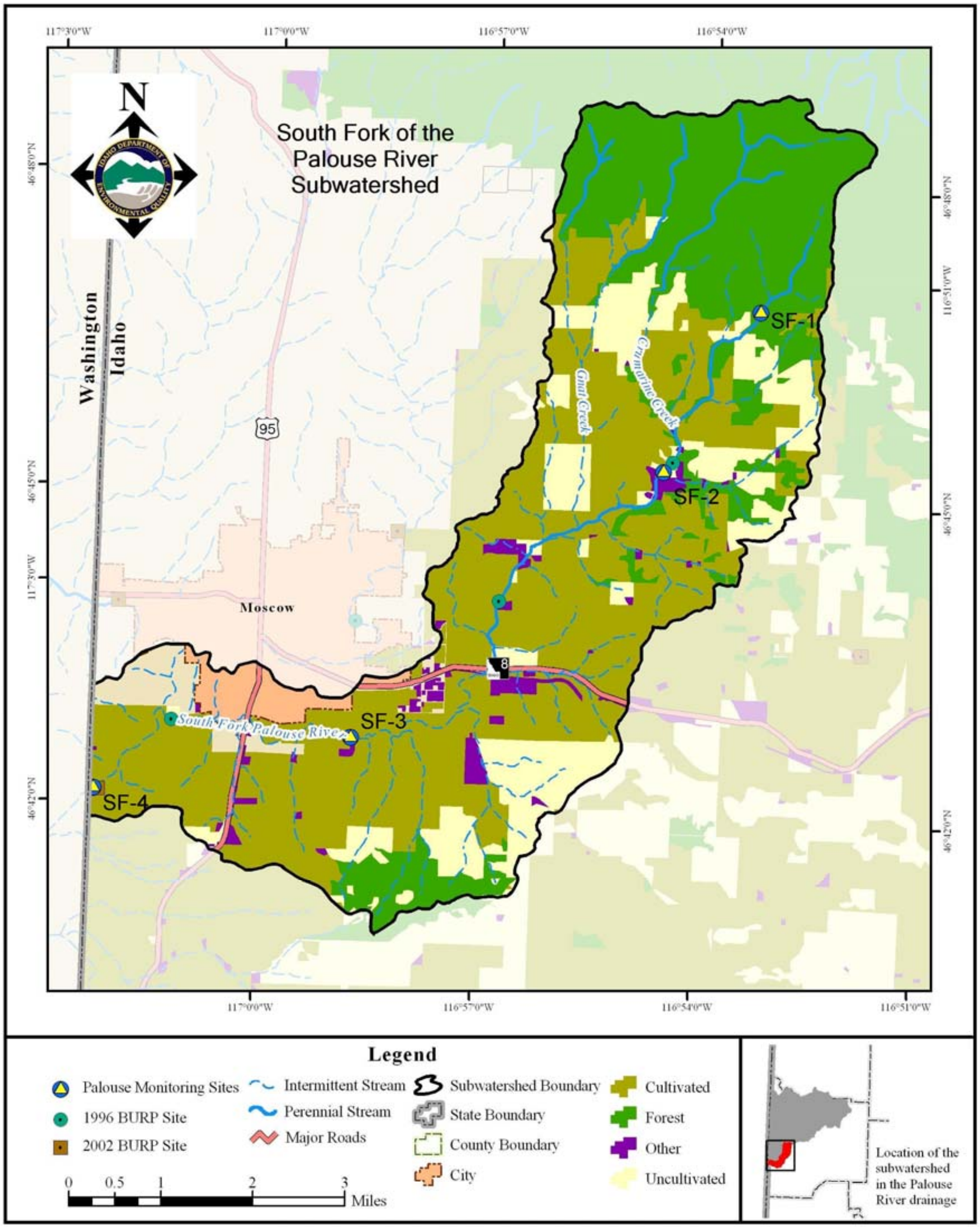

Figure A. General Geographic Location of the South Fork Palouse River Watershed

Key Findings

The South Fork Palouse River Assessment Unit #s ID17060108CL002_03 (Gnat Creek to Idaho/Washington border), ID17060108CL003_02 (Source to Crumarine Creek) and ID17060108CL003_03 (Crumarine Creek to Gnat Creek) were listed as not meeting state water quality standards in Section 5 of Idaho's 2002 Integrated Report (Figure B). Section 303(d) of the Clean Water Act states that waters that do not meet water quality standards are required to have total maximum daily loads developed to bring them into compliance with water quality standards.

The designated beneficial uses for the South Fork Palouse River watershed are cold water aquatic life, salmonid spawning, and secondary contact recreation (Table A). Table B lists the information included in Section 5 Idaho's 2002 Integrated Report for the South Fork Palouse River. Pollutants affecting the South Fork Palouse River beneficial uses are sediment, nutrients, stream temperature and bacteria.

Table A. South Fork Palouse River designated beneficial uses.

Water Body Name	Designated Beneficial Uses[1]
South Fork Palouse River	CWAL, SS, SCR

[1]CWAL – Cold Water Aquatic Life, SS – Salmonid Spawning, SCR – Secondary Contact Recreation

Table B. 2002 §303(d) listing information for the South Fork Palouse River.

Water Body Name	Assessment Unit ID Number	2002 §303(d) Boundaries	Pollutants	Listing Basis
SF Palouse River	ID17060108CL002_03 ID17060108CL003_02 ID17060108CL003_03	Gnat Cr. to ID/WA Border; Source to Crumarine Cr.; Crumarine Cr. to Gnat Cr.	Sediment, Nutrients, Temperature, Bacteria	IDEQ 2002 Integrated Report

A water quality sampling project was conducted by the Idaho Association of Soil Conservation Districts personnel from November 26, 2001 to November 18, 2002 in accordance with the Association's Quality Assurance Project Plan. Data used in this assessment were reviewed for compliance with the plan's quality assurance objectives and found to be acceptable.

Specific parameters for which sampling occurred included total phosphorus (TP), nitrite+nitrate as nitrogen (NO_2+NO_3-N), ammonia (NH_3), total suspended solids (TSS), and fecal coliform and *E. coli* bacteria. Other parameters collected in the field included flow, pH, specific conductivity, dissolved oxygen (DO), and water temperatures. Instantaneous Sampling occurred approximately every two weeks at four sites throughout the watershed.

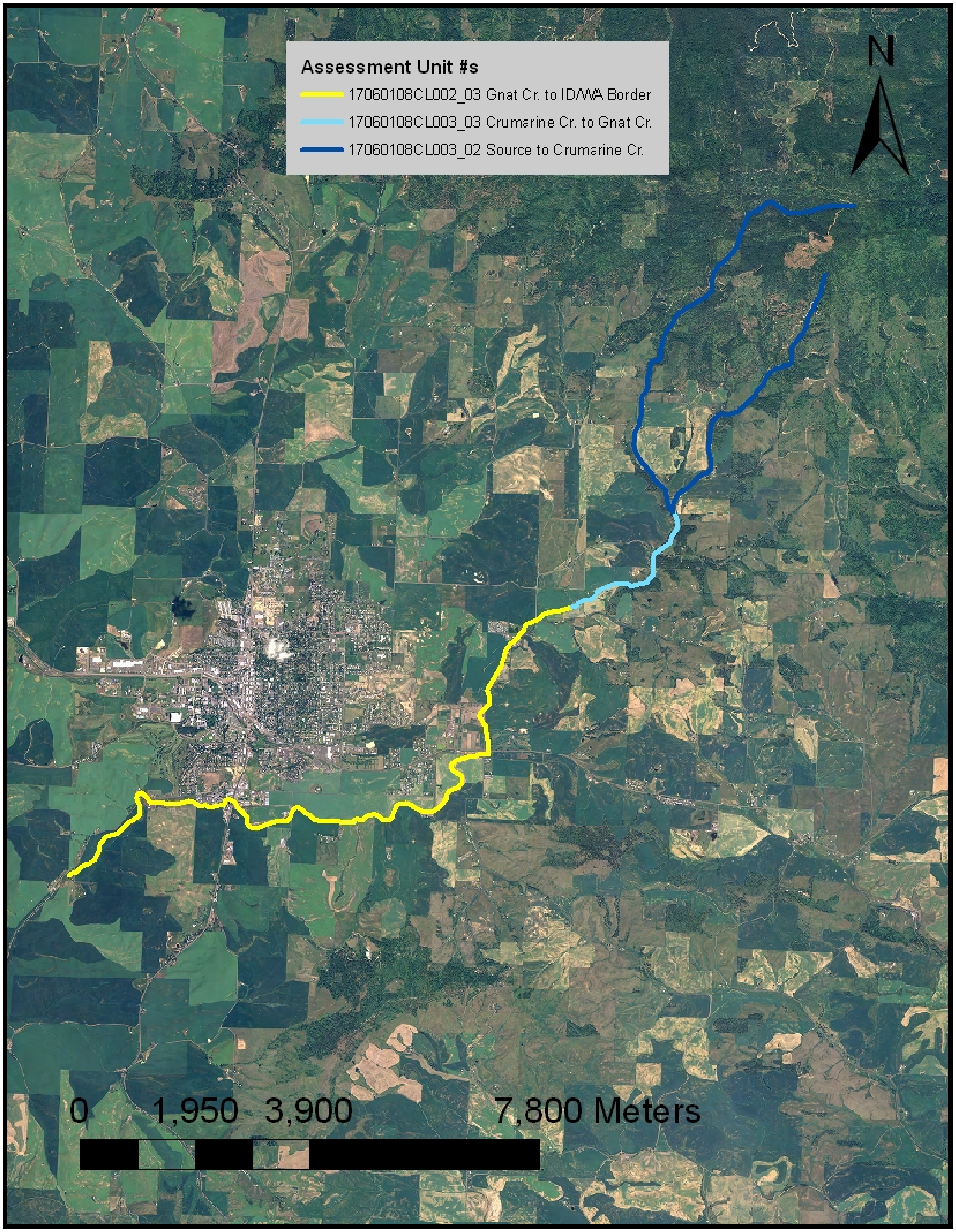

Figure B. South Fork Palouse River Assessment Units

The four sites are identified as SF-1, SF-2, SF-3, and SF-4 progressing from the upper most site in the watershed to the lower most site in the watershed. The site locations are illustrated in Figure A. Water quality monitoring completed by DEQ personnel in the watershed over the last decade is described in Section 2.4.

The TMDL assigns *E. coli* bacteria and temperature load allocations throughout the watershed. Sediment and nutrient TMDLs have been assigned to assessment units CL003_03, and CL002_03 to reflect cumulative loads. Assessment Unit CL003_03, South Fork Palouse River, source to Gnat Creek, is represented by SF-2. Assessment Unit CL002_03, Gnat Creek to state line, is represented by SF-4. Load reductions and load allocations are assigned at monitoring stations SF-2 and SF-4 to represent the load reductions and allocations corresponding to assessment units CL003_03 and CL002_03.

E. coli TMDL

During the 2001-2002 monitoring season, seven samples measured for *E. coli* bacteria were above Idaho's instantaneous water quality criterion of 576 colony forming units per 100 milliliters of solution (cfu/100 ml): three at site SF-1, two at site SF-2, one at site SF-3, and one at site SF-4.

Additional monitoring was conducted between mid June and early July 2006 at two monitoring sites (SF-2 and SF-4) and at a site to augment the data set between SF-2 and SF-3 (Mill Road Bridge), to assess compliance with Idaho's 126 cfu/100 ml geometric mean criterion. Analysis of the results showed *E. coli* bacteria in the South Fork Palouse River were above Idaho's geometric mean criterion.

Consequently, an *E. coli* bacteria TMDL was developed and allocated a daily concentration equal to the state standard to all sources contributing *E. coli* bacteria to the South Fork Palouse River watershed. As such, all contributing sources should be reduced by 25-41% (Table C).

Table C. E. *coli* bacteria allocations for the South Fork Palouse River (June-July 2006 data).

Location (Control Point)	Target (cfu/100 ml)[a]	Existing Load (cfu/100 ml)	Load Capacity (cfu/100 ml)	Daily Wasteload and Load Allocation (cfu/100 ml)	Load Reduction
SF-2 (Source to Robinson Park)	126	169	126	126	25%
Mill Bridge (Robinson Park to Mill Bridge)	126	213	126	126	41%
SF-4 (Mill Bridge to Idaho/Wash. State Line)	126	215	126	126	41%

[a]cfu/100 ml = colony forming units per 100 milliliters

Nutrient TMDL

Violations of Idaho's 6.0 mg/L dissolved oxygen criterion have been observed in the South Fork Palouse River. The low dissolved oxygen measurements observed are most likely affected by aquatic vegetative growth cycles during the late summer low flow period. The critical time period for nutrients in the South Fork Palouse River coincides with these violations of the dissolved oxygen standard (mid May through October). No additional nutrient loading and, specifically, a reduction in total phosphorus loading should occur beginning in mid May through October. During this period, instream flows decrease and instream temperatures increase affecting aquatic vegetation growth and subsequently dissolved oxygen. Nutrient management during this critical time period should limit phosphorous loading to the river while enhancing instream dissolved oxygen concentrations.

At present, monitoring data indicate that the ratio of mean nitrite+nitrate-N to mean total phosphorous is well over 7:1 at sites SF-2, 3 and 4 (ratios vary from 12:1 to 18:1). Nitrogen to phosphorous ratios greater than 7:1 indicate total phosphorous is the limiting nutrient for aquatic plant growth in the watershed. Since phosphorus is also considered to be easier and more cost-effective to manage than nitrogen, total phosphorous will be the primary nutrient of concern in this TMDL (Table D).

Table D. Total Phosphorous nonpoint source load allocations for the critical time period within the South Fork Palouse River watershed.

Location	Average daily flow (cfs)	Total Load Capacity (Kg/day)	Margin of Safety (Kg/day)	Load Allocation (Kg/day)	Existing Load (Kg/day)	Load Reduction (%)
SF-2	1.1	0.27	0.027	0.24	0.46	48
SF-4	2.53	0.62	0.062	0.56	1.1	49

A load and wasteload allocation has been developed for the months of February through March when discharge typically occurs from Syringa Mobile Home Park and Country Homes Mobile Park. Wasteload allocations for Syringa Mobile Home Park and Country Homes Mobile Park are included with the load allocation in the existing load. An April allocation has been developed to provide the ability for discharge to occur if needed. No load or wasteload reductions are required during these periods because discharges during these times occur prior to the critical time period for nutrients in the South Fork Palouse River (Table E). Maximum pollutant discharges in future National Pollutant Discharge Elimination System permits for Syringa Mobile Home Park and Country Homes Mobile Park should be based on these current seasonal existing loads and limited to these periods.

Table E. Total Phosphorous load and wasteload allocations for the months of February-March and April.

SF-3	Average daily flow (cfs)	Total Load Capacity (Kg/day)	Margin of Safety (Kg/day)	Existing Load (Kg/day)	Load and Wasteload Allocation (Kg/day)	Load and Wasteload Reduction (%)
February-March	62.6	NA[1]	NA	56.7	56.7	0.0
April	42.3	NA	NA	18.1	18.1	0.0

1=Not Applicable

Sediment TMDL

Sediment criteria found in Idaho Water Quality Standards (IDAPA 58.01.02) is narrative, meaning there is not a numeric value to assess whether a water body is in compliance with standards. Instead, we have a standard that states sediment shall be limited to a quantity that does not impair beneficial uses.

The effects of sediment on the most sensitive designated beneficial use in the South Fork Palouse River, aquatic life, are dependant on concentration and duration of exposure (DEQ 2003). Guidance developed by the Department for application of the narrative sediment criteria for protection of aquatic life beneficial uses states that a sediment target should incorporate both concentration and duration of exposure, not only to properly protect aquatic life, but also to allow for episodic spikes that can occur naturally with spring runoff or heavy precipitation events.

Based on the information contained in the guidance, a 25 milligram per liter (mg/L) TSS target averaged over a 30-day period, not to exceed 50 mg/L daily has been used to develop the sediment TMDL for the upper assessment units. This target is designed to maintain high level of protection for salmonid spawning populations (DEQ 2003).

A 50 mg/L TSS target averaged over a 30-day period, not exceed 80 mg/L daily has been used to develop the sediment TMDL for the lower assessment unit. This target is designed to maintain a moderate level of protection for salmonid rearing populations (DEQ 2003) in the South Fork Palouse River watershed.

These targets are applied to provide a higher level of protection for the upper assessment unit to reflect habitat conditions in the watershed since the lower assessment unit is in an area of extensive sediment deposits, while the upper assessments units are in an area of granitic bedrock. The weathered granite in the upper watershed provides an important source for stream bed gravels which are lacking in the lower watershed where basalt and silt dominate the watershed.

The critical time period for TSS in the South Fork Palouse River occurs in February, March and April (Tables F through I) when TSS concentrations become elevated as the result of increasing stream flow and overland runoff.

Table F. Daily TSS load allocation for site SF-2 for 2001-2002 monitoring period.

Date	Daily Flow (cfs)	TSS Concentration (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	MOS (lbs/day)	Load Allocation (lbs/day	Load Reduction (%)
11/26/2001	0.67	1	3.6	180.9	18.1	162.8	0
12/5/2001	0.46	1	2.5	123.0	12.3	110.7	0
12/19/2001	1.66	1	8.9	446.2	44.6	401.6	0
1/2/2002	0.87	1	4.7	234.5	23.5	211.1	0
1/16/2002	3.58	8	154.5	965.6	96.6	869.0	0
1/30/2002	6.07	7	229.2	1,636.9	163.7	1,473.3	0
2/12/2002	6.91	7	260.7	1,862.4	186.2	1,676.2	0
2/26/2002	19.68	48	5,090.7	5,302.8	530.3	4,772.5	6
3/12/2002	39.91	330	70,987.9	10,755.7	1,075.6	9,680.2	86
3/25/2002	35.24	60	11,397.4	9,497.9	949.8	8,548.1	25
4/8/2002	21.46	55	6,362.5	5,784.1	578.4	5,205.7	18
4/22/2002	12.92	41	2,854.6	3,481.2	348.1	3,133.1	0
5/8/2002	8.52	18	826.8	2,296.6	229.7	2,066.9	0
5/22/2002	7.08	10	381.7	1,908.7	190.9	1,717.8	0
6/4/2002	3.90	14	294.2	1,050.8	105.1	945.7	0
6/18/2002	2.83	37	564.8	763.2	76.3	686.9	0
7/3/2002	1.21	6	39.1	325.5	32.5	292.9	0
7/15/2002	0.53	9	25.7	142.8	14.3	128.6	0
7/30/2002	0.40	8	17.1	106.9	10.7	96.2	0
8/18/2002	0.55	8	23.6	147.5	14.8	132.8	0
8/27/2002	0.67	1	3.6	179.4	17.9	161.5	0
9/5/2002	0.38	15	30.7	102.5	10.2	92.2	0
9/24/2002	0.30	9	14.4	80.2	8.0	72.2	0
10/8/2002	0.19	1	1.0	51.9	5.2	46.7	0
10/22/2002	0.43	4	9.2	114.6	11.5	103.1	0
11/6/2002	0.35	1	1.9	94.9	9.5	85.4	0
11/19/2002	0.50	1	2.7	134.2	13.4	120.8	0

Table G. Daily TSS load allocation for site SF-4 for 2001-2002 monitoring period.

Date	Daily Flow (cfs)	TSS Concentration (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	MOS (lbs/day)	Load Allocation (lbs/day)	Load Reduction (%)
11/26/2001	0.00	18	NA[1]	NA	NA	NA	NA
12/5/2001	0.00	1	NA	NA	NA	NA	NA
12/19/2001	0.00	6	NA	NA	NA	NA	NA
1/2/2002	0.00	1	NA	NA	NA	NA	NA
1/16/2002	0.00	20	NA	NA	NA	NA	NA
1/30/2002	18.1	9.0	880.0	7,822.1	782.2	7,039.9	0.0
2/12/2002	23.5	11.0	1,395.6	10,149.9	1,015.0	9,134.9	0.0
2/26/2002	55.0	71.0	21,063.3	23,733.2	2,373.3	21,359.9	0.0
3/12/2002	99.1	560.0	299,153.6	42,736.2	4,273.6	38,462.6	87
3/25/2002	89.2	100.0	48,100.4	38,480.3	3,848.0	34,632.3	28
4/8/2002	62.1	33.0	11,036.8	26,756.0	2,675.6	24,080.4	0
4/22/2002	24.4	27.0	3,545.6	10,505.5	1,050.6	9,455.0	0
5/8/2002	15.0	16.0	1,297.8	6,489.1	648.9	5,840.2	0
5/22/2002	11.1	9.0	537.6	4,778.9	477.9	4,301.0	0
6/4/2002	5.5	10.0	296.7	2,373.6	237.4	2,136.3	0
6/18/2002	6.3	21.0	708.5	2,699.2	269.9	2,429.3	0
7/3/2002	1.9	1.0	10.1	805.8	80.6	725.2	0
7/16/2002	1.6	1.0	8.6	686.7	68.7	618.0	0
7/29/2002	2.1	6.0	69.4	924.8	92.5	832.4	0
8/18/2002	3.5	5.0	94.7	1,515.1	151.5	1,363.6	0
8/28/2002	2.1	1.0	11.2	893.2	89.3	803.9	0
9/5/2002	1.6	1.0	8.5	676.7	67.7	609.0	0
9/24/2002	0.3	1.0	1.7	132.6	13.3	119.3	0
10/7/2002	0.5	1.0	2.7	212.5	21.2	191.2	0
10/22/2002	0.4	1.0	2.4	189.1	18.9	170.2	0
11/5/2002	0.4	7.0	16.6	189.7	19.0	170.8	0
11/18/2002	0.4	1.0	2.3	181.1	18.1	163.0	0

[1]NA=Not Available because of missing flow data

Table H. Monthly TSS load allocation for site SF-2 for 2001-2002 monitoring period.

Month	Flow (cfs)	Concentration (mg/L)	Total Load Capacity (lbs/month)	MOS (lbs/month)	Load Allocation (lbs/month)	Existing Load (lbs/month)	Load Reduction (%)
January	3.5	5.3	14,185.1	1,418.5	12,766.6	3,007.2	0.0
February	13.3	27.5	53,739.2	5,373.9	48,365.3	59,113.1	18.2
March	37.6	195.0	151,902.0	15,190.2	136,711.8	1,184,835.5	88.5
April	17.2	48.0	69,490.0	6,949.0	62,541.0	133,420.7	53.1
May	7.8	14.0	31,539.2	3,153.9	28,385.3	17,661.9	0.0
June	3.4	25.5	13,605.0	1,360.5	12,244.5	13,877.1	11.8
July	0.7	7.5	2,876.3	287.6	2,588.6	862.9	0.0
August	0.6	4.5	2,452.2	245.2	2,207.0	441.4	0.0
September	0.3	12.0	1,370.0	137.0	1,233.0	657.6	0.0
October	0.3	2.5	1,248.7	124.9	1,123.9	124.9	0.0
November	0.5	1.0	2,050.0	205.0	1,845.0	82.0	0.0
December	1.1	1.0	4,269.5	426.9	3,842.5	170.8	0.0

Table I. Monthly TSS load allocation for site SF-4 for 2001-2002 monitoring period.

Month	Flow (cfs)	Concentration (mg/L)	Total Load Capacity (lbs/month)	MOS (lbs/month)	Load Allocation (lbs/month)	Existing Load (lbs/month)	Load Reduction (%)
January	6.0	10.0	48,888.4	4,888.8	43,999.5	9,777.7	0.0
February	39.3	41.0	317,654.6	31,765.5	285,889.1	260,476.8	0.0
March	94.2	330.0	761,404.9	76,140.5	685,264.4	5,025,272.2	86.4
April	43.3	30.0	350,080.5	35,008.1	315,072.5	210,048.3	0.0
May	13.1	12.5	105,637.4	10,563.7	95,073.7	26,409.3	0.0
June	5.9	15.5	47,558.0	4,755.8	42,802.2	14,743.0	0.0
July	1.9	2.7	15,108.3	1,510.8	13,597.5	805.8	0.0
August	2.8	3.0	22,577.8	2,257.8	20,320.0	1,354.7	0.0
September	0.9	1.0	7,586.8	758.7	6,828.1	151.7	0.0
October	0.5	1.0	3,765.2	376.5	3,388.7	75.3	0.0
November	0.3	4.0	2,317.7	231.8	2,085.9	185.4	0.0
December	N/A[1]	3.5	NA	N/A	N/A	N/A	N/A

[1]NA=Not Available because of missing flow data

Temperature TMDL

A temperature TMDL has been developed using Idaho's Natural Background Conditions standard. Instream water temperatures are affected by shading and solar heat. Streamside vegetation and channel morphology are factors influencing shade which can be most readily corrected and addressed by a TMDL, since they are the factors influenced by anthropogenic activities. This temperature TMDL applies the Potential Natural Vegetation method to reestablish natural background conditions and alleviate temperature impairment on beneficial uses.

TMDL Implementation Plan

The Watershed Advisory Group recommends the Implementation Plan to be developed for this TMDL include a survey to identify property-owners willing to participate in restoration and remediation of the South Fork Palouse River to address the pollutants for which TMDLs were developed (Table J).

First efforts to restore the South Fork Palouse River should focus on riparian enhancement, gravel augmentation, and channel substrate restoration projects designed to intercept the pollutants in runoff, increase opportunities for dissolved oxygen entrainment, and reduce stream temperatures. Sources of *E. coli* bacteria will be included in the survey for potential remediation projects. These projects should be monitored to determine effectiveness and social acceptability.

Table J. Summary of assessment outcomes.

Water Body Segment/ AU	Pollutants	TMDL(s) Completed	Recommended Changes to 2006 Integrated Report	Justification
South Fork Palouse River 17060108 CL003_02 and _03	*E. coli* Bacteria, Nutrients, Sediment and Temperature	Yes	Move to Section 4a	TMDLs Completed
South Fork Palouse River 17060108CL002_03	*E. coli* Bacteria, Nutrients, Sediment and Temperature	Yes	Move to Section 4a	TMDLs Completed

1. Subbasin Assessment – Watershed Characterization

The federal Clean Water Act requires that Idaho restore and maintain the chemical, physical, and biological integrity of state waters. Idaho, pursuant to Section 303 of the Clean Water Act, is to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. Section 305 of the Clean Water Act requires Idaho to monitor water quality conditions of State waters. Idaho must identify, prioritize, and report water bodies that do not meet water quality standards. Idaho must develop a total maximum daily load plan for waters reported as not meeting water quality standards, to restore the water body to water quality standards. An Integrated Report is periodically published by Idaho to meet the integrated requirements of Section 303 and 305 of the Clean Water Act.

This Watershed Assessment and Total Maximum Daily Load addresses the water bodies in the South Fork Palouse River watershed that were listed as not meeting Idaho's water quality standards in Idaho's 2002 Integrated Report. The watershed assessment and total maximum daily load analysis have been developed to comply with Idaho law and the federal Clean Water Act. The total maximum daily load describes the water quality data used to develop estimated loads, and identifies estimates for existing loads, allowable loads, and load reductions needed to meet Idaho water quality standards.

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." The Department of Environmental Quality (DEQ) is responsible for compliance with the Clean Water Act in Idaho. The U.S. Environmental Protection Agency is responsible to ensure Idaho's water quality program complies with the Clean Water Act.

Section 303 of the Clean Water Act requires DEQ to adopt water quality standards and to review those standards every three years. The Environmental Protection Agency must approve Idaho's water quality standards. In addition, DEQ must monitor state waters to identify those not meeting state water quality standards; these impaired waters are included on what is called the 303(d) list. A TMDL must be completed for each water body not meeting water quality standards to restore the water body and comply with the standards.

Interstate Waters

The South Fork Palouse River is an interstate water body flowing from Idaho State into Washington State. The Clean Water Act requires interstate waters meet downstream receiving water state standards when the water body crosses state lines. Idaho State has designated the South Fork Palouse River for Cold Water Aquatic Life, Salmonid Spawning, and Contact Recreation beneficial uses. These designated beneficial uses are considered to be comparable to the aquatic life and recreational beneficial uses designated by Washington State for the South Fork Palouse River. Both Idaho and Washington states' water quality standards are approved by the Environmental Protection Agency for adequacy in protection of aquatic life and recreational beneficial uses. Pollutant TMDLs included in this document are anticipated to restore the South Fork Palouse River to Idaho's water quality standards in Idaho and Washington State water quality standards when the South Fork Palouse River crosses the state border and enters Washington State.

1.2 Physical and Biological Characteristics

Figure 1 illustrates the general geographical location of the South Fork Palouse River watershed. The watershed originates in the forested headwaters on Moscow Mountain and skirts the south side of the city of Moscow until it reaches the Washington state line just upstream of the city of Pullman. The river flows through the city of Pullman before reaching its confluence with the Palouse River within the town of Colfax.

The South Fork and its main tributaries (Crumarine Creek, Gnat Creek and Howard Creek) originate from springs within the forested terrain of Moscow Mountain. Howard Creek, on the northeastern edge of the watershed, flows into Gnat Creek near the boundary between the forested lands of the mountain into the agricultural fields lower in the watershed. Gnat Creek flows into the South Fork about three quarters of a mile downstream of Latah County's Robinson Park. Crumarine Creek flows into the river about a half mile upstream of Robinson Park. Robinson Park was a reservoir until it filled with sediment. A portion of the dam was removed and the area was seeded with grass and is now a county park. The area around Robinson Park has some residential homes.

Land uses downstream of Robinson Park include dryland agriculture, residential homes, a golf course, two state highways, several county roads, the University of Idaho's arboretum and park, and some light industrial uses. As the river leaves the Moscow area there is about a mile of grazing and agricultural land use before it reaches the state line.

Bordering the South Fork Palouse River watershed on the north is the mainstem Palouse River and its tributaries, to the southeast is the Potlatch River drainage; and to the south is the Cow Creek drainage. The South Fork Palouse River watershed is approximately 30 square miles and is located wholly within Latah County. There are no anadromous fish in the Palouse River system as Palouse River Falls, located in Washington, blocks fish migration.

Climate

North Central Idaho is dominated by maritime air masses and prevailing westerly winds. During the fall, winter, and spring months, cyclonic storms move toward the east and produce low-intensity, long-duration precipitation, which accounts for most of the annual precipitation. Prolonged gentle rains and deep snow accumulations at higher elevations with fog, cloudiness, and high humidity can characterize the basin in the fall, winter, and spring months. Winter temperatures are often 15 ^{o}F to 25 ^{o}F warmer than the continental locations of the same latitude. A seasonal snow pack generally covers elevations above 4,000 feet from December to May. The climate during the summer months is influenced by high-pressure stationary systems. These systems sometimes produce high-intensity electrical storms, which cause frequent wildfires, especially during exceptionally hot and dry summers. Precipitation amounts in the watershed are illustrated in Figure 2.

Climatic data used for this report summarizes five geographical locations and is contained in Table 1. In general, as elevation increases, so does the amount of precipitation—with portions of that in snowfall. There is also a considerable temperature difference based on elevation. The City of Moscow (elevation 2,660 feet) averages over 25 days per year where the temperature exceeds 90 °F, while Moscow Mountain (elevation 4,700 feet) averages 3 days per year where temperatures exceed 90 °F. In the summer months, the average temperatures are about 10-15 °F warmer at the lower elevations than at the summit and butte locations. Hot summer temperatures are common at the middle to lower elevations and are the major factor influencing water temperatures. Air temperatures at the middle to lower elevations will exceed 90 °F anywhere from 20% to 70% of the time in the July and August.

Table 1. Summary of climate data.

Station Name	Type	Elevation (ft)	Period of Record	Mean Annual Temp (ºF)	Mean Annual Precipitation (inches)	# of Days > 90 ºF per year
Moscow, U of I	ISCS[1]	2660	1/1/71-12/31/00	47.3	27.4	25.4
Pullman, WA	WRCC[2]	2550	1/1/71-12/31/00	47.4	21.0	27.6
Potlatch, ID	ISCS	2600	1/1/71-12/31/00	45.5	26.6	11.2
Moscow Mt, ID	NRCS[3]	4700	1/1/01-12/31/02	41.5	40.1	3.0
Sherwin, ID	NRCS	3200	1/1/71-12/31/00	ND	42.2	ND

1=Idaho State Climate Services
2=Western Regional Climate Data Center
3=Natural Resources Conservation Service

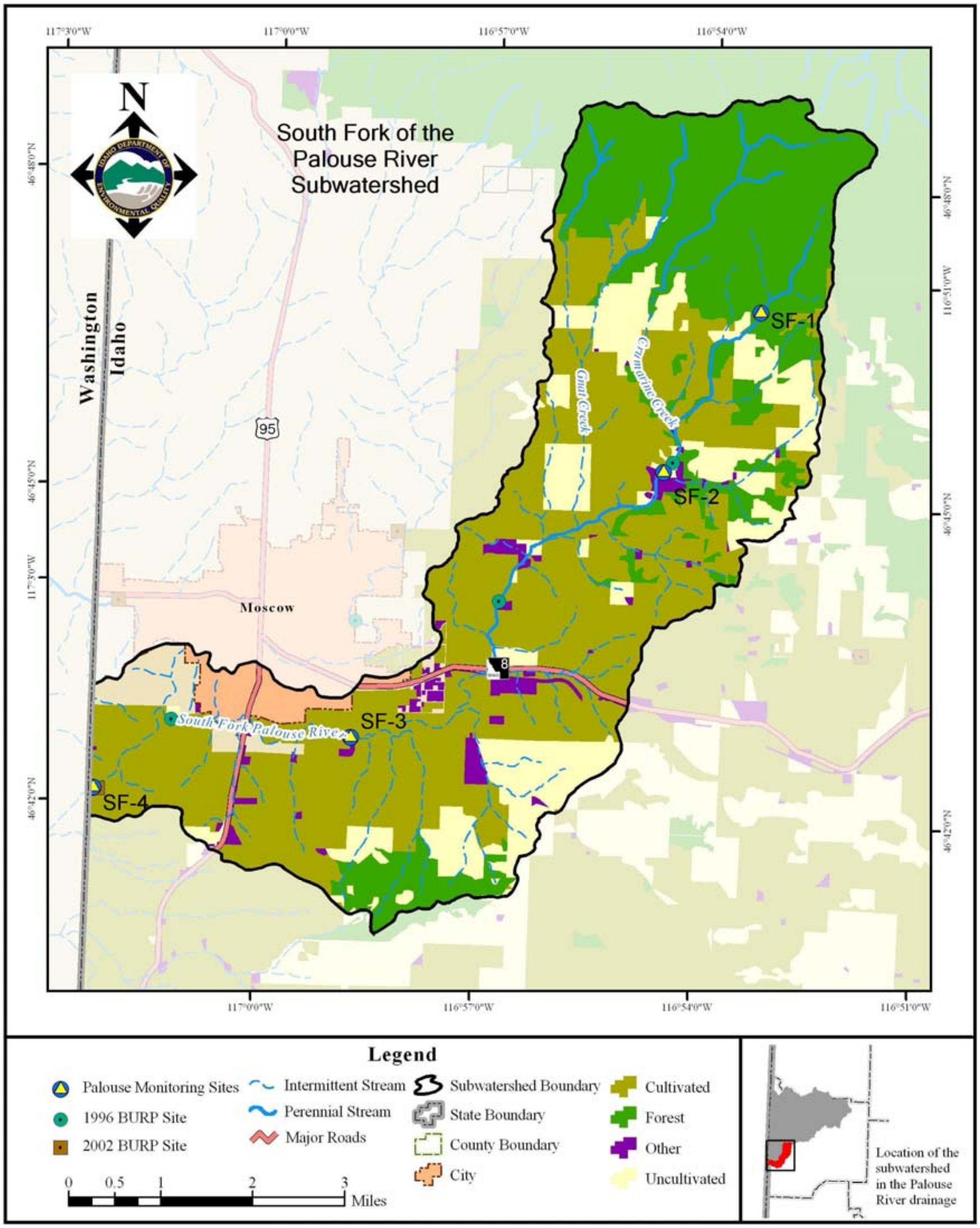

Figure 1. SF Palouse River General Location

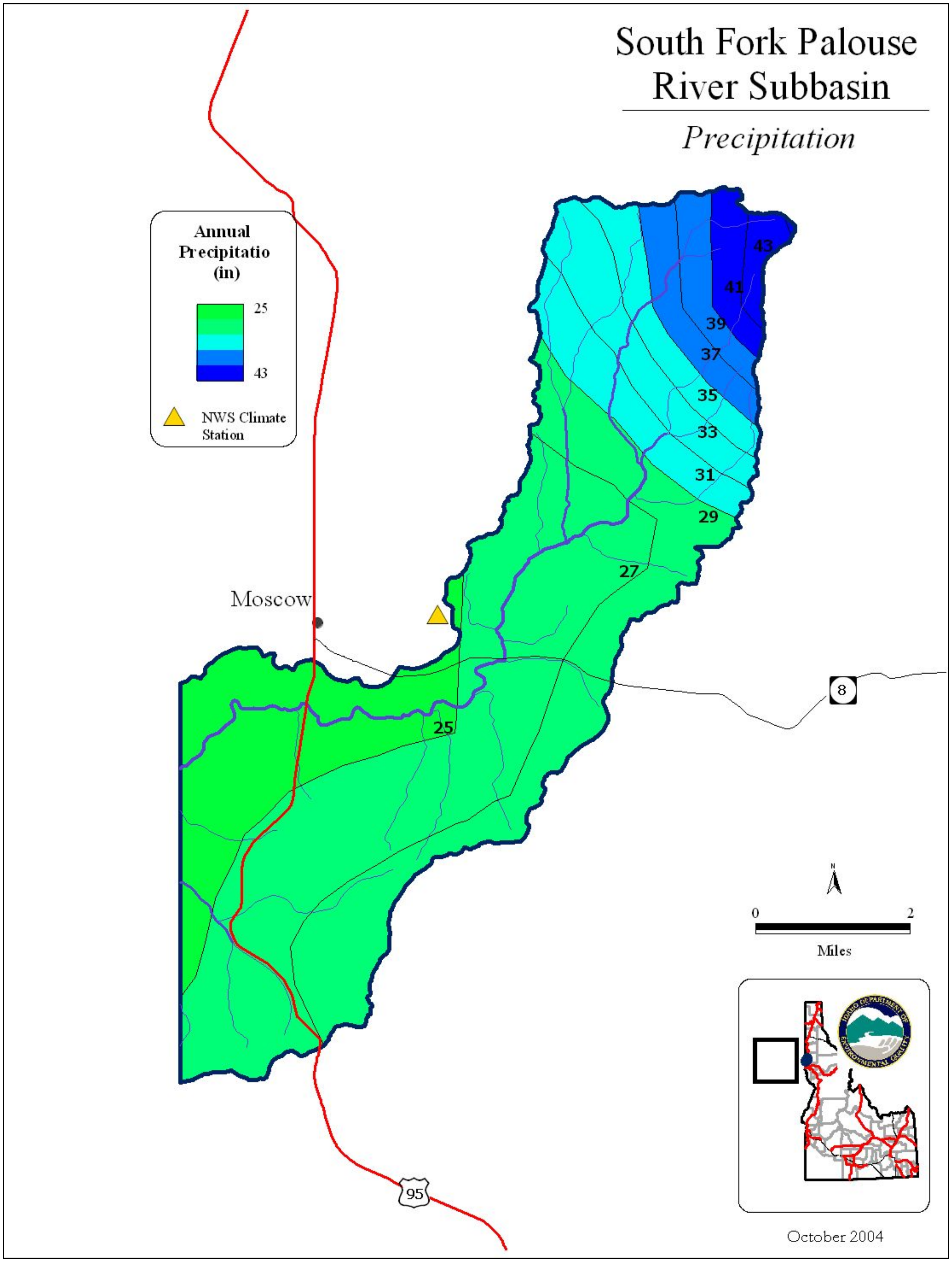

Figure 2. SF Palouse River Precipitation

Hydrology and Stream Characteristics

The South Fork Palouse River flows to the west approximately 13 miles from its headwaters on Moscow Mountain to the Washington state line. From the state line the South Fork flows through Colfax to its confluence with the Palouse River. The United States Geological Service has maintained a stream flow gauge on the river in Pullman. Stream flow data collected by the United States Geological Service for periods of record between1934 though 1942; 1960 though 1981; and 2001 though September 30, 2004 are displayed in Figures 3 though 5. Figure 6 displays stream flow data collected by the United States Geological Service from a gauge on the South Fork in Colfax from 1993 through 1995.

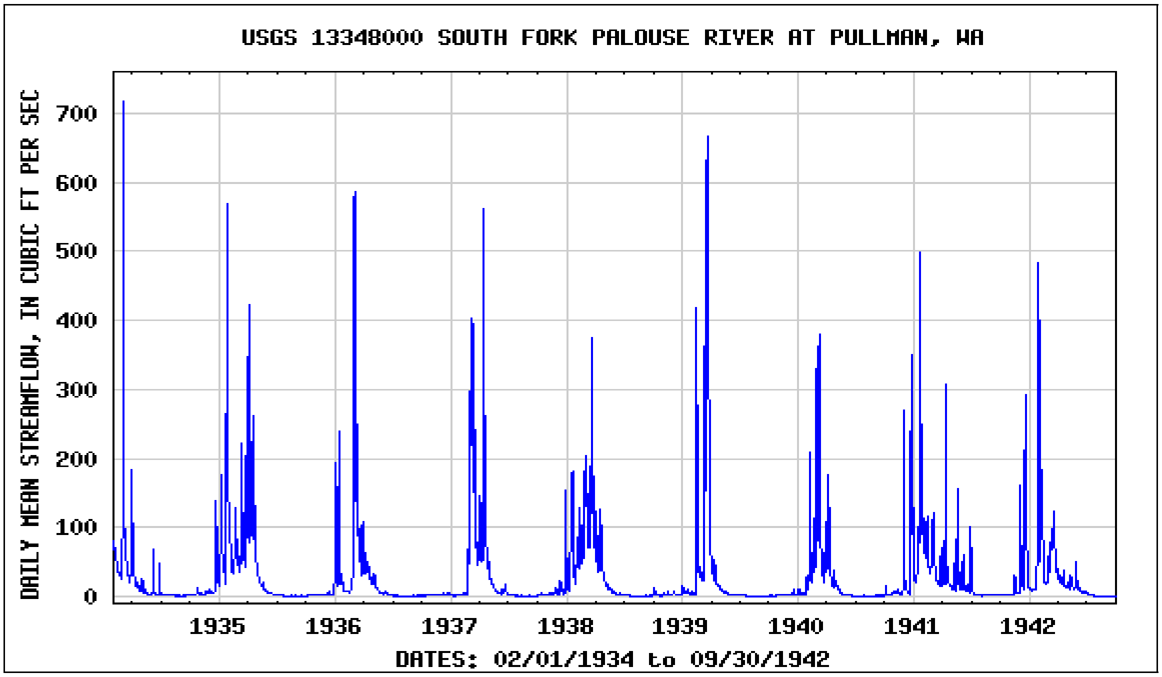

Figure 3. SF Palouse River Flow at Pullman WA (1934-1942)

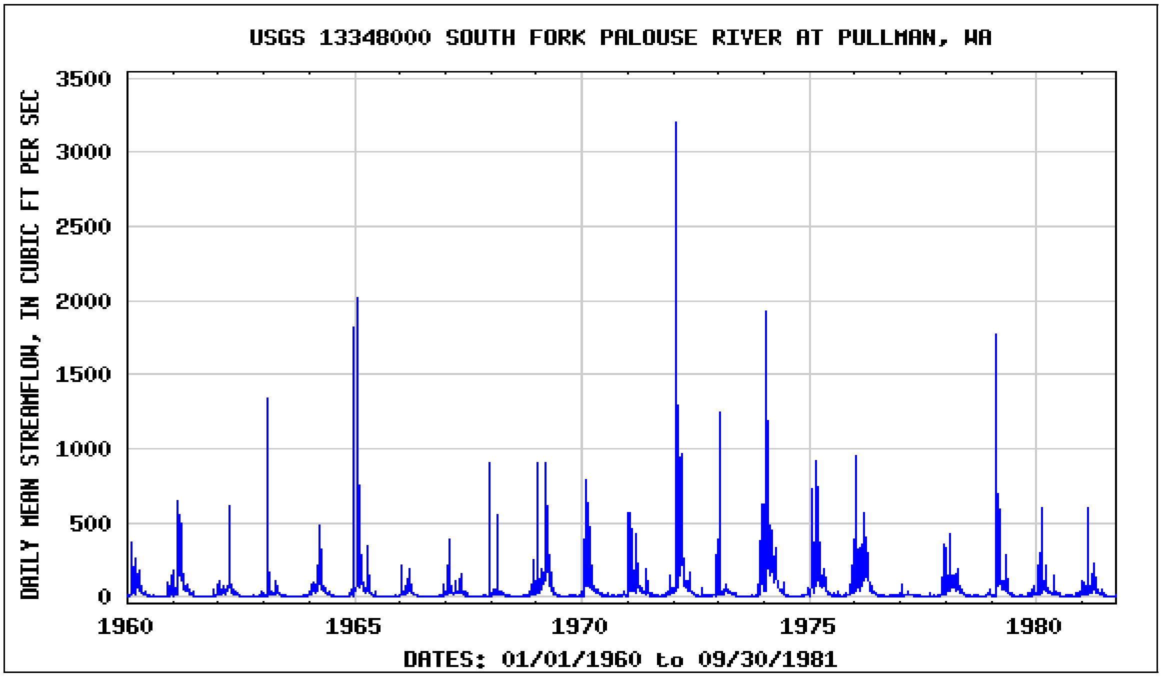

Figure 4. SF Palouse River Flow at Pullman WA (1960-1981)

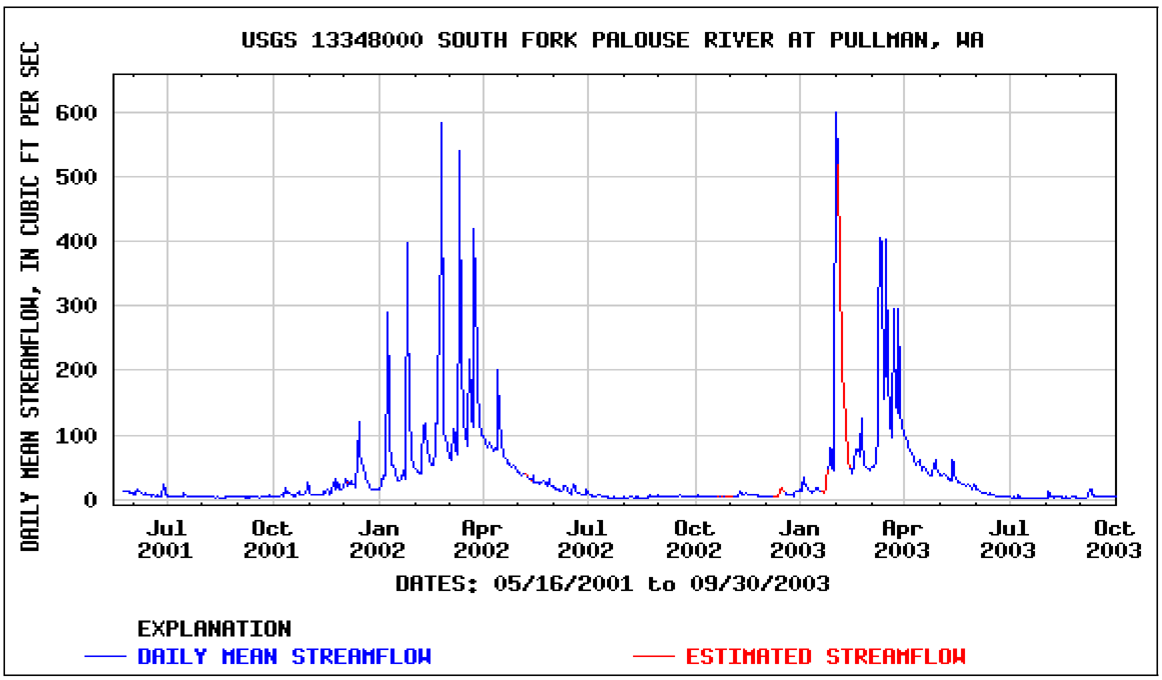

Figure 5. SF Palouse River Flow at Pullman WA (2001-2003)

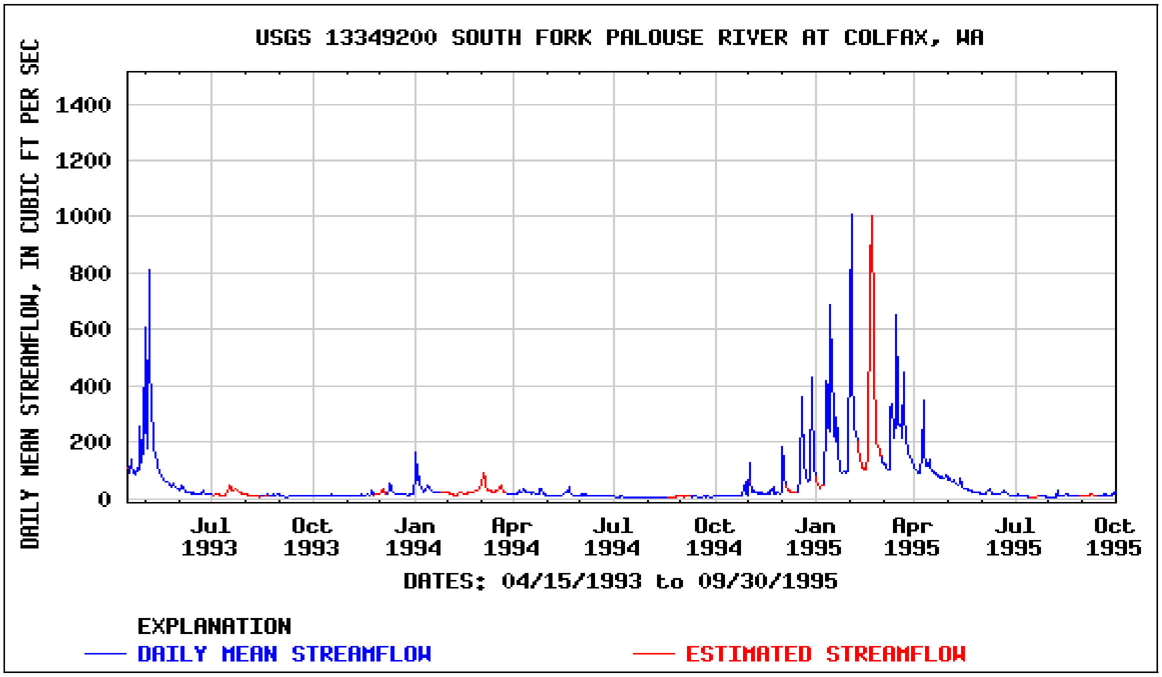

Figure 6. SF Palouse River Flow at Colfax WA (1993-1995)

The peak discharge is typically in late February, March or April. A peak discharge of 1,000 cubic feet per second was recorded at the gauge site in Colfax in February 1996, while a minimum flow of 0.09 cubic feet per second was recorded on September 24, 1973.

The South Fork Palouse River experiences low flows during the late summer and early fall months and high flows in the spring and early summer months. Most of the wetlands and flood plains in the Palouse have been drained or eliminated by modern land use, urbanization, and transportation infrastructure affecting channel sinuosity and diversity. These areas retained water during high flow periods and released water during the lower flow periods. Without these water storage areas, peak flows are higher and for a shorter period of time, creating instream channel erosion, flooding, and deeply incised channels.

Topography, Geology and Soils

Elevations in the watershed range from approximately 4,900 feet on Moscow Mountain to 2,550 feet at the state line. Palouse Loess covers most of the topography of the watershed, especially at elevations at or below 3,000 feet. For elevations below 3,000 feet the north slopes are of moderately to steeply rolling hills, while the south slopes are more moderate. Figure 7 displays the topographic relief of the SF Palouse River watershed.

Most the Palouse River Subbasin is covered by rolling hills (Palouse Loess), which were created by wind deposition. The hills are anywhere from 100 to 300 feet thick and form some of the most agriculturally productive soils in the world. These rich, silty-loam soils are the main reason the Palouse area was settled and the land converted from prairie grasslands into dryland agriculture.

The high elevation of the watershed is located on Moscow Mountain which is composed of weathered granite. Some basalt outcroppings appear underneath the Palouse Loess in the far western potions of the watershed. In the valley bottoms along the SF Palouse River is the Palouse Loess and coarse textured basalt alluvium.

The weathered granite in the upper watershed provides an important source for stream bed gravels which are lacking in the lower watershed where basalt and silt dominate the watershed. Stream bed gravels provide the needed habitat for salmonid spawning and can affect instream dissolved oxygen and temperature.

Vegetation

Historically, prairie grasslands, shrubs, and ponderosa forests dominated the Palouse landscape. The prairie grasslands were composed of Idaho fescue, blue bunch wheatgrass, and in the valley bottoms, camas root. Snowberry, serviceberry, wild rose, willows, red-osier dogwood, alder, ponderosa pine, and Douglas Hawthorn grew in the foothills. In a mosaic of age, structure, and successional classes, forested areas comprised primarily grand fir, western red cedar, western white pine, larch, and Douglas fir.

Currently, six major vegetation categories are recognized in the Palouse Range (IDFG 2001). These include cultivated fields, marshes, grasslands, brush lands, Ponderosa pine forests and mountain forests. Species are influenced by soil type, aspect, moisture, elevation, successional type, and disturbance through fire, agriculture, flooding, disease and insect outbreaks, logging, and urbanization. Dominant forest vegetation includes western white pine, larch, grand fir, Rocky Mountain Douglas Fir, Ponderosa pine, and lodgepole pine. Shrub species include willows and Rocky Mountain maple. Grass species include Idaho fescue, bluebunch, wheatgrass, and prairie junegrass.

Fisheries

The only salmonid native to the Palouse was an isolated population of Yellowstone cutthroat trout, as Palouse Falls was an effective barrier to redband trout migration. Currently no native salmonid species and no anadromous fish exist in the drainage. Idaho State Water Quality Standards do not distinguish between native and non-native salmonids for the designation and protection of the salmonid spawning beneficial use.

The following native fish may be found in the South Fork Palouse River:

Longnose dace	Speckled dace
Redside Shiner	Largescale sucker
Bridgelip sucker	

The following species have been introduced in the watershed:

Brook trout	Brown Trout
Rainbow trout	Northern pike minnow

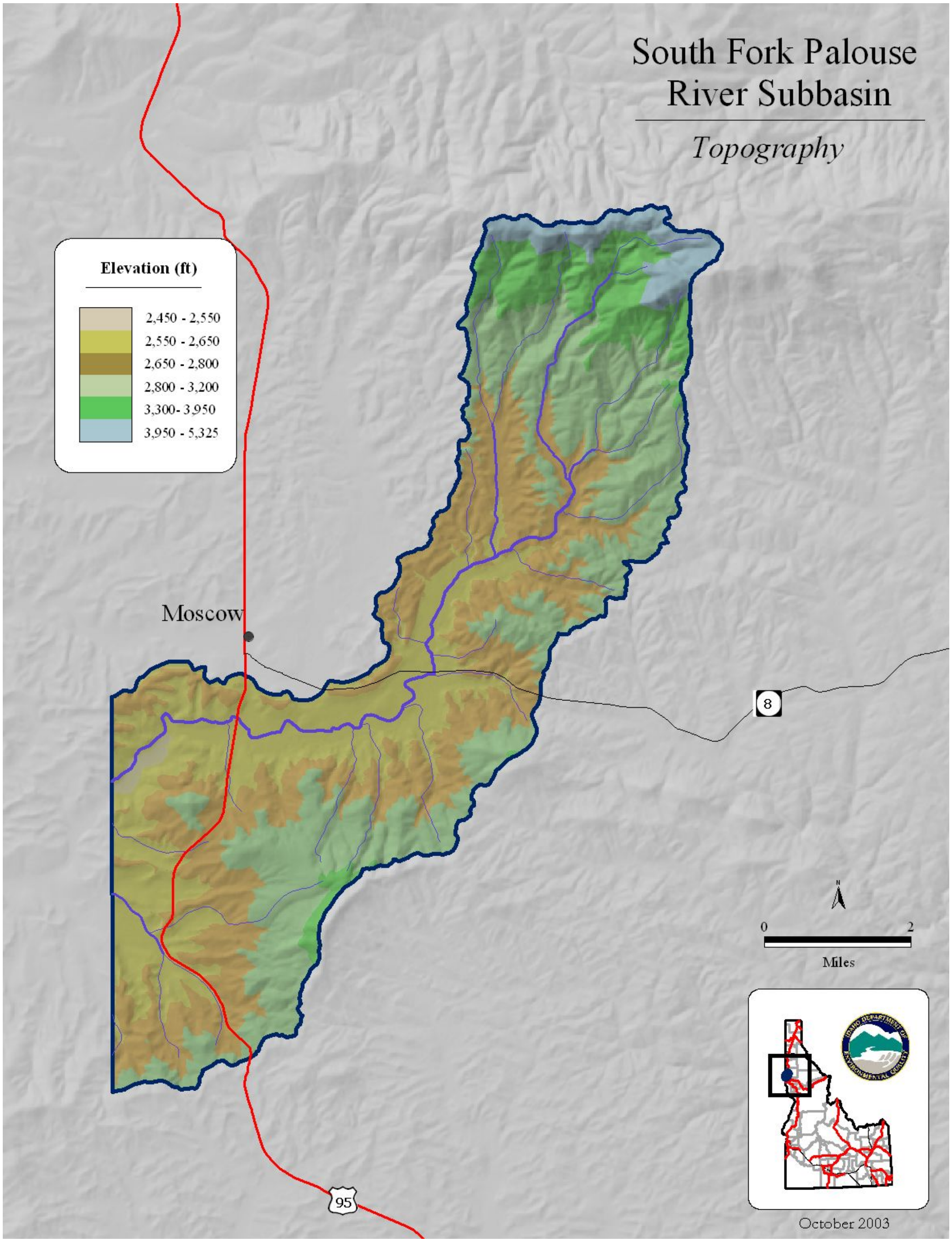

Figure 7. SF Palouse River Topographic Relief

1.3 Cultural Characteristics

The South Fork Palouse River has become a suburbanized agricultural watershed. The total population in Latah County in 2000 was 34,935 people. The city of Moscow's population was 21,219. The dominant land use in the South Fork Palouse River watershed is dry land grain and lentil agriculture, associated agribusinesses, and the urban area of the city of Moscow and the University of Idaho. Other land uses include timber production, livestock grazing, suburban residences and homesteads, light industrial uses, and hiking and motor trails. The various land uses are illustrated on Figure 8.

Tribal history suggests the Palouse was a transitional area between the Nez Perce and Coeur d'Alene tribes used for gathering of root foods, and grazing. The first European people to become familiar with the area were travelers on route to the gold discoveries in the North Fork Clearwater River country. Ranching, farming, logging, and mining were the main European activities that influenced the current landscape and environment. Latah County was established in 1888, with its county seat at Moscow. The establishment of the Land Grant University of Idaho and Washington State University in the late 1880s further increased and diversified the population of the Palouse.

Horse and mule teams cultivated the land in the early 1900s until the 1930s when most of the Palouse was being harvested by combines. Commercial fertilizer use increased crop production by about 300% in the 1950s, and federal programs encouraged farmers to drain seasonal wetland areas. Logging has been around since around 1900, and the industry peaked in the area around the late 1960s. Livestock grazing is minimal and currently typical mining activities are rock quarries for roads. Storm water from roadways, road ditches, and recreational hiking and motor trails has the potential to affect stream water quality and is considered a non point source.

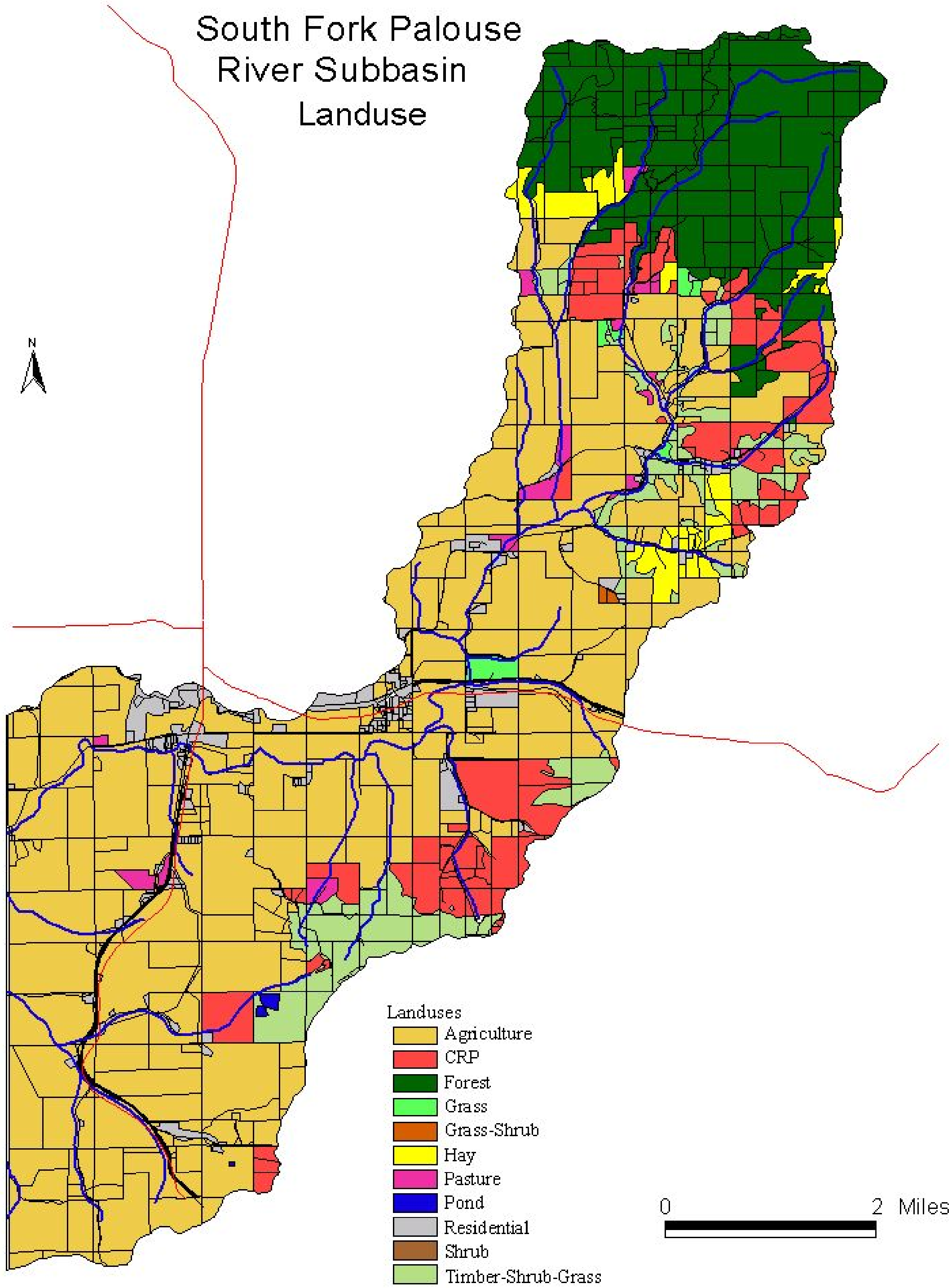

Figure 8. SF Palouse River Landuse

2. Subbasin Assessment – Water Quality Concerns and Status

The South Fork Palouse River Assessment Unit #s ID17060108CL002_03 (Gnat Cr. to Idaho/Washington border), ID17060108CL003_02 (Source to Crumarine Creek) and ID17060108CL003_03 (Crumarine Creek to Gnat Creek) were listed as not meeting state water quality standards in Section 5 of Idaho's 2002 Integrated Report (Figure B). Section 303(d) of the Clean Water Act states that waters that do not meet water quality standards are required to have total maximum daily loads developed to bring them into compliance with water quality standards.

Pollutants suspected of affecting the South Fork Palouse River are sediment, nutrients, stream temperature and bacteria. Table 2 lists the information included in Section 5 Idaho's 2002 Integrated Report for the South Fork Palouse River.

Table 2. 2002 §303(d) listing information for the South Fork Palouse River.

Water Body Name	Assessment Unit ID Number	2002 §303(d) Boundaries	Pollutants	Listing Basis
SF Palouse River	ID17060108CL002_03 ID17060108CL003_02 ID17060108CL003_03	Gnat Cr. to Idaho/Washington State Line; Source to Gnat Creek	Sediment, Nutrients, Temperature, Bacteria	IDEQ 2002 Integrated Report

2.1 About Assessment Units

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

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

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

Beginning in 2002, the U.S. Environmental Protection Agency combined Section 303(d) and 305(b) reporting requirements into an Integrated Report. The Integrated Report contains five sections that categorize water quality conditions relative to Section 303(d) and 305(b) of the Clean Water Act.

Section one and two of the Integrated Report lists water bodies that are attaining all (1) or some (2) of Idaho water quality standards. Section 3 lists water bodies with insufficient data and information to determine if any standards are attained. Section 4 corresponds to water bodies that are impaired or threatened for one or more standards but not needing a TMDL (de-listed). Section 5 corresponds to waters needing a TMDL (303(d)).

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

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

2.2 Applicable Water Quality Standards

Idaho has both narrative and numeric water quality standards to protect public health and water quality. Designation of beneficial uses for water bodies sets the criteria necessary to protect those uses. According to IDAPA 58.01.02.050 (02)a “wherever attainable, surface waters of the state shall be protected for beneficial uses which includes all recreational use in and on the water surface and the preservation and propagation of desirable species of aquatic biota.” Beneficial use support is determined by the Department of Environmental Quality through its water body assessment process.

Designated Beneficial Uses

Idaho water quality standards require surface waters of the state be protected for beneficial uses, wherever attainable (IDAPA 58.01.02.050.02). The Clean Water Act defines designated uses as “those uses specified in water quality standards for each water body or segment, whether or not they are being attained.” Designated uses are simply uses officially recognized by the state and specified in the State’s water quality standards. Water quality must be sufficiently maintained to meet the most sensitive use.

Table 3 contains a listing of designated beneficial uses for the South Fork Palouse River. Table 4 summarizes water quality standards associated with the beneficial uses and the pollutants of concern.

Table 3. South Fork Palouse River designated beneficial uses.

Water Body Name	Designated Uses[1]
South Fork Palouse River	CWAL, SS, SCR

[1]CWAL – Cold Water Aquatic Life, SS – Salmonid Spawning, SCR – Secondary Contact Recreation

Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life or salmonid spawning. Designated uses are specifically listed for water bodies in Idaho in tables in the Idaho water quality standards (see IDAPA 58.01.02.003.27 and .02.109-.02.160 in addition to citations for existing uses).

The South Fork Palouse River Watershed Advisory Group has voiced concern with the accuracy of the Salmonid Spawning designated beneficial use in the water body assessment unit ID 17060108CL002_03, and felt the procedures required to develop and gain federal approval of a Use Attainability Analysis to change the lower assessment unit should not delay the development of TMDLs for the South Fork Palouse River.

Based on the advice provided by the South Fork Palouse River Watershed Advisory Group, TMDLs in assessment unit CL002_03 will be written to reflect a Cold Water Aquatic Life beneficial use. Whether the beneficial use in the lower assessment unit is referenced as Salmonid Spawning or Cold Water Aquatic Life is a minimal concern for water quality protection since the same criteria, TMDLs, and TMDL targets will be applied.

Criteria to Support Beneficial Uses

Beneficial uses are protected by a set of criteria, which include narrative criteria for pollutants such as sediment and nutrients, and numeric criteria for pollutants such as bacteria, dissolved oxygen, pH, ammonia, temperature, and turbidity (IDAPA 58.01.02.250) (Table 4).

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

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

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

DEQ's procedure to determine whether a water body fully supports designated and existing beneficial uses is outlined in IDAPA 58.01.02.053 (Figure 9). The procedure relies heavily upon biological parameters and is presented in detail in the Water Body Assessment Guidance (Grafe et al. 2002).

Table 4. Selected numeric criteria supportive of designated beneficial uses in Idaho water quality standards.

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

Designated and Existing Beneficial Uses				
Water Quality Parameter	**Primary Contact Recreation**	**Secondary Contact Recreation**	**Cold Water Aquatic Life**	**Salmonid Spawning (During Spawning and Incubation Periods for Inhabiting Species)**
			Seasonal Cold Water: Between summer solstice and autumn equinox: 26 °C or less daily maximum; 23 °C or less daily average	
Turbidity			Turbidity shall not exceed background by more than 50 NTU[e] instantaneously or more than 25 NTU for more than 10 consecutive days.	
Ammonia			Ammonia not to exceed calculated concentration based on pH and temperature.	
EPA Bull Trout Temperature Criteria: Water Quality Standards for Idaho, 40 CFR Part 131				
Tempera-ture				7 day moving average of 10 °C or less maximum daily temperature for June - September

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

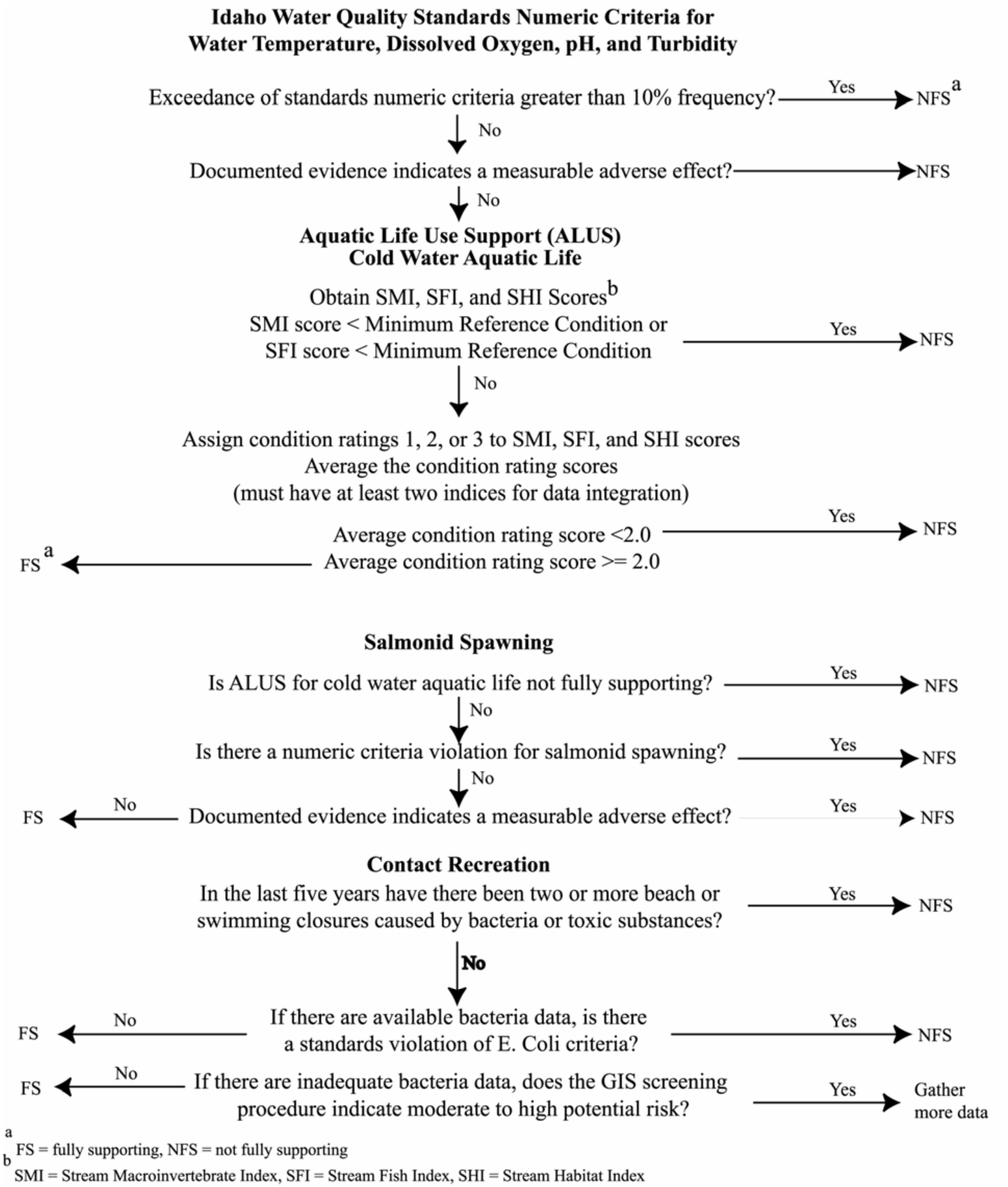

Figure 9. Determination Steps and Criteria for Determining Support Status of Beneficial Uses in Wadeable Streams: *Water Body Assessment Guidance*, Second Edition (Grafe *et al*. 2002)

2.3 Pollutant/Beneficial Use Support Status Relationships

Most of the pollutants that impair beneficial uses in streams are naturally occurring. That is, streams naturally have sediment, nutrients, bacteria, etc., but when human sources cause these to reach unnatural levels, they are considered “pollutants” and can impair the beneficial uses of a stream.

Temperature

Temperature is a water quality factor integral to the life cycle of fish and other aquatic species. Different temperature regimes also result in different aquatic community compositions. Water temperature dictates whether a warm, cool, or coldwater aquatic community is present. Many factors, natural and anthropogenic, affect stream temperatures. Natural factors include altitude, aspect, climate, weather, riparian vegetation (shade), and channel morphology (width and depth). Human influenced factors include heated discharges (such as those from point sources), riparian alteration, channel alteration, and flow alteration. Elevated steam temperatures can be harmful to fish at all life stages, especially if they occur in combination with other habitat limitations such as low dissolved oxygen or poor food supply. Acceptable temperature ranges vary for different species of fish, with cold water species being the least tolerant of high water temperatures. Temperature as a chronic stressor to adult fish can result in reduced body weight, reduced oxygen exchange, increased susceptibility to disease, and reduced reproductive capacity. Acutely high temperatures can result in death if they persist for an extended length of time. Juvenile fish are even more sensitive to temperature variations than adult fish, and can experience negative impacts at a lower threshold value than the adults, manifesting in retarded growth rates. High temperatures also affect embryonic development of fish before they even emerge from the substrate. Similar kinds of affects may occur to aquatic invertebrates, amphibians and mollusks, although less is known about them.

Dissolved Oxygen

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

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

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

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

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

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

Sediment

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

Newcombe and Jensen (1996) reported the effects of suspended sediment on fish, summarizing 80 published reports on streams and estuaries. For rainbow trout, physiological stress, which includes reduced feeding rate, is evident at suspended sediment concentrations of 50 to 100 mg/L when those concentrations are maintained for 14 to 60 days. Similar effects are observed for other species, although the data sets are less reliable. Adverse effects on habitat, especially spawning and rearing habitat presumably from sediment deposition, were noted at similar concentrations of suspended sediment.

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

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

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

Bacteria

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

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

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

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

Nutrients

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

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

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

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

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

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

Sediment – Nutrient Relationship

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

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

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

Floating, Suspended, or Submerged Matter (Nuisance Algae)

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

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

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

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

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

2.4 Summary and Analysis of Existing Water Quality Data

This section summarizes the available biological, chemical, and physical data used for the analyses of the South Fork Palouse River watershed. The majority of the data generated for use was provided by the Idaho Association of Soil Conservation Districts (Appendix B). Additional data was collected by Idaho Department of Environmental Quality (DEQ) personnel as needed and is described in the following subsections.

A water quality sampling project was conducted by the Idaho Association of Soil Conservation Districts personnel from November 26, 2001 to November 18, 2002. Specific parameters that were sampled for included total phosphorus (TP), nitrite+nitrate as nitrogen (NO_2+NO_3-N), ammonia (NH_3), total suspended solids (TSS), and fecal coliform and E. coli bacteria. Other parameters collected in the field included flow, pH, specific conductivity, dissolved oxygen (DO), and water temperatures. Instantaneous sampling occurred approximately every two weeks at four sites throughout the watershed. The four sites are identified as SF-1, SF-2, SF-3, and SF-4 progressing from the upper most site in the watershed to the lower most site in the watershed. The site locations are illustrated in Figure 10.

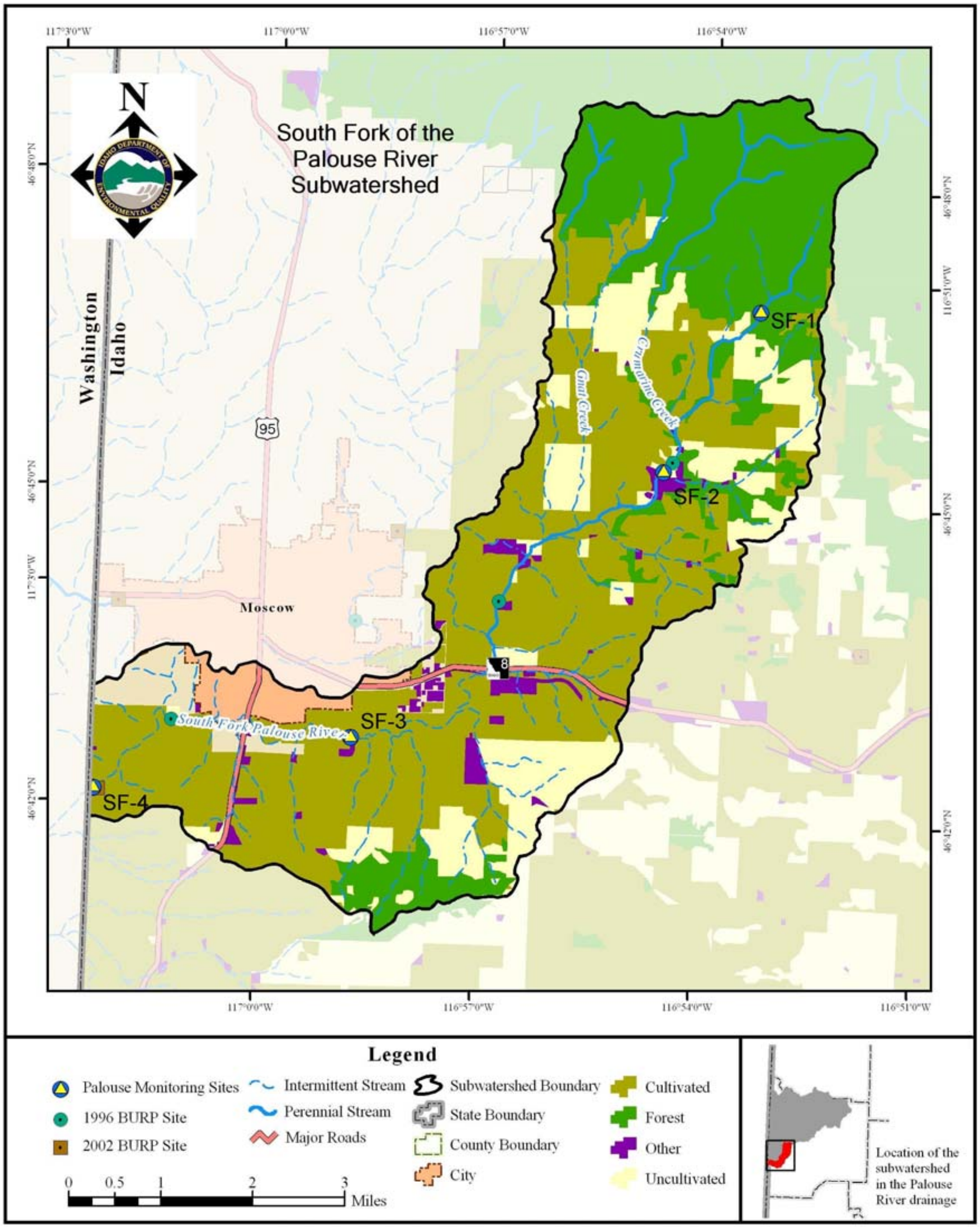

Figure 10. SF Palouse River Monitoring Sites

Flow Characteristics

Instantaneous flow measurements collected during the 2001-2002 monitoring season indicate the South Fork Palouse River sustains perennial flow below monitoring site SF-2 (Robinson Park) to the Idaho state line. Flow data was not collected from site SF-1 during the month of September 2002 due to dry conditions. Site observations in August and September 2006 verified that the stream segment at site SF-1 is intermittent.

Average annual flow for sites SF-1, SF-2, and SF-3 were 1.67 cfs, 5.99 cfs, and 13.42 cfs, respectively (Appendix B). Flow data was not collected at site SF-4 from November 26, 2001 through January 16, 2002 (five sampling events), because of personnel safety concerns for high water and frozen conditions (Clark, Personal Communication 2006). The average annual flow at site SF-4 was 17.25 cfs, based on the known flow values. Figure 11 displays the flow characteristics at each monitoring site during the 2001-2002 monitoring season.

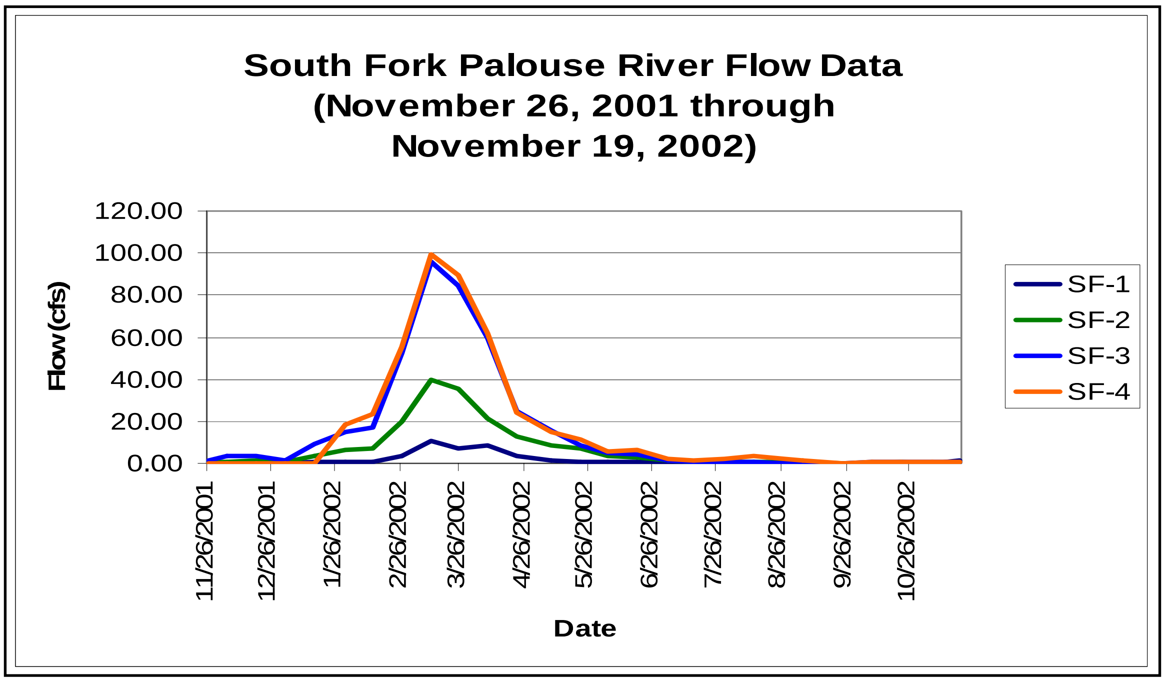

Figure 11. Instantaneous Flow Data for the South Fork Palouse River

Water Column Data

Pathogens

The state of Idaho criteria for E. coli is that bacteria are not to exceed 126 colony forming units per 100 milliliters of solution (cfu/100 ml) as a 30-day geometric mean or 406 cfu/100 ml as an instantaneous sample for primary contact recreation. Water bodies designated for secondary contact recreation, such as the South Fork Palouse River, must not exceed the 30-

day geometric mean criterion, and cannot exceed 576 cfu/100 ml as an instantaneous sample (IDAPA 58.01.02.251.01 & 02).

During the 2001-2002 monitoring season, 7 samples measured for E. coli bacteria exceeded the 576 cfu/100 ml criterion: three at site SF-1, two at site SF-2, one at site SF-3, and one at site SF-4.

Additional monitoring was conducted between mid June and early July 2006 at two monitoring sites (SF-2 and SF-4) and at a site to augment the data set between SF-2 and SF-3 (Mill Road Bridge), to assess compliance with Idaho’s 126 cfu/100 ml geometric mean criterion. Table 5 shows the concentrations from the sampling events, the resulting geometric mean, and the concentration allowed by Idaho water quality standards.

Table 5. *E. coli* bacteria concentrations at sites SF-2, Mill Bridge, and SF-4 (June-July 2006).

Date	SF-2 Concentration (cfu/100 ml)[1]	Mill Bridge Concentration (cfu/100 ml)	SF-4 Concentration (cfu/100 ml)
6/15/2006	55	214	435
6/19/2006	61	70	113
6/22/2006	308	345	866
6/26/2006	79	101	111
60/30/2006	579	328	141
7/5/2006	488	548	147
June-July geometric mean	169	213	215
Allowable concentration	126	126	126

[1] colony forming units per 100 milliliters of solution

As shown, samples collected and analyzed for *E. coli* bacteria at the three sites exceeded Idaho’s geometric mean criterion. Based on these measured samples, a 25-41% reduction in *E. coli* bacteria concentrations is needed to comply with Idaho water quality standards.

Stream Temperature

The temperature of a water body usually varies by geographic location because of climate, elevation, coverage of streamside vegetation, and groundwater input. Additionally, stream temperatures vary on a daily, seasonal, and annual basis. Air temperature, solar radiation, cloud cover, evaporation, wind, influence of tributaries, and channel width and depth are additional factors that affect stream temperature.

The South Fork Palouse River has been designated by the state of Idaho as having a cold water aquatic life and salmonid spawning beneficial use. Water bodies in the state of Idaho designated for a cold water aquatic life beneficial use are not to exceed water temperatures of 22 °C (71.6 ^oF), and a daily average of 19 °C (66.2 ^oF) (IDAPA 58.01.02.250.02.b). The cold water aquatic life criteria apply to all waters in the South Fork watershed year round. Salmonid spawning criteria of 9 ^oC (48.2 ^oF) as a daily average and 13 ^oC (55.4 ^oF) as a daily maximum apply to all waters in the South Fork watershed on a seasonal basis depending on which salmonid species are present. The salmonid species present in the South Fork Palouse River watershed and the time frame in which the salmonid spawning temperature criteria applies is shown in Table 6 (Barrett 2006, Grafe et al. 2002).

Table 6. Time periods of salmonid spawning and incubation in the South Fork Palouse River watershed.

Salmonid Species	Dates Criteria are Applicable
Brook Trout	September 15 - June 1

Table 7 contains the instantaneous stream temperature statistics from the data collected during the 2001-2002 monitoring season. Figure 12 illustrates data collected from a continuous temperature probe placed at site SF-4 near the Idaho state line from May 2002 through October 2002. As shown in both Figure 12 and Table 7, temperatures exceeded the Idaho cold water aquatic life daily average of 19 º C and the Idaho salmonid spawning daily average of 9 ºC, and a temperature TMDL for the South Fork Palouse River watershed is needed to restore temperatures to support the cold water aquatic life and salmonid spawning designated beneficial uses.

Table 7. Instantaneous stream temperatures in the South Fork Palouse River watershed (November 26, 2001 through November 19, 2002).

^oC	SF-1	SF-2	SF-3	SF-4
Mean	5.2	6.0	8.1	7.4
Maximum	14.9	18.9	29.4	22.1
Minimum	0.1	0.0	0.2	0.1
Range	14.8	18.9	29.2	22.0

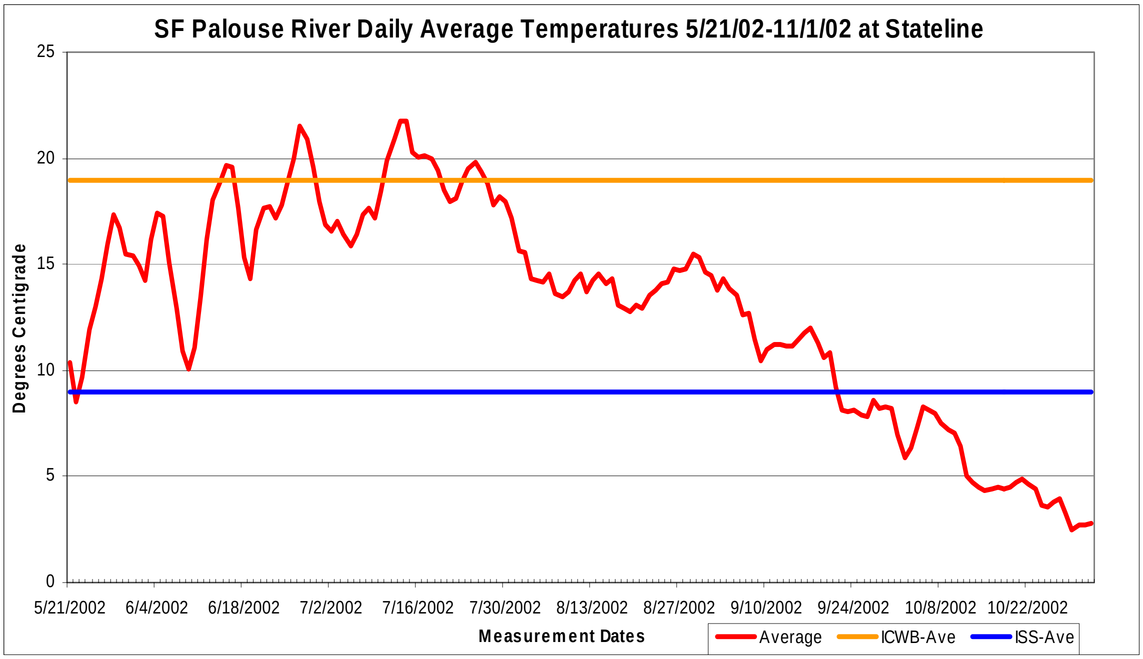

Figure 12. SF Palouse River Temperature at Site SF-4

Natural stream temperatures in Idaho streams and rivers can typically exceed water quality criteria during the summer months. Even streams at high elevations with little human impact have been shown to routinely exceed established temperature criteria. Data suggest that stream temperatures can naturally exceed criteria in the South Fork Palouse River watershed during the summer months as well. Provisions for natural conditions are provided in Idaho's water quality standards.

Idaho Water Quality Standards IDAPA 58.01.02.200.09 states: "When natural background conditions exceed any applicable water quality criteria set forth …., the applicable water quality criteria shall not apply; instead, pollutant levels shall not exceed the natural background conditions, except that temperature levels may be increased above natural background conditions when allowed under Section 401."

Section 401states: "If temperature criteria for the designated aquatic life use are exceeded in the receiving waters upstream of the discharge due to natural background conditions, then Subsections 401.03.a.iii. and 401.03.a.iv. do not apply, and instead wastewater must not raise the receiving water temperatures by more than three tenths (0.3) degrees C."

Dissolved Oxygen

Waters designated for cold water aquatic life must sustain dissolved oxygen concentrations of 6.0 milligrams per liter (mg/l) or greater at all times (IDAPA 58.01.02.250.02.a). The Idaho state criterion for dissolved oxygen in a water column for the salmonid spawning beneficial use is a one-day minimum of not less than 6.0 mg/L (IDAPA 58.01.02.250.02.f.2.a).

Figure 13 illustrates the instantaneous dissolved oxygen concentrations at the four sites by month. Table 8 lists the range of instantaneous dissolved oxygen concentrations measured throughout the watershed. Dissolved oxygen concentrations measured below the 6.0 mg/L Idaho criterion establishes a critical time period for dissolved oxygen between mid May and October.

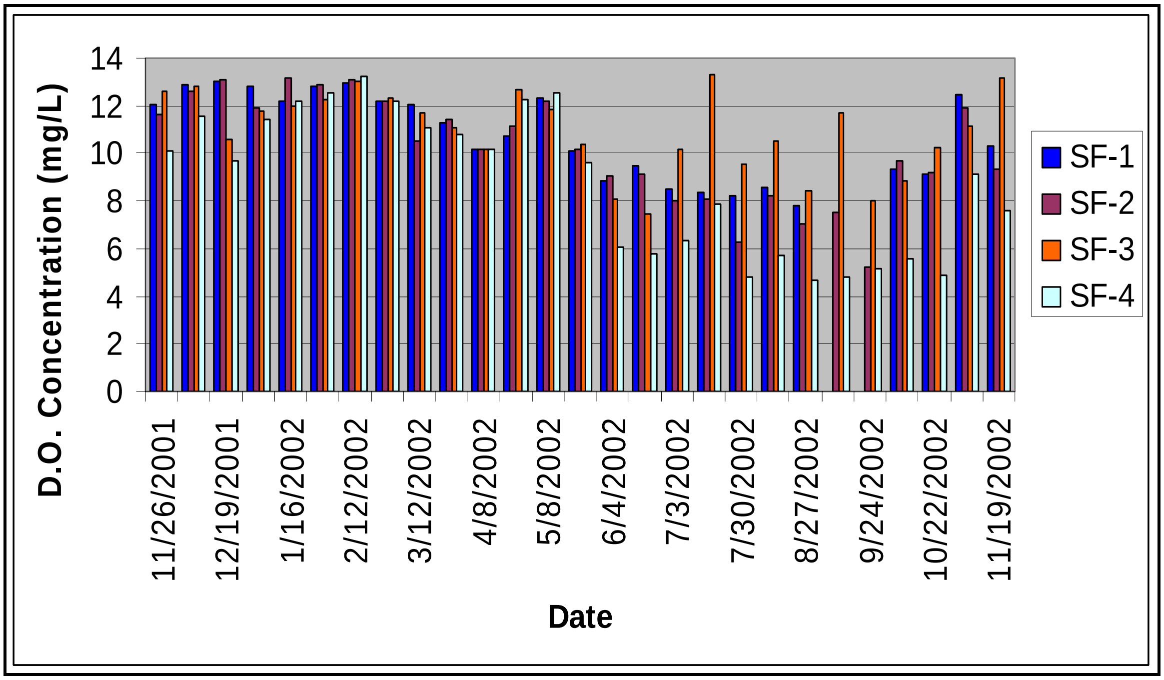

Figure 13. Instantaneous Dissolved Oxygen Concentrations in the South Fork Palouse River Watershed (November 26, 2001 to November 19, 2002).

Table 8. Instantaneous dissolved oxygen concentrations in the South Fork Palouse watershed (November 26, 2001 to November 19, 2002).

Mg/L	SF-1	SF-2	SF-3	SF-4
Mean	10.7	10.2	11.0	8.8
Maximum	13.0	13.2	13.3	13.3
Minimum	7.8	5.3	7.4	4.7
Range	5.2	7.9	5.9	8.6

Nutrients

Idaho's narrative standard for nutrients 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" (IDAPA 58.01.02.200.06). Nutrient loads in the South Fork Palouse River exist throughout the year and appear to decline through the summer months. Nutrient loads are present during the critical time period for dissolved oxygen. Nutrients are an important component of aquatic vegetation growth control and management along with temperature, flow, and sunlight. Aquatic vegetation growth affects instream dissolved oxygen concentrations. Therefore, nutrient loading will need to be controlled and managed to control and manage dissolved oxygen.

Nitrogen Compounds

In order to prevent nuisance algae growth, USEPA (1993) developed a national guideline for streams of 0.3 mg/L total nitrogen. More recently, USEPA (2000) recommended a nutrient criterion of 0.22 – 0.36 mg/L total nitrogen specific to the Columbia Plateau subecoregion streams.

Total nitrogen includes both inorganic and organic forms of nitrogen. Total inorganic nitrogen is the sum of nitrite plus nitrate as nitrogen (NO_2+NO_3-N) and total ammonia. These are the forms of nitrogen directly available for plant uptake. An analysis of the ammonia data that was collected during the 2001-2002 monitoring season showed no violations of the acute or chronic criterion include in Idaho State Water Quality Standards. The ammonia concentrations measured in samples collected were below detection limits or were negligible. Nitrite plus nitrate as nitrogen data is used in this analysis in lieu of Total Nitrogen.

Phosphorous Compounds

In order to prevent nuisance algae growth, the USEPA developed a national guideline for streams of 0.1 mg/L total phosphorus (USEPA 1986). More recently the Environmental Protection Agency developed a nutrient criterion for total phosphorus of 0.030 mg/L specific to Columbia Plateau subecoregion streams (USEPA 2000).

At present, monitoring data indicate that the ratio of annual mean nitrite+nitrate-N to annual mean total phosphorous is well over 7:1 at sites SF-2, 3 and 4 (ratios vary from 12:1 to 18:1). Nitrogen to phosphorous ratios greater than 7:1 indicate total phosphorous is the limiting nutrient for aquatic plant growth in the watershed. Since phosphorus is also considered to be easier and more cost-effective to manage than nitrogen, phosphorous will be the primary nutrient of concern in this TMDL.

Critical Time Period

The Environmental Protection Agency recommends that wherever possible, states develop site specific nutrient criteria that fully reflect localized conditions and protect specific designated uses. A critical time period of mid May through October is applicable for this

TMDL based on the seasonal decline of instream dissolved oxygen concentrations below state water quality standards. The critical time period for nutrients coincides with temperature increases and flow decreases, as illustrated in Figures 14 through 18.

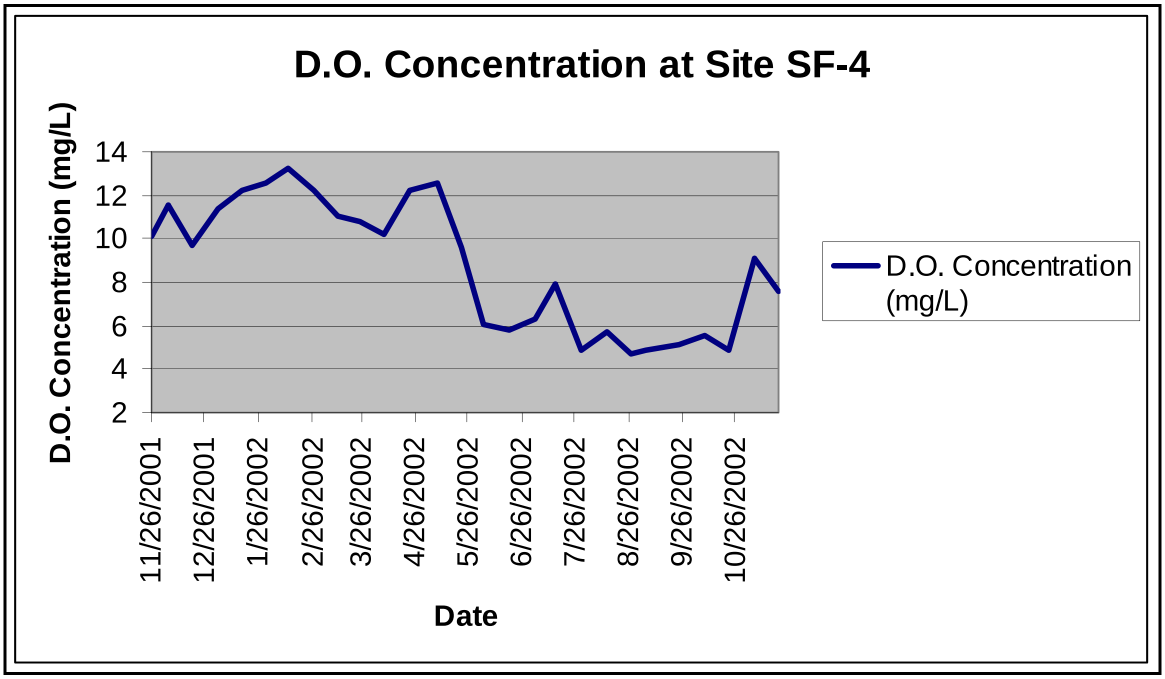

Figure 14. Critical Time Period for Instream Dissolved Oxygen Concentrations at Site SF-4

Nutrient Targets

The 1986 EPA Gold Book provides a guideline of 0.1 mg/L total phosphorus for prevention of nuisance algae growth will be used as the nutrient target for this TMDL since the South Fork Palouse River watershed is an established agricultural watershed, and one that is not anticipated to revert to reference quality. The more recent EPA 2000 guideline of 0.3 mg/L total nitrogen was compared to measured instream nitrite plus nitrate as nitrogen concentrations and the measured instream concentrations were found to be negligible during the critical time period.

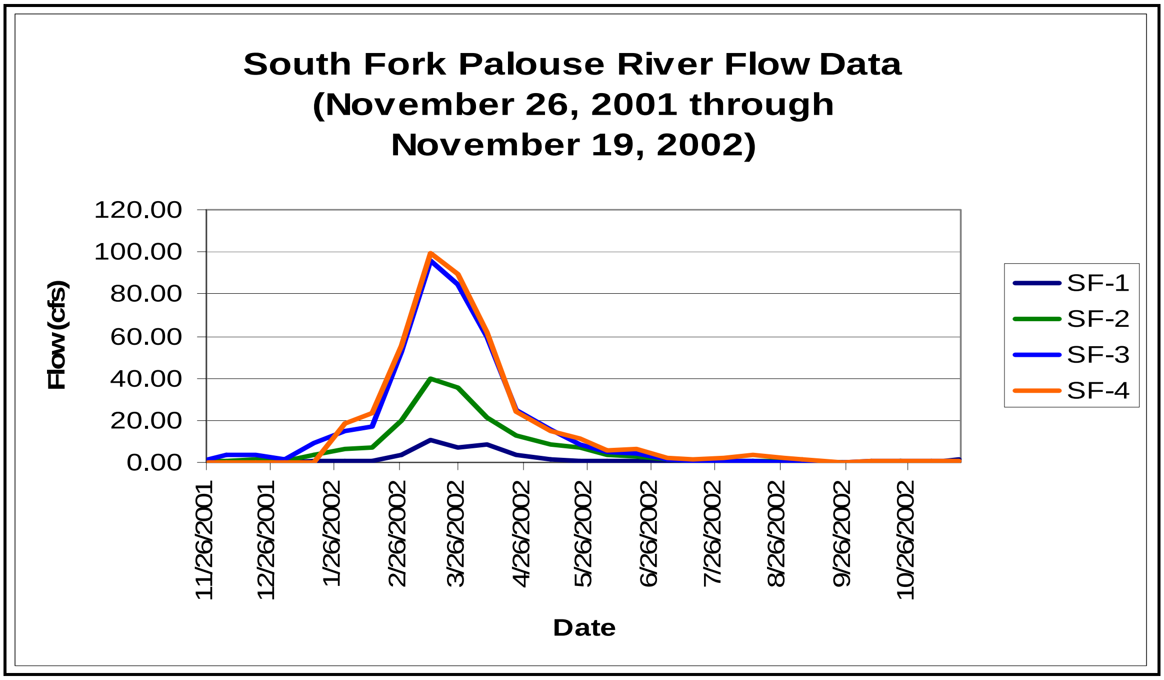

Figure 15. Critical Time Period for Instream Flow

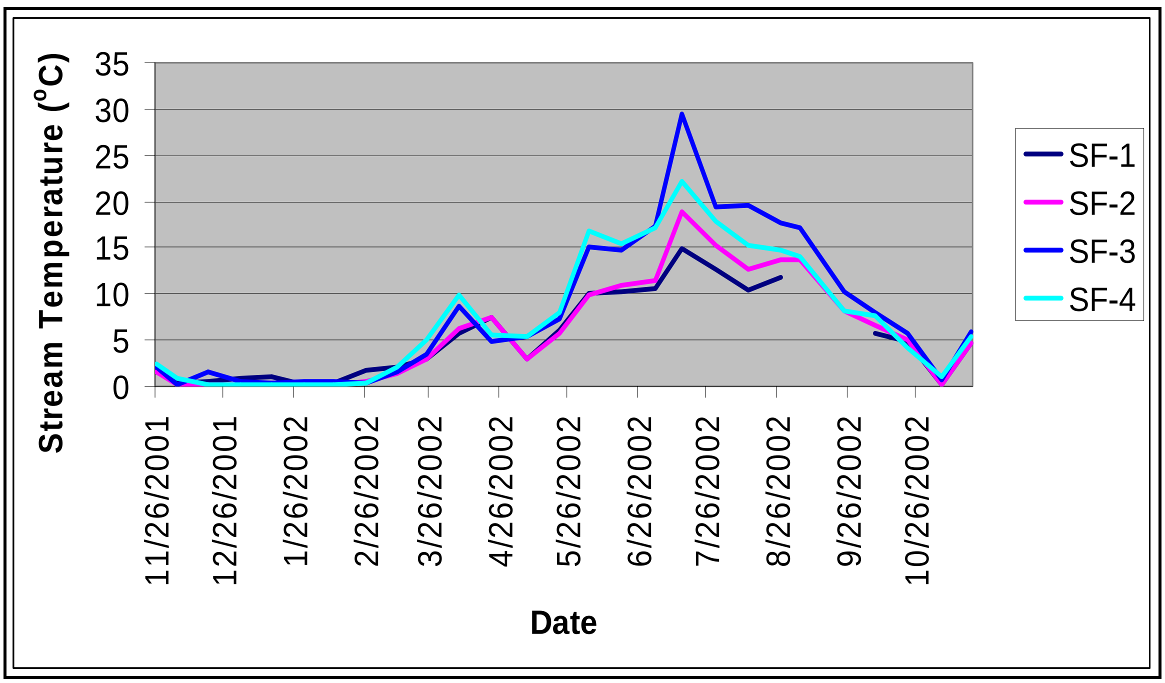

Figure 16. Temporal Variation in Stream Temperatures throughout the South Fork Palouse River Watershed

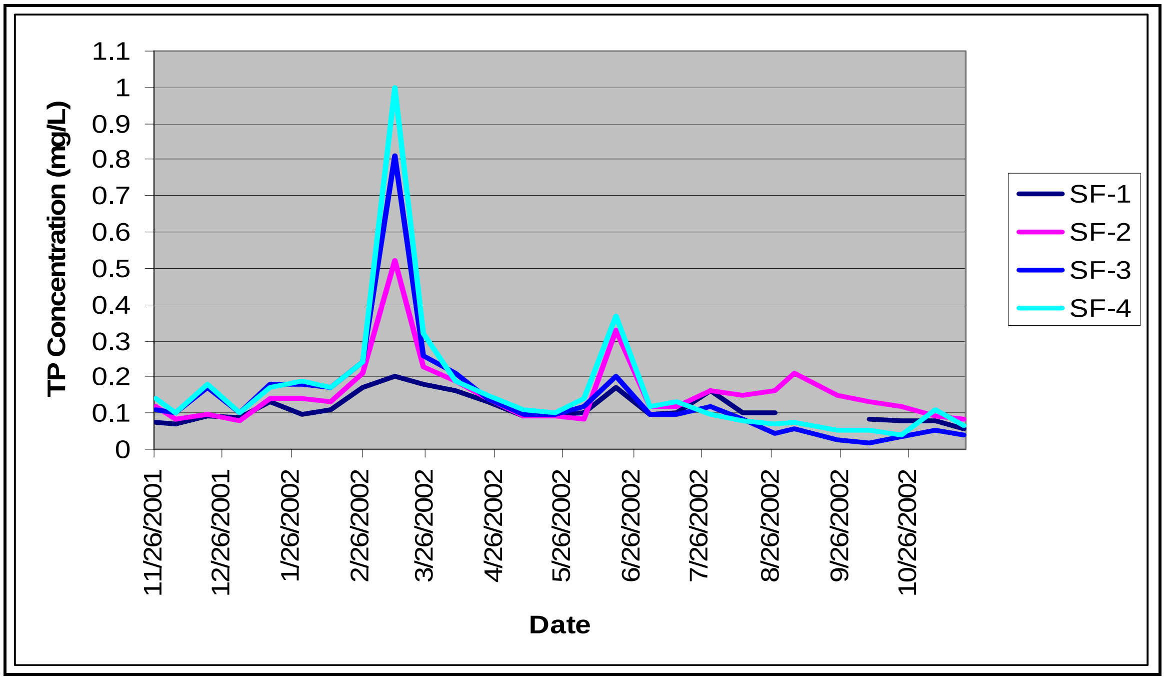

Figure 17. Temporal Variation in Total Phosphorus Concentrations

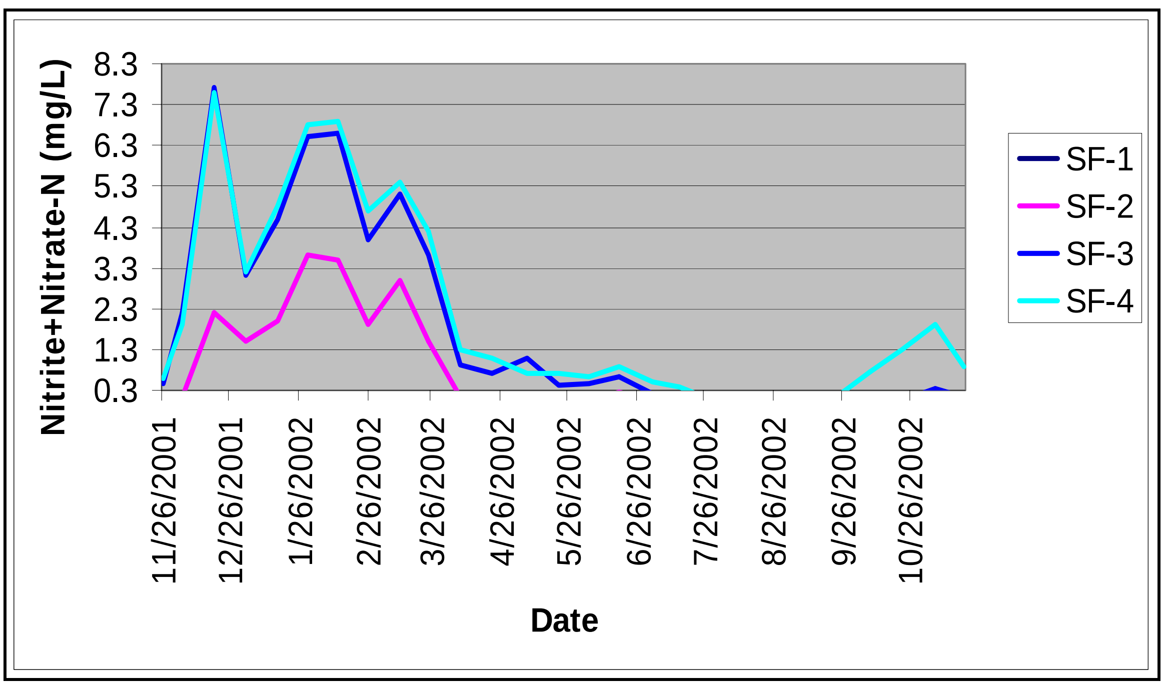

Figure 18. Temporal Variation in Nitrite+Nitrate-N Concentrations

Sediment (Total Suspended Solids)

Sediment criteria found in Idaho Water Quality Standards (IDAPA 58.01.02) is narrative, meaning there is not a numeric value to assess whether a water body is in compliance with standards; instead, Idaho has a requirement that states sediment shall be limited to a quantity that does not impair beneficial uses.

The available water column data for sediment are reported in terms of total suspended solids (TSS). TSS is a weighted measure of the total solid concentrations in the water, whether the particles are mineral, such as soil particles or organic, such as plants. Table 9 shows the average, maximum and minimum TSS concentrations. To compute the annual mean TSS concentration for each site, below detection limit readings were given a value of 1.0 mg/L, one-half the method detection limit of 2.0 mg/L.

A large episodic spike in water column TSS concentrations was observed on March 12, 2002 at sites SF-2, SF-3, and SF-4 relative to other TSS values obtained throughout the monitoring year. Late winter snowmelt runoff caused the increased stream flows which led to the spike in instream TSS concentrations.

Guidance developed in 2003 by the Department for application of the narrative sediment criteria for protection of aquatic life beneficial uses and restoration of habitat conditions suggests a 25 milligram per liter (mg/L) TSS target, averaged over a 30-day period, not to exceed 50 mg/L daily is appropriate to maintain high level of protection for salmonid populations. A 50 mg/L TSS target, averaged over a 30-day period, not to exceed 80 mg/L daily is appropriate to maintain a moderate level of protection for salmonid populations.

Table 9. TSS concentrations in the South Fork Palouse River watershed (November 26, 2001 to November 19, 2002).

mg/L	SF-1	SF-2	SF-3	SF-4
Mean	7	26	35	35
Maximum	30	330	530	560
Minimum	BDL	BDL	BDL	BDL

BDL – below detection limit

Biological Data

DEQ investigated the South Fork Palouse River cold water aquatic life designated beneficial use in accordance with Idaho Code 39-3607. Beneficial Use Reconnaissance Program data was collected from two sites in the South Fork Palouse River watershed in 1996 and at one site in 2002 (Figure 10), and one site in Crumarine Creek in 2005.

The Idaho Beneficial Use Reconnaissance Program protocol was followed to collect the biological samples and physical habitat data. Analysis of the 1996 data followed the Idaho Water Body Assessment Guidance for cold water aquatic life beneficial uses. Based on the macroinvertebrate population and poor habitat conditions found, and exceedance of the numeric temperature standards, the sites located downstream of SF-2 were determined to be not fully supporting cold water aquatic life beneficial uses.

Salmonid Spawning was recently verified as an existing use in segment CL003_02 by collecting three age classes of salmonids in a 2005 BURP survey of Crumarine Creek. Salmonids were also found in C003_03, but not in three age classes. Salmonids were not found in the lower segment CL002_03. These targets are applied to provide a higher level of protection for the upper assessment unit to reflect habitat conditions in the watershed. The lower assessment unit is in an area of extensive sediment deposits, while the upper assessments units are in an area of granitic bedrock. The weathered granite in the upper watershed provides an important source for stream bed gravels which are lacking in the lower watershed where basalt and silt dominate. Sources for stream bed gravels in the lower assessment unit are deficient and appear to be inaccessible for continuous recruitment for a healthy gravel substrate compared to the upper units.

Fish observed during the sampling efforts include rainbow trout, brook trout, brown trout, longnose dace, speckled dace, redside shiner, bridgelip sucker, and largescale sucker.

Conclusions

E. coli bacteria concentrations measured in samples collected from the South Fork Palouse River were above the geometric mean criterion set by the state of Idaho. Monitoring conducted in June-July of 2006 indicates that the development of a bacteria TMDL is needed to comply with Idaho water quality standards.

Instantaneous temperature data collected during the 2001-2002 monitoring season showed violations of the instantaneous maximum of 22 ^{o}C for cold water aquatic life. Continuous temperature data collected at site SF-4 from May 21, 2002 through November 1, 2002 showed violations of both the salmonid spawning criteria and cold water aquatic life criteria. This data indicate a temperature TMDL for the South Fork Palouse River watershed is needed.

Low dissolved oxygen measurements observed at site SF-4 are most likely affected by aquatic vegetative growth cycles during the late summer low flow critical time period. During the critical time period, average nitrite+nitrate-N are negligible compared to recommended target concentrations. Average total phosphorous concentrations during this period were observed to be above the 0.1 mg/L recommended target concentration. A total phosphorous TMDL has been developed to control aquatic vegetation growth when dissolved oxygen concentrations fall below the water quality criterion.

A sediment load capacity was determined for the South Fork Palouse River watershed based on Department guidance for the application of Idaho’s narrative aquatic life water quality standard for sediment. Sediment concentrations found during the 2001-2002 monitoring season from February through April warrant sediment load reductions during the peak flow period. Controlling sediment loads will also assist in managing nutrient loads in the South Fork Palouse River since nutrients, particularly phosphorous, bind to soil particles delivered to the stream.

2.5 Data Gaps

A credible database was used to adequately estimate continuous instream pollutant loads existing in the South Fork Palouse River. Additional data could be useful to determine long term trends and annual fluctuations in pollutant loads. Data collected represents ambient conditions found during a calendar based sample collection monitoring program. Calendar based sample collection monitoring programs typically miss some, if not all episodic pollutant loading events that occur. Additional monitoring to characterize pollutant loads attributable to episodic events may provide useful information in adjusting the pollutant loads estimated with the existing data set.

Reliable references and guidance were used to establish TMDL pollutant targets for instream pollutant load capacities. Further detailed analysis, which is beyond the scope of TMDL development, may provide additional understanding of individual watershed characteristics and site specific refinement of beneficial use requirements.

If in the future additional information and data becomes available, this TMDL will be revised to incorporate such information and data where appropriate.

3. Subbasin Assessment–Pollutant Source Inventory

3.1 Sources of Pollutants of Concern

Potential sources of pollutants cited as causing water quality impairment in the Idaho 2002 Integrated Report are identified and discussed in detail in this section. Pollutant sources may occur as point sources or as nonpoint sources of pollutants.

Point sources have a discrete conveyance, such as a pipe, ditch, or other identifiable "point" of discharge into waters of the state. Common point sources are industrial and municipal wastewater facilities regulated through the National Pollutant Discharge Elimination System permit program by the US Environmental Protection Agency. The National Pollutant Discharge Elimination System permit program allows point sources to discharge pollutants up to levels needed to protect designated beneficial uses in receiving waters. Such levels are referred to as water quality-based effluent limitations. Discharge permits for point sources may incorporate compliance schedules which allow a discharger to phase in, over time, compliance with water quality-based effluent limitations when new limitations are in the permit for the first time.

Nonpoint sources are pollutants coming off the landscape having no one exact point of discharge and are the result of activities essential to the economic and social welfare of the state. Nonpoint source activities in Idaho include, but are not limited to: irrigated and non irrigated lands used for grazing, crop production, silviculture, construction sites, recreation sites, septic tank disposal fields, mining, and run off from storms or other weather related events. Nonpoint sources and activities are not typically subject to regulation under the federal national pollutant discharge elimination system because the extent of most nonpoint source activities prevents the practical application of conventional wastewater treatment technologies.

Nonpoint source pollution management in Idaho is a process for protecting the designated beneficial uses and ambient water quality through the application and use of best management practices. Best management practices are designed, implemented and maintained to provide protection or maintenance of beneficial uses. Violations of water quality standards which occur in spite of implementation of best management practices are not subject to enforcement action. Instead, the practices are evaluated through monitoring of the effectiveness of the best management practices and modified as necessary by the appropriate designated management agency responsible for management of the activity. Idaho designated management agencies are the Department of Lands for timber harvest activities, oil and gas exploration and development, and mining activities; the Soil Conservation Commission for grazing and agricultural activities; the Transportation Department for public road construction; the Department of Agriculture for aquaculture; and the Department of Environmental Quality for all other activities.

3.2 Point Sources

Point sources in the watershed include the Syringa Mobile Home Park and the Country Homes Mobile Park. Both mobile home parks operate waste treatment systems which include a storage lagoon which discharges for a limited period during high stream flows. The Country Homes Mobile Park has applied to the US Environmental Protection Agency for a National Pollution Discharge Elimination System permit. The Syringa Mobile Home Park is in the permit application process as a result of the work associated with this watershed plan.

The Syringa Mobile Home Park is located upstream of a monitoring site at Mill Road Bridge. The Syringa lagoon discharges to the South Fork Palouse River several hundred feet above the Mill Road Bridge. The Country Homes Mobile Park is located upstream of monitoring site SF-3. The Country Homes lagoon discharges to an intermittent tributary which joins the South Fork Palouse River approximately one mile downstream of the mobile home park. Site SF-3 is approximately one half mile downstream of the unnamed intermittent tributary.

Existing pollutant loads for each point source have been developed using pollutant concentrations measured in samples collected either from the facilities storage lagoons or the monitoring station immediately below the discharge point to the stream, and calculated using the estimated volume of annual discharge from the lagoon.

Each point source will be provided a wasteload allocation for nutrients and bacteria within this TMDL. The nutrient wasteload allocation is the existing discharge during the high stream flow period typically in February through March, with allowance for discharge in April if needed. The allocation is intended to provide flexibility to discharge when needed during periods of high stream flow. If reductions in existing loads are needed to meet the pollutant waste load allocations provided by this TMDL, first consideration should be made to increasing the number of discharge events, thereby allowing smaller volumes to be discharged over a longer period of time, rather than limiting the total volume of discharge to a single event.

3.3 Nonpoint Sources

Common nonpoint sources occurring in the South Fork Palouse watershed include timber harvest activities, mining activities, grazing, agricultural crop production, road maintenance and construction, recreation, and septic tank disposal fields. Silviculture occurs in the forested areas of Moscow Mountain and its slopes. Dry land grain and lentil crop production dominates the watershed's agriculture. Recreation includes parks, golf courses, motorized and non motorized trails and pathways. Roads in the watershed are paved, graveled, public and private. Known mining sites are limited to road gravel production and gravel storage areas. Livestock grazing occurs mostly for cattle on a small scale, or for horses or other pleasure animals and pets. Septic tank disposal fields are widespread in the rural and suburban areas of the watershed outside the City of Moscow's sewage collection system service area.

Nonpoint source pollutant loads have been developed using pollutant concentrations measured in samples collected from strategically located monitoring stations between November 2001 and November 2002. Additional samples were collected and analyzed in 2006, because additional information was needed to refine pollutant load calculations.

It is very difficult to quantify accurately the quantity of each pollutant from nonpoint sources to the South Fork Palouse River watershed. However, a relative nonpoint source load contribution can be derived, at least in part, by examining land use activities upstream of a specific monitoring location. For example, monitoring site SF-1 is located below an area dominated by forested lands with rural residences and unimproved roads. Monitoring site SF-2 is located within a public park below an area heavily influenced by rural homes with livestock and pets, and to a lesser extent, agriculture and forestry activities. Site SF-3 is located in an area influenced by agriculture, rural homes, light industry machine shops, and below where the channel flows through a golf course. The site SF-4 location represents the largest cumulative area of agriculture upstream but is also considered to be influenced by rural homes, light industry, and the city of Moscow.

3.4 Pollutants

Sediment

Natural sediment erosion within the rolling hills of the Palouse country is considered to be extensive because of the native loess soil properties and the hill slopes created through the land forming processes present. Annual natural background soil erosion rates have been estimated to be approximately 60 to 80 tons per square mile in the Palouse country (DEQ 2005). The majority of sediment transport occurs during precipitation events and snow melt as water moves sediment off the landscape into the drainage network of the watershed.

Agriculture, instream and stream bank erosion, roads, and rural and suburban development are all considered to have the potential to be a sediment source. Cultivation of the soils for crop production results in periods of bare soil which is considered to be more vulnerable than native grass lands. Loss of wetlands and flood plains, and unimpeded stream channels results in increased peak stream flows causing instream and stream bank erosion. Unimproved roads and adjacent drain ditches funnel and direct flows to erode and transport exposed and vulnerable soils and gravels.

Temperature

The most commonly accepted controllable nonpoint source for elevated temperature in Idaho waters is exposure of the stream, the stream’s headwaters, or source to sunlight and low flow conditions in the summer when air temperatures increase. Sunlight and heat absorbed by a stream or its source is dependent on the amount of shade over the stream or its source. The loss of stream storage capacity resulting from the same actions that lead to increased peak flows can decrease and prolong low summer flows. Stream sinuosity, stream width, depth and channel bank conditions also effect water temperatures, but are not as easily managed.

Nutrients

Nitrogen and phosphorus fertilizers, septic system drain fields, and animal wastes are considered to be potential sources of nutrients in the watershed and can also contribute nutrients through direct runoff or leaching through the soil.

Bacteria

E. coli bacteria are typically in manure or water that has been in contact with manure. Nonpoint sources of bacteria in the watershed include livestock, septic tank disposal fields, pets and wildlife. Manure and *E. coli* is flushed into the creek in a variety of ways, most commonly by rain water, snow melt, or runoff. Manure can be deposited directly into the creek if animals have free access to the creek. Bacteria can be carried to the creek with runoff from roads when manure is tracked onto roads.

Cattle guards placed across the creek and used as bridges can cause manure to drop from trailers and trucks. Livestock and pet manure from pastures, rangeland, corrals and yards is the most manageable source of bacteria since it can be collected, diverted or moved before it comes into contact with runoff or reaches the creek. Septic system drain fields can be a source of bacteria if they are placed in close proximity to the creek.

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

The South Fork Palouse River watershed community has worked to manage and maintain the river channel and the watershed for economic and environmental concerns, and protection of property and infrastructure. The community has used a holistic planning process to adopt sustainable management practices for long term economic, social, and environmental interests.

Numerous programs and projects have been planned and designed for the South Fork Palouse River. Some have been successfully completed, others are being implemented, and still others remain to be started. Agricultural interests pursued conservation when soil erosion was recognized to be a problem. Community development has influenced watershed management for utility, infrastructure, and property protection. University resources provided research for solutions and state of the art knowledge on applied conservation practices, watershed management, and social philosophies.

4.1 Agricultural Best Management Practices

The Latah Soil and Water Conservation District, the Idaho Soil Conservation Commission, the Natural Resources Conservation Service, and the Farm Service Agency provide technical and financial assistance for planning and applying conservation practices.

Conventional tillage, which involves inverting much of the soil surface during multiple field passes, has been traditionally practiced on cropland in the watershed. Minimum tillage, which minimizes ground disturbance and maximizes surface residue cover, is used throughout the watershed. No-till farming is gradually becoming utilized in the watershed. No-till farming includes use of specialized equipment to place the fertilizer and seed directly into the previous year's crop residue without performing prior tillage operations. For at least one crop in a crop rotation, it is common to see no-till used to replace conventional or minimum tillage. No-till farming throughout a crop rotation is referred to as direct seed. Direct seed farming has increased the over-winter crop stubble throughout the agricultural areas in the watershed and decreased vulnerability of the soil surface to erosion.

4.2 Volunteer Improvements

The Palouse-Clearwater Environmental Institute (PCEI) is a local organization dedicated to watershed conservation. The PCEI promotes volunteer environmental responsibility through community organization and education. The organization is creating wetlands, performing stream side restoration projects and planting native plant species at several sites within the watershed. These projects are designed to improve water quality, habitat and flow conditions, and help reestablish native habitats within the watershed.

5. Total Maximum Daily Loads

A Total Maximum Daily Load calculates the allowable amount of a pollutant that can be in a water body according to state water quality standards. The allowable amount of the pollutant is called the pollutant load capacity. Once the load capacity is calculated it is distributed or allocated among the sources of the pollutant in the watershed.

There are two kinds of pollutant sources: point sources and nonpoint sources. Point sources get a wasteload allocation; nonpoint sources get a load allocation. Background is considered part of the load allocation, but it is not available for distribution.

A margin of safety is required to account for uncertainties used in the measurement, analysis, or calculation of the load capacity. The margin of safety may be conservative assumptions, or added as a separate quantity in the TMDL calculation.

The total maximum daily load (TMDL) can be written as an equation:

Load Capacity = Margin of Safety + Load Allocation + Waste load Allocation

A total maximum daily load is usually only required for water bodies that do not meet state water quality standards. Once the allowable loads are calculated, current loads also need to be calculated so load reductions are recognized and completed by the sources. 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). An estimate must be made for each point source. Nonpoint sources can be based on the type of source, area, or may be aggregated.

The load capacity must be based on critical conditions, the conditions when water quality standards are most likely to be violated. If protective under critical conditions, the load capacity will be protective under all conditions.

The load calculation is a product of pollutant concentration and water flow, whether it is the allowable pollutant concentration as per state standards, or the existing pollutant concentration found in samples collected from the water body. The critical time period is usually in the summer when the pollutant load stays the same but the flow in the water body is lower.

In the following sections, a TMDL is presented for each pollutant. The TMDL provides a description of the target, design condition, load capacity, estimated existing load, load and wasteload allocation, margin of safety, and a critical time period, if appropriate, for the pollutant. Background has been included with the identified load allocations for all pollutants. An explicit growth reserve is not included; the load capacity has been allocated to the existing sources currently in the watershed. Future sources will need to acquire a load allocation from existing allocations unless the load capacity is increased.

This TMDL assigns *E. coli* bacteria and temperature allocations throughout the watershed. Sediment and nutrient loads have been assigned to assessment units CL003_03, and CL002_03 to reflect cumulative loads. South Fork Palouse River, source to Gnat Creek, CL003_03 is represented by SF-2. Assessment Unit CL002_03, Gnat Creek to state line, is represented by SF-4. Load reductions and allocations are assigned at monitoring stations SF-2 and SF-4 to represent the load reductions and allocations corresponding to assessment units CL003_03, and CL002_03.

5.1 *E. coli* Bacteria TMDL

The South Fork Palouse River has been designated by the state of Idaho for secondary contact recreation. Data discussed in Section 2.4 indicates that the development of a bacteria TMDL is needed to achieve compliance with Idaho WQS and to restore full support of the secondary contact recreation beneficial use.

In-Stream Water Quality Target

Numeric water quality criteria that apply to water bodies designated for secondary contact recreation are as follows (IDAPA 58.01.02.251.02.):

a. Waters designated for secondary contact recreation are not to contain *E. coli* bacteria significant to the public health in concentrations exceeding a single sample of 576 *E. coli* organisms per 100 ml, or

b. A geometric mean of 126 *E. coli* organisms per 100 ml based on a minimum of five (5) samples taken every three (3) to five (5) days over a thirty (30) day period.

It is important to note that a single water sample exceeding the 576 *E. coli* organisms per 100 ml criterion does not in itself constitute a violation of WQS; however, additional samples shall be taken to compare the results against the 30-day geometric mean criterion to determine compliance with Idaho WQS (IDAPA 58.01.02.251.02).

The instream target used to establish the load capacity and allocations is based on the Idaho geometric mean criterion of 126 *E. coli* organisms per 100 ml.

Design Conditions

Bacteria are living organisms that have an associated die-off rate. The die-off rate fluctuates with varying water quality and atmospheric conditions (USEPA 2001). Flow and temperature dictate the actual mass of bacteria in the water and complicate the allocation process because of the continuous and constant fluctuation of flow and temperature that occurs during any given time period. To simplify this process, the daily allocation is expressed in terms of 126 colony forming units per 100 milliliters (cfu/100 ml), the target geometric mean concentration currently allowed by Idaho's Water Quality Standards.

Instream water quality samples were collected at established monitoring sites. This data has been used for calculating existing instream pollutant loads for bacteria. All sources upstream of each monitoring site will be provided an allocation based on the load capacity calculated at each site. Allocations are based on the load capacities calculated for each river segment between monitoring sites. Load reductions are based on the percent difference between existing loads and allocations.

Load Capacity

The *E. coli* bacteria load capacity for the South Fork Palouse River watershed is expressed as the geometric mean criterion. The load capacity is expressed as a concentration (cfu/100 ml) because it is difficult to calculate a mass load due to several variables (i.e. temperature, moisture conditions, flow) that influence the die-off rate of *E. coli* bacteria in the water column (USEPA 2001).

Estimates of Existing Pollutant Loads

Individual *E. coli* bacteria percent load contributions from both point and nonpoint sources cannot be determined from the limited data available at this time. Instead, instream concentrations have been measured at three monitoring sites, SF-2, between SF-2 and SF-3 to distinguish the two point sources, and at SF-4 during the months of June and July 2006.

Table 10 lists the existing *E. coli* bacteria concentrations found in 2006 at three monitoring stations; the secondary contact recreation geometric mean capacity, the loading allocation, and the reduction in *E. coli* bacteria concentrations that must occur to meet the load allocation.

Load Allocation

The *E. coli* bacteria total maximum daily load for the South Fork Palouse River allocates a daily concentration of 126 cfu/100 ml to sources of *E. coli* bacteria upstream of the respective control points. As such, sources extending upstream from this location must be managed to reduce instream *E. coli* bacteria concentrations by 25 to 41% (Table 10). To ensure that the criterion is not exceeded, this allocation will apply daily throughout the year.

Wasteload allocations are provided for Syringa Mobile Home Park and Country Homes Mobile Park (Table 10). Wasteload allocations are based on an allowable daily concentration of 126 cfu/100 ml. A maximum daily concentration of 126 cfu/100 ml will be included in future National Pollutant Discharge Elimination System permits for Syringa Mobile Home Park and Country Homes Mobile Park. Instream load capacity data immediately below the discharge point, and application of a mixing zone, may justify increasing the wasteload allocations for Syringa and Country Homes Mobile Parks above the target concentration of 126 cfu/100 ml. If data is generated justifying such increases, the increases will be included in future NPDES permits.

Table 10. E. *coli* bacteria allocations for the South Fork Palouse River (June-July 2006 data).

Location (Control Point)	Target (cfu/100 ml)[a]	Existing Load (cfu/100 ml)	Load Capacity (cfu/100 ml)	Daily Wasteload and Load Allocation (cfu/100 ml)	Load Reduction
SF-2 (Source to Robinson Park)	126	169	126	126	25%
Mill Bridge (Robinson Park to Mill Bridge)	126	213	126	126	41%
SF-4 (Mill Bridge to Idaho/Wash. State Line)	126	215	126	126	41%

[a]cfu/100 ml = colony forming units per 100 milliliters

Margin of Safety

An implicit MOS has been incorporated into the bacteria TMDL. The MOS used to develop the load capacity and allocations is in accordance with Idaho Water Quality Standards, where the geometric mean target concentration for *E. coli* bacteria was allocated to each control point. Utilizing this target concentration will ensure that the secondary contact recreational beneficial use is achieved when met.

Critical Time Period

The *E. coli* bacteria allocations apply on a daily basis annually since secondary contact recreation may occur at any time of year. This allocation ensures water quality standards are attained for the protection of public health. Table 11 shows the critical time period for bacteria.

Table 11. Critical time period for the E. coli bacteria TMDL.

Pollutant	Critical Period
E. Coli Bacteria	Year Round

5.2 Nutrient TMDL

The South Fork Palouse River has been designated by the state of Idaho for cold water aquatic life and secondary contact recreation beneficial uses. In Idaho, a narrative water quality standard is used to protect cold water aquatic life beneficial uses from excessive nutrients. Idaho's narrative standard for nutrients 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" (IDAPA 58.01.02.200.06). Aquatic life beneficial uses can be impaired when excessive algae decompose, depleting dissolved oxygen in the water column.

In-Stream Water Quality Target

Monitoring data indicate that the ratio of mean nitrite+nitrate-N to mean total phosphorous is well over 7:1 at sites SF-2, 3 and 4 (ratios vary from 12:1 to 18:1). Nitrogen to phosphorous ratios greater than 7:1 indicate total phosphorous is the limiting nutrient for aquatic plant growth in the watershed. A total phosphorous target of 0.1 mg/L is used for this TMDL based on the national USEPA guidance, watershed characteristics, and other regional nutrient TMDLs addressing total phosphorous in the Palouse Subbasin. By keeping instream total phosphorus concentrations levels below 0.10 mg/L, aquatic plant growth should be reduced and instream dissolved oxygen enhanced during the critical time period.

Design Conditions

Cumulative nutrient loads have been assigned to assessment units CL003_03, and CL002_03. South Fork Palouse River, source to Gnat Creek, CL003_03 is represented by SF-2. Assessment Unit CL002_03, Gnat Creek to state line, is represented by SF-4. Load reductions and load allocations are assigned at monitoring stations SF-2 and SF-4 to represent the load reductions and allocations corresponding to assessment units CL003_03, and CL002_03.

Load Capacity

The total phosphorous load capacity has been developed for the months of mid-May through October using flow and total phosphorous data collected during May and October 2002. Daily load was estimated by multiplying the measured concentration of total phosphorous and the estimated flow. Load capacities were estimated using target concentrations multiplied by the estimated flow. Background loads are included as part of the loading capacity.

Estimates of Existing Pollutant Load

Table 12 shows the existing total phosphorus loads for all four monitoring stations from April through October. The equation below describes how the existing loads were generated.

Existing total phosphorous loads during the period of February-March and the month of April are shown in Table 14 because they are the typical discharge period for the Country Homes Mobile Park and the Syringa Mobile Home Park. The total phosphorous load from the discharge is reflected in the existing load measured at SF-3.

$$\text{Existing load (kilograms per day)} = \frac{\text{daily concentration (mg/L)* daily flow (cfs)* 5.39}}{2.2}$$

Table 12. Existing total phosphorous pollutant loads for South Fork Palouse River monitoring sites.

		Early April	Late April	Early May	Late May	Early June	Mid June	Early July	Mid July	Late July	Mid Aug	Late Aug	Early Sep	Late Sep	Early Oct
SF-1	Flow (cfs)	8.8	3.2	1.6	0.9	0.5	0.7	0.2	0.08	0.09	0.05	0.04	*	*	0.033525
	Measured TP (mg/l)	0.16	0.13	0.1	0.1	0.1	0.17	0.1	0.1	0.16	0.1	0.1	*	*	0.083
	Measured TP load (kg/day)	3.5	1.0	0.4	0.2	0.1	0.3	0.05	0.01	0.03	0.01	0.01	*	*	0.01
SF-2	Flow (cfs)	21.5	12.9	8.5	7.1	3.9	2.8	1.2	0.5	0.4	0.5	0.7	0.4	0.30.02	0.1926
	Measured TP (mg/l)	0.19	0.14	0.09	0.09	0.08	0.33	0.12	0.12	0.16	0.15	0.16	0.2	0.16	0.13
	Measured TP load (kg/day)	10.0	4.4	1.9	1.61	0.8	2.3	0.4	0.16	0.16	0.2	0.26	0.2	0.11	0.06
SF-3	Flow (cfs)	59.24	25.1	15.9	8.8	4.9	4.3	1.4	0.7	0.7	0.4	0.3	0.3	0.130.02	0.4042
	Measured TP (mg/l)	0.21	0.14	0.1	0.1	0.12	0.2	0.1	0.1	0.12	0.09	0.05	0.06	0.03	0.017
	Measured TP load (kg/day)	30.5	8.6	3.7	2.1	1.4	2.1	0.3	0.16	0.2	0.07	0.03	0.04	0.01	0.02
SF-4	Flow (cfs)	62.05	24.4	15.0	11.1	5.5	6.3	1.9	1.6	2.1	3.5	2.1	1.6	0.30.13	0.4928
	Measured TP (mg/l)	0.19	0.15	0.11	0.1	0.14	0.37	0.12	0.13	0.1	0.08	0.07	0.08	0.05	0.052
	Measured TP load (kg/day)	28.9	9.0	4.1	2.7	1.9	5.7	0.5	0.5	0.5	0.7	0.36	0.29	0.04	0.06

*Monitoring data not available

Load and Waste Load Allocations

Total phosphorous load allocations for the two control points within the South Fork Palouse River are presented in Table 13. The nonpoint source loading analyses shown in Table 13 were developed by calculating the average daily flow from early April through late September by the average daily concentration for the same period.

Table 13. Total Phosphorous nonpoint source load allocations for the critical time period within the South Fork Palouse River watershed.

Location	Average daily flow (cfs)	Total Load Capacity (Kg/day)	Margin of Safety (Kg/day)	Load Allocation (Kg/day)	Existing Load (Kg/day)	Load Reduction (%)
SF-2	1.1	0.27	0.027	0.24	0.46	48
SF-4	2.53	0.62	0.062	0.56	1.1	49

The Syringa Mobile Home Park is operated as a no discharge contained system. The system discharges only when ground water infiltration and surface runoff into the lagoon create a threat that the lagoon will breach. Discharge occurs as overflow through a gate in the lagoon wall, so only the top layer of the second lagoon is discharged. Since weather conditions dictate when overflow conditions occur, discharge only occurs during high instream flow periods since the instream flow is affected by the same weather conditions as the lagoons.

Country Homes Mobile Park is a very small system that typically discharges over a one or two day period in February or March. Approximately 75% of the lagoon volume or 108,000 gallons (0.083 cfs/day or 0.167 cfs/2 days) is estimated to be discharged. This estimate is based on information from construction blue prints and a description of the operation by the owners of the Park. The system currently chlorinates to control bacteria.

A load and wasteload allocation has been developed for the months of February through March when discharge typically occurs from Syringa Mobile Home Park and Country Homes Mobile Park. An April allocation has been developed to provide the ability for discharge to occur if needed during atypical weather conditions (Table 14). No load or wasteload reductions are required during this time because the discharges occur prior to the critical time period for nutrients in the South Fork Palouse River.

Wasteload allocations for Syringa Mobile Home Park and Country Homes Mobile Park and the load allocation are not segregated and are derived from the existing load. Maximum pollutant discharges in future National Pollutant Discharge Elimination System permits for Syringa Mobile Home Park and Country Homes Mobile Park should be based on, and limited to, existing loads. These facilities have not been subject to National Pollutant Discharge Elimination System permit oversight in the past and total phosphorous concentrations in the effluent being discharged from the facilities has not been quantified nor tracked. Individual wasteload allocations for each facility can be derived from a portion of the total allowable allocation after data has been collected and applied. For example:

Individual portion of total allowable allocation = {(x Kg/d) / (56.7 Kg/d)}* 100

Where: x kg/day = Source load

If an individual wasteload allocation for each facility is needed, a compliance schedule should be included in future National Pollutant Discharge Elimination System permits to provide for data collection and determination of individual waste load allocations for each facility.

> IDAPA 58.01.02.400.03 - Compliance Schedules for Water Quality-Based Effluent Limitations. Discharge permits for point sources may incorporate compliance schedules which allow a discharger to phase in, over time, compliance with water quality-based effluent limitations when new limitations are in the permit for the first time.

Table 14. Total Phosphorous load and wasteload allocations for the months of February- March and April.

SF-3	Average daily flow (cfs)	Total Load Capacity (Kg/day)	Margin of Safety (Kg/day)	Existing Load (Kg/day)	Load and Wasteload Allocation (Kg/day)	Load Reduction (%)
February-March	62.6	NA[1]	NA	56.7	56.7	0.0
April	42.3	NA	NA	18.1	18.1	0.0

1=Not Applicable

Margin of Safety

An explicit margin of safety of 10% of the target load was deducted from the nonpoint source load allocation. Since the period of greatest aquatic plant growth and lowest flows was utilized to calculate the loading capacity, the loading capacity reflects a conservative estimate.

Critical Time Period

The critical time period for nutrients in the South Fork Palouse River coincides with violations of the dissolved oxygen standard (mid May through October). No additional nutrient loading and specifically a reduction in total phosphorus loading should occur beginning in mid May through October. During this period, instream flows decrease and instream temperatures increase affecting aquatic vegetation growth and subsequently dissolved oxygen.

5.3 Sediment TMDL

The South Fork Palouse River Watershed Advisory Group advises the Department of Environmental Quality to make use of the intended flexibility of the state's narrative sediment standard and apply a higher protective target to the upper assessment units and a moderately protective target to the lower assessment unit to reflect the questionable accuracy of the Salmonid Spawning designation in the lower assessment unit.

In-Stream Water Quality Target

Sediment criteria found in Idaho Water Quality Standards (IDAPA 58.01.02) is narrative, meaning there is not a numeric value to assess whether a water body is in compliance with standards. Instead, the standard states sediment shall be limited to a quantity that does not impair beneficial uses.

Numeric criteria exists for turbidity—the measure of light dispersion caused by particles suspended in a water column. Light penetration, turbidity, and suspended solids are correlated, though the characteristics of the particles in suspension can change the degree of light dispersion or penetration (DEQ 2003). This criteria relates specifically to mixings zones which are typically associated with point sources. Total suspended solids (TSS) has been found to correlate with turbidity in specific watersheds; however, the relationship between the two water column measures are sensitive to location and time period, so the application of a predictive model may be limited to the year and specific sites for which the model was developed (DEQ 2003). Additionally, applying the turbidity criteria requires delineation of background levels to assess compliance. This is extremely difficult and that data is not available for this TMDL.

The effects of sediment on the most sensitive designated beneficial use in the South Fork Palouse River, aquatic life, are dependant on concentration and duration of exposure (DEQ 2003). Guidance developed by the Department for application of the narrative sediment criteria for protection of aquatic life beneficial uses states that a sediment target should incorporate both concentration and duration of exposure, not only to properly protect aquatic life, but also to allow for episodic spikes in TSS that can occur naturally with spring runoff or heavy precipitation events.

Based on the information contained in the guidance, a 25 milligram per liter (mg/L) TSS target averaged over a 30-day period, not to exceed 50 mg/L daily has been used to develop the sediment TMDL for the upper assessment units. This target is designed to maintain a high level of protection for salmonid spawning populations (DEQ 2003).

A 50 mg/L TSS target averaged over a 30-day period, not to exceed 80 mg/L daily has been used to develop the sediment TMDL for the lower assessment unit. This target is designed to maintain a moderate level of protection for salmonid rearing populations (DEQ 2003) in the South Fork Palouse River watershed.

Design Conditions

Cumulative sediment loads have been assigned to assessment units CL003_03, and CL002_03. Assessment unit CL003_03, South Fork Palouse River, source to Gnat Creek, is represented by SF-2. Assessment Unit CL002_03, Gnat Creek to state line, is represented by SF-4. Load reductions and load allocations are assigned at monitoring stations SF-2 and SF-4 to represent the load reductions and allocations corresponding to assessment units CL003_03, and CL002_03.

Load Capacity

The TSS load capacities for the upper assessment units are calculated using the 50 mg/L target times the daily flow (Table 17) and 25 mg/L times the average monthly flow (Table19). The load capacity developed for site SF-4 is calculated using the 80 mg/L target times the daily flow (Table 18) and the 50 mg/L target times the average monthly flow (Table 20). The load capacity has been developed for each sampling event and month.

Estimates of Existing Pollutant Load

The average TSS concentrations for each sampling event and by month at sites SF-2 and SF-4 are shown in Tables 15 and 16. The equation below describes how the existing loads were generated as shown in Tables 19 and 20.

Existing load (pounds per month) = average monthly concentration(mg/L)* average monthly flow (cfs)* 5.39* 30 days

Where: 5.39 = Conversion factor (converts equation results to pounds per day)

Table 15. Average TSS concentration by month at Site SF-2 (2001-2002 data).

Month	Concentration (mg/L)
January	5.3
February	27.5
March	195
April	48
May	14
June	25.5
July	7.5
August	4.5
September	12
October	2.5
November	1
December	1

Table 16. Average TSS concentration by month at Site SF-4 (2001-2002 data).

Month	Concentration (mg/L)
January	10
February	41
March	330
April	30
May	12.5
June	15.5
July	2.7
August	3
September	1
October	1
November	4
December	3.5

Load Allocation

A flow based load allocation is given to the two control points, sites SF-2 and SF-4, representing assessment units CL003_03 and CL002_03 respectively. Tables 17 through 20 list the TSS concentrations found during the 2001-2002 season at monitoring sites SF-2 and SF-4. The load capacity, load allocation, and the load reduction in TSS concentrations that would be necessary to meet the load allocation are also included in the tables. Based on the 2001-2002 recorded flows and target concentrations, all sources upstream would require a reduction in the load to meet the load allocation at the control points. The load allocations presented are based on samples collected and flow measurements taken during the 2001-2002 monitoring season. Any future application of the load allocations presented should be based on current and appropriate flow measurements and the target TSS concentrations rather than fixed total load values derived from the 2001-2002 monitoring period.

Table 17. Daily TSS load allocation for site SF-2 for 2001-2002 monitoring period.

Date	Daily Flow (cfs)	TSS Concentration (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	MOS (lbs/day)	Load Allocation (lbs/day	Load Reduction (%)
11/26/2001	0.67	1	3.6	180.9	18.1	162.8	0
12/5/2001	0.46	1	2.5	123.0	12.3	110.7	0
12/19/2001	1.66	1	8.9	446.2	44.6	401.6	0
1/2/2002	0.87	1	4.7	234.5	23.5	211.1	0
1/16/2002	3.58	8	154.5	965.6	96.6	869.0	0
1/30/2002	6.07	7	229.2	1,636.9	163.7	1,473.3	0
2/12/2002	6.91	7	260.7	1,862.4	186.2	1,676.2	0
2/26/2002	19.68	48	5,090.7	5,302.8	530.3	4,772.5	6
3/12/2002	39.91	330	70,987.9	10,755.7	1,075.6	9,680.2	86
3/25/2002	35.24	60	11,397.4	9,497.9	949.8	8,548.1	25
4/8/2002	21.46	55	6,362.5	5,784.1	578.4	5,205.7	18
4/22/2002	12.92	41	2,854.6	3,481.2	348.1	3,133.1	0
5/8/2002	8.52	18	826.8	2,296.6	229.7	2,066.9	0
5/22/2002	7.08	10	381.7	1,908.7	190.9	1,717.8	0
6/4/2002	3.90	14	294.2	1,050.8	105.1	945.7	0
6/18/2002	2.83	37	564.8	763.2	76.3	686.9	0
7/3/2002	1.21	6	39.1	325.5	32.5	292.9	0
7/15/2002	0.53	9	25.7	142.8	14.3	128.6	0
7/30/2002	0.40	8	17.1	106.9	10.7	96.2	0
8/18/2002	0.55	8	23.6	147.5	14.8	132.8	0
8/27/2002	0.67	1	3.6	179.4	17.9	161.5	0
9/5/2002	0.38	15	30.7	102.5	10.2	92.2	0
9/24/2002	0.30	9	14.4	80.2	8.0	72.2	0
10/8/2002	0.19	1	1.0	51.9	5.2	46.7	0
10/22/2002	0.43	4	9.2	114.6	11.5	103.1	0
11/6/2002	0.35	1	1.9	94.9	9.5	85.4	0
11/19/2002	0.50	1	2.7	134.2	13.4	120.8	0

Table 18. Daily TSS load allocation for site SF-4 for 2002-2002 monitoring period.

Date	Daily Flow (cfs)	TSS Concentration (mg/L)	Existing Load (lbs/day)	Load Capacity (lbs/day)	MOS (lbs/day)	Load Allocation (lbs/day)	Load Reduction (%)
11/26/2001	0.00	18	NA[1]	NA	NA	NA	NA
12/5/2001	0.00	1	NA	NA	NA	NA	NA
12/19/2001	0.00	6	NA	NA	NA	NA	NA
1/2/2002	0.00	1	NA	NA	NA	NA	NA
1/16/2002	0.00	20	NA	NA	NA	NA	NA
1/30/2002	18.1	9.0	880.0	7,822.1	782.2	7,039.9	0.0
2/12/2002	23.5	11.0	1,395.6	10,149.9	1,015.0	9,134.9	0.0
2/26/2002	55.0	71.0	21,063.3	23,733.2	2,373.3	21,359.9	0.0
3/12/2002	99.1	560.0	299,153.6	42,736.2	4,273.6	38,462.6	87
3/25/2002	89.2	100.0	48,100.4	38,480.3	3,848.0	34,632.3	28
4/8/2002	62.1	33.0	11,036.8	26,756.0	2,675.6	24,080.4	0
4/22/2002	24.4	27.0	3,545.6	10,505.5	1,050.6	9,455.0	0
5/8/2002	15.0	16.0	1,297.8	6,489.1	648.9	5,840.2	0
5/22/2002	11.1	9.0	537.6	4,778.9	477.9	4,301.0	0
6/4/2002	5.5	10.0	296.7	2,373.6	237.4	2,136.3	0
6/18/2002	6.3	21.0	708.5	2,699.2	269.9	2,429.3	0
7/3/2002	1.9	1.0	10.1	805.8	80.6	725.2	0
7/16/2002	1.6	1.0	8.6	686.7	68.7	618.0	0
7/29/2002	2.1	6.0	69.4	924.8	92.5	832.4	0
8/18/2002	3.5	5.0	94.7	1,515.1	151.5	1,363.6	0
8/28/2002	2.1	1.0	11.2	893.2	89.3	803.9	0
9/5/2002	1.6	1.0	8.5	676.7	67.7	609.0	0
9/24/2002	0.3	1.0	1.7	132.6	13.3	119.3	0
10/7/2002	0.5	1.0	2.7	212.5	21.2	191.2	0
10/22/2002	0.4	1.0	2.4	189.1	18.9	170.2	0
11/5/2002	0.4	7.0	16.6	189.7	19.0	170.8	0
11/18/2002	0.4	1.0	2.3	181.1	18.1	163.0	0

[1]NA=Not Available because of missing flow data

Table 19. Monthly TSS load allocation for site SF-2 for 2001-2002 monitoring period.

Month	Flow (cfs)	Concentration (mg/L)	Total Load Capacity (lbs/month)	MOS (lbs/month)	Load Allocation (lbs/month)	Existing Load (lbs/month)	Load Reduction (%)
January	3.5	5.3	14,185.1	1,418.5	12,766.6	3,007.2	0.0
February	13.3	27.5	53,739.2	5,373.9	48,365.3	59,113.1	18.2
March	37.6	195.0	151,902.0	15,190.2	136,711.8	1,184,835.5	88.5
April	17.2	48.0	69,490.0	6,949.0	62,541.0	133,420.7	53.1
May	7.8	14.0	31,539.2	3,153.9	28,385.3	17,661.9	0.0
June	3.4	25.5	13,605.0	1,360.5	12,244.5	13,877.1	11.8
July	0.7	7.5	2,876.3	287.6	2,588.6	862.9	0.0
August	0.6	4.5	2,452.2	245.2	2,207.0	441.4	0.0
September	0.3	12.0	1,370.0	137.0	1,233.0	657.6	0.0
October	0.3	2.5	1,248.7	124.9	1,123.9	124.9	0.0
November	0.5	1.0	2,050.0	205.0	1,845.0	82.0	0.0
December	1.1	1.0	4,269.5	426.9	3,842.5	170.8	0.0

Table 20. Monthly TSS load allocation for site SF-4 for 2001-2002 monitoring period.

Month	Flow (cfs)	Concentration (mg/L)	Total Load Capacity (lbs/month)	MOS (lbs/month)	Load Allocation (lbs/month)	Existing Load (lbs/month)	Load Reduction (%)
January	6.0	10.0	48,888.4	4,888.8	43,999.5	9,777.7	0.0
February	39.3	41.0	317,654.6	31,765.5	285,889.1	260,476.8	0.0
March	94.2	330.0	761,404.9	76,140.5	685,264.4	5,025,272.2	86.4
April	43.3	30.0	350,080.5	35,008.1	315,072.5	210,048.3	0.0
May	13.1	12.5	105,637.4	10,563.7	95,073.7	26,409.3	0.0
June	5.9	15.5	47,558.0	4,755.8	42,802.2	14,743.0	0.0
July	1.9	2.7	15,108.3	1,510.8	13,597.5	805.8	0.0
August	2.8	3.0	22,577.8	2,257.8	20,320.0	1,354.7	0.0
September	0.9	1.0	7,586.8	758.7	6,828.1	151.7	0.0
October	0.5	1.0	3,765.2	376.5	3,388.7	75.3	0.0
November	0.3	4.0	2,317.7	231.8	2,085.9	185.4	0.0
December	N/A[1]	3.5	NA	N/A	N/A	N/A	N/A

[1]NA=Not Available because of missing flow data

Margin of Safety

An explicit margin of safety of 10% of the target load was deducted from the source allocations to account for uncertainties about the relationship between instream dynamics and TSS concentrations.

Critical Time Period

The critical time period for TSS in the South Fork Palouse River occurs in February, March and April when TSS concentrations become elevated as the result of increasing stream flow and overland runoff.

Construction Storm Water TMDL

Sediment is usually the main pollutant of concern in storm water from construction sites. This TMDL incorporates a gross waste load allocation for anticipated construction storm water activities. Construction storm water activities will be considered in compliance with provisions of the TMDL if they obtain a Construction General Permit under the National Pollution Discharge Elimination System program and implement the appropriate Best Management Practices. If a construction project disturbs more than one acre of land, the operator is required to apply for permit coverage from EPA after developing a site-specific Storm Water Pollution Prevention Plan. The operator must document the erosion, sediment, and pollution controls they intend to use, inspect the controls periodically and maintain the best management practices through the life of the project. The application of specific best management practices from *Idaho's Catalog of Storm Water Best Management Practices for Idaho Cities and Counties* is generally sufficient to meet the standards and requirements of the General Construction Permit, unless local ordinances have more stringent and site specific standards that are applicable.

5.4 Temperature TMDL

In-stream Water Quality Target

The potential natural vegetation (PNV) method has been applied to create the South Fork Palouse River temperature TMDL. Idaho Water Quality Standards IDAPA 58.01.02.200.09 states: "When natural background conditions exceed any applicable water quality criteria set forth …., the applicable water quality criteria shall not apply; instead, pollutant levels shall not exceed the natural background conditions, except that temperature levels may be increased above natural background conditions when allowed under Section 401." In these situations, natural conditions are the water quality standard, and the natural level of shade and channel width are the TMDL target. The instream temperature which results from these conditions is consistent with the water quality standard, even though it may exceed numeric temperature criteria (IDEQ, 2004).

Potential Natural Vegetation for Temperature TMDLs

Ground water temperature, air temperature and direct solar radiation are important contributors of heat to a stream (Poole and Berman 2001). Direct solar radiation is the source of heat most likely to be controlled or managed. Shade and stream morphology affect or control the amount of solar radiation reaching a stream. They are the most likely natural stream conditions impaired by anthropogenic activities that can be readily corrected.

Vegetation outside the riparian corridor can provide shade if there is enough relief in the surrounding watershed, however, riparian vegetation provides the most substantial amount of shade. Effective shade is shade that exists as the sun makes its way across the sky. Effective shade is measured using optical equipment similar to a fish eye lens on a camera called a solar pathfinder. Effective shade can be modeled using detailed information about riparian plant communities, topography, and the stream's aspect. Riparian canopy cover is the vegetation that hangs over a stream and is measured using a densiometer, or estimated on site or on aerial photography.

Potential natural vegetation (PNV) along a stream is the mature riparian plant community that has not been disturbed or reduced. The PNV is used as a temperature TMDL target because it provides a natural level of solar loading to the stream. A riparian plant community composed of less than PNV results in the stream heating up from excess solar radiation.

Existing shade was estimated for the South Fork Palouse River from aerial photos. The estimates were field verified by measuring shade with a solar pathfinder at selected points in the watershed. PNV targets were determined from an analysis of probable vegetation in the watershed and comparison with shade curves developed for similar vegetation communities in other TMDLs. A shade curve shows the relationship between effective shade and stream width. Shade decreases with increased width as the vegetation is less able to shade the center of a wide stream. Taller riparian vegetation allows shade to reach further across a stream channel.

Pathfinder Methodology

The solar pathfinder is a device that allows the outline of shade producing objects on monthly solar path charts to be tracked. The percentage of the sun's path covered by these objects is the effective shade on the stream at the spot that the tracing is made. In order to adequately characterize the effective shade on a reach of stream, ten traces are taken at systematic or random 100 foot intervals along the length of the stream in question.

At each sampling location, the solar pathfinder is placed in the middle of the stream at bankfull water level height and oriented to true south. Using a unique location, traces are then taken at fixed intervals proceeding upstream.

Aerial Photo Interpretation

Canopy coverage estimates are based on observation about the kind of vegetation present, its density, and the width of the stream. The typical vegetation type shows the kind of landscape a particular cover class usually falls into for a stream 5m wide or less.

Cover class	Typical vegetation type on 5m wide stream
0 = 0 – 9% cover	agricultural land, denuded areas
10 = 10 –19%	ag land, meadows, open areas, clearcuts
20 = 20 – 29%	ag land, meadows, open areas, clearcuts
30 = 30 – 39%	ag land, meadows, open areas, clearcuts
40 = 40 – 49%	shrublands/meadows
50 = 50 – 59%	shrublands/meadows, open forests
60 = 60 – 69%	shrublands/meadows, open forests
70 = 70 – 79%	forested
80 = 80 – 89%	forested
90 = 90 –100%	forested

The visual estimates of shade in this TMDL were field verified with a solar pathfinder. The pathfinder measures effective shade and takes into consideration other physical features that block the sun from hitting the stream surface (e.g. hillsides and canyon walls). The estimate of shade made visually from an aerial photo does not always take into account topography or any shading that may occur from physical features other than vegetation.

Stream Morphology

Measures of current bankfull width or near stream disturbance zone width may not reflect widths present under PNV. Width-to-depth ratios tend to increase and streams become wider and shallow as streams and riparian areas are disturbed. Channel width was not developed from the aerial photo work presented above. Bankfull width is estimated based on drainage area of the Clearwater River curve from Figure 19. Existing width is evaluated from available data. If the stream’s existing width is wider than that predicted by the Clearwater River curve in Figure 19, then the Figure 19 estimate of bankfull width is used in the loading analysis. If existing width is smaller, then existing width is used in the loading analysis. In most cases, existing widths are used.

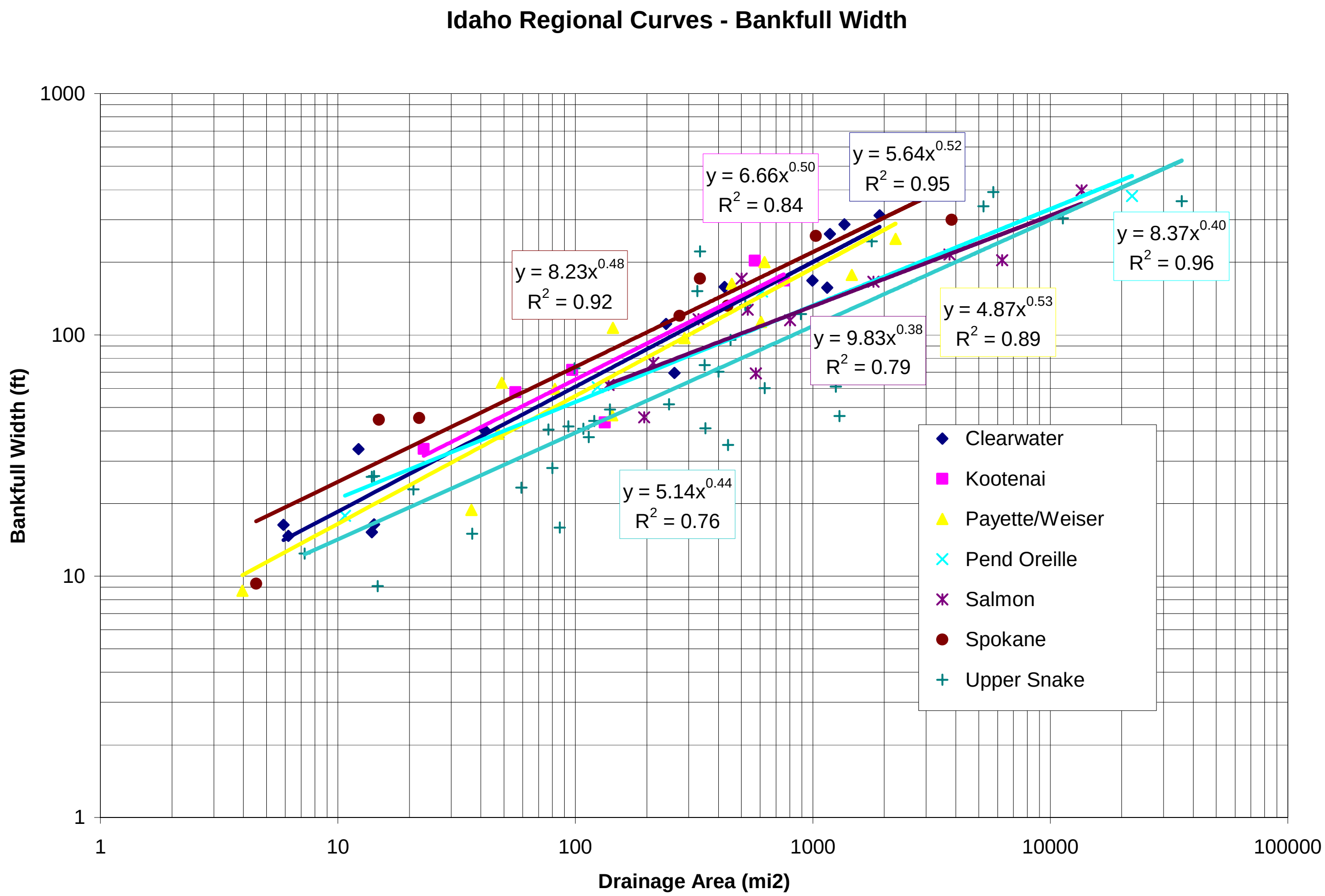

Figure 19. Bankfull Width as a Function of Drainage Area

Design Conditions

The natural vegetation of the upper Palouse River region in Latah County, Idaho can best be described as bunchgrass dominated steppe of the Palouse Prairie where it meets the conifer forest. Early botanist and explorer to the region, Charles Geyer in 1846, described the higher elevation grasslands of the Palouse region as bunchgrass prairie bordered by “spacious, open, grassy woods” of large widely spaced Ponderosa pine in “elegant parks” dotted with seasonally wet “spongy meadows” or “gamass” (camas) (Weddell 2000). Later, I.I. Stevens in performing railroad surveys for the Army in 1853-1855, wrote in 1860 that the Palouse region was “very fertile rolling country,” “a most beautiful prairie country, the whole of it adapted to agriculture,” “rolling table-land,” “comparable to that of the prairie of Illinois” (Weddell 2000). Stevens indicated that the bottomland of the Palouse “has great resources,” “it is heavily timbered with pine, but with very little underbrush” (Weddell 2000). Both of these explorers captured two very important images of the Palouse River region, the prairie steppe was extensively dominated by bunchgrasses, and valley bottoms and stream corridors may have been in open timber.

Rexford Daubenmire, one of the West’s best known plant ecologists, explained forest types for this region. His forest classification for northern Idaho and adjacent Washington (Daubenmire 1952) showed fescue grassland meeting forest in western Latah County. Weaver (1917) on the other hand, showed the entire Palouse River region east of the ID-WA border as coniferous woodland (see Figure 1 of Weaver 1917). Idaho fescue (*Festuca idahoensis*) /snowberry (*Symphoricarpus albus*) association (Franklin and Dryness 1973) probably dominated western Latah County near the Idaho border. How far up the Palouse River this vegetation type existed is perhaps debatable. Most authors suggest it occurred as far as Potlatch, or even beyond according to maps in Black et al. (1998). Fescue grasslands also dominated most of the South Fork Palouse River and Cow Creek areas. This fescue/low shrub grassland met lower elevation Ponderosa pine (*Pinus ponderosa*) forest in an open, parkland type setting described by the early explorers.

Daubenmire (1952) described forest habitat types that vary with elevation and other factors such as soil type, moisture and aspect. He described several predominant zones of vegetation that follow roughly a moisture/elevation gradient. The Ponderosa pine zone occupies the lowest and driest zone, then as one continues up the elevational/moisture gradient comes the Douglas fir (*Psuedotsuga menziesii*) zone, followed by the western redcedar (*Thuja plicata*)/ western hemlock (*Tsuga heterophylla*) zone, and finally the Engelmann spruce (*Picea engelmanni*)/subalpine fir (*Abies lasiocarpa*) zone. Franklin and Dryness (1973) in describing the forest zones of eastern Oregon and Washington, list seven forest zones with increasing elevation and moisture. Their list begins with western juniper forests not found in Idaho’s Latah County, then includes Ponderosa pine zone, lodgepole pine (*Pinus contorta*) zone, Douglas fir zone, grand fir (*Abies grandis*) zone, western hemlock zone (with western redcedar), and finally the subalpine fir zone at the top. Black et al. (1998) described forest communities of the Palouse region on higher elevation mountain and ridges with warmer sites occupied by Ponderosa pine and Douglas fir with a rich understory of oceanspray (*Holodiscus discolor*), ninebark (*Physocarpus malvaceus*), serviceberry (*Amelanchier* *alnifolia*), snowberry and rose (*Rosa sp.*) shrubs. On cooler north-west facing canyons western redcedar, grand fir, and western larch (*Larix occidentalis*) are supported.

In eastern Washington and presumably adjacent western Idaho, Ponderosa pine stands first appear within the matrix of steppe vegetation and increase in extent in wetter areas until steppe or shrub-steppe vegetation is reduced to mere islands in a matrix of Ponderosa pine forest (Franklin and Dryness 1973). Also, groves of aspen occur on riparian and poorly drained wet areas throughout the Ponderosa pine zone and adjacent forest/steppe zones as well (Franklin and Dryness 1973).

The native vegetation on the grasslands of the Palouse region is largely gone. Most of these lands have long since been converted to cropland, hay and pastureland. Very few remnants of the native Palouse Prairie vegetation survive. However, it is generally recognized that these grasslands were dominated by perennial bunchgrasses, either bluebunch wheatgrass (*Psuedoregneria spicata*) as the dominant in drier portions or Idaho fescue dominant in more moist parts of the prairie (Black et al. 1998, Weddell 2000, 2001). In western Latah County covering much of the landscape from the border with Washington to east of Moscow and Potlatch, the Palouse prairie was probably dominated by the Idaho fescue/snowberry zone of Franklin and Dryness (1973). This zone is described as the moistest of the steppe zones with a mosaic of herbaceous and woody species. Grasses included Idaho fescue, bluebunch wheatgrass, and prairie junegrass (*Koeleria cristata*), and shrubs included low growth forms of snowberry, Wood's rose (*Rosa woodsii*) and Nootka rose (*Rosa nutkana*).

While much has been written about forest types in this region (Daubenmire 1952, Franklin and Dryness 1973), and about the historic steppe and shrub-steppe vegetation of the Palouse Prairie (Black et al. 1998, Weddell 2000, and Weddell 2001), little has been written to describe the vegetation in riparian areas of this region.

Weaver (1917) included wet meadow and floodplain forest types in his "hydrosere" classification system. He described dense thickets of trees and shrubs along streams. Larger streams that cut canyons into the basalt had narrow riparian forests while smaller streams that were intermittent did not cut canyons and thus, were exposed to the wind resulting in no woody vegetation in the riparian area. Weaver described small groves of poplars where aspens or even black cottonwoods were dominant. But by far the major riparian community type was one containing a mixture of alders, hawthorns, willows, serviceberry and chokecherry. In some cases alders were the dominant life form, in others dense thickets of pure hawthorn and serviceberry became dominant. Weaver (1917) described wet meadows in both the mountains and in the prairie. He listed a variety of wet meadow "types" including tufted hairgrass meadows, sometimes as pure stands, and others such as camas and cow parsnip dominated meadows.

Within the fescue/snowberry zone moist draws were dominated by black hawthorn (*Crataegus douglasii*) (Black et al. 1998, Franklin and Dryness 1973, Weaver 1917). In fact, Franklin and Dryness (1973) describe two plant associations in these wet draws, a hawthorn/snowberry association and a hawthorn/cow-parsnip (*Heracleum lanatum*) association. These draws are dominated by 5 to 7 meter tall hawthorn and may include other shrubs such as shiny-leaf spirea (*Spiraea betulifolia*), Columbia hawthorn (*Crataegus columbiana*), chokecherry (*Prunus virginiana*), and serviceberry (*Amelanchier alnifolia*). Aspens (*Populus tremuloides*) occurred in phases in these hawthorn associations. Because aspen is short lived, aspen suckers would grow up through the hawthorns, dominate for several years, and then die back allowing hawthorns to predominate (Franklin and Dryness 1973).

There were two related riparian types briefly described by Daubenmire. They included a black cottonwood (*Populus trichocarpa*)/water-hemlock (*Cicuta douglasii*) association, which replaces hawthorn/cow-parsnip in drier portions of the steppe, and a white alder (*Alnus rhombifolia*) forest occurring in some riparian habitats, sometimes in association with black cottonwood (Franklin and Dryness 1973). Black et al. (1998) indicated that true riparian communities were largely limited to the Palouse and Potlatch Rivers. These communities were comprised of narrow gallery forest of plains cottonwood (*Populus deltoides*), aspens, mountain maple (*Acer glabrum*), and red alder (*Alnus rubra*).

There may have been some confusion on exact species over the years; however, the information clearly demonstrates that riparian areas, whether they were merely moist draws or river gallery forest, were dominated by tall shrubs and trees: hawthorns, aspens, cottonwoods, and alders. In terms of vegetation height, hawthorns and aspens are relatively small trees (3-12m), alders are of intermediate heights (10-25m), and cottonwoods can be very tall (25-30m). Vegetative cover over a small (<5m wide) stream typically vary from about 60-80% for mature hawthorn or aspen dominated communities, to about 70-100% cover for mature alder and cottonwood dominated communities.

Target Selection

The vegetation types selected to represent potential natural vegetation in the South Fork Palouse River and Crumarine Creek are a conifer type in the headwaters region, a conifer/shrub type at that margin between the forest and the lower elevations, and a shrub/grass meadow mix type along the lowland/meadow gradient to the border.

Effective shade curves from several existing temperature TMDLs were used to determine potential natural vegetation shade targets for the watershed (Tables 21 through 23). These TMDLs had previously used vegetation community modeling to produce these shade curves. Effective shade curves include percent shade on the vertical axis and stream width on the horizontal axis. For the South Fork Palouse River Watershed, curves for the most similar vegetation type were selected for shade target determinations. Shade targets were derived by taking an average of the various shade curves available.

The effective shade calculations are based on a six month period from April through September. This time period coincides with the critical time period when temperatures affect beneficial uses such as spring and fall salmonids spawning and when cold water aquatic life criteria may be exceeded during summer months. Late July and early August typically represent a period of highest stream temperatures. Solar gains can begin early in the spring and affect not only the highest temperatures reached later on in the summer, but solar loadings affect salmonids spawning temperatures in spring and fall. Thus, solar loading in these streams is evaluated from spring (April) to early fall (September).

Table 21. Shade targets as averages for the Conifer Vegetation Type at various stream widths.

Mixed Conifer	1m	2m	3m	4m	5m
VRU3 (IDEQ, 2004)	95	94	93	90	88
VRU10 (IDEQ, 2004)	91	90	89	85	83
Douglas fir (IDEQ, 2002)	91	89	85	85	83
Average	92	91	89	87	85

Table 22. Shade targets as averages for the Conifer/Shrub Vegetation Type at various stream widths.

Conifer/Shrub	1m	2m	3m	4m	5m
Ponderosa pine (IDEQ, 2002)	92	80	76	71	67
VRU12/16 (IDEQ, 2004)	89	70	45	38	32
Mountain alder (ODEQ, 2003)	91	89	85	80	72
Average	91	79	70	62	57

Table 23. Shade targets as averages for the Shrub/Bunchgrass-Meadow Vegetation Type at various stream widths.

Shrub/Meadow mix	1m	2m	3m	4m	5m
VRU12/16 (IDEQ, 2004)	89	70	45	38	32
willow mix (ODEQ, 2003)	90	86	78	70	65
Mtn alder (ODEQ, 2003)	91	89	85	80	72
Graminoid Willow (ODEQ, 2003)	37	29	18	12	11
Average	76	68	56	50	45

Load Capacity

The load capacity for a stream with PNV is the solar load allowed by the shade targets specified for the stream. The load is the solar load measured by a flat plate collector under full sun for a given period of time multiplied by the fraction of the solar radiation that is not blocked by shade. In other words, if a shade target is 60%, then the solar load hitting the stream under that target is 40% of the load hitting the flat plate collector under full sun.

Solar load data for flat plate collectors from the National Renewable Energy Laboratory weather station in Spokane were used for this TMDL. The solar loads used to calculate the shade target are spring and summer averages occurring between April and September. This period coincides with the time of year that stream temperatures are increasing and when vegetation is growing. Tables 24 and 25 show the PNV shade targets (Target or Potential Shade) and their corresponding potential summer load (in kWh/m^2/day and kWh/day) that serve as the loading capacities.

Estimates of Existing Pollutant Loads

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

Existing loads in this temperature TMDL come from estimates of existing shade determined through aerial photo interpretations (Figure 20). Gnat Creek and Howard Creek are shown in Figure 20; however, the temperature TMDL does not apply to those assessment units. Like target shade, existing shade was converted to a solar load by multiplying the fraction of open stream by the solar radiation measured on a flat plate collector from the Spokane weather station. Existing shade data are presented in Tables 24 and 25. Like loading capacities (potential loads), existing loads in Tables 24 and 25 are presented on an area basis ($kWh/m^2/day$) and as a total load (kWh/day).

Existing and potential loads in kWh/day can be summed for the entire stream or portion of stream examined in a single loading table. These total loads are shown at the bottom of their respective columns in each table. The difference between potential load and existing load is also summed for the entire table. Should existing load exceed potential load, this difference becomes the excess load to be discussed next in the load allocation section. The percent reduction shown in the lower right corner of each table represents how much total excess load there is in relation to total existing load.

Table 24. Existing and Potential Solar Loads for Crumarine Creek.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load ($kWh/m^2/day$)	Potential Shade (fraction)	Potential Summer Load ($kWh/m^2/day$)	Potential Load minus Existing load ($kWh/m^2/day$)	Segment Area (m^2)	Existing Summer Load (kWh/day)	Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Dominant Vegetation Community
4990	0.9	0.57	0.92	0.456	-0.11	4990	2844	1	2275	-569	Conifer
707	0.8	1.14	0.91	0.513	-0.627	1414	1612	2	725	-887	Conifer
2102	0.7	1.71	0.79	1.197	-0.513	4204	7189	2	5032	-2157	Conifer/shrub mix
201	0.7	1.71	0.79	1.197	-0.513	402	687	2	481	-206	**% Reduction**
					Total	**11,010**	**12,333**		**8,514**	**-3,818**	**-31**

Table 25. Existing and Potential Solar Loads for the South Fork Palouse River.

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Segment Area (m^2)	Existing Summer Load (kWh/day)	Stream Width (m)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Dominant Vegetation Community
3009	0.9	0.57	0.92	0.456	-0.11	3009	1715	1	1372	-343	Conifer
1485	0.8	1.14	0.91	0.513	-0.63	2970	3386	2	1524	-1862	Conifer
1989	0.7	1.71	0.7	1.71	0.00	5967	10204	3	10204	0	Conifer/shrub mix
232	0.4	3.42	0.62	2.166	-1.25	928	3174	4	2010	-1164	Conifer/shrub mix
144	0.2	4.56	0.62	2.166	-2.39	576	2627	4	1248	-1379	Conifer/shrub mix
250	0.4	3.42	0.62	2.166	-1.25	1000	3420	4	2166	-1254	Conifer/shrub mix
189	0.5	2.85	0.62	2.166	-0.68	756	2155	4	1637	-517	Conifer/shrub mix
207	0.2	4.56	0.62	2.166	-2.39	828	3776	4	1793	-1982	Conifer/shrub mix
538	0.4	3.42	0.62	2.166	-1.25	2152	7359.84	4	4661	-2699	Conifer/shrub mix
249	0.2	4.56	0.62	2.166	-2.39	996	4541.76	4	2157	-2384	Conifer/shrub mix
750	0.1	5.13	0.57	2.451	-2.68	3750	19237.5	5	9191	-10046	Conifer/shrub mix
2446	0.2	4.56	0.57	2.451	-2.11	12230	55768.8	5	29976	-25793	Conifer/shrub mix
478	0.3	3.99	0.57	2.451	-1.54	2390	9536.1	5	5858	-3678	Conifer/shrub mix
7974	0.1	5.13	0.45	3.135	-2.00	39870	204533.1	5	124992	-79541	Shrub/meadow
261	0.5	2.85	0.45	3.135	0.29	1305	3719.25	5	4091	372	Shrub/meadow
842	0.1	5.13	0.45	3.135	-2.00	4210	21597.3	5	13198	-8399	Shrub/meadow
841	0.5	2.85	0.45	3.135	0.29	4205	11984.25	5	13183	1198	Shrub/meadow
393	0.1	5.13	0.45	3.135	-2.00	1965	10080.45	5	6160	-3920	**% Reduction**
					Total	**89,107**	**378,813**		**235,422**	**-143,391**	-38

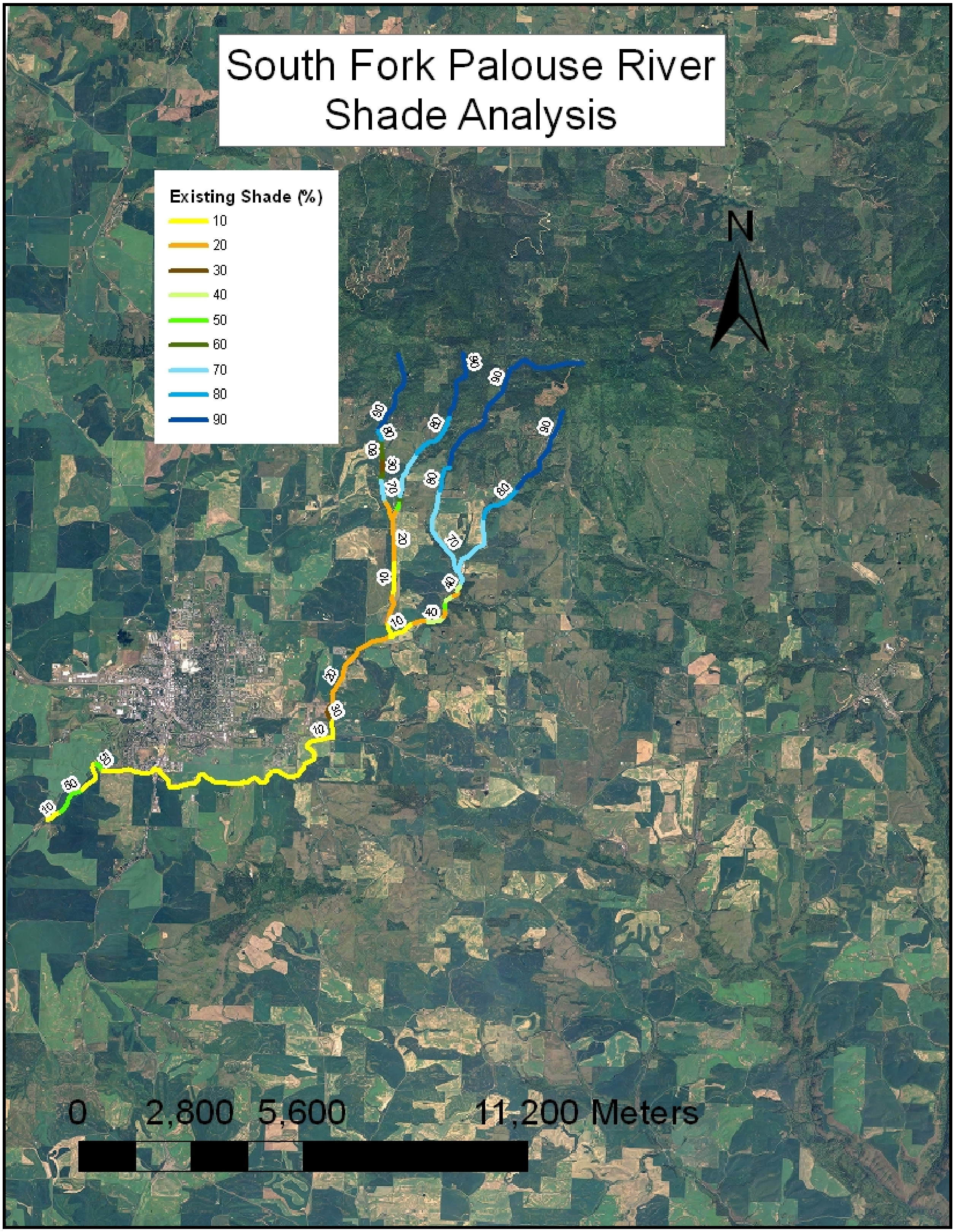

Figure 20. Existing Shade Estimated for the South Fork Palouse River Watershed by Aerial Photo Interpretation

Load Allocation

This TMDL is based on potential natural vegetation, which is equivalent to background loading. The load allocation is the desire to achieve background conditions. Load allocations are assigned to nonpoint source activities that have affected or may affect riparian vegetation and shade. Load allocations are therefore stream reach specific and are dependent upon the target load for a given reach. The potential shade and load capacity of the stream that is necessary to achieve background conditions are listed in Tables 24 and 25. The potential shade has been converted to a summer load by multiplying the inverse fraction (1-shade fraction) by the average loading to a flat plate collector for the months of April through September. There is no opportunity to allocate shade removal to an activity.

Table 26 shows the excess heat load (kWh/day) experienced by each water body examined and the percent reduction necessary to bring that water body back to target load levels. Figure 21 illustrates the desired riparian shade for each segment to achieve the load reductions.

Table 26 . Excess Solar Loads and Percent Reductions for the South Fork Palouse River Watershed.

Water Body	Excess Load (kWh/day)	Percent Reduction
Crumarine Creek	-3,818	31%
South Fork Palouse River	-143,391	38%

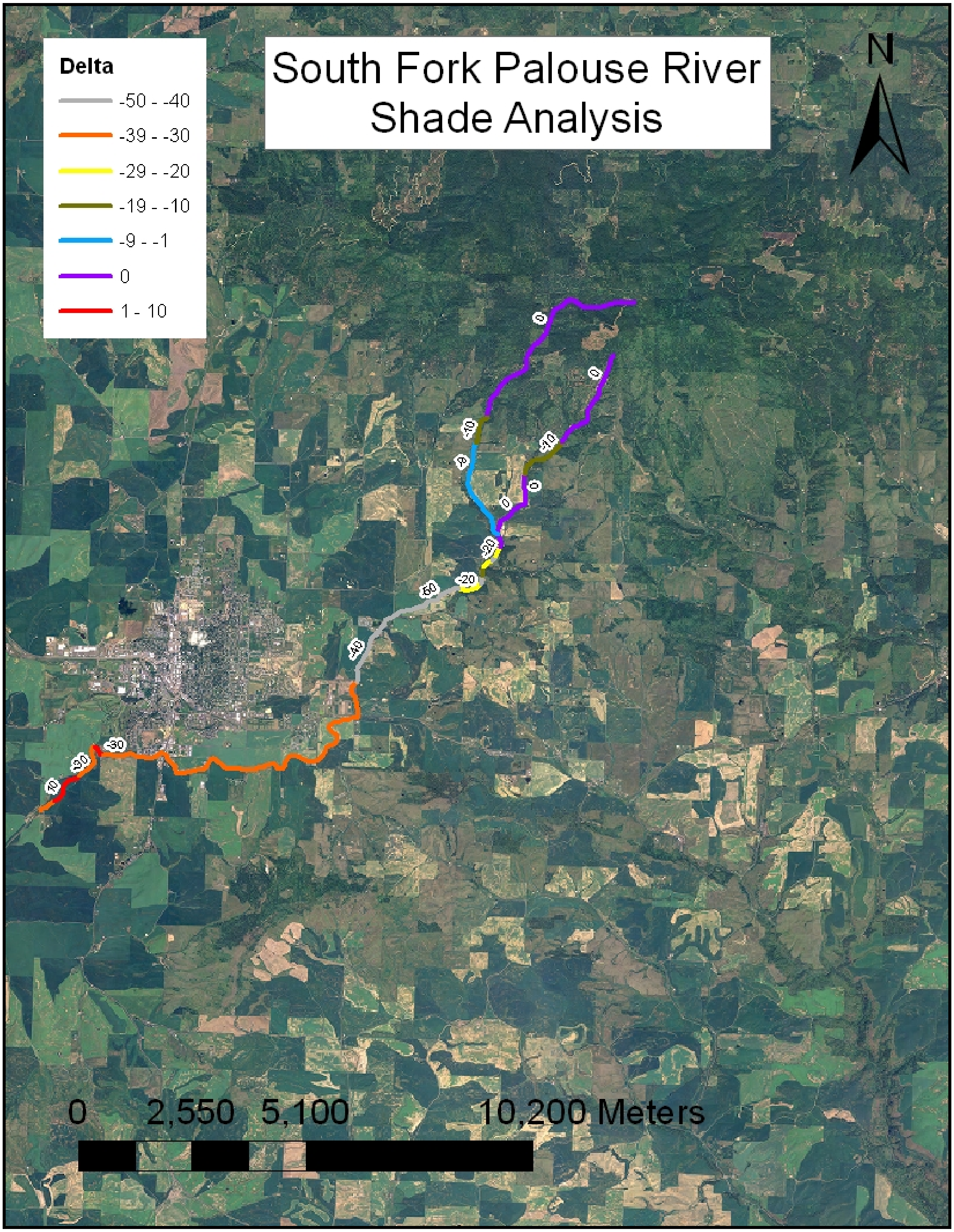

Figure 21. Change in Riparian Shade Needed to Meet the Required Load Reductions

Wasteload Allocation

Two point sources in the watershed discharge to a 303(d) listed segment of the South Fork Palouse River. Both dischargers operate a lagoon wastewater system. Discharge will occur during the winter months of February or March and April if needed for a short time period. Heat loading from these sources to the South Fork Palouse River is not anticipated to violate cold water aquatic life or salmonid spawning criteria.

Margin of Safety

The margin of safety in this TMDL is considered implicit in the design. Because the target is essentially background conditions, there are no loads allocated to specific sources or activities. Although the loading analysis used in this TMDL involves gross estimations that are likely to have large variances, there are no load allocations that may benefit or suffer from that variance.

Seasonal Variation

This TMDL is based on average summer loads. All loads have been calculated to be inclusive of the six month period from April through September. This time period was chosen because it represents the time period when the combination of increasing air and water temperatures coincides with increasing solar inputs and increasing vegetative shade. The critical time periods are June when spring salmonid spawning is occurring, July and August when maximum temperatures exceed cold water aquatic life criteria, and September during fall salmonid spawning. Water temperature is not likely to be a problem for beneficial uses outside of this time period because of cooler weather and lower sun angle.

5.5 Implementation Strategies

Idaho Code 39-3611 and 39-3612 provides guidance on the development and implementation of total maximum daily loads in Idaho. The guidance contained in code relies on participation and assistance of watershed advisory groups and designated management agencies.

Reasonable Assurance

Nonpoint sources will be managed by applying the combination of authorities the state has included in the Idaho Nonpoint Source Management Plan (IDEQ 1999). Section 319 of the Federal Clean Water Act requires each state to submit to EPA a management plan for controlling pollution from nonpoint sources within the state. Idaho’s authority for implementing the Idaho Nonpoint Source Management Plan has been certified by the Idaho Attorney General. The plan has been submitted to and approved by EPA as complying with Section 319 of the Clean Water Act.

Nonpoint source pollutant controls or best management practices determined to be ineffective in achieving the desired load reductions are subject to the feedback loop process or adaptive management to ensure load reductions are achieved, IDAPA 58.01.02.350. The feedback loop provides for water quality improvements and maintenance through best management practice installation, evaluation and modification. Implementing the feedback loop to modify best management practices until water quality standards are met results in compliance with the water quality standards.

Time Frame

A schedule for implementation of Best Management Practices, pollution control strategies, assessment reporting dates, and evaluation of progress will be developed with appropriate designated management agencies and the South Fork Palouse River Watershed Advisory Group and included in the South Fork Palouse River TMDL Implementation Plan. Based on such assessments and evaluations, implementation strategies for TMDLs may need to be modified if monitoring shows that the water quality standards are not being met.

Approach

This TMDL focuses on implementation of load allocations for *E. coli* bacteria, nutrients, sediment, and stream temperature. Both the biological and numeric water quality data analyzed for this project suggests the poor habitat conditions and exceedances of numeric standards are impairing the designated beneficial uses in the South Fork Palouse River. Nonpoint source best management practices for activities with the potential to contribute bacteria, nutrients, and sediment will be evaluated for application within the watershed by the designated management agencies responsible for such activities. Point source discharges will be managed by EPA’s National Pollution Discharge Elimination System through load allocations provided by this TMDL.

The Watershed Advisory Group recommends the Implementation Plan to be developed for this TMDL include a survey to identify property-owners willing to participate in restoration and remediation of the South Fork Palouse River to address the TMDL pollutants. First efforts to restore the South Fork Palouse River should focus on riparian enhancement, gravel augmentation, and channel substrate restoration projects designed to intercept the pollutants in runoff, increase opportunities for dissolved oxygen entrainment, and reduce stream temperatures. Sources of *E. coli* bacteria will be included in the survey for potential remediation projects. These projects should be monitored to determine effectiveness and social acceptability. Restoration of the river’s riparian area and establishment of river buffers can increase the load capacity by reducing instream temperatures and filtering nutrients, sediment, and bacteria from direct delivery to the river system.

Responsible Parties

Idaho Code 39-3612 states designated management agencies are to use TMDL processes for achieving water quality standards. The Department of Environmental Quality will rely on the designated management agencies to implement pollution control measures or best management practices for pollutant sources they identify as priority.

The Department of Environmental Quality also recognizes the authorities and responsibilities of local city, and county governments as well as applicable state and federal agencies and will enlist their involvement and authorities for protecting water quality through implementation of Idaho Administrative Procedures Act 58.01.02 and Clean Water Act Section 401.

The designated state agencies listed below are responsible for assisting and providing technical support for the development of specific implementation plans and other appropriate support to water quality projects. General responsibilities for Idaho designated management agencies are:

- Idaho Soil Conservation Commission: Grazing and Agriculture.
- Idaho Department of Agriculture: Aquaculture and Animal Feeding Operations.
- Idaho Department of Transportation: Public Roads.
- Idaho Department of Lands: Timber Harvest, Oil and Gas Exploration, and Mining.
- Idaho Department of Water Resources: Stream Channel Alteration activities.
- Idaho Department of Environmental Quality: All other activities.

Monitoring Strategy

Idaho Code 39-3611 requires the Department of Environmental Quality to review and evaluate each Idaho TMDL, supporting assessment, implementation plan and all available data periodically at intervals no greater than five years. Such reviews are to be conducted using the Beneficial Use Reconnaissance Program protocol and the Water Body Assessment Guidance methodology to determine beneficial use attainability and status and whether state water quality standards are being achieved.

A permanent control point for water quality monitoring has been established at site SF-4. Site SF-4 will be used for long term monitoring to assess trends in cumulative pollutant loading identified by this TMDL. Beneficial use support status monitoring and assessment will be conducted within each assessment unit of the watershed and evaluated using the Water Body Assessment Guidance for compliance with Idaho state water quality standards. Idaho Code 39-3621 requires designated agencies, in cooperation with the appropriate land management agency, to ensure best management practices are monitored for their effect on water quality. The monitoring results should be presented to the Department of Environmental Quality on a schedule agreed to between the designated agency and the Department. The designated management agency should report the effectiveness of the measures or practices implemented to the Department in the form of load reductions applicable to the TMDL.

Pollutant load reductions gained by the application of pollutant controls and best management practices will be monitored by the Department of Environmental Quality through reports provided by Designated Management Agencies. Information reported will be compiled and tracked over time to provide measurable pollutant load reductions relative to the total maximum daily load allocations.

5.6 Conclusions

Bacteria, nutrient, sediment, and temperature TMDLs have been developed for the South Fork Palouse River watershed (Table 27). The loads have been allocated to the existing sources currently in the watershed. A growth reserve is not included in the total maximum daily loads. Future sources will need to acquire a load allocation from existing allocations unless the load capacity is increased.

Table 27. Summary of assessment outcomes.

Water Body Segment/ AU	Pollutants	TMDL(s) Completed	Recommended Changes to Integrated Report	Justification
South Fork Palouse River 17060108 CL003_02 and _03	E. coli Bacteria, Nutrients, Sediment and Temperature	Yes	Move to Section 4a	TMDL Completed
South Fork Palouse River 17060108CL002_03	E. coli Bacteria, Nutrients, Sediment and Temperature	Yes	Move to Section 4a	TMDL Completed

The bacteria TMDL allocates a gross concentration to all sources of *E. coli* bacteria upstream from SF-4. Sources extending upstream from this location must be managed to reduce the *E. coli* bacteria concentrations by 41 percent. The *E. coli* bacteria allocation applies to any 30-day period annually since secondary contact recreation may occur at any time of year. This allocation ensures water quality standards are attained for the protection of public health.
A nutrient TMDL that addresses the limiting nutrient, total phosphorous, was developed for the watershed from mid May through October. The critical time period is based on measured dissolved oxygen violations. By controlling nutrient loading during this period, aquatic plant growth should be reduced and instream dissolved oxygen enhanced.

A sediment load capacity was determined for the South Fork Palouse River watershed based on Department guidance for the application of Idaho’s narrative aquatic life water quality standard for sediment. Sediment concentrations found during the 2001-2002 monitoring season from February through April warrant sediment load reductions during the peak flow period. Controlling sediment loads will also assist in managing nutrient loads in the South Fork Palouse River since nutrients, particularly phosphorous, bind to soil particles delivered to the stream.

A temperature TMDL that address riparian shading has been developed for the watershed. Streamside vegetation and channel morphology are factors influencing shade, which are most likely to have been influenced by anthropogenic activities, and which can be most readily corrected and addressed by a TMDL.

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GIS Coverages

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Glossary

305(b)
Refers to section 305 subsection “b” of the Clean Water Act. The term “305(b)” generally describes a report of each state’s water quality and is the principle means by which the U.S. Environmental Protection Agency, Congress, and the public evaluate whether U.S. waters meet water quality standards, the progress made in maintaining and restoring water quality, and the extent of the remaining problems.

§303(d)
Refers to section 303 subsection “d” of the Clean Water Act. 303(d) requires states to develop a list of water bodies that do not meet water quality standards. This section also requires total maximum daily loads (TMDLs) be prepared for listed waters. Both the list and the TMDLs are subject to U.S. Environmental Protection Agency approval.

Aeration
A process by which water becomes charged with air directly from the atmosphere. Dissolved gases, such as oxygen, are then available for reactions in water.

Aerobic
Describes life, processes, or conditions that require the presence of oxygen.

Aquatic
Occurring, growing, or living in water.

Aquifer
An underground, water-bearing layer or stratum of permeable rock, sand, or gravel capable of yielding of water to wells or springs.

Assemblage (aquatic)
An association of interacting populations of organisms in a given water body; for example, a fish assemblage or a benthic macroinvertebrate assemblage (also see Community) (EPA 1996).

Assessment 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.

Assessment Unit (AU)

A segment of a water body that is treated as a homogenous unit, meaning that any designated uses, the rating of these uses, and any associated causes and sources must be applied to the entirety of the unit.

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.

Bedload

Material (generally sand-sized or larger sediment) that is carried along the streambed by rolling or bouncing.

Beneficial Use

Any of the various uses of water, including, but not limited to, aquatic life, recreation, water supply, wildlife habitat, and aesthetics, which are recognized in water quality standards.

Beneficial Use Reconnaissance Program (BURP)

A program for conducting systematic biological and physical habitat surveys of water bodies in Idaho. BURP protocols address lakes, reservoirs, and wadeable streams and rivers

Benthic

Pertaining to or living on or in the bottom sediments of a water body

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.

Biochemical Oxygen Demand (BOD)

The amount of dissolved oxygen used by organisms during the decomposition (respiration) of organic matter, expressed as mass of oxygen per volume of water, over some specified period of time.

Biological Integrity

1) The condition of an aquatic community inhabiting unimpaired water bodies of a specified habitat as measured by an evaluation of multiple attributes of the aquatic biota (EPA 1996). 2) The ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the natural habitats of a region (Karr 1991).

Biomass

The weight of biological matter. Standing crop is the amount of biomass (e.g., fish or algae) in a body of water at a given time. Often expressed as grams per square meter.

Biota

The animal and plant life of a given region.

Biotic

A term applied to the living components of an area.

Clean Water Act (CWA)

The Federal Water Pollution Control Act (commonly known as the Clean Water Act), as last reauthorized by the Water Quality Act of 1987, establishes a process for states to use to develop information on, and control the quality of, the nation’s water resources.

Coliform Bacteria

A group of bacteria predominantly inhabiting the intestines of humans and animals but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms (also see Fecal Coliform Bacteria, *E. Coli*, and Pathogens).

Community

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

Conductivity

The ability of an aqueous solution to carry electric current, expressed in micro (μ) mhos/centimeter at 25 °C. Conductivity is affected by dissolved solids and is used as an indirect measure of total dissolved solids in a water sample.

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).

Decomposition

The breakdown of organic molecules (e.g., sugar) to inorganic molecules (e.g., carbon dioxide and water) through biological and nonbiological processes.

Designated Uses

Those water uses identified in state water quality standards that must be achieved and maintained as required under the Clean Water Act.

Discharge

The amount of water flowing in the stream channel at the time of measurement. Usually expressed as cubic feet per second (cfs).

Dissolved Oxygen (DO)

The oxygen dissolved in water. Adequate DO is vital to fish and other aquatic life.

Disturbance	Any event or series of events that disrupts ecosystem, community, or population structure and alters the physical environment.
E. coli	Short for *Escherichia coli*, *E. coli* are a group of bacteria that are a subspecies of coliform bacteria. Most *E. coli* are essential to the healthy life of all warm-blooded animals, including humans, but their presence in water is often indicative of fecal contamination. *E. coli* are used by the state of Idaho as the indicator for the presence of pathogenic microorganisms.
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.
Environment	The complete range of external conditions, physical and biological, that affect a particular organism or community.
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 Geological 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).

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.

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.

Flow
See *Discharge*.

Fluvial
In fisheries, this describes fish whose life history takes place entirely in streams but migrate to smaller streams for spawning.

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.

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.

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 Native American nations.

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.

Load(ing) Capacity (LC)

A determination of how much pollutant a water body can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, and a margin of safety, it becomes a total maximum daily load.

Loam

Refers to a soil with a texture resulting from a relative balance of sand, silt, and clay. This balance imparts many desirable characteristics for agricultural use.

Loess

A uniform wind-blown deposit of silty material. Silty soils are among the most highly erodible.

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.

Mean

Describes the central tendency of a set of numbers. The arithmetic mean (calculated by adding all items in a list, then dividing by the number of items) is the statistic most familiar to most people.

Median

The middle number in a sequence of numbers. If there are an even number of numbers, the median is the average of the two middle numbers. For example, 4 is the median of 1, 2, 4, 14, 16; 6 is the median of 1, 2, 5, 7, 9, 11.

Milligrams per Liter (mg/L)

A unit of measure for concentration. In water, it is essentially equivalent to parts per million (ppm).

Million Gallons per Day (MGD)

A unit of measure for the rate of discharge of water, often used to measure flow at wastewater treatment plants. One MGD is equal to 1.547 cubic feet per second.

Monitoring

A periodic or continuous measurement of the properties or conditions of some medium of interest, such as monitoring a water body.

National Pollution Discharge Elimination System (NPDES)

A national program established by the Clean Water Act for permitting point sources of pollution. Discharge of pollution from point sources is not allowed without a permit.

Natural Condition

The condition that exists with little or no anthropogenic influence.

Nitrogen

An element essential to plant growth, and thus is considered a nutrient.

Nonpoint Source

A dispersed source of pollutants, generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernable point or origin. They include, but are not limited to, irrigated and non-irrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.

Not Assessed (NA)

A concept and an assessment category describing water bodies that have been studied, but are missing critical information needed to complete an assessment.

Not 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.

Nuisance

Anything that is injurious to the public health or an obstruction to the free use, in the customary manner, of any waters of the state.

Nutrient

Any substance required by living things to grow. An element or its chemical forms essential to life, such as carbon, oxygen, nitrogen, and phosphorus. Commonly refers to those elements in short supply, such as nitrogen and phosphorus, which usually limit growth.

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.

Pathogens
A small subset of microorganisms (e.g., certain bacteria, viruses, and protozoa) that can cause sickness or death. Direct measurement of pathogen levels in surface water is difficult. Consequently, indicator bacteria that are often associated with pathogens are assessed. *E. coli*, a type of fecal coliform bacteria, are used by the state of Idaho as the indicator for the presence of pathogenic microorganisms.

Perennial Stream
A stream that flows year-around in most years.

Periphyton
Attached microflora (algae and diatoms) growing on the bottom of a water body or on submerged substrates, including larger plants.

pH
The negative $\log_{10}$ of the concentration of hydrogen ions, a measure which in water ranges from very acid (pH=1) to very alkaline (pH=14). A pH of 7 is neutral. Surface waters usually measure between pH 6 and 9.

Phosphorus
An element essential to plant growth, often in limited supply, and thus considered a nutrient.

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.
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 (Rand 1995). The goal of QA is to assure the data provided are of the quality needed and claimed (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 (Rand 1995). QC is implemented at the field or bench level (EPA 1996).
Quantitative	Descriptive of size, magnitude, or degree.
Reach	A stream section with fairly homogenous physical characteristics.

Reconnaissance
An exploratory or preliminary survey of an area.

Reference
A physical or chemical quantity whose value is known and thus is used to calibrate or standardize instruments.

Reference Condition
1) A condition that fully supports applicable beneficial uses with little affect from human activity and represents the highest level of support attainable. 2) A benchmark for populations of aquatic ecosystems used to describe desired conditions in a biological assessment and acceptable or unacceptable departures from them. The reference condition can be determined through examining regional reference sites, historical conditions, quantitative models, and expert judgment (Hughes 1995).

Reference Site
A specific locality on a water body that is minimally impaired and is representative of reference conditions for similar water bodies.

Representative Sample
A portion of material or water that is as similar in content and consistency as possible to that in the larger body of material or water being sampled.

Resident
A term that describes fish that do not migrate.

Respiration
A process by which organic matter is oxidized by organisms, including plants, animals, and bacteria. The process converts organic matter to energy, carbon dioxide, water, and lesser constituents.

Riffle
A relatively shallow, gravelly area of a streambed with a locally fast current, recognized by surface choppiness. Also an area of higher streambed gradient and roughness.

Riparian
Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a water body.

River

A large, natural, or human-modified stream that flows in a defined course or channel or in a series of diverging and converging channels.

Runoff

The portion of rainfall, melted snow, or irrigation water that flows across the surface, through shallow underground zones (interflow), and through ground water to creates streams.

Sediments

Deposits of fragmented materials from weathered rocks and organic material that were suspended in, transported by, and eventually deposited by water or air.

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.

Stream

A natural water course containing flowing water, at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.

Stream Order

Hierarchical ordering of streams based on the degree of branching. A first-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher order streams result from the joining of two streams of the same order.

Storm Water Runoff

Rainfall that quickly runs off the land after a storm. In developed watersheds the water flows off roofs and pavement into storm drains that may feed quickly and directly into the stream. The water often carries pollutants picked up from these surfaces.

Stressors

Physical, chemical, or biological entities that can induce adverse effects on ecosystems or human health.

Subbasin

A large watershed of several hundred thousand acres. This is the name commonly given to 4^{th} field hydrologic units (also see Hydrologic Unit).

Subbasin Assessment (SBA)

A watershed-based problem assessment that is the first step in developing a total maximum daily load in Idaho.

Surface Fines

Sediments of small size deposited on the surface of a streambed or lake bottom. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 605 millimeters depending on the observer and methodology used. Results are typically expressed as a percentage of observation points with fine sediment.

Surface 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).

Total Maximum Daily Load (TMDL)

A TMDL is a water body’s load capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual bases. A TMDL is equal to the load capacity, such that load capacity = margin of safety + natural background + load allocation + wasteload allocation = TMDL. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.

Total 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 (Franson et al. 1998) call for using a filter of 2.0 microns or smaller; a 0.45 micron filter is also often used. This method calls for drying at a temperature of 103-105 °C.

Tributary

A stream feeding into a larger stream or lake.

Trophic State

The level of growth or productivity of a lake as measured by phosphorus content, chlorophyll *a* concentrations, amount (biomass) of aquatic vegetation, algal abundance, and water clarity.

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 (Franson et al. 1998) 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.

Turbidity

A measure of the extent to which light passing through water is scattered by fine suspended materials. The effect of turbidity depends on the size of the particles (the finer the particles, the greater the effect per unit weight) and the color of the particles.

Wasteload Allocation (WLA)

The portion of receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. Wasteload allocations specify how much pollutant each point source may release to a water body.

Water Body

A stream, river, lake, estuary, coastline, or other water feature, or portion thereof.

Water Column

Water between the interface with the air at the surface and the interface with the sediment layer at the bottom. The idea derives from a vertical series of measurements (oxygen, temperature, phosphorus) used to characterize water.

Water Pollution

Any alteration of the physical, thermal, chemical, biological, or radioactive properties of any waters of the state, or the discharge of any pollutant into the waters of the state, which will or is likely to create a nuisance or to render such waters harmful, detrimental, or injurious to public health, safety, or welfare; to fish and wildlife; or to domestic, commercial, industrial, recreational, aesthetic, or other beneficial uses.

Water Quality

A term used to describe the biological, chemical, and physical characteristics of water with respect to its suitability for a beneficial use.

Water Quality Criteria

Levels of water quality expected to render a body of water suitable for its designated uses. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, or industrial processes.

Water Quality Limited

A label that describes water bodies for which one or more water quality criterion is not met or beneficial uses are not fully supported. Water quality limited segments may or may not be on a §303(d) list.

Water Quality Management Plan

A state or area-wide waste treatment management plan developed and updated in accordance with the provisions of the Clean Water Act.

Water Quality Standards

State-adopted and U.S. Environmental Protection Agency-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.

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)[a]	Cubic Meters per Second (m^3/sec)	1 cfs = 0.03 m^3/sec 1 m^3/sec = 35.31cfs	3 ft^3/sec = 0.09 m^3/sec 3 m^3/sec = 105.94 ft^3/sec
Concentration	Parts per Million (ppm)	Milligrams per Liter (mg/L)	1 ppm = 1 mg/L[b]	3 ppm = 3 mg/L
Weight	Pounds (lbs)	Kilograms (kg)	1 lb = 0.45 kg 1 kg = 2.20 lbs	3 lb = 1.36 kg 3 kg = 6.61 lb
Temperature	Fahrenheit (°F)	Celsius (°C)	°C = 0.55 (F - 32) °F = (C x 1.8) + 32	3 °F = -15.95 °C 3 °C = 37.4 °F

[a] 1 cfs = 0.65 million gallons per day; 1 million gallons per day is equal to 1.55 cfs.

[b] The ratio of 1 ppm = 1 mg/L is approximate and is only accurate for water.

Appendix B. Water Quality Data

Table B-1. South Fork Palouse River 2001-2002 monitoring data site SF-1.

Date	Time	D.O. (mg/L)	Temp (°C)	Cond (µS)	TDS (mg)	pH	Turbidity (NTU)	TSS (mg/L)	NO_2+NO_3 (mg/L)	NH_3 (mg/L)	TP (mg/L)	F-Coli Coli/100mL	E-Coli Coli/100mL	Flow (cfs)
11/26/2001	8:09	12.07	1.6	121.5	58	9.04	8.07	7	BDL	0.18	0.073	>2400	61	0.13655
12/5/2001	8:35	12.88	0.3	188	56	8.93	5.94	BDL	BDL	BDL	0.068	820	64	0.20475
12/19/2001	8:52	13.01	0.6	111.3	53	8.31	12.3	BDL	BDL	BDL	0.09	>2400	63	0.30545
1/2/2002	8:40	12.79	0.8	101.8	48	8.22	10.1	5	BDL	0.12	0.086	2200	390	0.20045
1/16/2002	8:45	12.2	1	89.5	42	8.38	50.3	5	BDL	BDL	0.13	870	53	0.93335
1/30/2002	9:00	12.85	0.2	121.9	59	8.42	24.2	BDL	BDL	BDL	0.096	1100	230	0.68205
2/12/2002	8:30	12.93	0.4	72	34	7.76	21.1	BDL	BDL	BDL	0.11	690	37	0.718
2/26/2002	14:20	12.18	1.8	56	27	7.3	37.5	10	BDL	BDL	0.17	980	57	3.2407
3/12/2002	8:30	12.06	2.1	50	25	7.2	83.1	19	0.14	BDL	0.2	>2400	79	10.5521
3/25/2002	8:30	11.26	3	48.8	24	7.3	38.6	14	BDL	BDL	0.18	2000	93	7.08725
4/8/2002	16:00	10.15	5.8	40.5	21	7.4	40.9	24	BDL	BDL	0.16			8.82175
4/22/2002	16:00	10.75	7.4	38.2	20	7.4	30.6	13	BDL	BDL	0.13	610	45	3.219225
5/8/2002	8:30	12.34	2.9	46.7	23	7.1	19.6	BDL	BDL	BDL	0.092	>2400	56	1.63955
5/22/2002	8:30	10.12	6	44.7	22	7.7	18.2	BDL	BDL	BDL	0.098	490	9	0.8829
6/4/2002	8:30	8.87	10	49.5	26	7.8	16.3	4	BDL	BDL	0.1	330	23	0.46025
6/18/2002	8:30	9.5	10.2	52.8	28	7.8	20.3	13	BDL	BDL	0.17	>2400	110	0.722
7/3/2002	9:00	8.47	10.6	65	38	8	8.33	BDL	BDL	BDL	0.097	1700	140	0.2117
7/15/2002	14:00	8.34	14.9	67.5	36	7.1	7.12	4	BDL	BDL	0.1	2400	980	0.08085
7/30/2002	8:30	8.25	12.7	71.6	38	8.2	13.1	30	BDL	BDL	0.16	>2400	340	0.09945
8/13/2002	9:00	8.6	10.4	76.9	39	7.1	5.8	6	BDL	BDL	0.1	>2400	1200	0.0513
8/27/2002	8:30	7.8	11.8	72.8	38	6.9	5.86	BDL	BDL	BDL	0.1	>2400	690	0.04665
9/5/2002														Dry
9/24/2002														Dry
10/8/2002	9:00	9.31	5.7	81	40	8.2	5.69	BDL	BDL	BDL	0.083	>2400	83	0.033525
10/22/2002	9:00	9.13	4.8	78.1	39	8.3	10.2	6	BDL	BDL	0.08	>2400	160	0.043775
11/6/2002	8:00	12.5	0.1	78.6	38	8.5	6.65	BDL	BDL	BDL	0.077	>2400	440	0.1448
11/19/2002	13:50	10.3	4.6	79.1	39	7.7	6.42	BDL	BDL	BDL	0.059	>2400	47	1.2162

Table B-2. South Fork River 2001-2002 monitoring data site SF-2.

Date	Time	D.O. (mg/L)	Temp (°C)	Cond (µS)	TDS (mg)	pH	Turbidity (NTU)	TSS (mg/L	NO2+NO3 (mg/L)	NH3 (mg/L)	TP (mg/L)	F-Coli Coli/100mL	E-Coli Coli/100mL	Flow (cfs)
11/26/2001	8:42	11.66	1.5	126.2	60	8.82	8.3	BDL	BDL	0.13	0.12	>2400	130	0.67125
12/5/2001	9:17	12.61	0.1	128.5	60	7.17	6.96	BDL	0.15	0.11	0.085	610	34	0.4565
12/19/2001	9:15	13.11	0.1	162.6	76	7.48	13.9	BDL	2.2	BDL	0.098	>2400	120	1.6558
1/2/2002	9:30	11.91	0.1	154	73	7.31	11.7	BDL	1.5	0.11	0.078	2400	41	0.8702
1/16/2002	9:00	13.17	0.3	143.4	68	7.32	39.7	8	2	BDL	0.14	2400	63	3.58275
1/30/2002	9:17	12.91	0	122.6	57	7.98	24	7	3.6	BDL	0.14	2400	45	6.074025
2/12/2002	9:00	13.1	0.2	119	96	7.63	21.9	7	3.5	BDL	0.13	>2400	550	6.9106
2/26/2002	14:50	12.22	0.6	84.1	40	7.2	49.2	48	1.9	BDL	0.21	>2400	140	19.6765
3/12/2002	9:00	10.54	1.4	74	37	7.1	167	330	3	BDL	0.52	>2400	160	39.96
3/25/2002	9:00	11.42	3	64	31	7.3	51.6	60	1.5	BDL	0.23	>2400	88	35.2425
4/8/2002	16:30	10.14	6.3	42	21	7.3	47	55	0.14	BDL	0.19			21.4623
4/22/2002	16:30	11.11	7.5	41.9	22	7.3	35.7	41	BDL	BDL	0.14	2000	28	12.9174
5/8/2002	8:45	12.22	3	41	21	7.2	25	18	BDL	BDL	0.091	>2400	24	8.5216
5/22/2002	9:00	10.19	5.7	36	18	7.6	15.3	10	BDL	0.23	0.093	980	15	7.0822
6/4/2002	9:00	9.08	9.9	39.6	20	7.6	11.7	14	BDL	BDL	0.082	1700	210	3.899
6/18/2002	9:00	9.1	11	66.7	35	7.7	39.4	37	0.24	0.12	0.33	>2400	>2400	2.832
7/3/2002	9:15	8	11.4	55	28	7.7	8.46	6	BDL	BDL	0.12	6900	230	1.2077
7/15/2002	14:30	8.05	18.9	55.6	30	7.2	9.99	9	BDL	BDL	0.12	>2400	900	0.53
7/30/2002	9:02	6.27	15.2	61.1	32	7.6	8.57	8	BDL	BDL	0.16	>2400	520	0.396825
8/18/2002	10:00	8.24	12.6	59.8	32	6.9	10.7	8	BDL	BDL	0.15	>2400	100	0.5474
8/27/2002	9:00	7.04	13.7	62.7	33	7	8.91	BDL	BDL	BDL	0.16	>2400	21	0.6658
9/5/2002	9:00	7.55	13.7	64	33	7.6	6.35	15	BDL	BDL	0.21	>2400	110	0.3802
9/24/2002	9:30	5.25	8.1	71	36	8	8	9	BDL	BDL	0.15	>2400	59	0.2976
10/8/2002	9:30	9.66	6.6	72.3	36	8	7.78	BDL	BDL	BDL	0.13	>2400	17	0.1926
10/22/2002	9:30	9.18	5	77.9	39	8.1	6.59	4	BDL	BDL	0.12	>2400	15	0.4252
11/6/2002	9:00	11.9	0.2	73.9	25	8.2	7.92	BDL	BDL	BDL	0.093	1700	2	0.3522
11/19/2002	14:00	9.3	4.6	76.1	38	7.6	6.01	BDL	BDL	BDL	0.083	2400	2	0.49785

Table B-3. South Fork Palouse River 2001-2002 monitoring data site SF-3.

Date	Time	D.O. (mg/L)	Temp (°C)	Cond (µS)	TDS (mg)	pH	Turbidity (NTU)	TSS (mg/L)	NO2+NO3 (mg/L)	NH3 (mg/L)	TP (,g/L)	F-Coli Coli/100mL	E-Coli Coli/100mL	Flow (cfs)
11/26/2001	9:25	12.59	2.1	241	116	8.94	13	8	0.47	0.19	0.11	>2400	15	1.264
12/5/2001	9:48	12.84	0.2	293	140	9.05	11	6	2.2	BDL	0.1	>2400	36	3.635
12/19/2001	9:50	10.61	1.5	342	163	8.94	32.6	26	7.7	BDL	0.17	>2400	40	3.3485
1/2/2002	9:45	11.76	0.5	291	139		14.1	11	3.1	0.11	0.1	>2400	23	1.524
1/16/2002	9:35	12	0.4	245	116	8.32	42.9	14	4.5	BDL	0.18	1200	31	9.144
1/30/2002	10:00	12.25	0.5	197.2	91	7.47	27.3	11	6.5	BDL	0.18	>2400	31	14.9791
2/12/2002	9:30	13	0.5	244	115	5.03?	25.1	9	6.6	BDL	0.17	1700	36	17.24955
2/26/2002	15:30	12.3	0.4	122	59	7.3	64.1	74	4	BDL	0.24	>2400	130	52.8507
3/12/2002	9:30	11.73	1.5	116	56	7.1	328	530	5.1	BDL	0.81	>2400	74	too deep
3/25/2002	9:45	11.08	3.5	110	55	7.4	64	74	3.6	BDL	0.26	>2400	38	84.5185
4/8/2002	16:45	10.18	8.6	71.3	37	7.5	58.3	32	0.92	BDL	0.21			too deep
4/22/2002	8:30	12.68	4.8	73.8	37	7.9	37.6	28	0.71	BDL	0.14	1500	53	25.061
5/8/2002	9:30	11.82	5.3	92.2	46.3	7.5	25.3	12	1.1	BDL	0.095	>2400	39	15.89
5/22/2002	9:30	10.36	7.3	72.6	37	7.8	15.5	10	0.42	BDL	0.097	730	25	8.8028
6/4/2002	9:30	8.07	15.1	11.7	77.3	7.6	41	8	0.46	BDL	0.12	2000	110	4.8949
6/18/2002	10:00	7.42	14.7	103.8	54	7.6	42.9	34	0.64	BDL	0.2	>2400	>2400	4.3281
7/3/2002	9:30	10.16	17.4	114	60	8.2	7.72	6	0.22	BDL	0.097	350	140	1.40295
7/15/2002	15:00	13.32	29.4	130.2	69	9.3	7.95	5	BDL	BDL	0.098	1800	90	0.6753
7/30/2002	10:00	9.52	19.4	161.7	88	9.2	7.57	7	BDL	BDL	0.12	>2400	65	0.71055
8/13/2002	10:45	10.55	19.6	175.6	94	8.6	9.14	8	BDL	BDL	0.085	>2400	100	0.3652
8/27/2002	10:00	8.43	17.6	195.4	103	8	4.16	BDL	BDL	BDL	0.045	1400	64	0.32105
9/5/2002	14:30	11.72	17.1	180	95	8.8	6.43	7	BDL	BDL	0.055	920	39	0.29015
9/24/2002	10:00	8.03	10.3	210	109	8.2	2.66	4	BDL	BDL	0.025	1120	20	0.12915
10/8/2002	10:00	8.88	7.9	195	99	7.9	4.6	BDL	BDL	BDL	0.017	870	4	0.4042
10/22/2002	10:00	10.26	5.8	194.8	100	8.2	7.82	BDL	BDL	BDL	0.033	>2400	5	0.498
11/6/2002	10:00	11.12	0.7	185	90	8	9.06	10	0.33	BDL	0.051	>2400	1	0.47425
11/19/2002	14:40	13.19	5.9	141.2	70	7.8	4.13	BDL	0.14	BDL	0.04	>2400	1	0.45115

Table B-4. South Fork Palouse River 2001-2002 monitoring data site SF-4.

Date	Time	D.O. (mg/L)	Temp (°C)	Cond (µS)	TDS (mg)	pH	Turbidity (NTU)	TSS (mg/L)	NO2+NO3 (mg/L)	NH3 (mg/L)	TP (mg/L)	F-Coli Coli/100mL	E-Coli Coli/10mL	Flow (cfs)
11/26/2001	9:45	10.12	2.4	392	193	8.18	9.15	18	0.59	0.24	0.14	>2400	15	NA
12/5/2001	10:28	11.54	0.8	460	215	8.2	10.2	BDL	1.9	BDL	0.1	1700	62	NA
12/19/2001	10:18	9.66	0.2	431	205	8.25	25.6	6	7.6	BDL	0.18	>2400	110	NA
1/2/2002	10:04	11.42	0.2	428	205		7.11	BDL	3.2	BDL	0.1	>2400	10	NA
1/16/2002	10:00	12.2	0.2	283	135	7.83	44.8	20	4.8	BDL	0.17	2000	60	NA
1/30/2002	10:20	12.55	0.1	243	113	7.46	24.2	9	6.8	BDL	0.19	>2400	76	18.1404
2/12/2002	10:00	13.25	0.2	246	120	6.67	23.9	11	6.9	BDL	0.17	2400	50	23.53875
2/26/2002	15:40	12.22	0.3	90.3	45	7.5	68.7	71	4.7	BDL	0.24	>2400	66	55.04
3/12/2002	10:00	11.06	2	111	54	7.3	474	560	5.4	BDL	1	>2400	200	99.11
3/25/2002	10:00	10.8	5.1	126	63	7.5	83.1	100	4.2	0.13	0.32	>2400	140	89.24
4/8/2002	17:00	10.18	9.9	92	47	8.9	55.2	33	1.3	BDL	0.19			62.05
4/22/2002	9:00	12.25	5.6	99	50	7.9	40	27	1.1	BDL	0.15	1300	40	24.3635
5/8/2002	10:00	12.57	5.4	121.6	60	7.8	21.5	16	0.71	BDL	0.11	>2400	52	15.04895
5/22/2002	10:00	9.64	7.9	107.4	55	7.8	14.7	9	0.73	BDL	0.1	1300	53	11.08275
6/4/2002	10:00	6.08	16.8	132.3	70	7.7	11.3	10	0.62	BDL	0.14	>2400	220	5.5047
6/18/2002	10:30	5.79	15.5	109.6	95	76	21.9	21	0.87	BDL	0.37	>2400	920	6.2598
7/3/2002	10:00	6.33	17.1	213	113	7.8	18	BDL	0.5	BDL	0.12	>2400	150	1.86875
7/16/2002	15:30	7.9	22.1	271	145	8	4.33	BDL	0.39	BDL	0.13	>2400	31	1.5925
7/29/2002	11:00	4.84	17.9	345	184	7.8	5.55	6	BDL	BDL	0.098	>2400	68	2.1448
8/18/2002	12:00	5.72	15.3	324	173	7.6	6.94	5	BDL	BDL	0.078	2400	59	3.5136
8/28/2002	10:30	4.69	14.8	409	218	7.5	3.31	BDL	BDL	BDL	0.07	2400	86	2.0715
9/5/2002	15:00	4.84	14	349	185	7.8	4.17	BDL	BDL	BDL	0.075	2400	33	1.56935
9/24/2002	10:30	5.14	8.2	420	219	8	3.65	BDL	0.19	BDL	0.051	>2400	28	0.3074
10/7/2002	10:30	5.57	7.6	391	203	7.7	5.18	BDL	0.76	BDL	0.052	>2400	7	0.4928
10/22/2002	10:30	4.9	4.2	390	196	7.8	4.7	BDL	1.3	BDL	0.038	>2400	10	4.3856
11/5/2002	10:30	9.13	1.1	367	179	7.9	6.22	7	1.9	BDL	0.11	2400	4	0.44
11/18/2002	14:55	7.56	5.4	272	135	7.6	2.2	BDL	0.9	BDL	0.064	410	2	0.42

Appendix C. Public Comments

Public Comments

The Watershed Advisory Group voted to provide a 30 day public comment period for a Public Comment Draft of the South Fork Palouse River Watershed Assessment and Total Maximum Daily Load document during the December Watershed Advisory Group meeting. Notice was provided to the general public through the Lewiston Morning Tribune, and the Moscow Pullman Daily News.

Copies of the document were made available through the Lewiston and State Offices of the Department of Environmental Quality, the Latah Soil Water Conservation District Office, the Palouse Clearwater Environmental Institute, the Latah County and University of Idaho Libraries, City of Moscow, Watershed Advisory Group Members, Clearwater Basin Advisory Group Members, and the US Environmental Protection Agency's Idaho Operations Office.

The comments received were reviewed and discussed by the Watershed Advisory Group during the February 2007 meeting. The Watershed Advisory Group provided the agency advice on the following responses and actions to the comments received.

Written comments were received from:

US Environmental Protection Agency
Region 10, Idaho Operations Office
Boise, Idaho

State of Washington
Department of Ecology
Spokane, Washington

Comments received are summarized and addressed below.

Comment 1: The Clean Water Act requires the protection of "existing uses." An existing use is defined in the Clean Water act as "those uses actually attained in the waterbody on or after November 28, 1975, whether or not they are included in the water quality standards." The fact that you did not find three year classes of salmonids present in the lower reaches of the South Fork of the Palouse on one or two dates is not proof positive that salmonid spawning is not an existing use. Pages 35-36.

Response: We agree.

Comment 2: On page 35, in the fourth paragraph, it is stated that you want to use a TSS target of 80 mg/l average concentration over a 30-day period to provide moderate protection for salmonid populations in the lower portion of the watershed. The guidance (DEQ 2003) calls for a 50 mg/l 30-day average concentration with an 80 mg/l daily maximum concentration. We do not believe that an average of 80 mg/l is protective of salmonid populations.

Response: The sediment TMDL has been revised to reflect targets of a 25 mg/l TSS monthly average with a 50 mg/l TSS daily maximum for the upper portion of the watershed and a 50 mg/l TSS monthly average with an 80 mg/l TSS daily maximum in the lower portion of the watershed.

Comment 3: We do not understand the use of seasonal load allocations for TSS. Any time a major storm event or high flow event occurs these allocations are important. We believe these allocations should apply year round, not just part of the year. If the required loads aren't exceeded during a dry part of the year then the stream is meeting the TMDL and is in compliance. If you have an unexpected run-off event, the TMDL requirements are still in place and the target needs to be met. Pages 56-57.

Response: The TMDL has been revised accordingly.

Comment 4: The load allocations on page 57 for TSS are all expressed in "pounds per month." Under the current policy, based on the Anacostia River TMDL case, these loads need to be expressed in "pounds per day."

Response: The TMDL has been revised accordingly.

Comment 5: Each of the mobile home parks included in the wasteload allocation need to have separate individual allocations. I understand the need to "estimate" their relative contributions to the total as an interim allocation. When you obtain sufficient information to develop a final wasteload allocation for each facility, you can attach an amendment to the TMDL. Until that time, the WLAs as stated in the TMDL will remain in effect. (Pages 52-53).

Response: The TMDL will be revised and separate waste load allocations will be developed for Syringa and Country Homes when the needed information becomes available.

Comment 6: Executive Summary, page xix, 1st paragraph: Table B does not refer to sediment and nutrient loads.

Response: Reference to Table B has been corrected.

Comment 7: Executive Summary: The executive summary should be changed to reflect comments outlined below.

Response: We agree.

Comment 8: Section 1.1: Please include language regarding the requirement to meet downstream water quality standards in the description of the Clean Water Act.

Response: Reference to Clean Water Act requirements for downstream water quality standards is included in Section 1.1.

Comment 9: Section 1.2, pages 6-8: On Figures 3 through 6, it would be more useful to have the same scale for the y-axis on all figures (using log-scale would provide more information about low-flows; also on Figure 11 on page 26).

Response: Graphs presented, in their entirety, are from the US Geological Survey.

Comment 10: Section 2.4, page 24, 1st paragraph: The reference to Appendix A should be to Appendix B.

Response: The TMDL has been corrected.

Comment 11: Section 2.4, page 30, 1st paragraph: This paragraph references the need to meet Washington's water quality standards and indicates the TMDL will attempt to meet Washington's dissolved oxygen standard. This statement should apply to all pollutants, not just dissolved oxygen. Please include language indicating that the TMDLs will be established to meet all Washington State water quality standards at the border. A reference to Washington's standard under each pollutant section may be beneficial to future implementation planning.

Response: Reference to Clean Water Act requirements for downstream water quality standards is included in Section 1.1.

Comment 12: Section 2.4, page 30, Table 8: The table should show the range of times or the average time of day that the instantaneous samples were taken (looking at Tables B1-B4, it looks like between 8:30 and 10:30 in the morning), and there should be some acknowledgement that DO concentrations probably reach much lower levels than sampled (at night and early morning).

Response: Table 8 summarizes the data collected; diurnal concentrations were not available for this analysis.

Comment 13: Section 2.4, page 31, last paragraph: The season of concern is established on page 32, Figure 14 to be May through October. The river appears to be nearly devoid of nitrogen at all sites during this time period based on Figure 18 (the y-axis should originate at 0 on Figure 18 so we can see how low the nitrate values go) and it appears obvious that the N:P ratios are below 7 during the critical time period, a nitrogen limiting situation. The range of N:P ratios referred to (12:1 to 18:1) does not appear to be right for the critical time period. These rations may exist at other time of the year.

Response: The N:P ratios presented are annual mean concentrations. Figure 18 presents nitrogen concentrations relative to the recommended target. During the critical time period, average nitrogen concentrations are below the recommended target.

Comment 14: Section 2.4, page 32, 2nd paragraph: The first sentence does not read right.

Response: The sentence has been revised for clarity.

Comment 15: Section 2.4, page 36, 2nd paragraph: The sentence about total phosphorus being "sufficiently high to be limiting" does not make sense. The data appears to show that nitrogen is limiting during the critical time period (see above comment).

Response: The sentence has been revised for clarity. During the critical time period, average nitrogen concentrations are below the recommended target while total phosphorus concentrations are above the recommended target.

Comment 16: Section 2.5, page 37, 1st paragraph: How is the database credible? There is no acknowledgement that the data was collected under a Quality Assurance Project Plan and there is no QA/QC analysis of the data presented.

Response: Data used in this assessment was collected by the Idaho Association of Soil Conservation Districts in accordance with the Association's Quality Assurance Project Plan. The data were reviewed for compliance with the plan's quality assurance objectives and found to be acceptable. The Association's Quality Assurance Project Plan can be viewed through the Idaho Department of Agriculture internet web page.

Comment 17: Section 2.5, page 37, last paragraph: This section should acknowledge that Idaho must meet WA State water quality standards in the South Fork Palouse River at the state line and that the TMDL may need to be revised to ensure these conditions are met.

Response: Reference to Clean Water Act requirements for downstream water quality standards is included in Section 1.1.

Comment 18: Section 5.1, page 46, last paragraph: There needs to be a better argument to use a mass concentration versus a mass load for the E. coli TMDL. Mass loads are calculated for TSS and phosphorus and they both have loss and gain processes (e.g., settling, resuspension, uptake, etc.) and are subject to continuous and constant fluctuation of flow and yet loads were established.

Response: TMDL regulations allow application of a concentration based pollutant allocation. This TMDL applies the Idaho State Water Quality Standard to achieve the concentration based pollutant allocation.

Comment 19: Section 5.1, page 47, 2nd paragraph: The EPA citation should read "USEPA 2001" as in the references. The cited reference does not state that it is difficult to calculate a mass load for bacteria. Loads are actually easy to calculate, but maybe interpretation of a mass load balance would be complicated by losses and gains. The EPA reference actually offers methods for using a first-order loss coefficient to account for losses when calculating a linkage analysis.

Response: The citation has been corrected.

Comment 20: Section 5..1, page 47, 4th paragraph: Table 11 should be Table 10.

Response: The TMDL has been revised.

Comment 21: Section 5.1: The bacteria TMDL does not take into account the WA State standards that must be met at the state line.

Response: The Idaho Water Quality Standard's bacteria criterion is approved by the US EPA for support of recreational beneficial uses. As such, the Idaho Water Quality Standard for recreational beneficial use support is comparable with Washington State's Water Quality Standard for support of recreational beneficial uses.

Comment 22: Section 5.2, page 49, 3rd paragraph: See above comment about critical season being N-limited. Is there evidence that keeping P levels below 0.10 mg/L will increase DO levels to meet standards?

Response: The nutrient targets used in this TMDL are provided by guidance contained within the references published by the US EPA.

Comment 23: Section 5.2, page 50, 4th paragraph: Margin of safety sentence belongs in MOS section and the table referred to should be Table 13.

Response: Revisions have been made to the document.

Comment 24: Section 5.2, page 53, 4th paragraph: Not sure why Table 14 is referred to here.

Response: Table 14 provides load allocations and waste load allocations to dischargers located within the watershed.

Comment 25: Section 5.2, page 54, last paragraph: The critical time period was earlier referred to being from April through September on pages 50 and 53; here it is stated to be mid-May through October.

Response: The TMDL has been corrected.

Comment 26: Section 5.2, page 54: The flow data used to calculate the average daily flow (eventually used to develop daily loads from the phosphorus concentrations specified in IDEQ guidance documents) is scant. See similar comment below concerning sediment loads.

Response: The available data set reflects the limitations in monitoring resources.

Comment 27: Section 5.3, page 56: The flow data used to calculate the average monthly flow (eventually used to develop monthly loads from the sediment concentrations specified in IDEQ guidance documents) is scant. There are usually only 2 instantaneous flows for each month from the one study year (Nov 2001-Nov 2002) used to determine the monthly average flow. Though there is some continuous flow data acknowledged on pages 6-8, there appears to be no analysis of how the study-year flows compare to other flow years. A longer flow record should be used to develop monthly average flows to determine loads. It seems there would be a potential to use the flow data at the USGS station in Pullman to develop some correlated record at the Idaho sites.

Response: Additional data could be useful and will be applied when available.

Comment 28: Section 5.3, page 58: The load allocations are given in pounds per month. Does Idaho have guidance on how many measurements must be made in order to check compliance with this allocation (e.g., an average of X samples over a 30-day period)?

Response: This TMDL will be accompanied by a TMDL implementation plan which will provide guidance for monitoring pollutant load allocations.

Comment 29: Section 5.4, page 60, 4th paragraph: Second to last sentence should read “Shade decreases with increased width…:”

Response: This sentence has been revised.

Comment 30: Section 5.4, page 60, 2nd paragraph: How long are the reaches that the 10 traces are taken from?

Response: The TMDL has been revised to provide an explanation.

Comment 31: Section 5.4, page 61, 1st paragraph and table: What differentiates the cover class percentages when the vegetation types are the same?

Response: Bank full width differentiates the cover class percentages when the vegetation types are the same.

Comment 32: Section 5.4, page 61, last paragraph: What stream width data was used? Was there an attempt to develop a drainage specific bankful width to drainage area relationship with the available data?

Response: Field measurements were used for stream width data. Drainage specific bank full width was considered and found not to be applicable due to channel modifications for flood control.

Comments 33: Section 5.4, page 65, 3rd paragraph, last sentence: How were the ranges of percent vegetative covers for the different communities derived? This needs a reference.

Response: Effective shade curves from existing temperature TMDLs were used to determine potential natural vegetation shade targets. Shade target tables list the references.

Comments 34: Section 5.4, page 65, Tables 19-21: What does “Shade targets as 10% class intervals…” mean in the table titles?

Response: Class intervals represent averages rounded to 10% intervals. The document has been revised for clarity.

Comment 35: Section 5.4, page 67, 1st paragraph, second sentence: “plat” needs an “e”.

Response: The document has been corrected.

Comment 36: Section 5.4, page 67: More discussion is needed about the potential solar loads, particularly the averaging periods. It says they are spring and summer averages, but I am not sure how these fit into the analysis. A table showing the derivation of the potential solar loads would be good.

Response: Potential solar loads are based on a 6 month average between April and September.

Comment 37: Section 5.4, Table 23: Why is the 0.4 shade fraction under potential shade for the shrub/meadow part of the river not 0.45 as in Table 21?

Response: The document has been corrected.

Comment 38: Section 5.4, Figure 20: This figure is not referenced in the text anywhere.

Response: The figure has been referenced in the document.

Comment 39: Section 5.4, Table 24: Where do the excess load numbers come from: They don’t match Table 22 and 23.

Response: Loads presented in table 26 originate from tables 24 and 25.

Appendix D. Distribution List

Department of Environmental Quality, Lewiston Regional Office
1118 F Street, Lewiston, Idaho, 83501

Department of Environmental Quality, State Office
1410 North Hilton, Boise, Idaho 83706

US Environmental Protection Agency, Idaho Operations Office
1435 North Orchard, Boise, Idaho 83706

Idaho Soil Conservation Commission
220 East 5th Street, Room 212-A, Moscow, Idaho 83843

Idaho Department of Lands
3780 Industrial Avenue, Coeur d'Alene, Idaho 83815

Idaho Transportation Department
2600 Frontage Road, Lewiston, Idaho 83501

Clearwater Basin Advisory Group Members

South Fork Palouse River Watershed Advisory Group Members

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