Portneuf River TMDL Revision and Addendum



Lower Marsh Creek, upstream of the confluence with the Portneuf River

Department of Environmental Quality

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Portneuf River TMDL Revision and Addendum

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Abbreviations, Acronyms, and Symbols

§303(d)	Refers to section 303 subsection (d) of the Clean Water Act, or a list of impaired water bodies required by this section
µ	micro, one-one thousandth
§	Section (usually a section of federal or state rules or statutes)
ADB	assessment database
AU	assessment unit
AWS	agricultural water supply
BAG	Basin Advisory Group
BLM	United States Bureau of Land Management
BMP	best management practice
BOD	biochemical oxygen demand
BOR	United States Bureau of Reclamation
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
CWE	cumulative watershed effects
DEQ	Department of Environmental Quality

DO	dissolved oxygen
DOI	U.S. Department of the Interior
DWS	domestic water supply
EMAP	Environmental Monitoring and Assessment Program
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
F	Fahrenheit
FPA	Idaho Forest Practices Act
FWS	U.S. Fish and Wildlife Service
GIS	Geographical Information Systems
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
IDWR	Idaho Department of Water Resources
INFISH	the federal Inland Native Fish Strategy
IRIS	Integrated Risk Information System
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

MRCL multiresolution land cover

MWMT maximum weekly maximum temperature

n.a. not applicable

NA not assessed

NB natural background

nd no data (data not available)

NFS not fully supporting

NPDES National Pollutant Discharge Elimination System

NRCS Natural Resources Conservation Service

NTU nephelometric turbidity unit

ORV off-road vehicle

ORW Outstanding Resource Water

PACFISH the federal Pacific Anadromous Fish Strategy

PCR primary contact recreation

PFC proper functioning condition

ppm part(s) per million

QA quality assurance

QC quality control

RBP rapid bioassessment protocol

RDI DEQ's River Diatom Index

RFI DEQ's River Fish Index

RHCA riparian habitat conservation area

RMI DEQ's River Macroinvertebrate Index

RPI DEQ's River Physiochemical Index

SBA subbasin assessment

SCR secondary contact recreation

SFI DEQ's Stream Fish Index

SHI DEQ's Stream Habitat Index

SMI DEQ's Stream Macroinvertebrate Index

SRP soluble reactive phosphorus

SS salmonid spawning

SSOC stream segment of concern

STATSGO State Soil Geographic Database

TDG total dissolved gas

TDS total dissolved solids

T&E threatened and/or endangered species

TIN total inorganic nitrogen

TKN total Kjeldahl nitrogen

TMDL total maximum daily load

TP total phosphorus

TS total solids

TSS total suspended sediment

U.S. United States

U.S.C. United States Code

USDA United States Department of Agriculture

USDI United States Department of the Interior

USFS United States Forest Service

USGS United States Geological Survey

WAG Watershed Advisory Group

WBAG *Water Body Assessment Guidance*

WBID water body identification number

WET whole effluence toxicity

WLA wasteload allocation

WQLS water quality limited segment

WQMP water quality management plan

WQRP water quality restoration plan

WQS water quality standard

Executive Summary

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

This document addresses water bodies in the Portneuf River subbasin that are on Idaho's current §303(d) list, including carryovers from previous lists (2002, 1998, and 1996), and also revisions to assessment units with approved TMDLs (listed in Section 4a) or that have been delisted and appear in the Section of Delisted Assessment Units in the 2008 §303(d)/305(b) Integrated Report.

These TMDL analyses have been developed to comply with Idaho's TMDL schedule. The assessment briefly describes the physical, biological, and cultural setting; water quality status; pollutant sources in the Portneuf River subbasin, located southeast Idaho.

The first part of this document provides a brief update to the Portneuf River Subbasin Assessment (SBA) approved in April 2001 and is followed by the loading summary that represents the focus of the revision to the original TMDL. Idaho's 2008 §303(d)/305(b) Integrated Report approved on 4 February 2009 represents the most current Impaired Waters' list and describes thirty water quality limited assessment units in the Portneuf River subbasin (Table B). However, the starting point for this assessment began with the 2002 Integrated Report which identified nineteen water quality limited assessment units in the Portneuf River subbasin; eight assessment units were carried over from 2002 onto the 2008 list. The remainder of the 2002-listed waters are proposed for delisting or received TMDLs as part of this document to revise loads approved in Section 4a of the 2008 Integrated Report (see Table C). These TMDL analyses quantify pollutant sources and allocate responsibility for load reductions needed to return listed waters to a condition that meets water quality standards or targets described in this revision and ultimately restores beneficial uses to all listed waters.

Subbasin at a Glance

The Portneuf River subbasin (4th Field Hydrologic Unit Code 17040208) is approximately 1,326.6 mi^2 and ranges in elevation from 9,280 ft to 4,350 ft. The climate is semiarid mid-latitude steppe; average annual precipitation is 12.7 inches and annual temperatures range from an average July maximum of 89.5°F to average January minimum of 17.9°F.

The 2008 §303(d)/305(b) Integrated Report identified 30 water quality limited assessment units in the Portneuf River subbasin. This list included 3 mainstem segments, 26 tributary assessment units, and Hawkins Reservoir. For this TMDL revision and addendum, the starting point was the 2002 list plus the incorporation of assessment unit translations and a carryover from the 23 water quality limited assessment units in the Portneuf River subbasin identified in the 1996 list.

Six pollutants were identified from the 2008 §303(d)/305(b) Integrated Report and are summarized in order of decreasing number of AUs impaired: *Escherichia coli*/fecal coliforms (22 AUs; Idaho's current WQS for fecal indicators is *E. coli*), temperature (7 AUs), dissolved oxygen (6 AUs), phosphorus (2 AUs), nitrogen (1 AU), and sediment (1 AU). The 2002 list described five pollutants including: sediments (16 AUs), pathogens/bacteria/*E. coli* (10 AUs; Idaho's current WQS for fecal indicators is *E. coli*), nutrients (8 AUs), oil and grease (1 AU), and dissolved oxygen (1 AU). In 2002, some AUs were listed for unknown causes (3 AUs impaired); the cause of impairment was presumed to be sediments and nutrients for unnamed tributaries to Marsh Creek, sediment, nutrients, and oil and grease for the Portneuf River – Marsh Creek to the Fort Hall Reservation Boundary, and *E. coli* for Indian Creek.

The beneficial uses affected by these pollutants include cold water aquatic life (CWAL) and primary (PCR) and secondary contact recreation (SCR).

The Portneuf Watershed Advisory Group endorsed targets for the Portneuf River subbasin are as follows: 35 mg/L (low flow) and 80 mg/L (high flow) TSS, 0.07 mg/L (low flow) and 0.125 mg/L (high flow) TP, and 5 mg/L oil and grease. High flow months include March, April, May and June. The *E. coli* criterion for the subbasin follows the state of Idaho numeric criterion of 126 organisms/100 mL *E. coli*. In addition, a 1.0 mg/L TN target was established for tributaries to the Portneuf River. Lastly, a chlorophyll *a* target of 0.015 mg/L, DO criterion of 6.0 mg/L, and reduced TP target of 0.03 mg/L were applied to Hawkins Reservoir.

The goal of this TMDL revision was to establish empirical-derived targets that would restore beneficial uses. The implementation plans that are produced subsequent to this revision of the TMDL will establish timeframes for achieving water quality targets and standards.

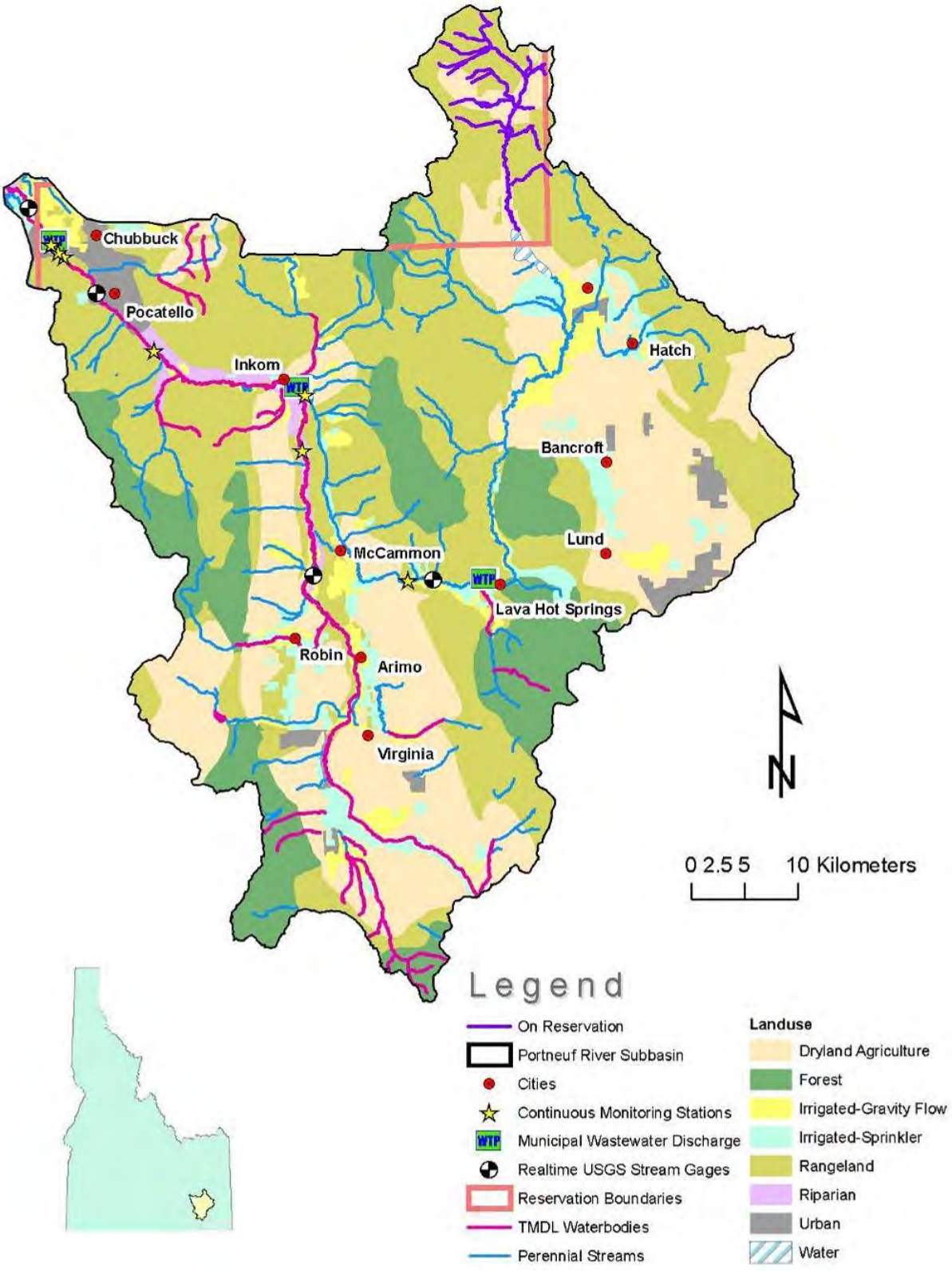


Figure A. Map of Portneuf River Subbasin.

Key Findings

Include the following:

- Exceedances of sediment targets in the Portneuf River subbasin are widespread. Elevated concentrations of total suspended solids (TSS) are commonly detected in the mainstem during spring runoff and high flow periods. In the tributaries, elevated sediments are detected year-round, particularly in lower tributary segments (IASCD 2001). Sediment loading from tributaries presents unique but potentially manageable situations since tributaries offer opportunities to implement best management practices (BMPs) that can have immediate and measurable impacts on tributary water quality and beneficial use support (IASCD 2005).
- Nutrient loading in the subbasin is more difficult to summarize, but was documented in assessment units from both mainstem and tributary sites. Phosphorus loading from point sources represents a relatively minor contribution to the watershed, even though reductions from the cities of Inkom and Pocatello are described within. Phosphorus loading during runoff periods is widespread in the subbasin and presumably this problem is directly tied to sediment loading in the subbasin. In contrast, phosphorus-rich ground water in the lower Portneuf represents a significant yet localized problem in the subbasin; considerable reductions in ground water loading will be necessary to achieve the subbasin's TP target. Nitrogen loading from tributaries in the subbasin exceeds the revised nutrient target. In Marsh Creek, loads and concentrations vary considerably by season and suggest that the in-stream processing potential of some tributaries is high during summer months.
- *E. coli* loading from tributaries is widespread in the subbasin and a total of 22 assessment units are listed for *E. coli* on the 2008 §303(b)/305(d) Integrated Report. Of these, *E. coli* TMDLs were developed for 10 assessments units as part of this revision (see Tables B and C).
- Interannual and seasonal loads, wasteloads, and corresponding allocations are summarized as daily loads by month in Section 5 of this document. An abbreviated summary of the sediment and TP loads and wasteloads are provided in Table A and show where reductions are necessary. Where pollutant targets (described in Table 5.1) and the corresponding pollutant loads are below the target allocation, the measured water quality levels (i.e., concentrations) and the corresponding loads will serve as the target and allocation. This approach is consistent with the antidegradation policy for the State of Idaho (IDAPA §58.01.02.051(01)) and is necessary for the maintenance and protection of existing conditions and uses.
- The assessment units and pollutants for which TMDLs were developed as part of this revision are shown in Tables B, C, and 5.28 and in the subwatershed maps that follow (Figures B through G).
- From the assessment evidence available from the DEQ's Beneficial Use Reconnaissance Program work in the subbasin, delisting recommendations are as follows: Cherry Creek (ID17040208SK014_02a and _02) for sediment and nutrients (TN and TP); lower Yago Creek (ID17040208SK006_02c) for sediment; North Fork of

Pocatello Creek (ID17040208SK026_02 and _02a) for sediment; and lower Rapid Creek (ID17040208SK023_03) for sediment.

- The 2008 §303(d)/305(b) Integrated Report includes the following assessment units (and identifies the pollutant) not present on the 2002 §303(d)/305(b) Integrated Report: Papoose Creek (*E. coli*); Portneuf River – Marsh Creek to the Fort Hall Reservation Boundary (DO, Temperature); South Fork of Mink Creek (*E. coli*); Mink Creek (*E. coli*); Indian Creek (*E. coli*); Arkansas Creek (Sediment, TN, and TP); Marsh Creek (4 AUs; DO, Temperature); upper Garden Creek (*E. coli*); Yellow Dog Creek (*E. coli*); Birch Creek from Cherry Creek to Marsh Creek confluence (*E. coli*); upper Birch Creek (*E. coli*); East Bob Smith Creek (*E. coli*); West Bob Smith Creek (*E. coli*); Portneuf River – Chesterfield Dam to Marsh Creek (Temperature); upper Dempsey Creek (*E. coli*); lower Pebble Creek (*E. coli*); North Fork Pebble Creek (*E. coli*); upper Moonlight Creek (*E. coli*); Moonlight Creek (*E. coli*); and North Fork Pocatello Creek (*E. coli*).
- The Portneuf Watershed Advisory Group was established to advise DEQ in its efforts to develop a revised TMDL for the Portneuf River Subbasin. The WAG began meeting formally on 21 November 2006 and published its Working Charter and Membership on 17 April 2007 (Appendix E and http://www.deq.state.id.us/about/regions/portneuf_river_tribs_wag/).

Table A. Summary of daily loads, wasteloads and load allocations for the Portneuf River.

	TSS load (tons/day)	TSS load/wasteload allocation (tons/day)		TP load (lbs/day)	TP load/wasteload allocation (lbs/day)
Watershed at Topaz* (low flow)	4.3	4.3†		27.3	27.3†
Watershed Topaz* (high flow)	80.0	36.2		227.3	113.2
City of Lava H.S. WWTP (Permit No. ID-002182-2)	0.004	0.04		1.2	1.2
Idaho Lava Foundation (Permit No. ID-002717-1)	*Existing discharge*	*Existing discharge x TSS targets*		*Existing discharge*	*Existing discharge x TP targets*
Riverside Inn (Permit No. ID-002519-4)	*Existing discharge*	*Existing discharge x TSS targets*		*Existing discharge*	*Existing discharge x TP targets*
Watershed at Edson Fichter Nature Area* (low flow)	12.3	10.0		48.3	40.0
Watershed at Edson Fichter Nature Area* (high flow)	143.0	36.2		458.7	113.1
City of Inkom WWTP (Permit No. ID-002024-9)	0.006	0.013		1.5	0.71
Watershed at Batiste* (low flow)	13.0	11.7		61.2	46.9
Watershed Batiste Road* (high flow)	168.9	41.1		574.7	128.3
MS 4 Permittee's storm water** (Permit No. IDS-028053)	6.3	*(daily Batiste – EFNA discharge) x TSS targets*		9.0	*(daily Batiste – EFNA discharge) x TP targets*
Watershed at Siphon Road* (low flow)	45.5	33.9		2548.5	135.7
Watershed at Siphon Road* (high flow)	196.4	91.9		2801.5	287.0
City of Pocatello WWTP (Permit No. ID-002178-4)	0.1	1.5		32.3	25.1
Batise Springs Trout Farm (Permit No. IDG-130000)	0.1	0.4		8.4	13.0
Papoose Springs Fish Hatchery (Permit No. ID-0072-8 [expired])	0.2	0.2		0.9	0.9

*Watershed loads represent the median annual daily load using 2004 to 2006 monthly averages. † When annual daily load targets for the watershed are meeting their targets, loads are set at current levels. **MS4 Permittee's storm water wasteload estimates represent the median daily TSS and TP loads translated from daily turbidity monitoring data collected during calendar years 2004 to 2006 and from monitoring stations above and below the Pocatello Urbanized Area (PUA; total of 647 daily estimates). Storm water loads were developed by calculating the difference in loads between the upstream (EFNA) and downstream (Batiste Rd) monitoring sites. The ranges in storm water TSS and TP loads recorded from 2004 to 2006 were -106.1 to 263.9 tons TSS/day and -280.0 to 618.9 lbs TP/day. Negative values indicate that the average daily load was greater at EFNA than Batiste and suggest that there was deposition of sediment in the reach that spans the PUA. Storm water target loads/load allocations is estimated by the difference in discharge between Batiste and EFNA monitoring stations and the approved TSS and TP targets. All other wasteload summaries and allocations are based on median annual estimates. See Tables 5.5 to 5.14 for seasonal and interannual estimates of daily loads and wasteloads for all sites. MS4 Permittees are the City of Pocatello, the City of Chubbuck, Bannock County, and the Idaho Transportation Department - District #5.

Table B. 2008 §303(d)/305(b) Integrated Report and list of Assessment Units for which TMDLs were developed (see Table C for a complete list of TMDLs completed as part of this revision).

Water Body Name	Assessment Unit	Pollutants	TMDL as part of this Revision
Papoose Creek – headwaters to Portneuf River	ID17040208SK001_02c	*E. coli*	
Portneuf River Marsh Creek to Fort Hall Reservation Boundary	ID17040208SK001_05	Dissolved Oxygen, Temperature	
South Fork Mink Creek	ID17040208SK004_02c	*E. coli*	
Mink Creek (lower) – USFS boundary to Portneuf River	ID17040208SK004_04	*E. coli*[a]	*E. coli*
Mink Creek – USFS Boundary to Portneuf River	ID17040208SK004_04a	*E. coli*	
Indian Creek	ID17040208SK005_02	*E. coli*[a]	*E. coli*
Arkansas Creek – Arkansas Rd crossing to Portneuf Marsh Valley Canal	ID17040208SK006_02a	Sediment, Nitrogen, Phosphorus,	
Marsh Creek (upper middle) – Red Rock Pass to Birch Creek	ID17040208SK006_03	Dissolved Oxygen, Temperature	
Marsh Creek (upper) - Confluence of Rt and Lt Fks to Red Rock Pass	ID17040208SK006_03a	Dissolved Oxygen, Temperature	
Marsh Creek (lower) – Cottonwood Creek to Portneuf River	ID17040208SK006_04	Dissolved Oxygen, Temperature	
Marsh Creek (lower middle)– Birch Creek to Cottonwood Creek	ID17040208SK006_04a	Dissolved Oxygen, Temperature, *E. coli*[a]	*E. coli*
Garden Creek (upper) – headwaters to Garden Cr Gap	ID17040208SK010_02a	*E. coli*	
Garden Creek (lower) – Garden Cr Gap to Marsh Creek	ID17040208SK010_02b	*E. coli*[a]	*E. coli*
Hawkins Reservoir	ID17040208SK012L_0 L	Dissolved Oxygen[a], Phosphorus[a]	DO, TP
Yellow Dog Creek	ID17040208SK013_02b	*E. coli*	
Cherry Creek – ephemeral tributaries	ID17040208SK014_02	*E. coli*[a]	*E. coli*
Cherry Creek – Headwaters to USFS boundary	ID17040208SK014_02a	*E. coli*[a]	*E. coli*
Cherry Creek – USFS boundary to Cherry Creek	ID17040208SK014_02b	*E. coli*[a]	*E. coli*

Water Body Name	Assessment Unit	Pollutants	TMDL as part of this Revision
Birch Creek - Cherry Creek to Marsh Creek	ID17040208SK014_04	*E. coli*	
Birch Creek (upper) – confluence to Mill Creek and Precipice Creek to aqueduct	ID17040208SK015_03a	*E. coli*	
East Bob Smith Creek	ID17040208SK016_02b	*E. coli*	
West Bob Smith Creek	ID17040208SK016_02c	*E. coli*	
Portneuf River – Chesterfield Reservoir Dam to Marsh Creek	ID17040208SK016_03	Temperature	
Portneuf River – Toponce Creek to Twenty-four Mile Creek	ID17040208SK016_04	Temperature	
Dempsey Creek (upper) – headwaters to East Creek (to 3rd order)	ID17040208SK017_02d	*E. coli*	
Pebble Creek (lower) – North Fork Pebble Creek to Portneuf River	ID17040208SK022_03	*E. coli*	
North Fork of Pebble Creek – 3rd order to Pebble Creek	ID17040208SK022_03a	*E. coli*	
Moonlight Creek (upper) – headwaters to AU break	ID17040208SK023_02e	*E. coli*	
Moonlight Creek (upper) – headwaters to AU break	ID17040208SK023_02f	*E. coli*	
North Fork Pocatello Creek – headwaters to Pocatello Creek	ID17040208SK026_02a	*E. coli*	
[a]Carryover from the 2002 §303(d)/305(b) Integrated Report.			

Table C. List of Assessment Units for which TMDLs were developed in this revision (basis of list is 2002 §303(d)/305(b) Integrated Report).

Water Body Name	Assessment Unit	Pollutants	Action/Recommendation of this Revision
Cherry Creek – ephemeral tributaries	ID17040208SK014_02	Bacteria[a,d]	*E. coli* TMDL.
Cherry Creek – Headwaters to USFS boundary	ID17040208SK014_02a	Bacteria[a,d], Nutrients[c], Sediment[c]	*E. coli* TMDL. Delist for nutrients and sediment.
Cherry Creek – USFS boundary to Cherry Creek	ID17040208SK014_02b	Bacteria[a,d], Nutrients, Sediment[c]	*E. coli* TMDL. Delist for nutrients and sediment.
Dempsey Creek (lower) – East Creek to Portneuf River	ID17040208SK017_03	Pathogens[a]	*E. coli* TMDL.
Beaverdam Creek	ID17040208SK017_02c	Sediment[c]	Sediment TMDL.
Garden Creek (lower) – Garden Cr Gap to Marsh Creek	ID17040208SK010_02b	Bacteria[a,d]	*E. coli* TMDL.
Indian Creek - source to mouth	ID17040208SK005_02	Unknown[b] (*Presumed E. coli*[d])	*E. coli* TMDL.
Marsh Creek (lower middle)– Birch Creek to Cottonwood Creek	ID17040208SK006_04a	Pathogens[a,d]	*E. coli* TMDL.
Marsh Creek (upper) - Confluence of Rt and Lt Fks to Red Rock Pass	ID17040208SK006_03a	Bacteria[a], Nutrients[c], Sediment[c]	*E. coli*, TP, TN, and sediment TMDLs.
Yago Creek	ID17040208SK006_02c	Sediment	Delist for Sediment.
Kinney Creek – headwaters to Mink Creek	ID17040208SK004_02a	Sediment[c]	Sediment TMDL.
Mink Creek (lower) – USFS boundary to Portneuf River	ID17040208SK004_04	Pathogens[a,d]	*E. coli* TMDL.
North Fork Pocatello Creek – Unnamed Tributaries	ID17040208SK026_02a	Sediment[c]	Delist for Sediment.
North Fork Pocatello Creek	ID17040208SK026_02	Sediment[c]	Delist for Sediment.
Portneuf River - Marsh Creek to the Fort Hall Reservation Boundary	ID17040208SK001_05	Unknown[b] (*Presumed Sediment*[c], *Nutrients*[c], *Oil and grease*[c])	*E. coli*, Sediment, TP, and oil and grease TMDLs.

Portneuf River – source to Chesterfield Reservoir	ID17040208SK020_02	Sediment[c]	On reservation.
Portneuf River – source to Chesterfield Reservoir	ID17040208SK020_03	Sediment[c]	On reservation.
Rapid Creek (lower) – BURP break to Portneuf River	ID17040208SK023_03	Sediment[c]	Delist for Sediment.
South Fork Pocatello Creek – headwaters to Pocatello Creek	ID17040208SK025_02	Sediment[c]	Sediment TMDL.
Hawkins Reservoir	ID17040208SK012L_0L	DO[d], Nutrients[d]	DO, TP, and TN TMDLS (Chlorophyll *a* surrogate proposed to achieve DO standard).

[a]Pathogens and bacteria used in the 2002 §303(d) list were previously used to refer to fecal indicators. The DEQ now uses *Escherichia coli* as an indicator of fecal contamination. In Idaho, surface waters designated for primary (e.g., swimming) or secondary (e.g., wading) contact recreation are not to contain a geometric mean *E. coli* concentration of >126 organisms/100 mL of sample water within a 30-day period (IDAPA §58.01.02.251.01). [b]Unknown causes listed above are followed by the presumed pollutants. [c]Assessment unit-pollutant combinations with approved TMDLs (i.e., present in Section 4a of 2008 §303(d)/305(b) Integrated report) that were revised or recommended for delisting as part of this revision are highlighted in green. Revisions occurred as a result of changes to targets (e.g., TSS, TP, and TN targets) or because of the availability of more current support status or water quality information. Delisting recommendations were based on the most current support status or water quality information. [d]Assessment units present on the 2008 §303(d)/305(b) list of impaired waters (Section 5) are highlighted in yellow.

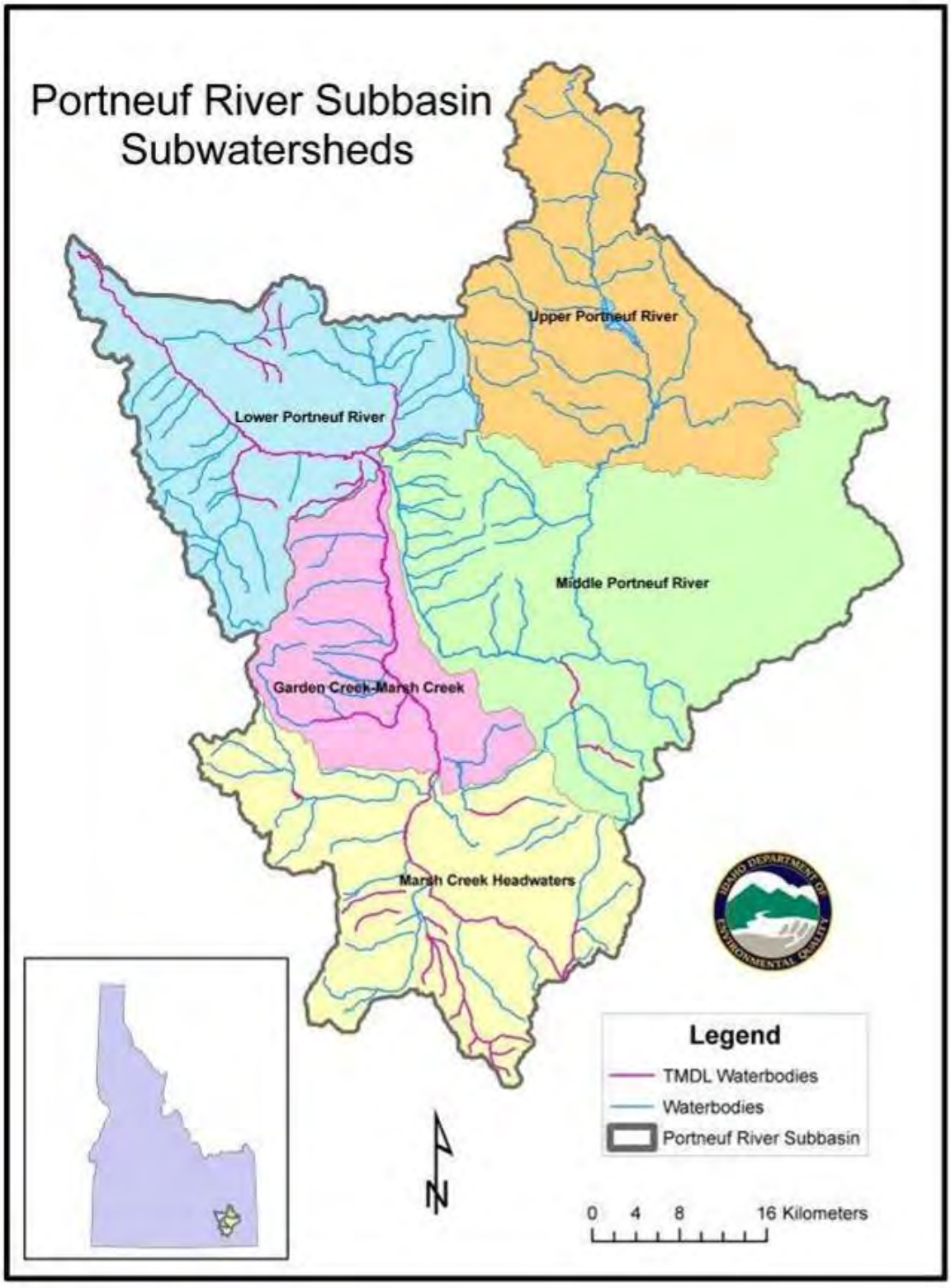


Figure B. Portneuf River subwatersheds and §303(d)-listed assessment units.



Figure C. Upper Portneuf River subwatershed.

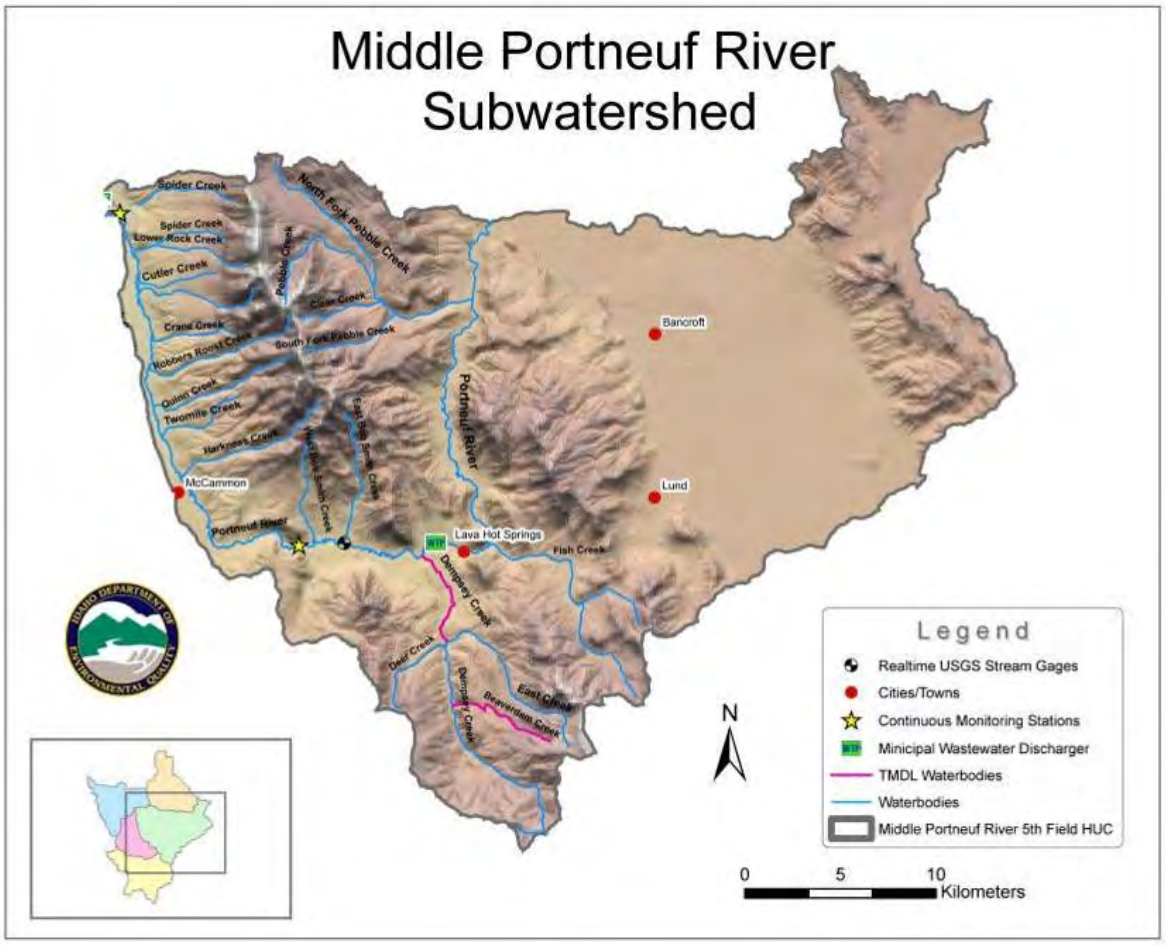


Figure D. Middle Portneuf River subwatershed and §303(d)-listed assessment units.

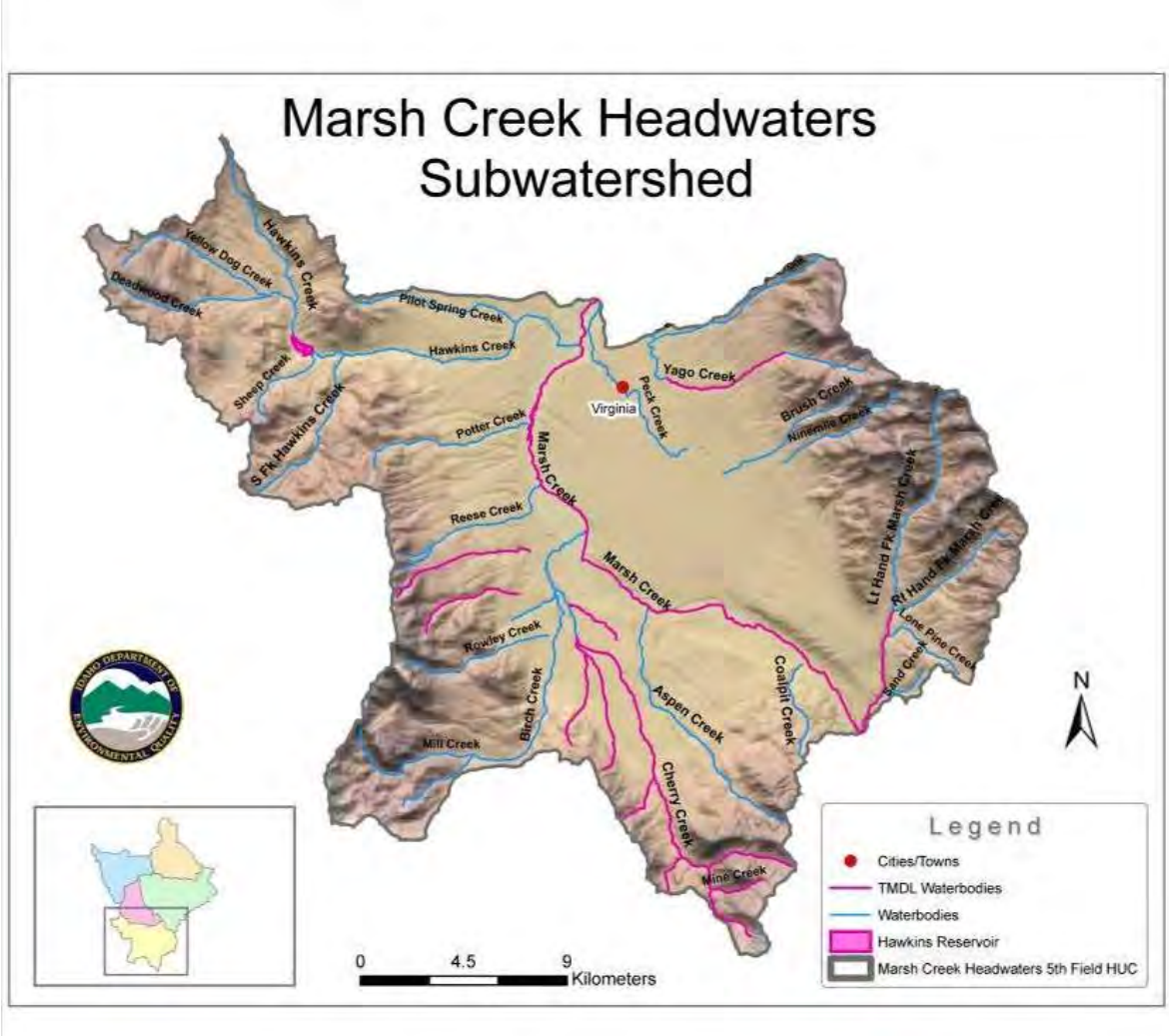


Figure E. Marsh Creek headwaters subwatershed with §303(d)-listed assessment units.

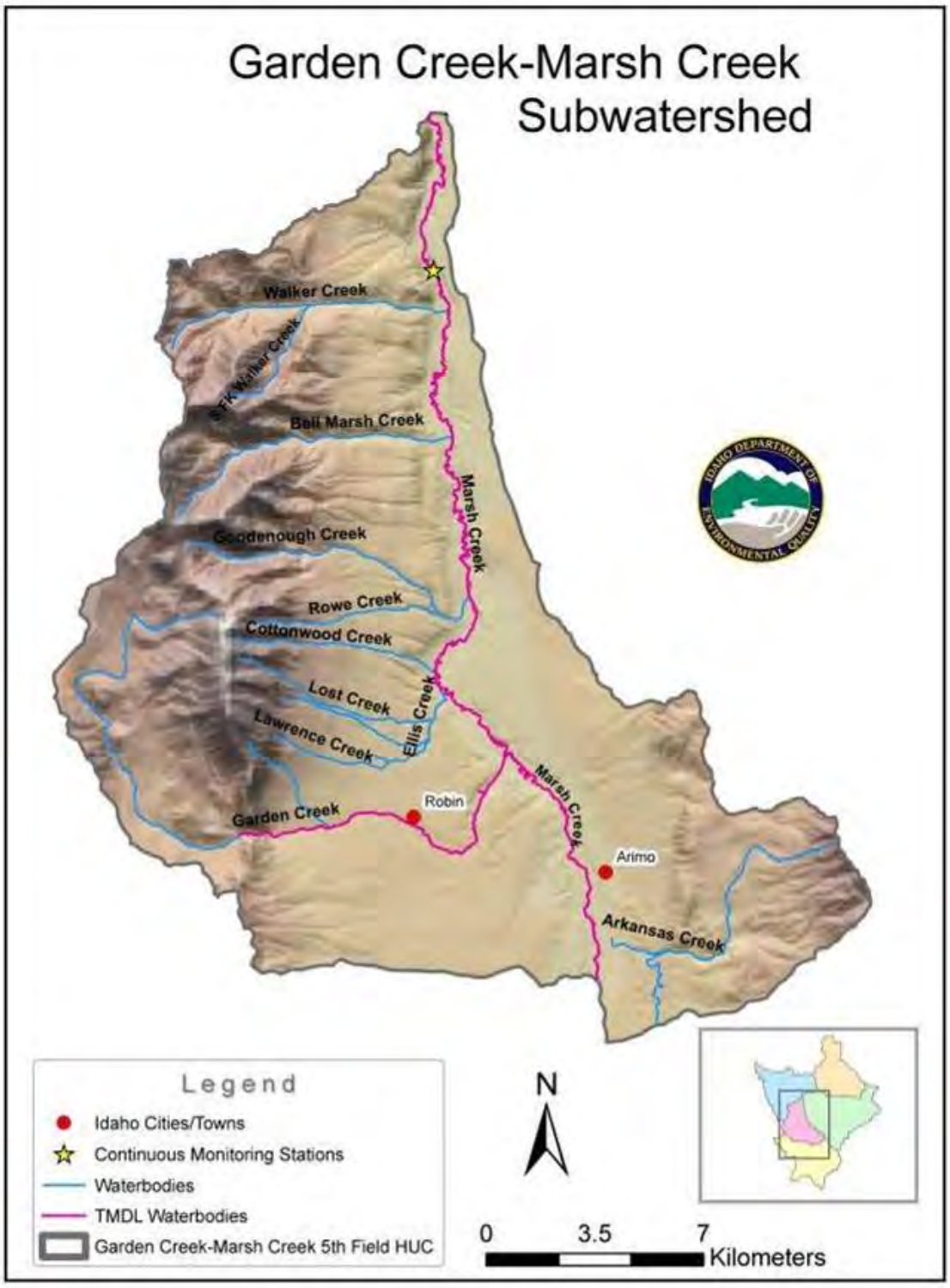


Figure F. Garden Creek and lower Marsh Creek subwatershed and §303(d)-listed assessment units.

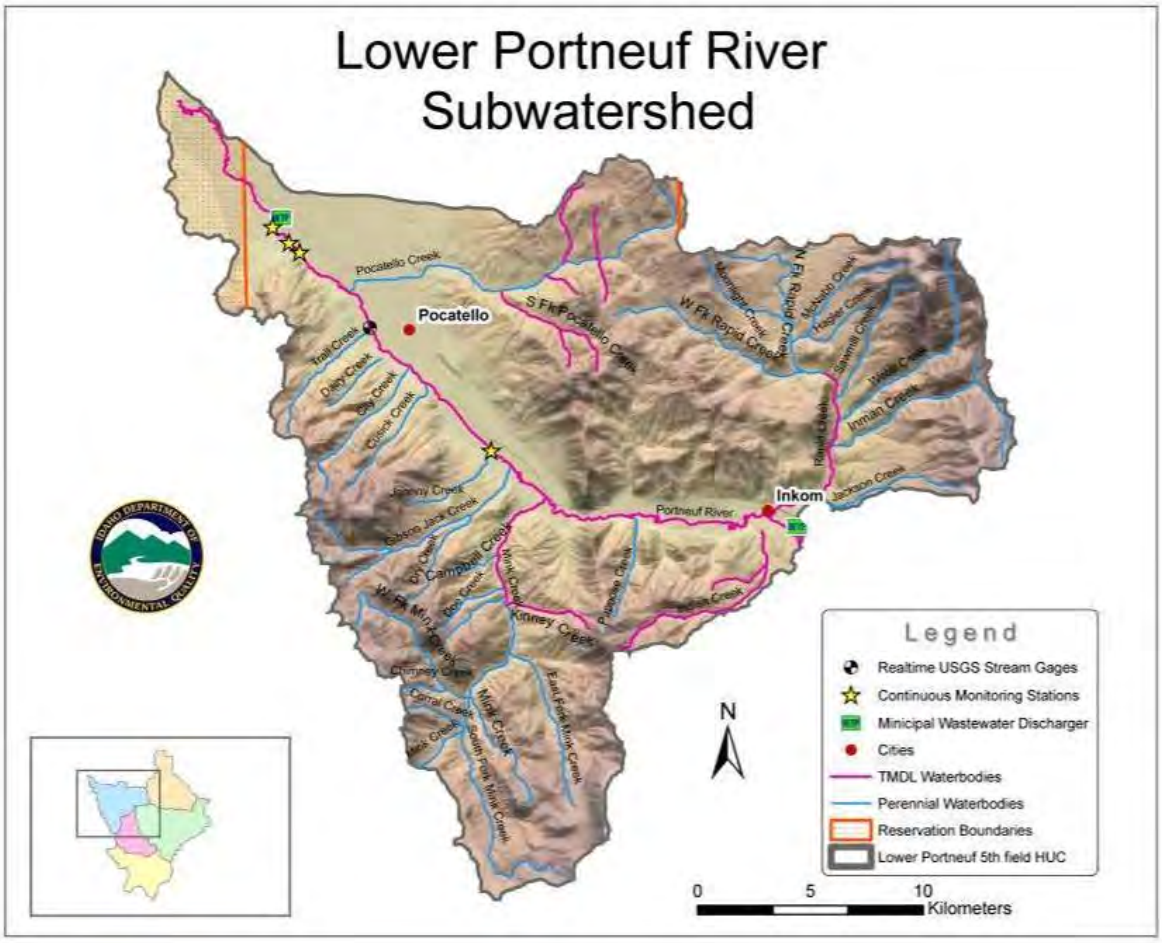


Figure G. Lower Portneuf River subwatershed and §303(d)-listed assessment units.

1. Subbasin Assessment – Watershed Characterization

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

This document addresses eight assessment units in the Portneuf River subbasin that have been placed on Idaho's recently approved 2008 §303(d)/ §305(b) Integrated Report list and all of the assessment units included on Idaho's 2002 §303(d)/ §305(b) Integrated Report list.

The overall purpose of the subbasin assessment (SBA) and total maximum daily load (TMDL) is to characterize and document current pollutant loads within the Portneuf River subbasin. A comprehensive subbasin assessment was completed for the Portneuf River Subbasin as part of the 2001 TMDL. Therefore, this document includes an abbreviated characterization of the watershed followed by a discussion of the status of previously listed segments and current water quality concerns, in Sections 1 to 4. This information was used to develop TMDLs for listed waters in the Portneuf River subbasin (Section 5).

1.1 Introduction

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

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

Background

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

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

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

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

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

Idaho's Role

Idaho adopts water quality standards to protect public health and welfare, enhance the quality of water, and protect biological integrity. A water quality standard defines the goals of a water body by designating the use or uses for the water, setting criteria necessary to protect those uses, and preventing degradation of water quality through antidegradation provisions.

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

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

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

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

- Determine the degree of support provided by the water body for support of designated beneficial uses (i.e., it is attaining or not attaining water quality standards).
- Determine the degree to which biological integrity is achieved.
- Compile descriptive information about the water body, particularly the identities and locations of pollutant sources.
- Determine the causes and extent of the impairment of water bodies that are not attaining water quality standards.

1.2 Physical and Biological Characteristics

The Portneuf River subbasin, identified with the hydrologic unit code (HUC) 17040208, is part of the Upper Snake River Basin and is a major drainage area (1,360 square miles) in southeast Idaho. The Portneuf River is affected by a suite of anthropogenic impacts that range from local to global in scale. These include impacts linked to nutrient enrichment, invasive species introductions, hydrologic alterations, and climate change (Hopkins 2007). The Portneuf River is a 5th-order river, approximately 100 miles long, originating on Fort Hall Indian Reservation, flowing south to Chesterfield Reservoir, it flows from Chesterfield Reservoir via the Toponce Canal bypassing the pre-existing river channel and rejoining the river approximately 8 miles downstream. Beyond Chesterfield, the river continues flowing south to Lava Hot Springs, where numerous thermal inflows along with effluents from this upstream-most municipality enter the river. The river then turns west for approximately 10 miles before flowing north approximately 40 miles to its confluence with Snake River at American Falls Reservoir (DEQ 2001a).

In the City of Pocatello, the most permanent and arguably conspicuous river alteration is apparent; in this river segment, approximately 1.5 miles of river was routed through a vertical-walled concrete channel as part of a U.S. Army Corps of Engineers (USACE) flood protection project completed in 1968 (Section 204, paragraph "Columbia River

Basin", Flood Control Act of 1950). The construction of the channel resulted in the loss of approximately 4.1 miles of natural river channel by removing natural meandering and approximately 144 acres of riparian habitat. Moreover, the channel acts as a barrier to City Creek for trout and other fish (USACE 1992, DEQ 2001a) and has other significant, albeit indirect, effects on aquatic organisms by the disruption of energy fluxes between the stream and [lost] riparian habitats (*sensu* Laeser et al. 2005).

There are at least two major gaining reaches in the river (Perry and Clark 1990, Barton 2004). One gaining reach extends from approximately 2 miles above the confluence with Pebble Creek to Fish Creek and results in approximately 136 cubic feet per second (cfs) increase in discharge. Another gaining reach includes a complex of 27 springs in the lower Portneuf River. This lower spring complex is roughly bounded by I-86 to the south and Siphon Road to the north (Perry and Clark 1990) and contributes approximately 225 cfs.

Hydrology

Hydrographs in the Portneuf River subbasin vary according to location but exhibit a general pattern of high spring flows and lower baseflows occurring in late summer and extending into fall. There are also marked changes in discharge associated with the seasonal management of reservoirs, irrigation withdrawals, or intentional water level manipulations for diversion purposes (e.g., below Siphon Road). Still, the hydrographs are generally highest in the springtime with the months of March through June coinciding with the melt-off of snow at higher elevations and representing high flows throughout the subbasin (Figure 1.1). A decadal summary of flows in the Portneuf River at Pocatello, Idaho, shows that average flows during this decade are among the lowest for the period of record at that gage.

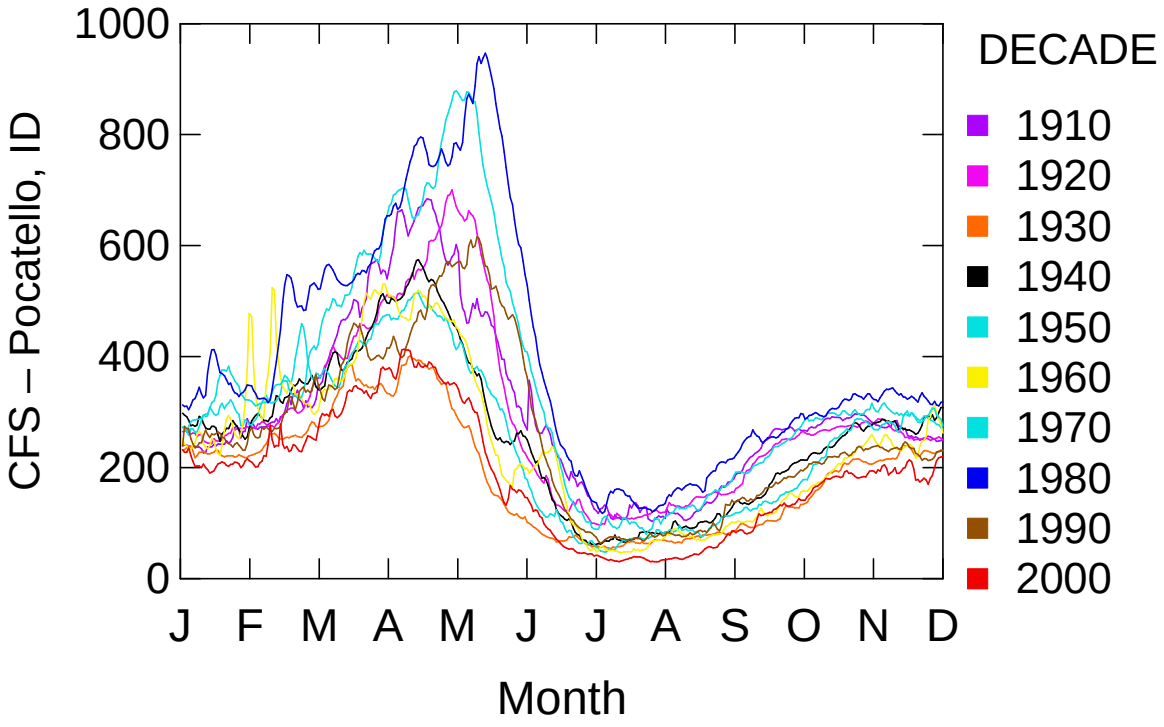


Figure 1.1. Decadal hydrographs for the Portneuf River at Pocatello, Idaho (USGS Gage Number 13075500 Portneuf River at Pocatello) shown by calendar month. Each month is summarized by the first letter of the month (e.g., F = February). Figure used with permission from R. Inouye.

Reservoirs and diversions undoubtedly influence flow characteristics in the subbasin. Chesterfield Reservoir, located in the upper Portneuf River, influences the magnitude and duration of high flows and diversions from the Portneuf Marsh Valley Canal seasonally direct waters from the Portneuf River away from the mainstem for irrigation purposes. Other smaller reservoirs or diversions in the subbasin likely have similar but localized influences, but cumulatively these manipulations have a profound influence on Portneuf River discharge.

The Portneuf River lies entirely within the Northern Basin and Range Ecoregion at the northeastern extreme of the Basin and Range Physiographic province. Potential natural vegetation for the ecoregion includes Great Basin sagebrush (*Artemisia* spp.), saltbush (*Atriplex* spp.), and greasewood (*Sarcobatus vermiculatus*). Land use of the desert and shrubland is grazing (DEQ 2001a). Soils in the subbasin are primarily aridisols. Geologically, the subbasin is mostly sedimentary with localized basalts in Bancroft, along lower Marsh Creek and the lower Portneuf River. Lake Bonneville deposits also underlay large portions of the subbasin. Topsoils are predominantly loess and are very erodible (Merrell and Onstott 1965).

Climate

The climate in the subbasin is semi-arid; the subbasin climate is continental and influenced by the presence of the Cascades and Sierras to the west and Rockies and Bitterroots to the north. These mountains effectively remove moisture traveling from the Pacific Ocean. Moreover, the Portneuf and Bannock Ranges influence local weather patterns in the subbasin. Average annual precipitation is 12.7 inches with 57% of the moisture being delivered in the winter and spring (Figure 1.2). The annual temperature maxima occur in July; on average July is also the driest month (National Weather Service, internet communication). From 1899 to 2008, the maximum temperature range for the Pocatello 2, Idaho Station (107208) is -24°F to 106°F.

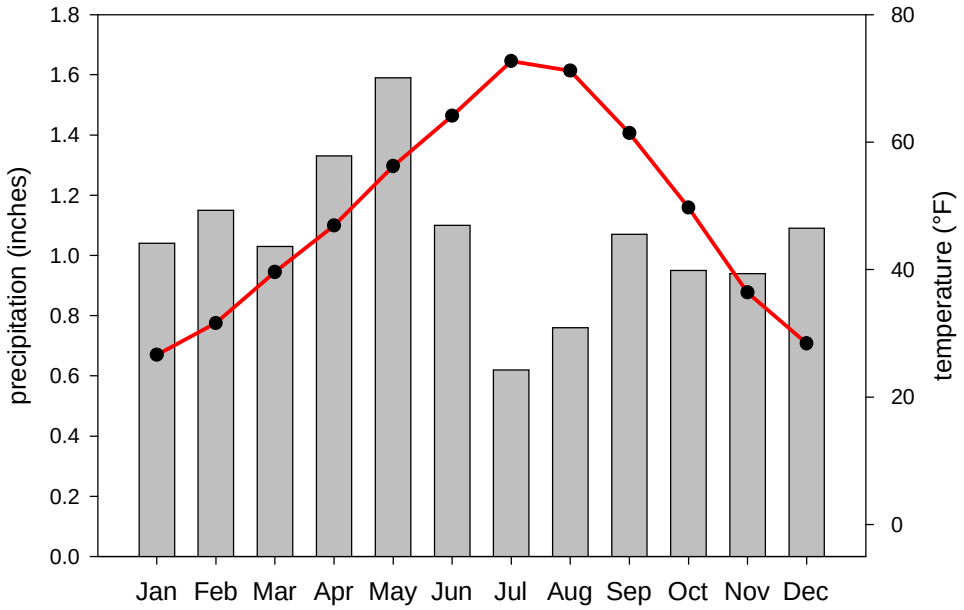


Figure 1.2. Climograph from 1899 to 2008 precipitation and air temperature summaries for Pocatello, Idaho. Monthly precipitation is summarized by vertical bars and monthly temperatures are shown by the points.

Biological Assemblages

No aquatic species that are currently federally listed as threatened or endangered under the Endangered Species Act are documented in the Portneuf River subbasin. One species, Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*), has been recognized by various entities as follows:

- Listed as a sensitive species by the U.S. Forest Service's Northern Region.
- Listed as an imperiled species by the U.S. Bureau of Land Management.
- Listed as an imperiled subspecies by the Idaho Department of Fish and Game (Idaho Department of Fish and Game, internet communication).

- The U. S. Fish and Wildlife Service recently determined that federal listing of Yellowstone cutthroat trout was not necessary because "stable, viable and self-sustaining populations of the fish are widely distributed throughout its historic range" (http://www.fws.gov/mountain-prairie/PRESSREl/06-15.htm).

A comprehensive summary of the biological assemblages and processes surveyed in the Portneuf River subbasin over the last decade are provided in the Portneuf River Subbasin Biological Assessment that is included as Appendix F. The original subbasin assessment included in the 2001 TMDL also provides detailed descriptions of fish surveys in the Portneuf River subbasin. What follows here is a brief discussion of the major biological assemblages in the subbasin.

Macrophytes are common and widespread in the Portneuf River subbasin and assemblages likely reflect water quality conditions (*sensu* Onaindia et al. 2005). Some of the most common and widely distributed macrophyte species (e.g., *Potamogeton pectinatus*) in the Portneuf River subbasin are indicators of eutrophic waters. In addition, the abundance of macrophytes likely reflects nutrient availability and Wilhelm (2006) showed that productivity was high in gaining reaches and particularly in the lower Portneuf River where ground water is rich in both nitrogen (N) and phosphorus (P). Elevated nutrients in the lower Portneuf River are translated into additional plant biomass and promote luxury uptake of N and P by macrophytes. High macrophyte abundance in the lower Portneuf River is also associated with the export of nutrient rich macrophytes to the American Falls Reservoir and to higher daily fluctuations in dissolved oxygen in the lower Portneuf River during summer months.

Values for macroinvertebrate assemblage metrics (e.g., River Macroinvertebrate Index; RMI) in the mainstem Portneuf River indicate that reaches downstream of Lava Hot Springs, near McCammon, and downstream of Interstate 86, are below the minimum evaluation threshold for cold water aquatic life. Although RMI scores alone do not determine the support status for the cold water aquatic life use, these scores warrant more focused monitoring of these reaches to fully characterize the cold water aquatic life use. Of the 43 assessment units (AUs) associated with Portneuf River tributaries and evaluated during Beneficial Use Reconnaissance Program (BURP) surveys from 2001 to 2006, nine AUs sampled did not support the cold water aquatic life use.

Salmonids in the Portneuf River subbasin predominate in the mainstem river above major flow diversions or reaches supplemented by significant ground water flows. Wild populations of salmonids exist in the Portneuf River above and below Lava Hot Springs. However, below the Portneuf Marsh Valley Canal diversion (i.e., Topaz monitoring station; see Table 5.2), salmonids represent a smaller component of the fishery, although cool-water fish species still predominate. In Marsh Creek, salmonids were not present in two reaches sampled in 2007. In the lower Portneuf River downstream of Batiste Road, salmonids again predominate. These findings indicate that the distribution and abundance of fish in the mainstem Portneuf River are tightly coupled with localized hydrologic conditions. The U.S. Forest Service surveyed 25 tributaries and found that salmonids are widespread in tributaries within the Caribou-Targhee National Forest and speculated that fishless tributaries were affected most by low flow conditions. DEQ BURP surveys of

tributaries to the Portneuf River and Marsh Creek documented fish assemblages that were above the minimum condition threshold.

1.3 Cultural Characteristics

Land ownership includes private, federal, state, and tribal (Figure A). Almost 60% of the land within the subbasin is privately owned (DEQ 2001a). The largest landowners in the subbasin are the Caribou National Forest, Shoshone-Bannock Tribes, and Bureau of Land Management. The majority of the Portneuf River subbasin is contained within Bannock and Caribou counties, and 2007 census data shows that Bannock County has a considerably larger population (79,925) than Caribou (6,862). Moreover, recent census data indicates that population in Bannock County grew by 5.8% between 2000 and 2007 while the population in Caribou Country decreased by 6.1%. Caribou County has a higher proportion of rural population as compared to Bannock County. Incorporated cites and towns, with 2007 U.S. Census population estimates, include: Pocatello (54,572), Chubbuck (11,550), McCammon (802), Inkom (688), Downey (558), Lava Hot Springs (486), Bancroft (347), and Arimo (315). The 2007 population estimates were provided by the U.S. Census Bureau (www.census.gov).

2. Subbasin Assessment – Water Quality Concerns and Status

The mainstem Portneuf River, 15 tributaries, and Hawkins Reservoir were present on the 1996 §303(d) list. Pollutants included for those water bodies on the 1996 list were sediment, nutrients, bacteria, flow alteration, oil and grease, and dissolved oxygen. The 1998 §303(d) list included the mainstem Portneuf River, six of the tributaries listed in 1996, and Hawkins Reservoir. In addition, three tributaries not present on the 1996 list were added to the 1998 list.

The 1996 and 1998 §303(d) lists generally described impaired waters as water quality-limited segments (WQLSs). In 2002, DEQ implemented the use of assessment units, as a cataloguing tool. The translation of the WQLSs to AUs for this subbasin is included as Table 2.1. Generally, a WQLS may contain one or more assessment units. Each assessment unit number is a unique identifier for a stream, river, lake or reservoir, or portion thereof. Included in Table 2.1 is a summary of the assessment history, beneficial use support status, and supporting water quality data related to Portneuf River TMDL targets.

The mainstem Portneuf River above Marsh Creek appears to support the cold water aquatic life use. Below Marsh Creek and above the Fort Hall Reservation Boundary, exceedances of the dissolved oxygen criterion for cold water aquatic life were documented at multiple locations. At Siphon Road, these exceedances were documented on most days between June 15 and September 15 in calendar years 2005 and 2006. The secondary contact recreation (SCR) criterion was also exceeded in this assessment unit at North City Park in 2003 with a 5-day geometric mean of 1,518 *E. coli* organisms/100 mL).

Combined, 18 tributaries and Hawkins Reservoir were on the 1996 and 1998 §303(d) lists, representing a total of 52 AUs. BURP assessment summaries showed that there were a total of 12 AUs fully supporting the CWAL use and an equal number that did not support the CWAL use (Table 2.1). The remaining tributary AUs (28) were either not assessed or the assessment work was more than 5 years old. DEQ requires that beneficial use determinations be based on high quality scientific data (Tier I data), which requires that only the most current (< 5 years old) information is used in the evaluation/determination process (Graffe et al. 2002).

Table 2.1. Water quality limited segments and current assessment unit translations in the Portneuf River Subbasin from the 1996 and 1998 §303(d). Beneficial use support status, assessment history, and water quality target comparisons are described.

Water Body Name on 1996 and 1998 §303(d) lists	1996 Pollutant	1998 Pollutant	Current Assessment Unit	Beneficial Use Support
Portneuf River – Headwaters to Chesterfield Reservoir	Sediment	Sediment	On Reservation	N/A
Portneuf River – Chesterfield Reservoir to American Falls Reservoir*	Bacteria, nutrients, sediment		a. ID17040208SK016_03 (Chesterfield to Marsh Creek) a1. Portneuf River at the Topaz-Marsh Valley Diversion. a2. Portneuf River above Marsh Creek. b. ID17040208SK001_05 (Portneuf River from Marsh Creek to Fort Hall Reservation Boundary) b1. Portneuf River at Edson Fichter Nature Area b2 Portneuf River at Batiste Road b3. Portneuf River at Siphon Road	a1. Not assessed using DEQ 5-day geomean criteria; : monthly sampling from July 2003 to Nov. 2005 showed that E. coli ranged from 15 to 654 organisms/100 mL, and from April to November, exceedances of the single-sample PCR[a] and SCR[b] criteria were detected three times. a2. Not assessed using DEQ 5-day geomean criteria; : monthly sampling from July 2003 to Dec. 2005 showed that E. coli concentrations ranged from 3 to 218 organisms/100mL, and the single-sample SCR criterion was not exceeded. b1. Not assessed using DEQ 5-day geomean criteria; monthly samples collected between September 2001 and October 2005 showed that E. coli concentrations ranged from 3 to 354 organisms/100 mL, and the single-sample SCR criterion was not exceeded. b2. Not supporting SCR; monthly samples collected over a six-year period show that the median concentration of E. coli in the Portneuf River at Batiste Road was 197 organisms/100 mL. From 2002 to 2006, the single-sample SCR criterion was exceeded annually. In 2003, surface water samples from North City Park (upstream of the concrete channel in the City of Pocatello) had a geomean of 1,518 E. coli organisms/100 mL of sample water. b3. Not assessed using DEQ 5-day geomean criteria monthly sampling from January 2001 to December 2006 showed that E. coli concentrations ranged from 0 to >6,000 organisms/100 mL; however, the single-sample SCR criterion was exceeded only twice and the median concentration was 32 organisms/100 mL. See Below for Nutrients and Sediment.

Water Body Name on 1996 and 1998 §303(d) lists	1996 Pollutant	1998 Pollutant	Current Assessment Unit	Beneficial Use Support
a. Portneuf River – Chesterfield Res. to Chesterfield Canal* b. Portneuf River – Chesterfield Canal to Lava Hot Springs* c. Portneuf River – Lava Hot Springs to Topaz (PVC) Diversion* d. Portneuf River – Topaz (PVC) Diversion to Marsh Creek*	a. Nutrients, sediment b. Nutrients, sediment, flow alteration c. Sediment, nutrients d. Sediment	a. Bacteria, Flow alteration, nutrients, sediment b. Bacteria, Flow alteration, nutrients, sediment c. Bacteria, nutrients, sediment d. Bacteria, nutrients, sediment	ID17040208SK016_03 (Chesterfield to Marsh Creek) a1. Portneuf River at the Topaz-Marsh Valley Diversion. a2. Portneuf River above Marsh Creek.	a1. Full Support CWAL: RMI = 5 downstream of Lava Hot Springs Wastewater Treatment Plant (WWTP) – 2005 (RMI presumably influenced by proximity to WWTP and natural geothermal discharges from the resort community Lava Hot Springs); brown trout and rainbow trout detected during fish collection efforts in 2007; using monthly samples collected from 2004 to 2006, TSS sediment targets were met at Topaz (median low and high flow concentrations were 17.0 and 40.5 mg/L) and TP targets were met (median TP concentration was 0.054 mg/L). a2. Full Support CWAL: RMI = 19 at Crane Creek Sportsman's Access – 2005; brown trout, Paiute sculpin, mottled sculpin, Utah suckers, longnose dace, speckled dace and redside shiner were detected in 2007 survey; TSS sediment targets were met in the Portneuf River above Marsh Creek (median low and high flow concentrations were 12.1 and 39.3 mg/L) and TP targets were met (median TP concentration was 0.040 mg/L).
a. Portneuf River - Marsh Creek to Johnny Creek* b. Portneuf River – Johnny Creek to I-86* c. Portneuf River – I-86 to Fort Hall Reservation Boundary*	a. Sediment b. Sediment, oil and grease c. Nutrients, sediment	a. Bacteria, nutrients, sediment b. Bacteria, nutrients, oil and grease, sediment c. Bacteria, nutrients, sediment	ID17040208SK001_05 (Portneuf River from Marsh Creek to Fort Hall Reservation Boundary) a1. Portneuf River at Edson Fichter Nature Area. a2 Portneuf River at Batiste Road a3. Portneuf River at Siphon Road	a1. Full Support CWAL: RMI = 19 at Cheyenne Crossing immediately downstream of EFNA – 2005; one brown trout and one rainbow trout detected along with Paiute and mottled sculpin, Utah suckers, redside shiners, speckled and longnose dace during surveys in 2007; using monthly samples collected from 2004 to 2006, high flow TSS sediment targets were not met at EFNA (median low and high flow concentrations were 28.9 and 100.8 mg/L) and TP targets were regularly exceeded during high flows (median TP concentration was 0.073 mg/L; low flow median 0.063 mg/L and high flow median 0.152 mg/L). a2. Not supporting CWAL: between 15 June and 15 Sep., daily dissolved oxygen (DO) in the Portneuf River at Batiste Rd dropped below the CWAL criteria on 29% and 30% of the days during this critical low flow period. The RMI at Kraft Road bridge located immediately downstream of channelized section of Portneuf River was 13 in 2005. Just below Batiste Road, 75% of fish sampled in 2007 surveys were salmonids (19% cutthroat trout, 34% rainbow trout, 6% rainbow/cutthroat hybrids, 17% mountain whitefish) and other fish present included redside shiner, common carp, and Utah chub; from monthly samples collected from 2004 to 2006, high flow TSS sediment targets were not met in the Portneuf River at Batiste Rd (median low and high flow concentrations were 25.6 and 116 mg/L) and the median TP concentration exceeded the TP target (median

Water Body Name on 1996 and 1998 §303(d) lists	1996 Pollutant	1998 Pollutant	Current Assessment Unit	Beneficial Use Support
				TP 0.075 mg/L; low flow median 0.055 mg/L and high flow median 0.185 mg/L). Irregular oil and grease sampling of mainstem locations (EFNA, Fremont Br., Lander Br., Center St., and Batiste Rd) from 2006 to 2008 shows that oil and grease targets are exceeded following some storm events. a3. Not supporting CWAL: between 15 June and 15 Sep., DO in the in the Portneuf River at Siphon Rd dropped below the CWAL criteria on 85% and 76% of the days in 2005 and 2006. The RMI immediately downstream of City of Pocatello's WWTP was 9 in 2005. From monthly samples collected from 2004 to 2006, TSS sediment targets were met in the Portneuf River at Siphon Rd (median low and high flow concentrations were 16.2 and 72 mg/L) and the median TP concentration exceeded the TP target by two orders of magnitude (median 2004 to 2006 TP 1.15 mg/L).
Portneuf River – Fort Hall Reservation Boundary to American Falls Res.		Bacteria, nutrients, sediment	On Reservation	N/A
Arkansas Creek – Headwaters to Marsh Creek**		Unknown (presumed sediment, nutrients)	ID17040208SK006_02a (Arkansas Rd crossing to Portneuf Marsh Valley Canal)	Not Supporting CWAL (31.04 SMI and 37 SHI - 2001); the TSS high flow sediment target was exceeded on 27 June 2006 (130 mg/L TSS) and the bank stability sediment target was not met in 2001 (53% bank stability). Mean TN and TP concentrations did not meet nutrient targets and averaged 7.29 mg/L and 0.120 over three sampling periods between 2006 and 2007.
Bell Marsh Creek – Headwaters to Marsh Creek*	Sediment		a. ID17040208SK008_02 (Ephemeral tributaries to Bell Marsh Creek) b. ID17040208SK008_02a (Upper Bell Marsh Creek – headwaters to USFS boundary) c.ID17040208SK008_02b (Lower Bell Marsh Creek – USFS boundary to Marsh Creek)	a. Not Assessed b. Full Support CWAL (77.95 SMI and 60.0 SHI – 2006, 73.55 SMI and 78.0 SHI – 2005, 88.34 SMI and 66.0 SHI – 2004, 87.85 SMI, 72.0 SHI, and 72.38 SFI - 2003); bank stability sediment target met (100% in 2007, 81% in 2006, 96% in 2005, 94% and 91% for two reaches in 2004, 73.5% in 2003, 89% for two reaches in 2002, 88% and 85% for two reaches in 2001, and 85% in 1995). c. Not assessed in last 5 years. Cutthroat trout and other salmonids detected in 1995 survey; the TSS sediment targets were met in 1999 and 2000 (average low and high flow concentrations were 30 and 28 mg/L; IASCD 2001), however, the bank stability sediment target was not met in 1995 (77% bank stability).

Water Body Name on 1996 and 1998 §303(d) lists	1996 Pollutant	1998 Pollutant	Current Assessment Unit	Beneficial Use Support
Birch Creek – Headwaters to Marsh Creek (1996)*; Birch Creek Road to Marsh Creek (1998)**	Nutrients, sediment	Nutrients, sediment	a. ID17040208SK015_03a (Confluence of Mill Creek and Precipice Creek to Aqueduct) b. ID17040208SK015_03 (Aqueduct to Cherry Creek Confluence) c. ID17040208SK014_04 (Birch Creek from Cherry Creek to Marsh Creek confluences)	a. Full Support CWAL: Cutthroat and brook trout and Paiute sculpin detected in 2002 survey; sediment target met (bank stability 97% in 2007, 89% in 2002, and 100% in 1995). b. Full Support CWAL (47.26 SMI and 57.0 SHI – 2004); sediment target met (bank stability 99% in 2004). c. Not Supporting CWAL (10.0 SHI – 2005); the bank stability sediment target not assessed in 2005 and not met in 1995 (65% bank stability) and the high flow TSS sediment target was exceeded between 1999 and 2000 and averaged 80 mg/L (IASCD 2001). Annual average TIN and TP concentrations for Birch Creek were 1.08 and 0.1 mg/L and exceeded the nutrient targets.
Cherry Creek – Headwaters to Marsh Creek (1996); USFS boundary to Marsh Creek (1998)*	Nutrients, sediment		a. ID17040208SK014_02 (Ephemeral tributaries to Cherry Creek) b. ID17040208SK014_02a (Upper Cherry Creek – Headwaters to USFS boundary) c. ID17040208SK014_02b (Middle Cherry Creek - USFS boundary to 3rd order) d. ID17040208SK014_03 (Lower Cherry Creek - 3rd order to Birch Creek)	a. Not assessed in last 5 years; sediment target met in 1998 (bank stability 100%) b. Full Support CWAL (78.57 SMI and 79.0 SHI – 2005 and rainbow and brook trout were detected in 1996 survey); sediment target met (bank stability 92% in 2005, 94% in 2002, 98% in 1996, and 98% in 1994 and TSS concentrations were 18, 2.2, and 19 mg/L on 27 June 2006, 25 September 2006, and 18 July 2007); nutrient targets met (median TN and TP concentrations were 0.31 mg/L and 0.04 mg/L from five sampling events during 2004 to 2007). c. Not assessed in last 5 years. Sediment target not met in 1995 (36% bank stability). d. Not Assessed.
Dempsey Creek – Headwaters to Portneuf River*	Sediment		a. ID17040208SK017_02 (Unnamed tributary to Dempsey Creek) b. ID17040208SK017_02d (Upper Dempsey Creek - Headwaters to East Creek – 3rd order) c. ID17040208SK017_03 (Lower Dempsey Creek – East Creek to Portneuf River)	a. Not Assessed. b. Not Assessed in last 5 years. Cutthroat and brook trout detected in 1994 survey; sediment target met in 1997 (bank stability 93%), but not met in 1994 (52% bank stability). c. Not Supporting CWAL (28.47 SMI and 35.0 SHI – 2005), however, cutthroat, brown and brook trout were detected during 1997 surveys; sediment target met in 2005 (bank stability 87%), but not met in 1997 (73% bank stability) and 1994 (3% bank stability) and TSS concentrations met the high flow sediment TSS target in 2007 and averaged 52.2 mg/L across a 6 hour sampling bout on 30 March 2007. Bimonthly TSS sampling in 1999 and 2000 showed that TSS concentrations in lower Dempsey Creek regularly exceeded the high flow target (mean high flow concentration 117 mg/L TSS; IASCD 2001).

Water Body Name on 1996 and 1998 §303(d) lists	1996 Pollutant	1998 Pollutant	Current Assessment Unit	Beneficial Use Support
Garden Creek – Headwaters to Garden Creek Gap (1996) and Garden Creek Gap to Marsh Creek (1996, 1998)*	Nutrients, sediment	Nutrients, sediment	a. ID17040208SK010_02 (Ephemeral tributaries to Garden Creek) b. ID17040208SK010_02a (Upper Garden Creek – Headwaters to Garden Creek Gap). c. ID17040208SK010_02b (Lower Garden Creek – Garden Creek Gap to Marsh Creek).	a. Not Assessed. b. Full Support CWAL (57.05 and 54.55 SMI and 64 and 44 SHI - 2002); brook trout and sculpin were detected during 1997 surveys and cutthroat trout, brook trout, and mottled sculpin were detected during surveys in 1994; bank stability sediment target met (bank stability 99% in 2007, 80% and 87% for two reaches in 2002, 84% and 90% for two reaches in 1997, 5% and 99% for two reaches in 1994). The low and high flow TSS sediment targets were exceeded on several occasions in 2001 and 2002 (range 4 to 104 mg/L; IASCD 2005). TP and TIN concentrations in upper Garden Creek exceeded the TP and TIN targets on 94% and 53% of the sampling bouts conducted in 2001 and 2002 (IASCD 2005). c. Not Supporting CWAL (36.91 SMI, 47 SHI, 94.38 SFI); brook trout, mottled sculpin, unidentified sculpins, and Utah suckers were detected during 2001surveys; TSS concentrations regularly exceeded the TSS sediment targets between 2000 and 2002 (range 4 to 1055 mg/L), however, the bank stability sediment target was met in 2001 (bank stability 95%). TP and TIN concentrations in lower Garden Creek exceeded the TP and TIN targets on 89% and 84% of the sampling bouts conducted from 2000 to 2002 (IASCD 2005).
Gibson Jack Creek – Headwaters to Portneuf River*	Sediment		a. ID17040208SK003_02a (Upper Gibson Jack Creek – Headwaters to USFS boundary) b. ID17040208SK003_02 (Lower Gibson Jack Creek – USFS boundary to the Portneuf River)	a. Full Support CWAL (82.98 SMI and 84 SHI - 2002); cutthroat trout, Paiute sculpin, and other salmonids were detected in a 1995 survey; sediment target met (bank stability 100%in 2007, 95% in 2002, and 88% in 1995). b. Not Assessed. TSS concentrations met the 80 mg/L high flow sediment (TSS) target in 2007 and averaged 19.2 mg/L across a 6 hour sampling bout on 30 March 2007.
Goodenough Creek – Headwaters to Marsh Creek*	Sediment		a. ID17040208SK009_02a (Upper Goodenough Creek – Headwaters to fork) b. ID17040208SK009_02b (Lower Goodenough Creek – Fork to mouth) c. ID17040208SK009_02 (Rowe Creek – small tributary to Goodenough Creek)	a. Not Assessed in last 5 years. Cutthroat trout detected in 1995 survey; sediment target not met (62.5% bank stability in 1995) b. Full Support CWAL (59.39 SMI and 70 SHI - 2002); 3 age classes of cutthroat trout detected in 2003 survey. Sediment target met in 2002 (90% bank stability), but not in 1995 (62.5% bank stability). The mean 1999/2000 annual low and high flow TSS concentrations met the TSS sediment targets (8 and 58 mg/L respectively; IASCD 2001) c. Not Assessed.

Water Body Name on 1996 and 1998 §303(d) lists	1996 Pollutant	1998 Pollutant	Current Assessment Unit	Beneficial Use Support
Hawkins Creek – Headwaters to Marsh Creek*	Nutrients, sediment	Nutrients, sediment	a. ID17040208SK011_02 (Ephemeral tributaries to Hawkins Creek including Pilot Creek, Sheep Creek, and other unnamed tributaries) b. ID17040208SK011_02a (Upper Hawkins Creek – above Hawkins Reservoir) c. ID17040208SK011_03 (Lower Hawkins Creek – Yellow Dog Creek to Hawkins Reservoir)	a. Pilot Springs Creek – Not Supporting CWAL (10.0 SHI in 2005). b. Full Support CWAL (59.05 SMI and 49 SHI - 2001) only mottled sculpin were detected in survey efforts in 1995; eight sampling bouts were completed from June 2006 to Mar. 2008 and showed that low and high flow TSS sediment targets were not met (mean TSS concentration 76 mg/L) even though the bank stability sediment target was met in 2001 (90% bank stability, 95% in 1995); TN and TP concentrations exceeded nutrient targets and averaged 2.19 and 0.20 mg/L between 2006 and 2008. c. Not Assessed in last 5 years. Eight sampling events completed from June 2006 to Mar. 2008 showed that TSS sediment targets were met (mean TSS concentration 3.5 mg/L TSS), but that TP concentrations exceeded the target (mean 0.28 mg/L) in Hawkins Creek immediately below Hawkins Reservoir. Bimonthly TSS sampling in 1999 and 2000 near the mouth of Hawkins Creek showed that average TSS concentrations in lower Hawkins Creek exceeded the sediment targets (mean low and high flow concentrations 198 and 236 mg/L TSS) and exceeded the TIN and TP targets (mean TIN and TP were 1.56 and 0.44 mg/L; IASCD 2001). The bank stability sediment target was not met (50% bank stability in 1995).
Hawkins Reservoir**	Nutrients, dissolved oxygen	Dissolved oxygen, nutrients	ID17040208SK012L_0L	Not Supporting CWAL: eight sampling visits from 2006 to 2008 documented DO exceedances in July 2006, Jan. 2007, July 2007 and Mar. 2008. Total nitrogen and TP samples from all eight sampling dates exceeded nutrient targets for this assessment unit. Estimates of phytoplankton biomass from chlorophyll a concentrations show that chlorophyll concentrations on 9 April 2007 (66.0 µg/L) were more than 4X the target concentration.
Indian Creek – USFS boundary to Portneuf River**		Unknown (presumed sediment, nutrients)	ID17040208SK005_02 (Headwaters to Portneuf River)	Full Support CWAL (46.92 and51.67 SMI and59 and 48 SHI - 2002); the bank stability sediment target is currently met (100% bank stability in 2007, 90% and 85% for two reaches in 2002), but not met in 1996 (18% stability). Bimonthly TSS sampling in 1999 and 2000 showed that average TSS concentrations in Indian Creek met the TSS sediment targets (mean low and high flow concentrations 13 and 52 mg/L TSS) but exceeded the TIN and TP targets (mean TIN and TP were 0.98 and 0.08 mg/L; IASCD 2001).

Water Body Name on 1996 and 1998 §303(d) lists	1996 Pollutant	1998 Pollutant	Current Assessment Unit	Beneficial Use Support
Marsh Creek – Headwaters to Portneuf River (1996); Calvin Road to Portneuf River (1998)*	Nutrients, sediment	Nutrients, sediment	a. ID17040208SK006_03 (Upper middle Marsh Creek upper middle – Red Rock Pass to Birch Creek) b. ID17040208SK006_04a (Lower middle Marsh Creek– Birch Creek to Cottonwood Creek) c. ID17040208SK006_04 (Lower Marsh Creek – Cottonwood Creek to Portneuf River)	a. Not Assessed for CWAL. Bimonthly TSS sampling in 1999 and 2000 showed that average TSS concentrations in upper Marsh Creek did not meet the low flow TSS sediment target (mean low flow concentration was 64 mg/L TSS) and also exceeded the TP target (mean TP was 0.12 mg/L; IASCD 2001). b. Not Supporting CWAL (33.14 SMI and 53 SHI - 2006); redside shiner, chub, dace, and suckers were detected in a 1997 survey. The bank stability sediment target was not met in 2006 (73% bank stability), but was met at three reaches in 1997 (87%, 100%, and 100%, respectively). Bimonthly TSS sampling in 1999 and 2000 showed that average TSS concentrations in middle Marsh Creek did not meet the high flow TSS sediment target (mean high flow concentration was 117 mg/L TSS) and also exceeded the TIN and TP targets (mean TIN and TP were 1.30 and 0.15 mg/L; IASCD 2001). c. Not Supporting CWAL (50.47 SMI and 54 SHI – 2006 and 18.9 SMI, 33 SHI, and 44.53 SFI - 2003); common carp, speckled dace, redside shiner, and a mottled sculpin were detected in a 2007 survey, common carp, Utah chub, longnose dace, speckled dace, redside shiner, Utah sucker, bluehead sucker, and unidentified minnows were detected in a 2003 survey, and longnose dace, leopard dace, redside shiner, Utah sucker, and sculpin were detected in a 1997 survey. The bank stability sediment target was met in 2006 (82% stable), 1997 (93% stable), and 1994 (98% stable), but not in 2003 (59% stable). From monthly samples collected in 2004, 2005, and 2006, the high flow TSS sediment target was not met in lower Marsh Creek (median low and high flow concentrations were 28.3 and 112 mg/L), median TP concentration exceeded the TP targets (median TP 0.09 mg/L; low flow median 0.08 mg/L and high flow median 0.165 mg/L), and median TN concentrations (1.5 mg/L) exceeded the nitrogen target.

Water Body Name on 1996 and 1998 §303(d) lists	1996 Pollutant	1998 Pollutant	Current Assessment Unit	Beneficial Use Support
Mink Creek – Headwaters to Portneuf River*	Nutrients, sediment		a. ID17040208SK004_02 (Ephemeral tributaries to Mink Creek; Buck Creek, Corral Creek) b. ID17040208SK004_03a (Mink Creek – South Fork confluence to East Fork confluence) c. ID17040208SK004_04a (Middle Mink Creek – East Fork to USFS Boundary) d. ID17040208SK004_04 (Lower Mink Creek – USFS Boundary to Portneuf River).	a. Not Assessed. b. Assessment pending (BURP assessed in 2007; 63.0 SHI). Sediment target met in 2007 (bank stability 100%). c. Not Assessed in last 5 years. Brown trout and sculpin (Paiute sculpin in 1994) were detected in 1997 and 1994 surveys. The sediment target was met in 1997 (bank stability 92%) and 1994 (bank stability 98%). d. Not Assessed for CWAL. TSS concentrations met the 80 mg/L high flow sediment (TSS) target in 2007 and averaged 36.3 mg/L across a 6 hour sampling bout on 30 March 2007.
Pebble Creek – Headwaters to Portneuf River*	Sediment		a. ID17040208SK022_02 (unnamed tributary to Pebble Creek) b. ID17040208SK022_02a (Upper Pebble Creek – Headwaters to North Fork of Pebble Creek) c. ID17040208SK022_03 (North Fork of Pebble Creek to the Portneuf River)	a. Not Assessed. b. Not Assessed in last 5 years. Sediment target met in 1999 (bank stability 92%). c. Full Support CWAL (73.69 SMI and 77 SHI - 2002); sediment target met (bank stability 99% in 2002, 100% in 1996, and 52% and 100% in two reaches in 1993) and TSS concentrations met the 80 mg/L high flow sediment (TSS) target in 2007 and averaged 7.9 mg/L across a 6 hour sampling bout on 30 March 2007.
Pocatello Creek – Headwaters to Portneuf River*	Sediment	Sediment	a. ID17040208SK024_02 (Unnamed tributaries to Pocatello Creek) b. ID17040208SK024_03a (Middle Pocatello Creek – North and South Forks of Pocatello Creek to I-15 off ramps) c. ID17040208SK024_03 (Lower Pocatello Creek – below 1-15 off ramps to the Portneuf River)	a. Not Assessed. b. Not supporting CWAL (29.94 SMI and 45 SHI - 2002); sediment target met (bank stability 93% in 2007 and 99% in 2002). c. Not Supporting CWAL (10.0 SHI – 2005); TSS concentrations exceeded the 80 mg/L high flow sediment (TSS) target on 22 May 2008 (89 mg/L; City of Pocatello 2008), but met the target on 30 March 2007 and averaged 42.9 mg/L across a 6 hour sampling bout.

Water Body Name on 1996 and 1998 §303(d) lists	1996 Pollutant	1998 Pollutant	Current Assessment Unit	Beneficial Use Support
Rapid Creek – Headwaters to Portneuf River*	Sediment	Sediment	a. ID17040208SK023_02 (Ephemeral Tributaries to Rapid Creek) b. ID17040208SK023_03c (Upper Rapid Creek – North Fork Rapid Creek to 42.850415N, 112.223346W) c. ID17040208SK023_03 (Lower Rapid Creek - 42.850415N, 112.223346W to the Portneuf River)	a. Not Assessed. b. Not Supporting CWAL (39.91 SMI and 49.0 SHI – 2006); bank stability sediment target met in 2006 (bank stability 100%); high flow TSS concentrations exceeded the 80 mg/L high flow sediment (TSS) target during 1999 and 2000 (average 138 mg/L; IASCD 2001). c. Full Support CWAL (54.93 and 72.53 SMI and 56 and 79 SHI - 2001); the mean 1999/2000 annual low and high flow TSS concentrations in lower Rapid Creek met the TSS sediment targets (8 and 58 mg/L respectively; IASCD 2001) and 2007 sampling on 30 March 2007 met the 80 mg/L high flow sediment (TSS) target in 2007 (average 23.6 mg/L across a 6 hour sampling bout). Bank stability sediment targets were met (bank stability 100% and 90% in two reaches in 2001 and 93% in 1995).
Twentyfourmile Creek*		Sediment	a. ID17040208SK018_02 (Twentyfourmile Creek – Headwaters to reservoir including Eighteenmile Creek) b. ID17040208SK018_02a (Below reservoir to Eighteenmile Creek) c. ID17040208SK018_03a (3rd order below Eighteenmile Creek)	a. Not Assessed. b. Not supporting CWAL (40.93 SMI and 40.0 SHI – 2006); bank stability sediment target not met (bank stability 50% in 2006, 77% in 2001, and 35% in 1995). Bimonthly TSS sampling in 1999 and 2000 showed that average TSS concentrations in Twentyfourmile Creek met the TSS sediment targets (mean low and high flow concentrations 22 and 60 mg/L TSS; IASCD 2001). c. Not supporting CWAL (21.95 SMI and 37.0 SHI – 2006); bank stability sediment target not met (bank stability 51% in 2006).

Water Body Name on 1996 and 1998 §303(d) lists	1996 Pollutant	1998 Pollutant	Current Assessment Unit	Beneficial Use Support
Toponce Creek*	Sediment		a. ID17040208SK021_02 (Unnamed tributary to Toponce Creek) b. ID17040208SK021_02e (Unnamed tributary to Toponce Creek in Black Canyon) c. ID17040208SK021_03a (Middle Toponce Creek – North Fork Toponce to Lower Toponce Creek—BURP Site break) d. ID17040208SK021_03 (Lower Toponce Creek – BURP site break to Portneuf River)	a. Not Assessed. b. Not Assessed. c. Not Assessed in last 5 years. The sediment target was not met in 1993 (bank stability 0%). d. Full Support CWAL (64.21 SMI, 60 SHI, and 58.51 SFI – 2004 and 50.41 SMI and 68.0 SHI - 2002); brown trout, speckled dace, mountain sucker, mottled sculpin and unidentified suckers and sculpin were detected during 2004 survey. Sediment target met in 2004 (bank stability 97%) and 2002 (bank stability 100%).
Walker Creek*	Sediment		a. ID17040208SK007_02a (Headwaters to South Fork Walker Creek) b. ID17040208SK007_02 (South Fork Walker to Marsh Creek)	a. Not Assessed in last 5 years. Cutthroat trout were detected in a 1994 survey. The bank stability sediment target was not met in 1997 (bank stability 74%) and 1994 (bank stability 63%). b. Not Assessed in last 5 years. Cutthroat trout and other salmonids detected in 1997 survey. The bank stability sediment target was not met in 1997 (bank stability 75%). Sediment target met in 1994 (bank stability 100%).
*2001 approved TMDL. **TMDL as part of this revision. The EPA does not consider certain unnatural conditions, such as flow alteration, human-caused lack of flow, or habitat alteration, that are not the result of the discharge of a specific pollutants as “pollution”, consequently, the DEQ will not write a TMDL for flow alteration.				

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2.1 Water Quality Limited Assessment Units Occurring in the Subbasin

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

Idaho's 2008 §303(d)/305(b) Integrated Report was approved on February 4, 2009, and represents the most current list of impaired waters; the 2008 list describes 30 water quality limited assessment units (AUs) in the Portneuf River subbasin (see Table B). However, the starting point for the assessment in this document was the 2002 §303(d)/305(b) Integrated Report, which identified 19 water quality-limited AUs in the subbasin. Translation of the 2002 WQLSs/AUs into current AU descriptions resulted in a total of 22 AUs from the 2002 list plus Hawkins Reservoir, a carryover from the 1996 and 1998 lists (Table 2.2). The 2002 list included two mainstem segments, 20 tributary AUs, and Hawkins Reservoir. Pollutants identified from the 2002 list included sediment in 16 AUs, pathogens/bacteria/*E. coli* in 10 AUs (Idaho's current WQS for fecal indicators is *E. coli*), nutrients in 8 AUs, oil and grease in 1 AU, and dissolved oxygen in 1 AU. For those waters listed as impaired by unknown causes (3 AUs), the causes of impairment are presumed to be sediments and nutrients for unnamed tributaries to Marsh Creek; sediment, nutrients, and oil and grease for the Portneuf River – Marsh Creek to the Fort Hall Reservation Boundary; and *E. coli* for Indian Creek.

Table 2.2. §303(d)-listed water bodies/assessment units in the Portneuf River Subbasin from the 2002 §303(d)/305(b) Integrated Report.

Water Body Name	Assessment Unit	Pollutants[a,b]	Date of Listing
Cherry Creek – ephemeral tributaries	ID17040208SK014_02	Bacteria	2002
Cherry Creek – Headwaters to USFS boundary	ID17040208SK014_02a	Bacteria, Nutrients, Sediment	2002
Cherry Creek – USFS boundary to Birch Creek	ID17040208SK014_02b	Bacteria, Nutrients, Sediment	2002
Dempsey Creek (lower) – East Creek to Portneuf River	ID17040208SK017_03	Pathogens	2002
Beaverdam Creek	ID17040208SK017_02c	Sediment	2002
Garden Creek (lower) – Garden Cr Gap to Marsh Creek	ID17040208SK010_02b	Bacteria	2002
Indian Creek - source to mouth	ID17040208SK005_02	Unknown (*Presumed E. coli*)	2002
Marsh Creek (lower middle)– Birch Creek to Cottonwood Creek	ID17040208SK006_04a	Pathogens	2002
Marsh Creek (upper) - Confluence of Rt and Lt Fks to Red Rock Pass	ID17040208SK006_03a	Bacteria, Nutrients, Sediment	2002
Marsh Creek (upper middle) – Red Rock Pass to Birch Creek	ID17040208SK006_03	*E. coli*, Nutrients, Sediment	2002
Marsh Creek (unnamed tributaries)– source to mouth	ID17040208SK006_02	Unknown (*Presumed sediments, nutrients*)	2002
Marsh Creek (lower) – Cottonwood Creek to Portneuf River	ID17040208SK006_04	Pathogens	2002
Yago Creek (lower) – USFS boundary to Portneuf Marsh Valley Canal	ID17040208SK006_02c	Sediment	2002
Kinney Creek – headwaters to Mink Creek	ID17040208SK004_02a	Sediment	2002
Mink Creek (lower) – USFS boundary to Portneuf River	ID17040208SK004_04	Pathogens	2002
North Fork Pocatello Creek – unnamed tributaries	ID17040208SK026_02a	Sediment	2002
North Fork Pocatello Creek – headwaters to Pocatello Creek	ID17040208SK026_02	Sediment	2002

Water Body Name	Assessment Unit	Pollutants[a,b]	Date of Listing
Portneuf River - Marsh Creek to the Fort Hall Reservation Boundary	ID17040208SK001_05	Unknown (*Presumed sediment, nutrients, oil and grease*)	2002
Portneuf River - source to Chesterfield Reservoir	ID17040208SK020_02	Sediment	2002
Portneuf River - source to Chesterfield Reservoir	ID17040208SK020_03	Sediment	2002
Rapid Creek (lower) – N42.850415, W-112.223346 to Portneuf River	ID17040208SK023_03	Sediment	2002
South Fork Pocatello Creek – headwaters to Pocatello Creek	ID17040208SK025_02	Sediment	2002
Hawkins Reservoir	ID17040208SK012L_0L	Dissolved oxygen, nutrients	1996

a. Unknown causes listed above are followed by the presumed pollutants.

b. Previously, including in the 2002 §303(d) list, DEQ used pathogens and bacteria to refer to fecal indicators. DEQ now uses *Escherichia coli* (E. Coli) as an indicator of fecal contamination. In Idaho, surface waters designated for primary (e.g., swimming) or secondary (e.g., wading) contact recreation are not to contain E. coli bacteria in concentrations of more than 126 organisms/100 mL of sample water, based on five samples within a 30-day period (IDAPA §58.01.02.251.01).

About Assessment Units

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

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

However, the new framework of using AUs for reporting and communicating needs to be reconciled with the legacy of §303(d) listed streams. Due to the nature of the court-ordered 1994 §303(d) listings, and the subsequent 1998 §303(d) list, all segments were added with boundaries from "headwater to mouth." In order to deal with the vague boundaries in the listings, and to complete TMDLs at a reasonable pace, DEQ originally

set about writing TMDLs at the watershed scale (HUC), so that all the waters in the drainage are and have been considered for TMDL purposes since 1994.

The boundaries from the 1998 §303(d)-listed segments have been transferred to the new AU framework, using an approach quite similar to how DEQ has been writing SBAs and TMDLs. All AUs contained in the listed segment were carried forward to the 2002 §303(d) listings in Section 5 of the Integrated Report. AUs not wholly contained within a previously listed segment, but partially contained (even minimally), were also included on the §303(d) list in 2002. This was necessary to maintain the integrity of the 1998 §303(d) list and to maintain continuity with the TMDL program. New AUs will lead to better assessment of water quality listing and de-listing and are used in the current (2008) integrated report.

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, which is Section 5 of the Integrated Report.

2.2 Applicable Water Quality Standards

Beneficial Uses

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

Existing Uses

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

Designated Uses

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

standards (see IDAPA 58.01.02.003.27 and .02.109-.02.160 in addition to citations for existing uses).

Presumed Uses

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

Applicable Beneficial Uses

In Idaho's water quality standards the state is divided into six separate hydrologic basins; the Portneuf River subbasin is one of 23 subbasins nested with the Upper Snake River Basin. Within each basin, the major rivers, lakes/reservoirs, and streams are identified as having (designated for) specific beneficial uses. Table 2.3 summarizes all of Idaho's beneficial uses and criteria for its water bodies, including those uses designated for selected water bodies within the Portneuf River subbasin.

Table 2.3. State of Idaho recognized Beneficial Uses

Beneficial Uses	Applicable Criteria
Agricultural Water Supply	Waters which are suitable or intended to be made suitable for the irrigation of crops or as drinking water for livestock. (IDAPA §58.01.02.100.03.b) Numeric criteria as needed are derived from the USEPA's Blue Book. (IDAPA §58.01.02.252.02)
Domestic Water Supply	Waters which are suitable or intended to be made suitable for drinking water supplies. (IDAPA §58.01.02.100.03.a) Numeric criteria for specific constituents and turbidity. (IDAPA §58.01.02.252.01.a-b)
Industrial Water Supply	Waters which are suitable or intended to be made suitable for industrial water supplies. This use applies to all waters of the state. (IDAPA §58.01.02.100.03.c) Numeric criteria are categorized as general surface water quality criteria. (IDAPA §58.01.02.252.03)

Beneficial Uses	**Applicable Criteria**
Cold Water Aquatic Life	Cold water (CWAL): water quality appropriate for the protection and maintenance of a viable aquatic life community for cold water species. (IDAPA §58.01.02.100.01.a). This designation requires water temperatures of twenty-two (22) degrees C or less with a maximum daily average of no greater than nineteen (19) degrees C (IDAPA §58.01.02.250.02.b).. Numeric criteria are established for pH, DO, gas saturation, residual chlorine, water temperature, ammonia, turbidity, and toxic substances. (IDAPA §58.01.02.250.02.a-d)
Salmonid Spawning	Waters which provide or could provide habitat for active self-propagating populations of salmonid fishes. (IDAPA §58.01.02.100.01.b) Numeric criteria are established for pH, gas saturation, residual chlorine, DO, intergravel DO, water temperature, ammonia, and toxic substances. (IDAPA §58.01.02.250.02.e). See Table B-1 for a list of time periods for salmonid spawning in the Portneuf River subbasin.
Primary Contact Recreation	Surface waters which are suitable or are intended to be made suitable for prolonged and intimate contact by humans or for recreational activities when the ingestion of small quantities of water is likely to occur. Such waters include, but are not restricted to; those used for swimming, water skiing, or skin diving. (IDAPA §58.01.02.100.02.a) Numeric criteria are established for fecal coliform bacteria and applied between May 1 and September 30 (recreation season). (IDAPA §58.01.02.251.01.a-b)
Secondary Contact Recreation	Surface waters which are suitable or are intended to be made suitable for recreational uses on or about the water which are not included in the primary contact category. These waters may be used for fishing, boating, wading, and other activities where ingestion of raw water is not probable. (IDAPA §58.01.02.100.02.b) Numeric criteria are established for fecal coliform bacteria. (IDAPA §58.01.02.251.02.a-b)
Wildlife Habitats	Waters which are suitable or are intended to be made suitable for wildlife habitats. This use applies to all surface waters of the state. (IDAPA §58.01.02.100.04) Numeric criteria are categorized as general surface water quality criteria. (IDAPA §58.01.02.253.01)
Aesthetics	This use applies to all surface waters of the state. (IDAPA 58.01.02.100.05) Numeric criteria are categorized as general surface water quality criteria. (IDAPA §58.01.02.253.02)

Beneficial Uses	**Applicable Criteria**
Special Resource Water	Those specific segments or waterbodies which are recognized as needing intensive protection to preserve outstanding or unique characteristics. Designation as a special resource water recognizes at least one of the following characteristics: (1) the water is of outstanding high quality, exceeding both criteria for primary contact recreation and cold water aquatic life; (2) the water is of unique ecological significance; (3) the water possesses outstanding recreational or aesthetic qualities; (4) intensive protection of the quality of the water is in paramount interest of the people of Idaho; (5) the water is part of the National Wild and Scenic River System, is within a state or national park or wildlife refuge and is of prime or major importance to that park or refuge; (6) intensive protection of the quality of the water is necessary to maintain an existing but jeopardized beneficial use. (IDAPA §58.01.02.056) for special resource waters, additional point source discharge restrictions are applied. (IDAPA §58.01.02.054.03 and 400.01.b)
NOTE: All waters are protected through general surface water quality criteria. Narrative criteria prohibit ambient concentrations of certain pollutants that impair designated uses. Substances for which narrative criteria are established in Idaho water quality standards include hazardous materials; toxic substances; deleterious materials; radioactive materials; floating, suspended, or submerged matter; excess nutrients; oxygen-demanding materials and sediment. (See IDAPA §58.01.02.200.01-08)	

In the Idaho Water Quality Standards, the Portneuf River subbasin is further divided into 26 water body units; units are cataloged with their designated beneficial uses (IDAPA § 58.01.02.150.10). Four of the 26 units define the mainstem Portneuf River and Marsh Creek and the remainder include select tributaries. The first unit is the Portneuf River above Chesterfield Reservoir, which is listed as having the designated uses of cold water aquatic life (CWAL), salmonid spawning (SS), primary contact recreation (PCR), domestic water supply (DWS), and as a special resource water (SRW); however, beneficial use designations do not apply to waters of the Fort Hall Reservation. The second unit extends from Chesterfield Reservoir Dam downstream to the confluence with Marsh Creek. The designated uses for this unit are CWAL, SS, PCR, DWS, and SRW. The third unit extends from the confluence with Marsh Creek to the Fort Hall Reservation boundary and is designated for CWAL, SS, and secondary contact recreation (SCR). Marsh Creek (source to mouth) is designated for CWAL and SCR (Table 2.4).

Most tributary waters do not have beneficial uses specifically designated. These "undesignated" waters are protected for all recreation uses and for the protection and propagation of fish, shellfish, and wildlife wherever attainable (IDAPA §58.01.02.101.01.a.). Industrial and agricultural water supplies, wildlife habitats, and aesthetics are minimum designated standards for all waters of the state.

Table 2.4. Water body units and beneficial uses for the Portneuf River Subbasin.

Unit	Water	Aquatic Life*	Recreation*	Other*
US-1	Portneuf River - Marsh Cr. to the Fort Hall Reservation Boundary	CWAL SS	SCR	
US-2	City Creek - source to mouth			
US-3	Gibson Jack Creek - source to mouth			
US-4	Mink Creek - source to mouth			
US-5	Indian Creek - source to mouth			
US-6	Marsh Creek - source to mouth	CWAL	SCR	
US-7	Walker Creek – source to mouth			
US-8	Bell Marsh Creek – source to mouth			
US-9	Goodenough Creek - source to mouth			
US-10	Garden Creek - source to mouth			
US-11	Hawkins Creek - Hawkins Res. Dam to mouth			
US-12	Hawkins Reservoir			
US-13	Hawkins Creek - source to Hawkins Res.			
US-14	Cherry Creek - source to mouth			
US-15	Birch Creek - source to mouth			
US-16	Portneuf River - Chesterfield Res. Dam to Marsh Cr.	CWAL SS	PCR	DWS SRW
US-17	Dempsey Creek - source to mouth			
US-18	Twentyfourmile Creek - source to mouth			
US-19	Chesterfield Reservoir			
US-20	Portneuf River - source to Chesterfield Reservoir**	CWAL SS	PCR	DWS SRW
US-21	Toponce Creek - source to mouth			
US-22	Pebble Creek - source to mouth			
US-23	Rapid Creek - source to mouth			
US-24	Pocatello Creek - confluence of North and South Fork Pocatello Creeks to mouth			
US-25	South Fork Pocatello Creek - source to mouth			
US-26	North Fork Pocatello Creek - source to mouth			

* Aquatic life, recreation, and other designations are from IDAPA 58.01.02. CWAL = cold water aquatic life; SS = salmonid spawning; PCR and SCR = primary and secondary contact recreation; DWS = domestic water supply; and SRW = special resource waters. DEQ presumes most waters in the state will support CWAL and PCR or SCR beneficial uses, so the DEQ will apply CWAL and PCR or SCR criteria to undesignated waters unless Sections 101.01.b and 101.01.c are followed.

** Beneficial use designations do not apply to waters of the Fort Hall Reservation.

Criteria to Support Beneficial Uses

Beneficial uses described above 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 2.5).

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."

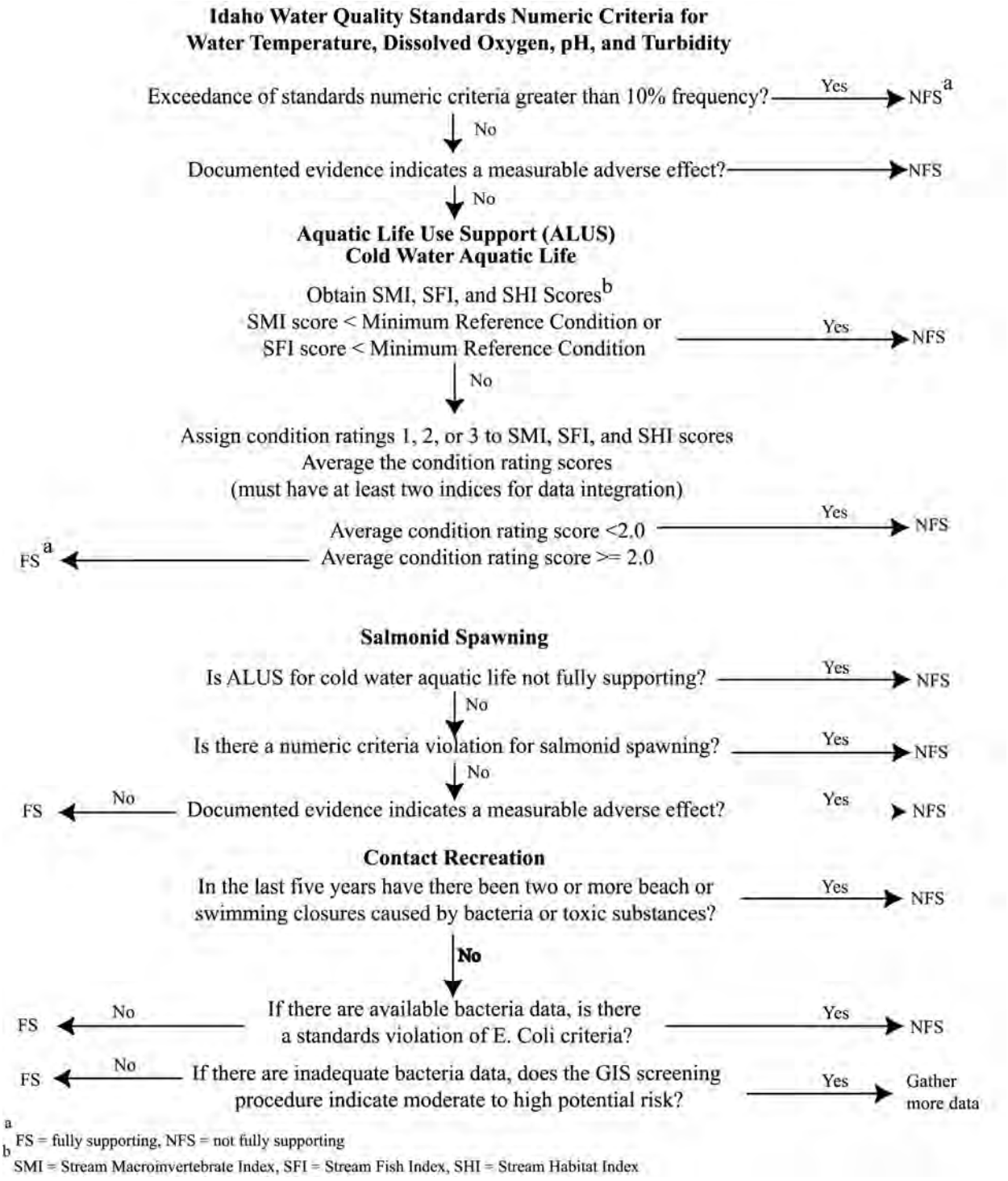
DEQ's procedure to determine whether a water body fully supports designated and existing beneficial uses is outlined in IDAPA 58.01.02.053. The procedure relies heavily upon biological parameters and is presented in detail in the WBAG II (Grafe et al. 2002). This guidance requires the use of the most complete data available to make beneficial use support status determinations. Table 2.5 includes the most common numeric criteria used in TMDLs. Figure 2.1 provides an outline of the stream assessment process for determining support status of the beneficial uses of cold water aquatic life, salmonid spawning, and contact recreation.

Table 2.5. 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; a sample greater than 406 *E. coli* /100ml requires 4 additional samples to determine a geometric mean	Less than 126 *E. coli*/100 ml as a geometric mean of five samples over 30 days; a sample greater than 576 *E. coli*/100 ml requires 4 additional samples to determine a geometric mean	pH between 6.5 and 9.0 DO[b] exceeds 6.0 mg/L[c,d]	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

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)**
Tempera-ture[e]			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
			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[f] instantaneously or more than 25 NTU for more than 10 consecutive days.	
Ammonia			Ammonia not to exceed calculated concentration based on pH and temperature.	

[a] *Escherichia coli* per 100 milliliters
[b] dissolved oxygen
[c] milligrams per liter
[d] DO exemption - The bottom twenty percent (20%) of water depth in natural lakes and reservoirs where depths are thirty-five (35) meters or less.
[e] 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.
[f] Nephelometric turbidity units



[a] FS = fully supporting, NFS = not fully supporting

[b] SMI = Stream Macroinvertebrate Index, SFI = Stream Fish Index, SHI = Stream Habitat Index

Figure 2.1. 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 stream characteristics that have been altered by humans. That is, streams naturally have sediment, nutrients, and aquatic plants, but when anthropogenic sources cause these to reach unnatural levels, they are considered "pollutants" and can impair the beneficial uses of a stream.

Temperature

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

Elevated stream temperatures can be harmful to fish at all life stages, especially if they occur in combination with other habitat limitations such as low dissolved oxygen or poor food supply. Acceptable temperature ranges vary for different species of fish, with cold water species being the least tolerant of high water temperatures. Temperature as a chronic stressor to adult fish can result in reduced body weight, reduced oxygen exchange, increased susceptibility to disease, and reduced reproductive capacity. Acutely high temperatures can result in death if they persist for an extended length of time. Juvenile fish are even more sensitive to temperature variations than adult fish, and can experience negative impacts at a lower threshold value than the adults, manifesting in retarded growth rates. High temperatures also affect embryonic development of fish before they even emerge from the substrate. Similar kinds of effects 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. 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 cold water aquatic life. When DO levels fall below 6 mg/L, organisms are stressed, and if levels fall below 3 mg/L for a prolonged period, these organisms may die; oxygen levels that remain below 1-2 mg/L for a few hours can result in large fish kills. Dissolved oxygen

levels below 1 mg/L are often referred to as hypoxic; anoxic conditions refer to those situations where there is no measurable DO.

Juvenile aquatic organisms are particularly susceptible to the effects of low DO due to their high metabolism and low mobility (they are unable to seek more oxygenated water). In addition, oxygen is necessary to help decompose organic matter in the water and bottom sediments. The dissolved oxygen level 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, algal, or photosynthetic bacterial communities can have significant DO fluctuations throughout the day. A sag in dissolved oxygen 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 have the potential to contain more DO than warmer waters. As flows decrease, the amount of aeration typically decreases and the in-stream temperature increases, resulting in decreased DO. Channels that have been altered to increase the effectiveness of conveying water (for example, irrigation canals) often have fewer riffles and less aeration. Thus, these systems may show depressed levels of DO in comparison to levels before the alteration. Nutrient-enriched waters have a higher biochemical oxygen demand due to the amount of oxygen required for organic matter decomposition and other chemical reactions. This oxygen demand results in lower in-stream DO levels.

Sediment

Both suspended (transported in the water column) and bedload (moving 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. Sigler et al. (1984) showed experimentally that elevated sediment in water resulted in reduced growth rates and increased emigration rates of salmonids in waters with turbidities as low as 25 nephelometric turbidity units (NTU).

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. When coarse substrate habitat is reduced, community structure, specifically diversity, of the aquatic macroinvertebrate community is diminished

Settleable solids are defined as the volume (milliliters [ml]) or weight (mg) of material that settles out of a liter of water in one hour (Franson et al. 1998). Settleable solids may consist of large silt, sand, and organic matter. Total suspended solids (TSS) are defined as the material collected by filtration through a 1.5-µm (micrometer) filter (Standard Methods 1975, 1995). Settleable solids and total suspended solids (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.

Sediment ranks third among the top 100 impairers of water quality (EPA 2007) and is the leading stressor for benthic impairment in many states (Benham et al. 2005) including Idaho (Rowe et al. 2003). As noted above, suspended sediment concentrations are also strongly correlated with concentration of other relevant pollutants including sorbed trace elements (e.g., mercury; Balogh et al. 1997, 1998), TP (Degenhardt and Fromuth 1993, Grayson et al. 1996), and synthesized organics (e.g., pesticides and petroleum; Domagalski and Kuivila 1993).

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. *E. coli* is often measured in colony forming units (cfu), and more simply as *E. coli* organisms per 100 ml. Pathogens are a small subset of microorganisms (e.g., certain bacteria, viruses, and protozoa), which, if ingested via contaminated water or food, can cause sickness or even death. Some pathogens also 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 regulated 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.

Nutrients

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

The first step in identifying a water body's response to nutrient flux is to define which of the critical nutrients is limiting. A limiting nutrient is one that normally is in short supply relative to biological needs. The relative quantity affects the rate of production of aquatic biomass. Usually, either phosphorus (P) or nitrogen (N) may be the limiting factor for algal growth, although P is most commonly managed as 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 P 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 P is mainly soluble orthophosphate (ortho-P), a form of P that is more biologically available than TP, and consequently leads to a more rapid growth of algae. Therefore it is important to monitor concentrations and relative amounts of each form in order to determine sources and predict results of reducing in-stream concentrations.

Nitrogen may be a limiting factor at certain times if there is substantial depletion of N in sediments due to uptake by rooted macrophyte beds. In systems dominated by blue-green algae, N is not thought to limit productivity, because some cyanobacteria are capable of fixing atmospheric N at the water/air interface.

Nutrients primarily cycle between the water column and sediment. Aquatic plants rapidly assimilate dissolved nutrients, particularly orthophosphate. If sufficient nutrients are available in the sediments or the water column, aquatic plants will store an abundance of such nutrients in excess of the plants' actual needs; this physiological phenomenon is 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 liberated 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 or benthos. 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 P 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 aquatic plant growth is by reducing surface erosion and sedimentation.

Sediment acts as a nutrient sink under aerobic conditions. However, when conditions become anoxic, sediments release P into the water column. This phenomenon is common to reservoirs like Hawkins Reservoir that seasonally undergo anoxia. Nitrogen can also be released, but the mechanism by which it happens is fundamentally different. The exchange of N between sediment and the water column is primarily a microbial process controlled by the amount of oxygen in the sediment. When conditions become anaerobic, the oxygenation of ammonia (nitrification) ceases and ammonia production increases resulting in a reduction of the amount of nitrogen oxides (NO_x) lost to the atmosphere.

Sediments can play an integral role 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 cyanobacteria (i.e., 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 (i.e., sediment-associated 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 an aquatic ecosystem can act as a mechanism for water quality improvements, particularly in surface-water systems dominated by cyanobacteria, which can acquire nitrogen directly from the atmosphere (i.e., N-fixation) and the water column. Phosphorus management within these systems can potentially result in improvement in the levels of nutrients (phosphorus), nuisance algae, DO, and pH.

2.4 Summary and Analysis of Existing Water Quality Data

The Portneuf Watershed Partnership has been collecting water samples on a regular basis for several years to characterize physical and chemical conditions in the Portneuf River and lower Marsh Creek. Samples are collected at permanent monitoring stations monthly during ice-free periods coinciding with NPDES requirements for the City of Pocatello's wastewater treatment plant (WWTP). A minimum of 10 samples are collected annually from each site. Supplemental sampling during runoff events is conducted as resources permit. In addition, continuous monitoring of water quality is conducted using data sondes that support five different sensors. Data sondes measure water quality constituents including temperature, specific conductance, DO, pH, and optical turbidity at regular

intervals and allow greater resolution than periodic water sampling in tracking trends for several water quality parameters (Brock and Ray 2004).

A synthesis of the contemporary biological monitoring completed by DEQ and partnering agencies and Idaho State University are described in the Portneuf River Subbasin Biological Assessment (BA) that serves as a companion to this document and is included as Appendix F. Excerpts and summaries from the BA are provided in the following summaries but the reader is directed to the BA for a comprehensive summary of the biological assemblages in the Portneuf River.

River discharge is measured at four gaging stations by means of continuous water level recorders that are calibrated by regular field measurements of velocity and depth at several permanent water quality monitoring stations. These stations also supplement the discharge record collected from the gaging network maintained by U.S. Geological Survey (see Figure A for monitoring station and gaging station locations in the subbasin). A summary of flow characteristics, water column physicochemical conditions, and biological data from the Portneuf River subbasin is contained below.

Flow Characteristics

Characterization of the mainstem flows in the Portneuf River subbasin is facilitated by the presence and operation of four USGS permanent gaging stations (Figure A). There are three mainstem stations (USGS Gage Number 13073000 for the Portneuf River at Topaz, Idaho; USGS Gage Number 13075500 Portneuf River at Pocatello, Idaho; and USGS Gage Number 13075910 Portneuf River near Tyhee, Idaho) and one Marsh Creek station (USGS Gage Number 13075000 Marsh Creek near McCammon, Idaho). Daily duration hydrographs or time-series plots of average daily discharge using the long-term flow record are shown for each USGS gaging station (Figure 2.2). The mainstem gages show hydrographs characteristic of mountain regions of the western U.S.; western watersheds commonly store precipitation as snow pack which feeds rivers during melt-off. Additionally, flows in the Portneuf River peak during the annual spring pulse and decline precipitously as anthropogenic demand for water occurs concomitant with warming temperatures and increased insolation. A dramatic rebound in discharge in the fall reflects reduced water demands and cooler temperatures (Dettinger 2005).

Flows in the mainstem Portneuf River and Marsh Creek are altered by storage and delivery, permitted and unpermitted withdrawals, diversions, and/or because of the receipt of irrigation return flows. The extent of hydrologic manipulation varies throughout the subbasin, but comparisons with an unregulated hydrograph from Birch Creek near Downey (daily discharge average during the years 1938 to 1949) indicate that annual peak in discharge is shorter and late season flows in the Portneuf River are lower than those expected in unregulated streams (Van Kirk 2007). The Marsh Creek hydrograph shows less annual variation than mainstem sites, in part because it is seasonally augmented by irrigation return flows originating from the Portneuf River and diverted through the Portneuf Marsh Valley Canal. Higher winter flows recorded at Tyhee, relative to those at Pocatello reflect considerable ground water contributions; the dramatic summer depression in daily discharge at Tyhee shows the impact of irrigation water withdrawal below Siphon Road (Figure 2.2).

Long-term changes in discharge in the Portneuf River subbasin are shown in a plot of decadal hydrographs from the USGS Pocatello gage (Figure 2.3). This plot shows both a trend towards earlier snowmelt and also reduced daily discharge across the calendar year; both patterns have been reported throughout the western U.S. (Dettinger 2005).

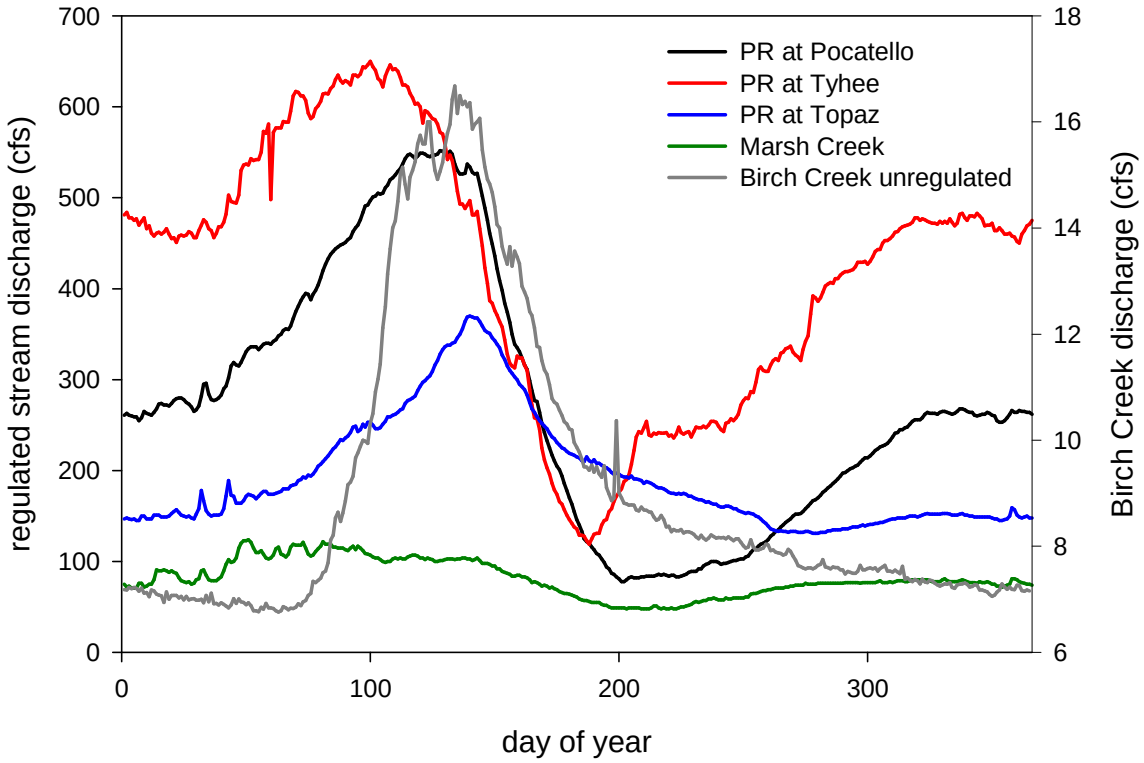


Figure 2.2. Hydrograph of average daily discharge for USGS gaging stations in the Portneuf River subbasin. The period of record for each gaging station varies. Birch Creek is included separately (on right vertical axis) to accommodate direct comparisons of the shape of regulated and unregulated hydrographs in the subbasin.

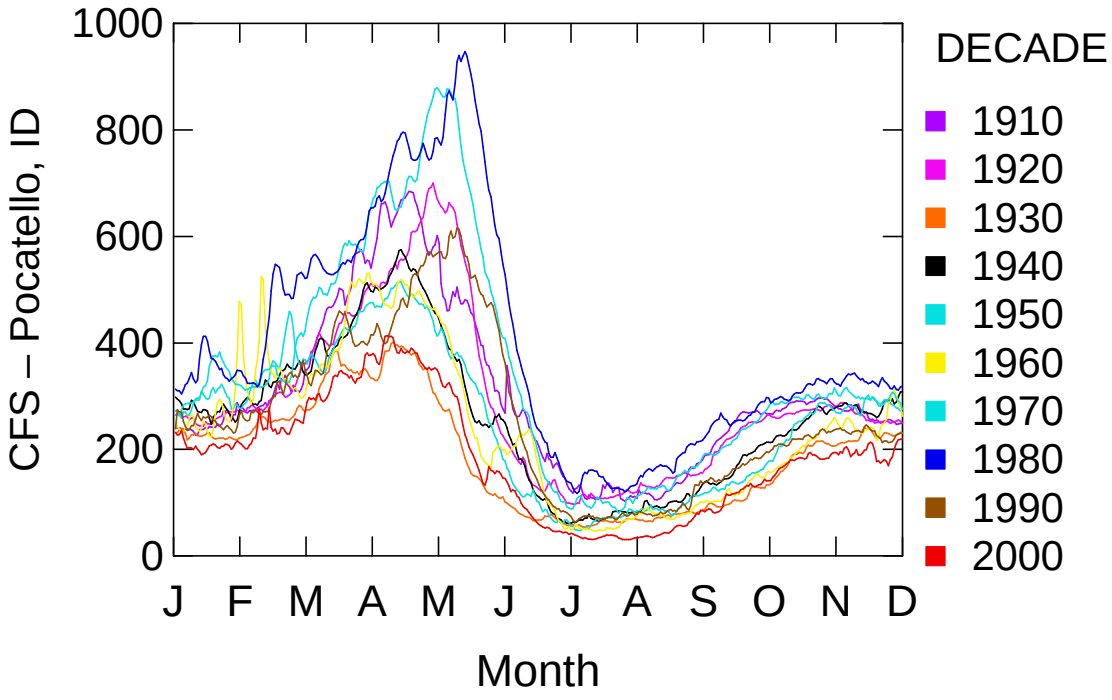


Figure 2.3. Decadal hydrographs for the Portneuf River at Pocatello Idaho (USGS Gage Number 13075500 Portneuf River at Pocatello) shown by calendar month. Each month is signified by the first letter of the month (e.g., F = February). Figure used with permission from R. Inouye.

Water Column Data

The Portneuf River has been the subject of water quality investigations for nearly 40 years. Early monitoring efforts showed that the river was becoming increasingly impaired from land use and hydrologic alterations (Minshall and Andrews 1973). In the 1960s, longitudinal patterns in turbidity, alkalinity, pH, nutrients, and fluoride were described from the outfall of Chesterfield Reservoir to Siphon Road. While no clear longitudinal trends were apparent for turbidity and pH, a general decrease in alkalinity and total dissolved solids downstream was noted. In contrast to this pattern, both nitrogen and phosphorus generally increased downstream with the largest concentrations occurring at Batiste Road (Minshall and Andrews 1973). The authors also documented the profound influence of geothermal springs on stream temperatures near the City of Lava Hot Springs and described the reduced diel temperature patterns at Siphon Road. In the Portneuf River above Siphon Road, natural spring inputs are thought to moderate diel and annual temperature variations. Elevated water temperatures were also documented downstream of McCammon and attributed, in part, to a reduction in river discharge following upstream irrigation withdrawals (Minshall and Andrews 1973).

From 1990 to 1991, focused sampling of phosphorus in the middle and lower segments of the Portneuf River showed that average ortho-P concentrations in the Portneuf River increased from McCammon (0.070 ± 0.044 mg/L; mean ± 1 SD) to a maximum at a

monitoring station below Batiste Road (4.43 ± 5.53 mg/L; mean ± 1 SD). The average concentration of TP in the Portneuf River at Siphon Road during this same period was 2.88 ± 3.83 mg/L (mean ± 1 SD; Campbell et al. 1992).

Current (2003 to 2008) water quality conditions of the mainstem Portneuf River and lower Marsh Creek are summarized in Figures 2.4 and 2.5 from monthly sampling information. The median multi-year temperature plots indicate surface water temperatures decrease in the Portneuf River from Topaz to Siphon Road. The greatest variation in temperature was recorded at Edson Fichter Nature Area (EFNA) and lower Marsh Creek monitoring stations. There were no longitudinal trends in conductance, however, the greatest range of conductance over this 5+ year period were documented at the EFNA and lower Marsh Creek stations. Portneuf River at Siphon Road had a lower pH than at all other monitoring sites. The marked difference in this measure at Siphon Road most likely reflects the contribution of low pH ground water to this reach (Baldwin et al. 2004). Median dissolved oxygen concentrations were lowest at Topaz and Siphon Roads. Lower dissolved oxygen at Topaz may reflect the influence of geothermal inputs (Minshall and Andrews 1973). Similarly, inputs of ground water may act to depress in-stream DO concentrations at Siphon Road relative to upstream reaches. Turbidity summaries for all sites exhibit right-skewed distributions. This skewness (larger upper quartile) in Portneuf River at Batiste Road and lower Marsh Creek is most pronounced and indicates that between 2003 and 2008 there were more high turbidity events than at other mainstem monitoring sites.

Total suspended sediment (or suspended sediment concentration) summaries show that concentrations above the high flow sediment target (80 mg/L; DEQa 2001) occurred at each site (Figure 2.5). Median TSS/ suspended sediment concentration (SSC) concentrations were lowest in Portneuf River above Marsh Creek (10 mg/L) and at Siphon Road (13 mg/L) and highest in lower Marsh Creek (48 mg/L). Median TP concentrations increased downstream; however, the increase between Batiste and Siphon Roads is over 1.1 mg/L (Figure 2.5). Nitrogen (expressed as NO_2+NO_3-N) is highest at Siphon Road, but median concentrations decrease between Topaz and Batiste Road. Both N and P concentrations at Batiste Road have decreased considerably since Minshall and Andrews' (1973) seminal work in the late 1960s. Additionally, TP concentrations at Batiste Road have dropped considerably since 1991 when the first P-rich discharge from phosphate ore-processing facilities was eliminated (Campbell et al. 1992). Detailed descriptions of water quality for specific assessment units is provided in Section 5 of this document.

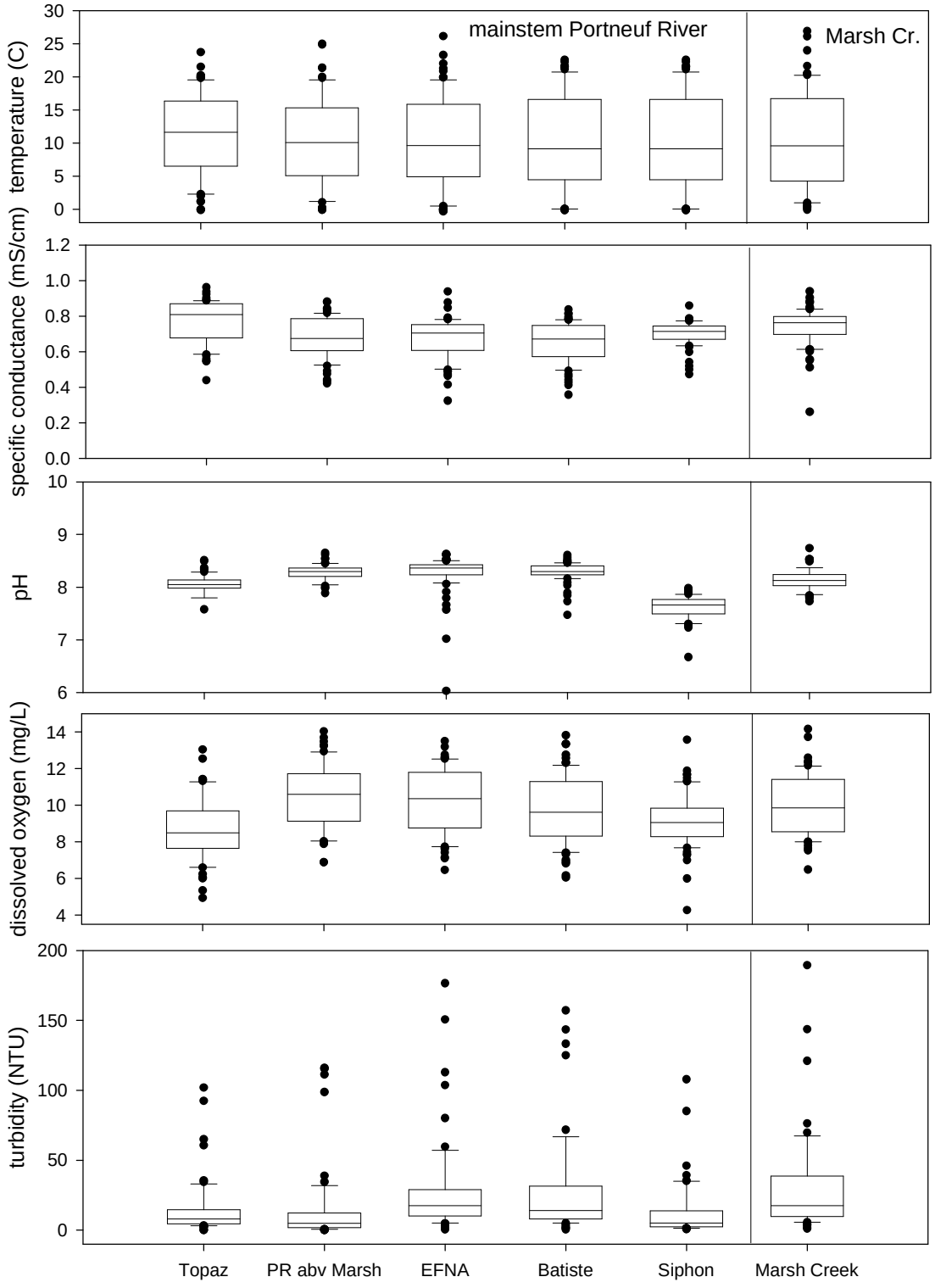


Figure 2.4. Water quality characteristics for mainstem Portneuf River and lower Marsh Creek monitoring locations; data shown summarize discrete monthly measurements from 2003 to 2008.

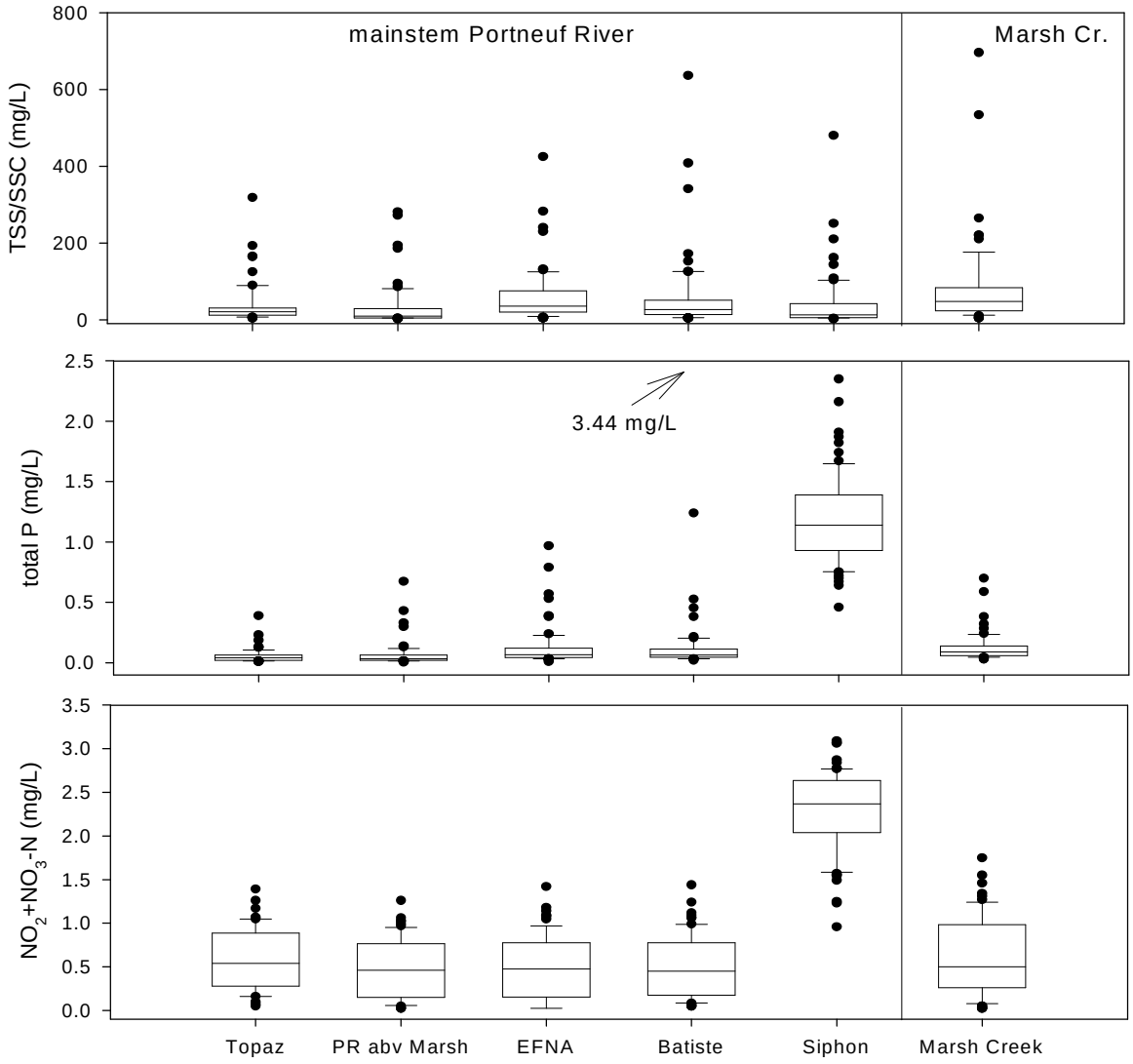


Figure 2.5. Sediment (total suspended solids or suspended sediment concentration), total phosphorus, and nitrate + nitrite-nitrogen concentrations in mainstem Portneuf River and Marsh Creek monitoring locations. Data shown summarize monthly samples from years 2003 to 2008.

Total Suspended Solids and Total Phosphorus Loading Estimates using the Continuous Record

Data sondes provide a near continuous record of water quality conditions in the Portneuf River. Although sondes measure multiple parameters simultaneously, the focus of this section is to summarize the turbidity record at multiple locations in the Portneuf River and lower Marsh Creek. Turbidity is a useful surrogate for both TSS and TP (see Stubblefield et al. 2007). Since sediment and TP are both listed as pollutants in the mainstem Portneuf River and Marsh Creek, the summaries that follow describe three years of estimated loads of both TSS and TP in the Portneuf River, derived from turbidity

and discharge measurements. The three years described (2004, 2005, and 2006) represent the basis of analyses described in Section 5 of this document. Before discussing results from the sonde record, a brief discussion of the deployment, quality assurance, and data processing procedures are provided.

Sondes were calibrated prior to deployment, with deployment periods ranging from 7 to 10 days. Calibration followed the manufacturer's recommendations. To ensure that the sonde records adhered to quality assurance/quality control (QA/QC) goals, readings from a second, recently calibrated sonde were used to verify measurements of the sonde being retrieved. All data collected by the sondes that did not meet QA/QC criteria were excluded from the sonde records used in the summaries that follow. QA/QC criteria for each water quality parameter are discussed in Brock and Ray (2004). Since turbidity is used here as a surrogate for both TSS and TP, QA/QC criteria for turbidity value rejection are explicitly described. Turbidity data was accepted from the retrieved sonde only if there was a difference of less than 30%, or less than 3 NTU, whichever was greater, from the turbidity measurement on the recently calibrated sonde (Inouye et al., *in review*; Wagner et al., 2007 Brock and Ray, 2004). Gaps in the data record exist and are present because: data were rejected, there were equipment problems, or sondes were removed during icing periods.

Turbidity data that met the QA/QC criteria were then mathematically filtered to remove additional outliers likely caused by one of three occurrences: 1) failure of the mechanical probe wiper to adequately clean the optical window, 2) parking of the mechanical wiper over the optical window, or 3) presence of large particulate matter that interfered with the measurement. Values were also excluded if they exceeded the average of the five previously accepted values by more than a factor of 1.75 and by more than 10 NTU (Inouye et al., *in review*). Data were then reviewed using time series plots to assure no accurate data was removed from the dataset. In cases where sudden rises in turbidity (more than 1.75 times the mean of the five previously accepted values) were followed by gradual declines, indicating a true turbidity pattern, those data were reinstated in the approved data set.

Discharge data from four USGS gages were used to estimate discharge for different monitoring locations in the subbasin. To estimate discharge at the Topaz monitoring location, USGS Gage 13073000 Portneuf River at Topaz, Idaho, was used. Estimates of discharge for Portneuf River above Marsh Creek were developed using a combination of discharge records from the USGS Topaz gage, the USGS 13075500 Portneuf River at Pocatello, Idaho gage and irrigation records from Portneuf Marsh Valley Canal as follows:

> discharge (cfs) = -16.035 + (1.198 x USGS Topaz discharge (cfs) before and after the irrigation season ($R^2 = 0.922$, $P<0.001$) and discharge (cfs) = 10.780 + (0.0936 x EFNA Q) + (0.0634 x PMV Canal Diversions) during the irrigation season ($R^2_{adj} = 0.678$, $P=0.004$).

To estimate discharge at Batiste and EFNA monitoring sites, we used empirical relationships based on discharge measurements at each site and the USGS Pocatello gage

(Batiste discharge (cfs) = 1.030 x Pocatello discharge - 4.887; $R^2 = 0.9825$, $P < 0.001$; EFNA discharge (cfs) = 0.961 x Pocatello discharge - 14.423; $R^2 = 0.9923$, $P < 0.001$).

Using data from the USGS 13075910 Portneuf River at Tyhee, Idaho gage, plus irrigation records from the Bureau of Indian Affairs pump station, we were able to estimate discharge at Siphon Road. Finally, estimates of discharge in lower Marsh Creek were calculated using empirical relationships based on discharge measurements at the lower Marsh Creek monitoring station and the USGS 13075000 Marsh Creek near McCammon, Idaho gage (lower Marsh Creek discharge (cfs) = 1.2954 x (Marsh Creek gage) - 6.4261; $R^2 = 0.9680$, $P < 0.001$). Discharge was estimated at all sites using 30-minute data collected at 0 and 30 minutes of each hour (Inouye et al., *in review*). Discharge varied considerably over the study period (2004 to 2006) and was lowest in 2004 and highest in 2006.

Optical turbidity measured at each site was converted to TSS and TP concentrations with an empirical relationship based on samples taken at six long-term sampling locations along the Portneuf River. These relationships were linear and statistically significant (TSS $R^2 = 0.95$, $P < 0.001$, N = 217 and TP $R^2 = 0.90$, $P < 0.001$, N = 192).

$$\text{TSS (mg/L)} = 2.3597 \times \text{turbidity (NTU)} + 9.609 \qquad \textbf{Equation 1}$$

$$\text{TP (mg/L)} = 0.003 \times \text{turbidity (NTU)} + 0.0264 \qquad \textbf{Equation 2}$$

Using these equations, daily sediment and phosphorus loads were developed with the following equation: TSS or TP concentration (mg/L) x discharge (cfs) x 2.45 (L x kg x sec/mg x ft^3 x d) x 2.205 (lbs/kg) = lbs/day. Daily load estimates represented the average of all 30-minute TSS or TP loads available for a given day. For some days, only partial records were available because the QA/QC or filtering approaches described above, resulted in removal of some data. For these days, the daily average was estimated with all data that passed assurance and filtering approaches. TSS was used instead of suspended sediment concentration (SSC) because much of the dataset included TSS values. For approximately 5% of the samples for which only SSC was analyzed, highly significant relationships (all R^2 values > 0.95) between the two parameters allowed us to estimate TSS for each monitoring site (see Inouye et al., *in review*).

At Siphon Road, TSS and TP were predicted from equations that were unique to that site. TSS was predicted using the following equation:

$$\text{TSS (mg/L)} = 2.356 \times \text{turbidity (NTU)} + 7.486 \ (R^2 = 0.842, P < 0.001) \qquad \textbf{Equation 3}$$

TP was predicted using a rating curve approach as follows:

$$\log \text{TP (mg/L)} = -0.6109 \times \log \text{discharge (cfs)} + 1.6613 + e^{0.0106} \ (R^2 = 0.660, P < 0.001) \qquad \textbf{Equation 4}$$

After estimates of TSS and TP were generated for Siphon Road, conversion of concentrations to loads was completed using the same equations described for all other sites above. Figures 2.6 and 2.7 summarize the average annual and monthly loads for TSS and TP expressed as a daily load for six monitoring locations and three years (2004 to 2006). Target TSS and TP loads are also summarized in the figures that follow. The low- and high-flow TSS and TP target concentrations used to estimate target loads are 35 and 80 mg/L TSS and 0.07 and 0.125 mg/L TP; the approach used to develop these targets is summarized in Section 5 of this document.

Across all sites and years, exceedances of the TSS target occurred during runoff; an exception to this trend was measured in the Portneuf River at Topaz in 2004 (Figure 2.6). Daily TSS loads in 2006 deviated most from the target TSS load at all sites (Figures 2.6 to 2.11). The average annual daily loads were greatest in 2006 and least in 2004 for all sites. The interannual variation in loading was smallest for lower Marsh Creek and greatest for Portneuf River above Marsh Creek (Table 2.6). Across all sites and years, average daily load was greatest in April, but this statistic was strongly influenced by loading in 2006 (Table 2.6).

Estimates of phosphorus loading followed the same general trends as sediment loading (Figures 2.12 to 2.17 and Table 2.7). An exception was Siphon Road, which is more strongly influenced by P-contaminated waters from the Eastern Michaud Flats Superfund sites (Baldwin et al. 2004) than variations in surface water discharge. The interannual variation in average daily TP loading was greatest in Portneuf River above Marsh Creek; at this location, the average annual daily TP load in 2006 was 11X greater than in 2004. In lower Portneuf River, interannual variation was much lower (Table 2.7). The coefficient of variation in the average annual daily load was 0.74 at Batiste Road and only 0.08 at Siphon Road. This latter value demonstrates how constant the TP load is at this site and highlights the significance of ground water P inputs in this river segment.

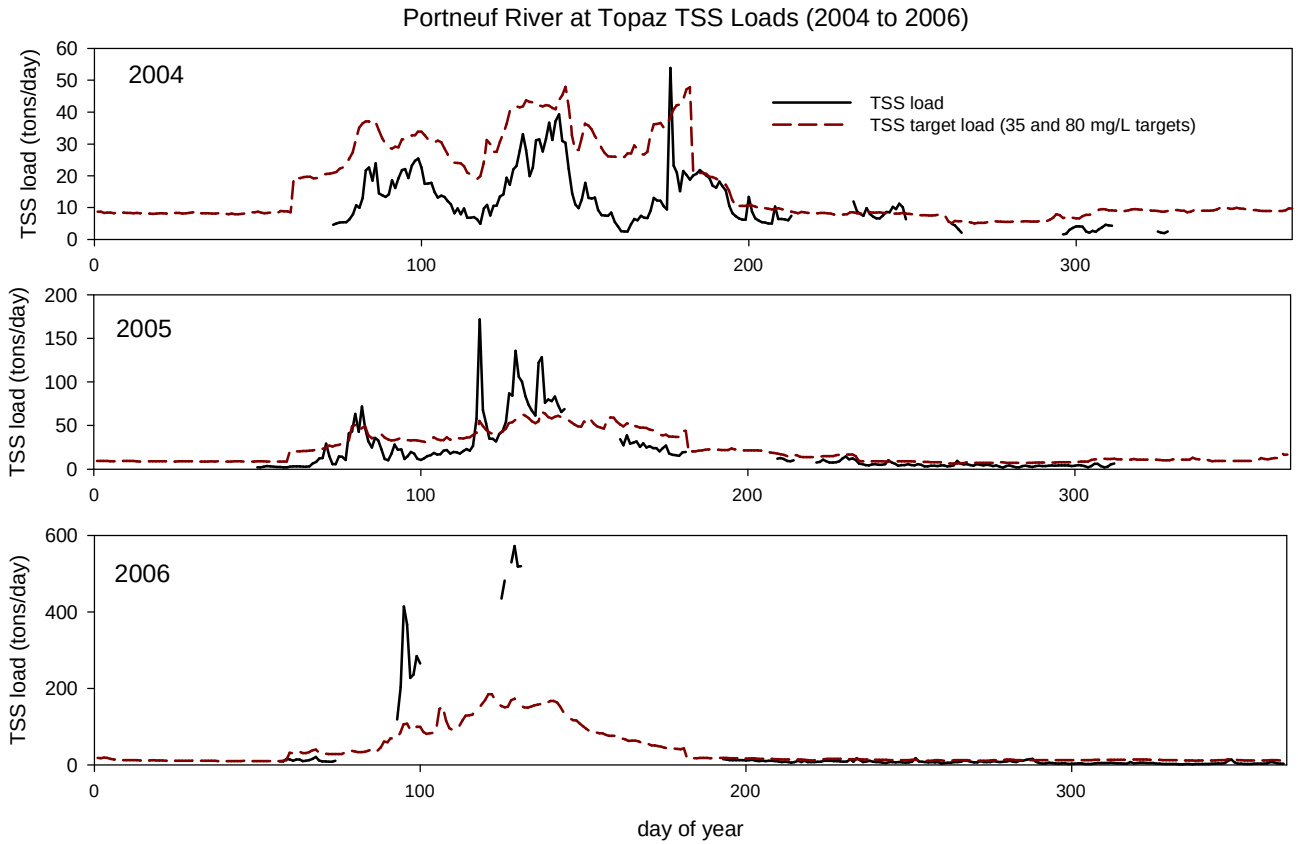


Figure 2.6. Estimated and target daily total suspended solids (TSS) loads for the Portneuf River at Topaz. Daily load estimates were calculated as the average of all 30-min estimates of discharge and measurements of turbidity (translated into TSS using Equation 1) at Topaz and expressed in tons/day. Average daily target loads were developed using high (80 mg/L) and low (35 mg/L) flow sediment targets proposed in Section 5 and the same 30-min estimates of discharge. The months of March through June were considered high flow months.

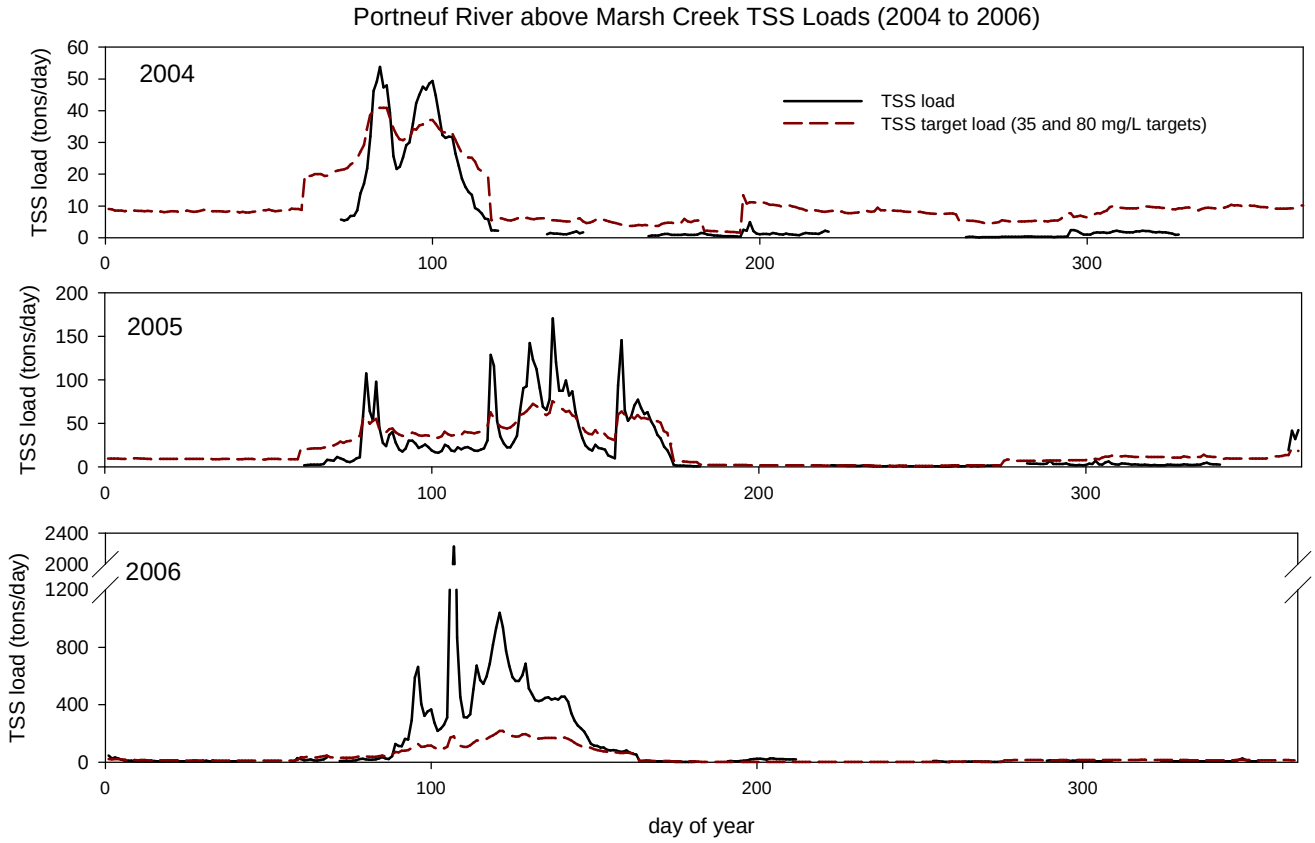


Figure 2.7. Estimated and target daily total suspended solids (TSS) loads for the Portneuf River above Marsh Creek. Daily load estimates were calculated as the average of all 30-min estimates of discharge and measurements of turbidity (translated into TSS using Equation 1) above Marsh Creek and expressed in tons/day. Average daily target loads were developed using high (80 mg/L) and low (35 mg/L) flow sediment targets proposed in Section 5 and the same 30-min estimates of discharge. The months of March through June were considered high flow months.

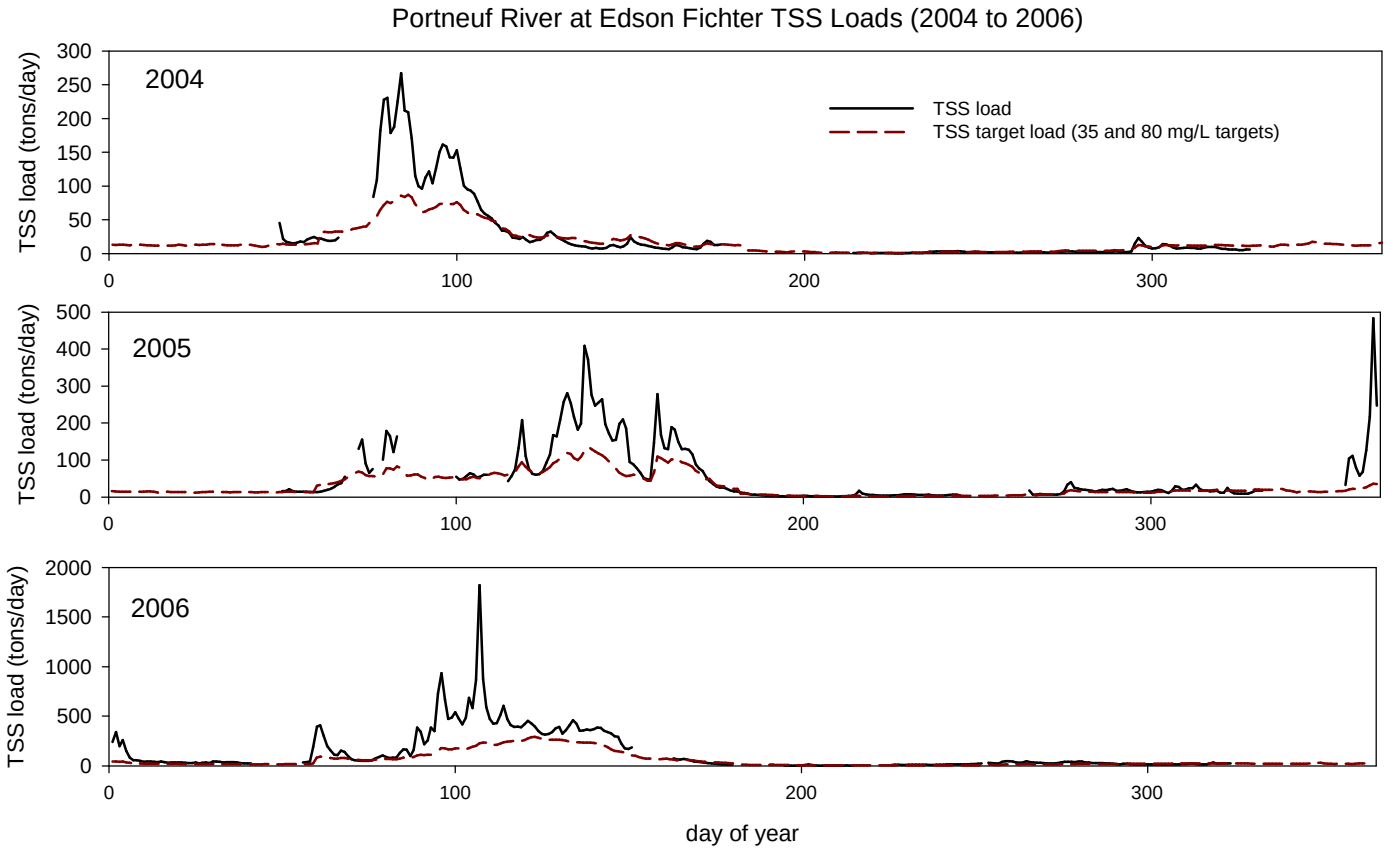


Figure 2.8. Estimated and target daily total suspended solids (TSS) loads for the Portneuf River at Edson Fichter Nature Area (EFNA). Daily load estimates were calculated as the average of all 30-min estimates of discharge and measurements of turbidity (translated into TSS using Equation 1) at EFNA and expressed in tons/day. Average daily target loads were developed using high (80 mg/L) and low (35 mg/L) flow sediment targets proposed in Section 5 and the same 30-min estimates of discharge. The months of March through June were considered high flow months.

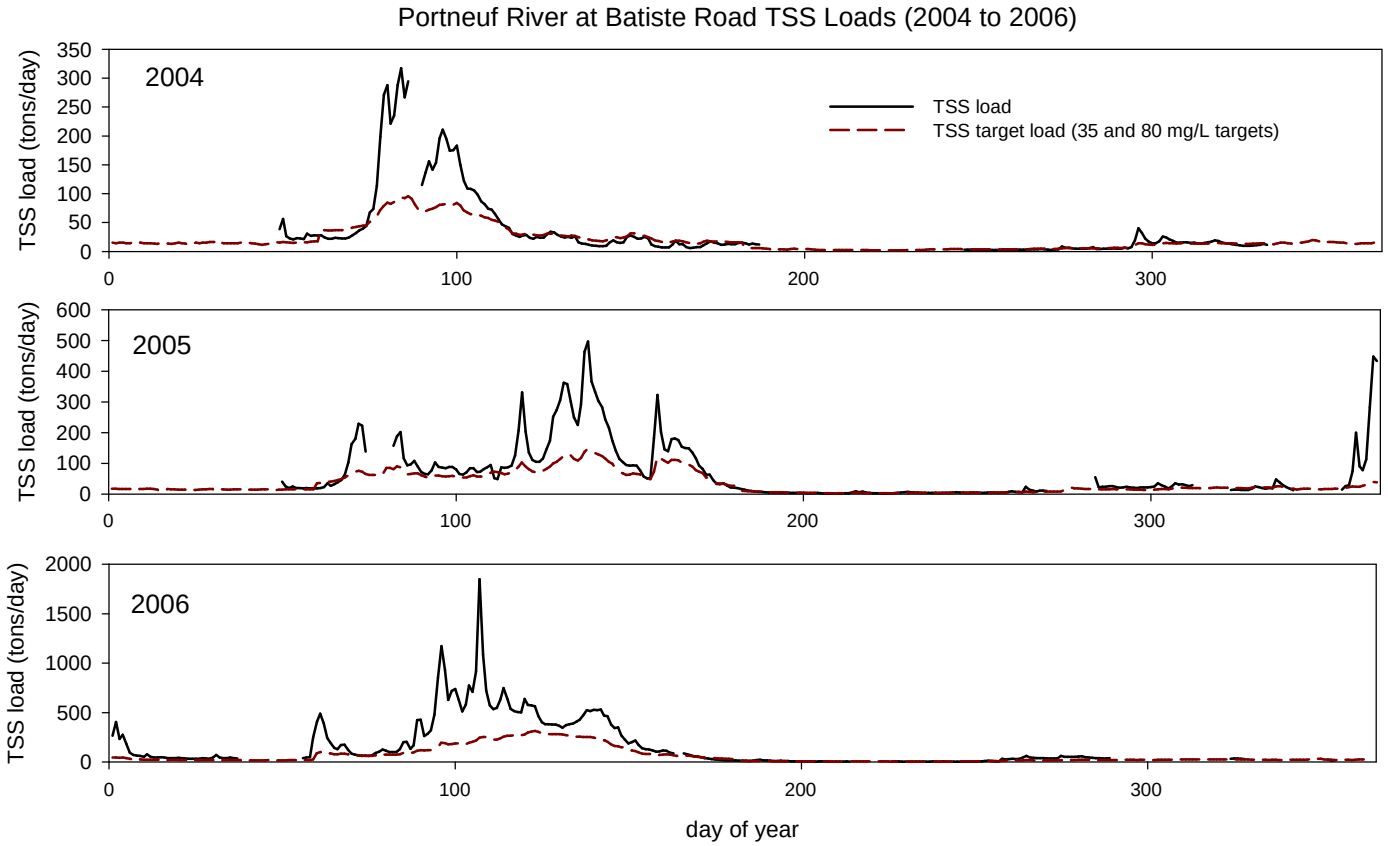


Figure 2.9. Estimated and target daily total suspended solids (TSS) loads for the Portneuf River at Batiste Road. Daily load estimates were calculated as the average of all 30-min estimates of discharge and measurements of turbidity (translated into TSS using Equation 1) at Batiste Road and expressed in tons/day. Average daily target loads were developed using high (80 mg/L) and low (35 mg/L) flow sediment targets proposed in Section 5 and the same 30-min estimates of discharge. The months of March through June were considered high flow months.

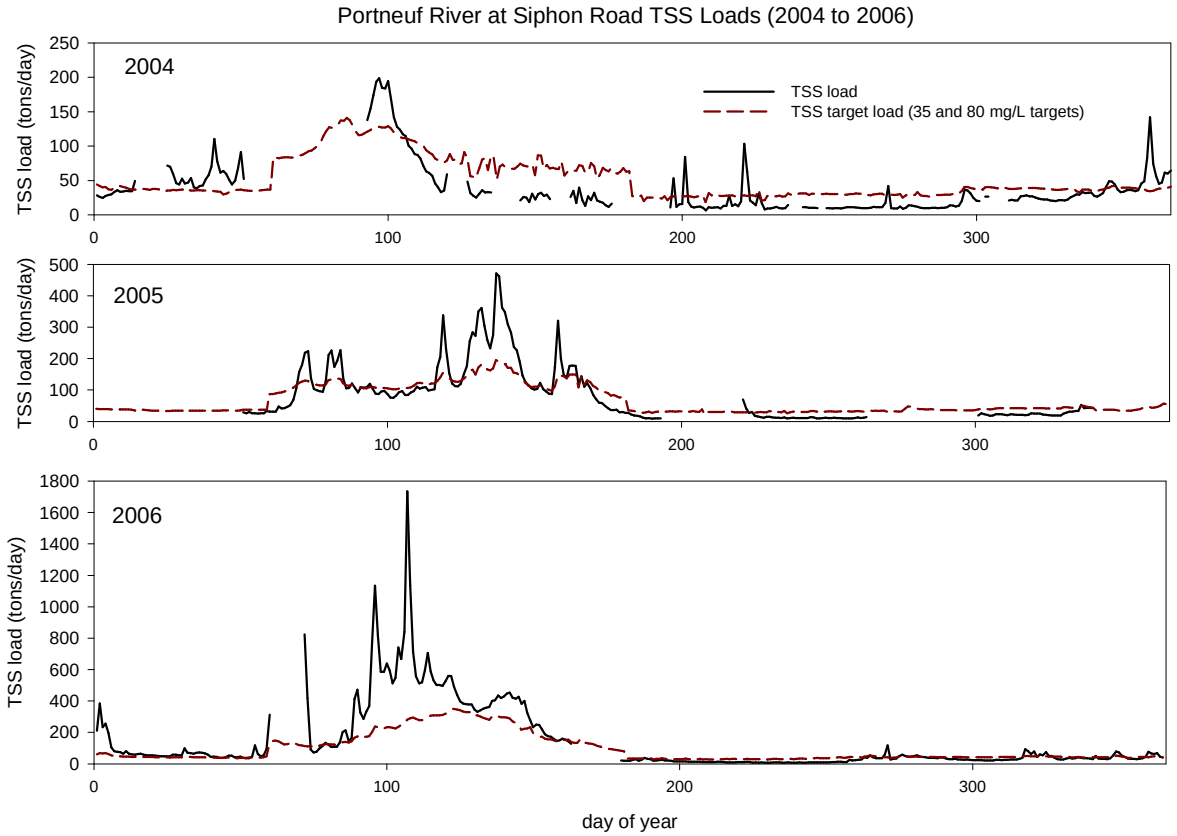


Figure 2.10. Estimated and target daily total suspended solids (TSS) loads for the Portneuf River at Siphon Road. Daily load estimates were calculated as the average of all 30-min estimates of discharge and measurements of turbidity (translated into TSS using Equation 3) at Siphon Road and expressed in tons/day. Average daily target loads were developed using high (80 mg/L) and low (35 mg/L) flow sediment targets proposed in Section 5 and the same 30-min estimates of discharge. The months of March through June were considered high flow months.

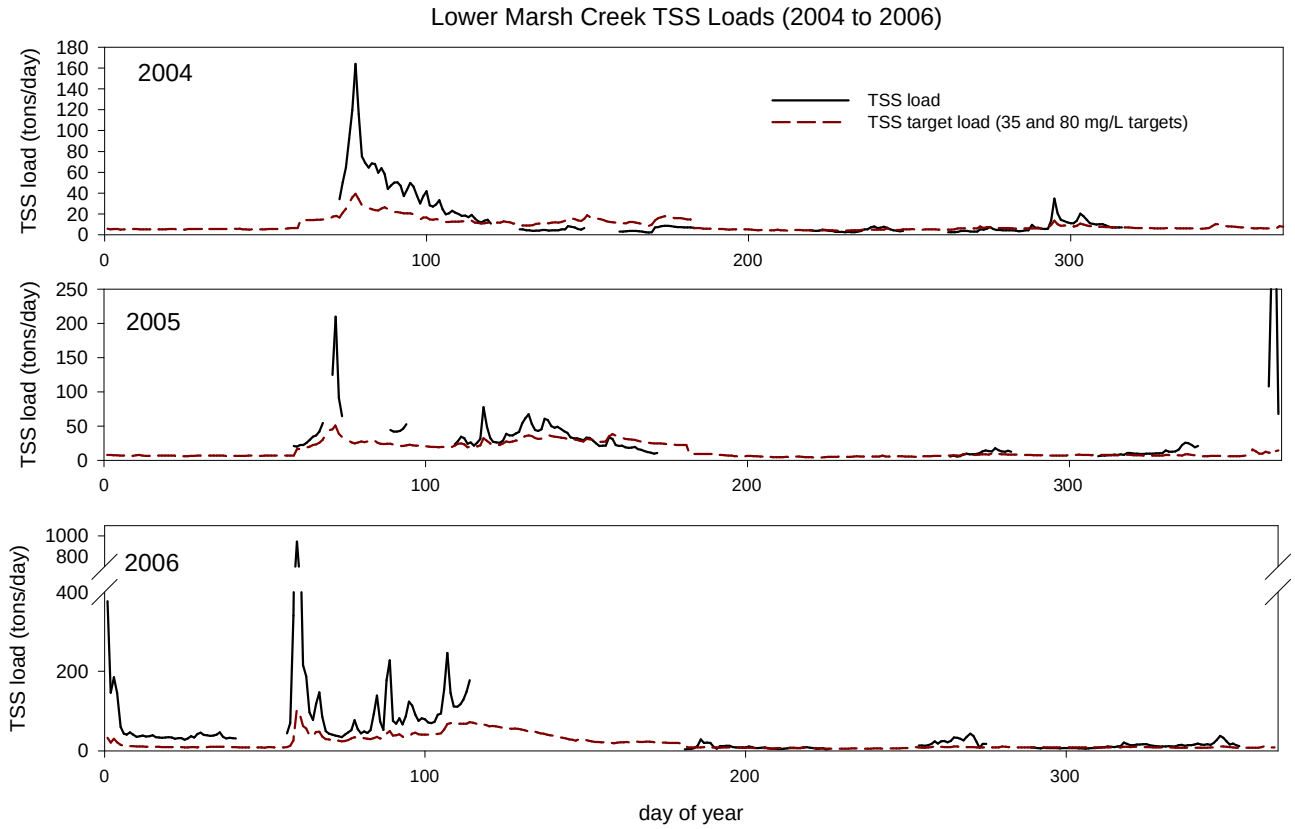


Figure 2.11. Estimated and target daily total suspended solids (TSS) loads for lower Marsh Creek. Daily load estimates were calculated as the average of all 30-min estimates of discharge and measurements of turbidity (translated into TSS using Equation 1) in lower Marsh Creek and expressed in tons/day. Average daily target loads were developed using high (80 mg/L) and low (35 mg/L) flow sediment targets proposed in Section 5 and the same 30-min estimates of discharge. The months of March through June were considered high flow months.

Table 2.6. Average annual and monthly total suspended solids (TSS) loads calculated from 30-min discharge and turbidity estimates for calendar years 2004 to 2006 and expressed as daily load in tons/day.

Monitoring Location	Year	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Portneuf River at Topaz	2004	13	--	--	12.4	14.0	22.7	11.6	11.3	8.4	6.5	3.0	3.2	--
	2005	20	--	2.5	20.4	27.7	75.5	24.8	11.5	8.2	4.8	3.5	4.5	--
	2006	34	--	11.6	12.2	264.5	503.7	--	11.5	9.2	7.9	7.2	4.2	4.3
Portneuf River above Marsh Creek	2004	8	--	--	25.1	25.6	1.4	0.9	1.2	1.6	0.2	0.8	1.8	--
	2005	21	--	--	23.8	29.7	67.4	35.5	0.9	1.2	0.9	3.4	2.8	14.4
	2006	129	10.9	7.5	25.8	533.7	455.7	33.8	17.0	--	3.7	9.0	7.3	8.4
Portneuf River at EFNA	2004	29	--	21.3	128.6	79.5	15.6	10.7	--	1.5	1.7	6.1	7.5	--
	2005	57	--	15.3	78.2	74.3	185.3	89.5	3.4	5.7	7.5	18.5	17.1	152.6
	2006	134	71.4	44.5	145.1	558.5	341.8	37.8	4.1	9.5	28.3	24.5	19.2	29.7
Portneuf River at Batiste Road	2004	38	--	28.6	117.0	100.2	20.2	12.4	12.7	--	3.1	11.3	13.8	--
	2005	70	--	22.5	102.7	97.4	226.7	103.3	5.2	4.5	7.5	25.2	21.6	109.7
	2006	174	85.0	63.7	173.9	684.3	413.0	77.8	10.2	5.2	23.8	46.9	33.8	21.4
Portneuf River at Siphon Road	2004	37	40.2	58.6	--	111.9	29.5	22.8	18.0	19.0	11.6	16.1	23.8	46.2
	2005	86	--	27.6	117.2	115.5	230.0	105.7	14.5	17.7	11.1	22.4	22.9	43.0
	2006	141	93.9	55.8	216.6	646.0	392.7	149.2	19.0	9.2	26.1	36.3	40.9	44.0
Lower Marsh Creek	2004	17	--	--	71.6	26.6	5.2	5.5	6.7	4.5	3.6	9.6	8.8	--
	2005	33	--	21.0	57.6	36.9	41.4	19.6	--	--	8.4	14.0	9.8	97.5
	2006	47	60.0	62.9	127.4	108.8	4.1	3.3	9.8	6.5	23.8	8.1	11.6	18.5

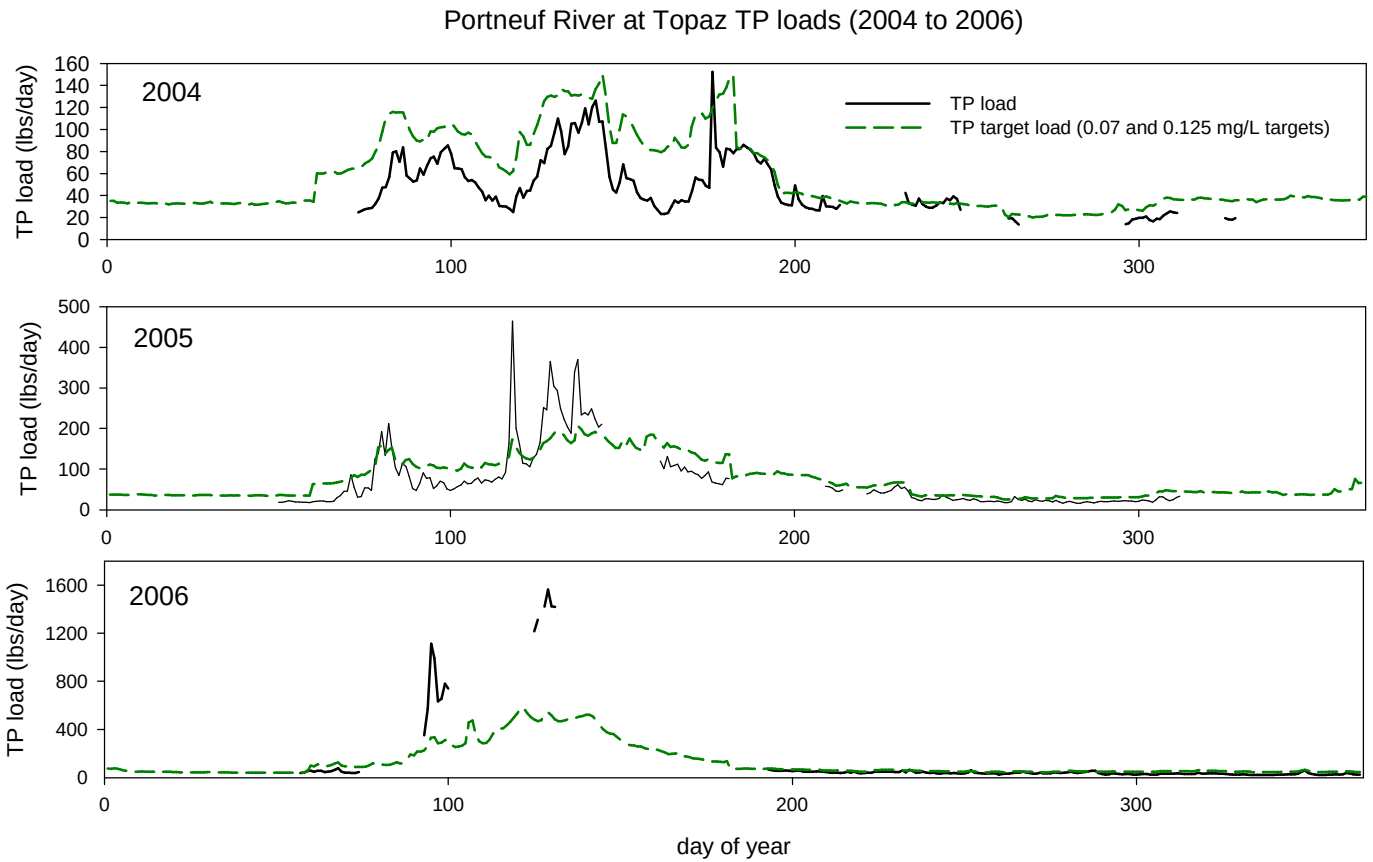


Figure 2.12. Estimated and target daily total phosphorus (TP) loads for the Portneuf River at Topaz. Daily load estimates were calculated as the average of all 30-min estimates of discharge and measurements of turbidity (translated into TP using Equation 2) at Topaz and expressed in lbs/day. Average daily target loads were developed using high (0.125 mg/L) and low (0.07 mg/L) flow TP targets proposed in Section 5 and the same 30-min estimates of discharge. The months of March through June were considered high flow months.

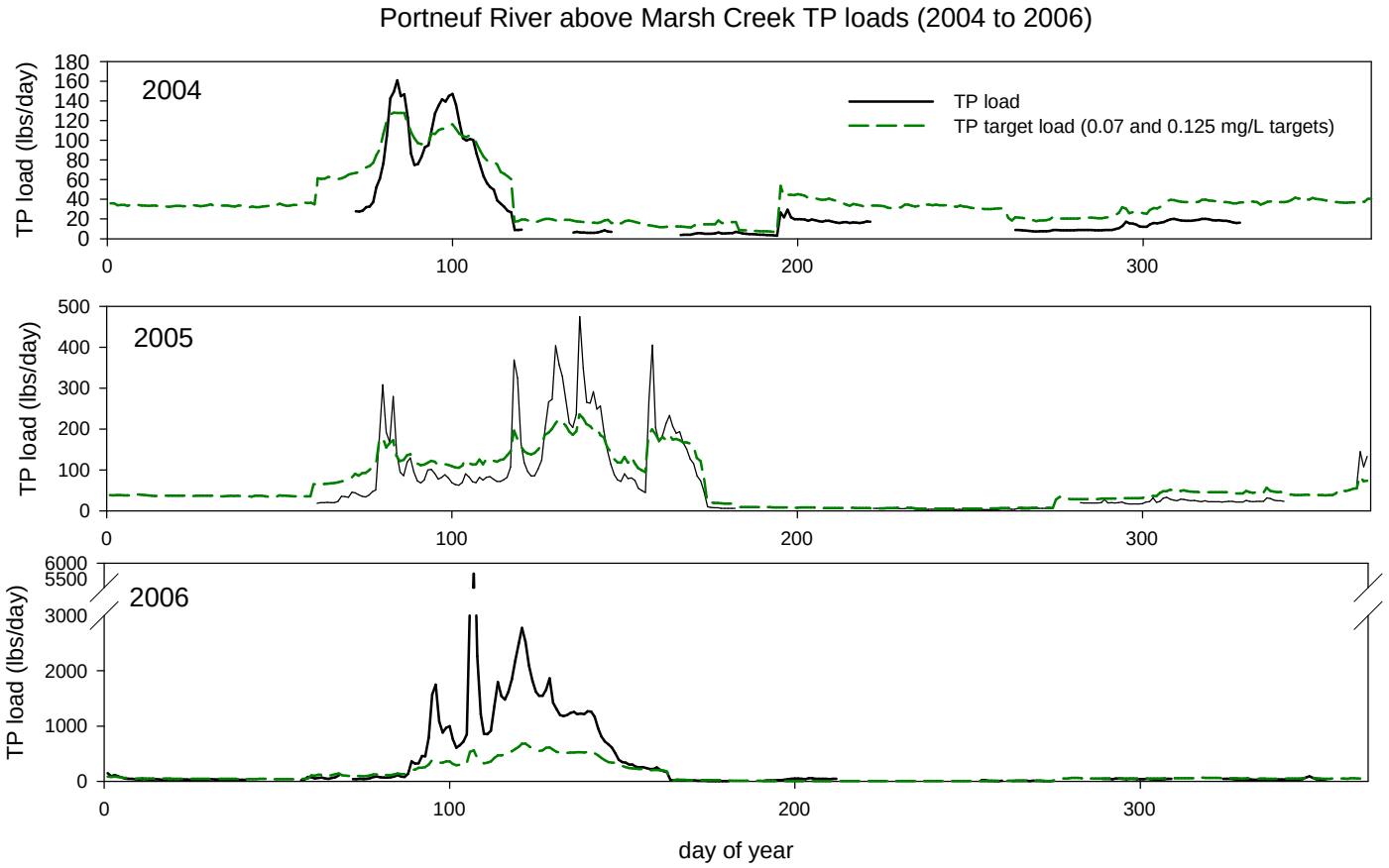


Figure 2.13. Estimated and target daily total phosphorus (TP) loads for the Portneuf River above Marsh Creek. Daily load estimates were calculated as the average of all 30-min estimates of discharge and measurements of turbidity (translated into TP using Equation 2) above Marsh Creek and expressed in lbs/day. Average daily target loads were developed using high (0.125 mg/L) and low (0.07 mg/L) flow TP targets proposed in Section 5 and the same 30-min estimates of discharge. The months of March through June were considered high flow months.

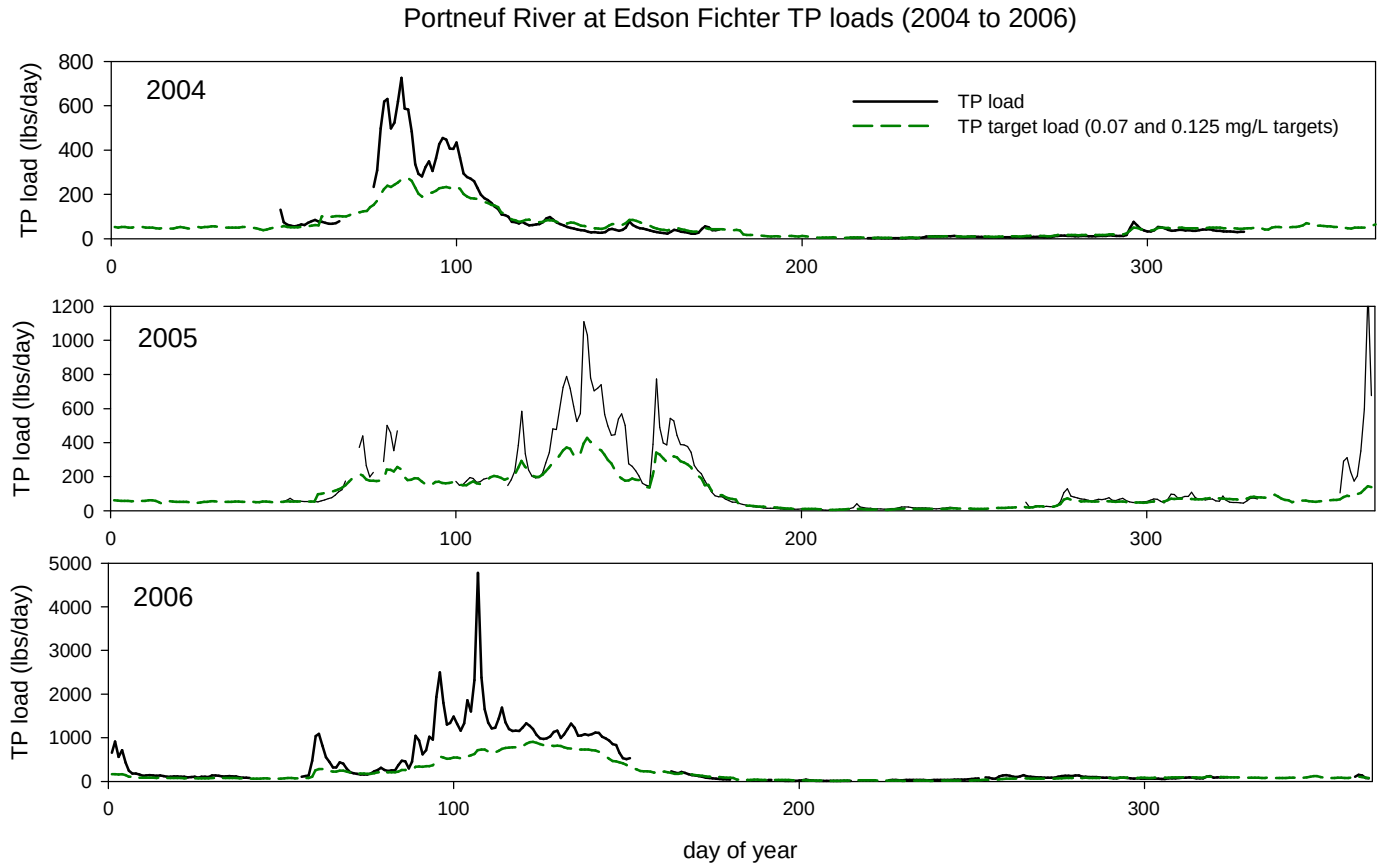


Figure 2.14. Estimated and target daily total phosphorus (TP) loads for the Portneuf River at Edson Fichter Nature Area (EFNA). Daily load estimates were calculated as the average of all 30-min estimates of discharge and measurements of turbidity (translated into TP using Equation 2) at EFNA and expressed in lbs/day. Average daily target loads were developed using high (0.125 mg/L) and low (0.07 mg/L) flow TP targets proposed in Section 5 and the same 30-min estimates of discharge. The months of March through June were considered high flow months.

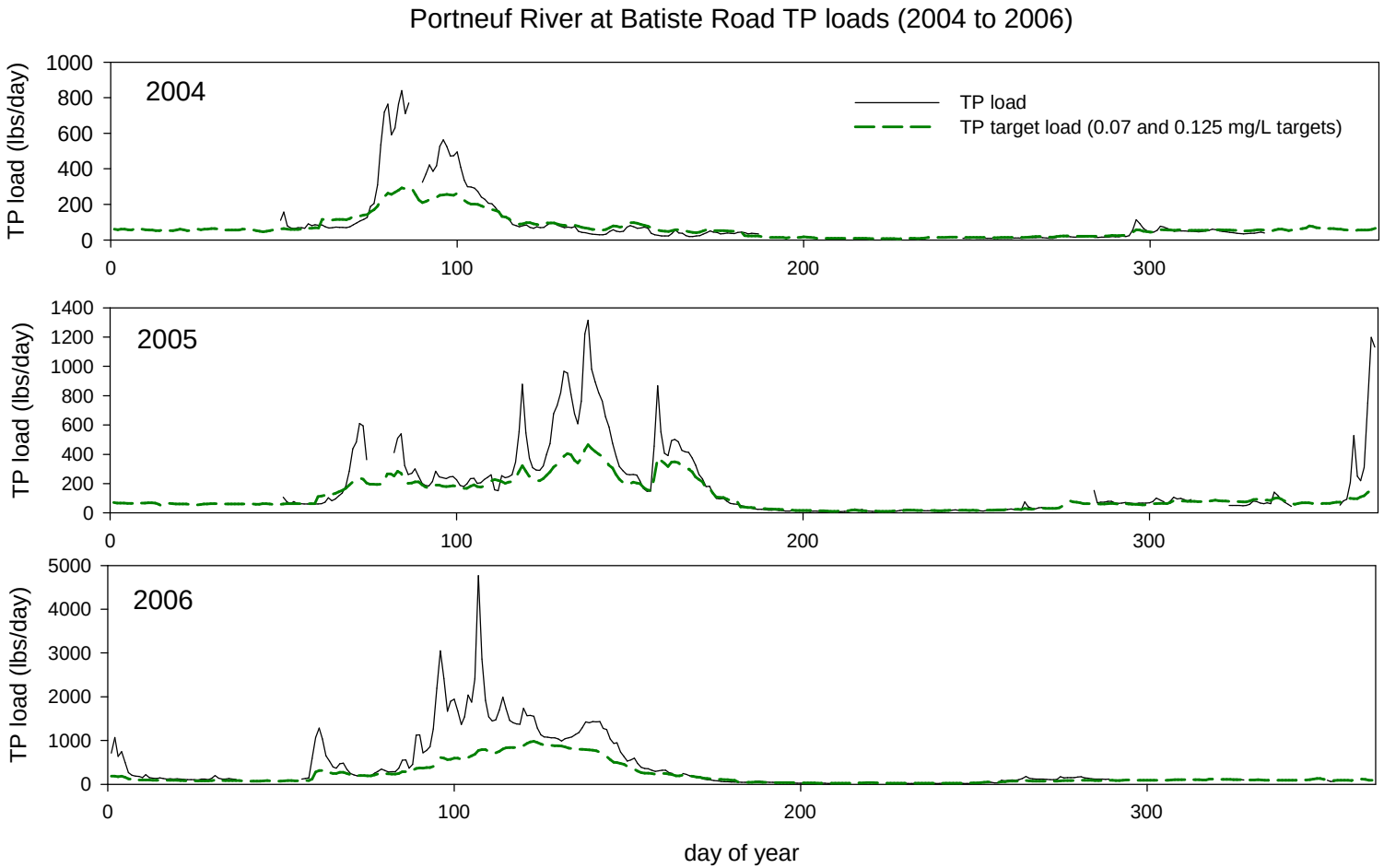


Figure 2.15. Estimated and target daily total phosphorus (TP) loads for the Portneuf River at Batiste Road. Daily load estimates were calculated as the average of all 30-min estimates of discharge and measurements of turbidity (translated into TP using Equation 2) at Batiste Road and expressed in lbs/day. Average daily target loads were developed using high (0.125 mg/L) and low (0.07 mg/L) flow TP targets proposed in Section 5 and the same 30-min estimates of discharge. The months of March through June were considered high flow months.

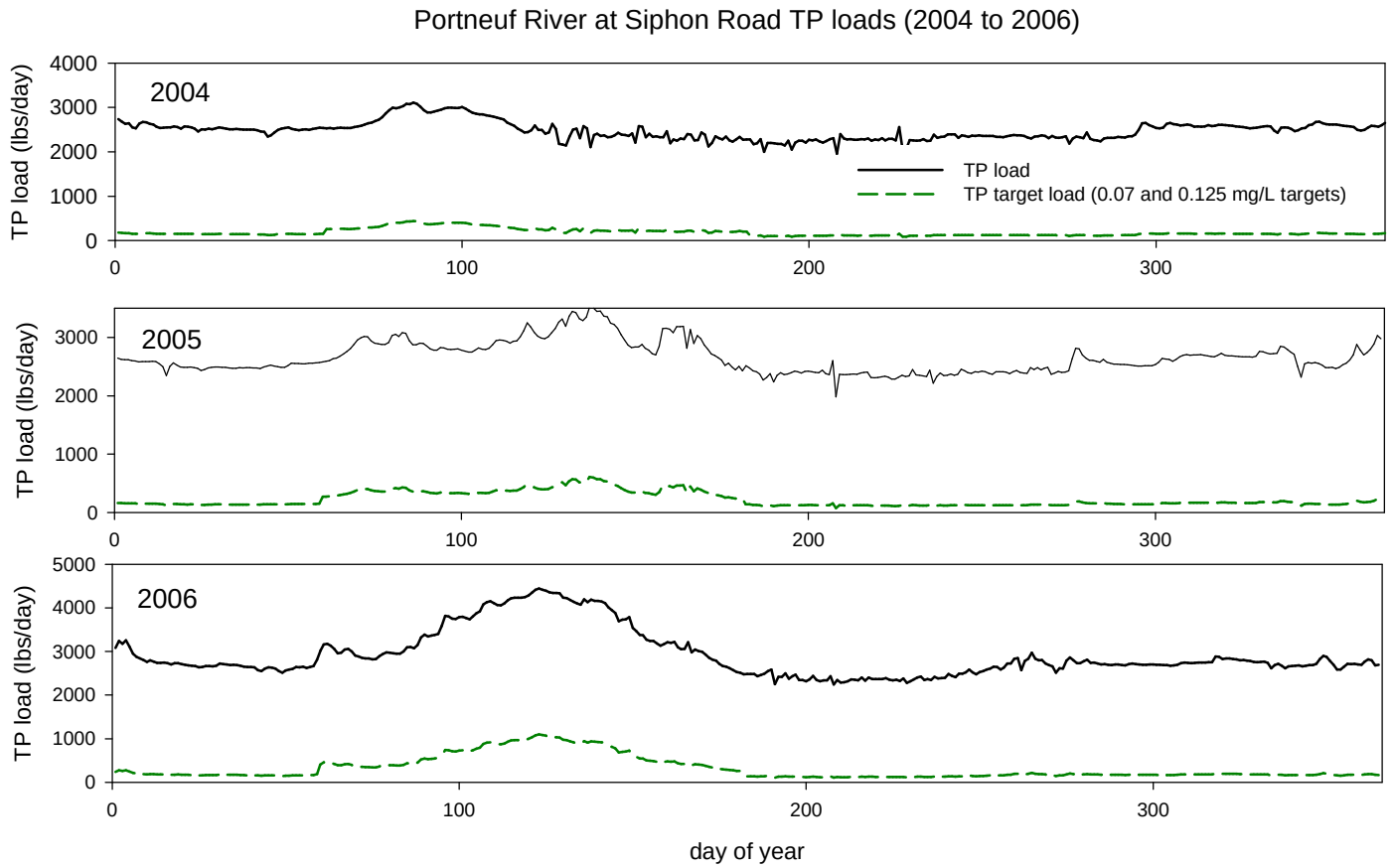


Figure 2.16. Estimated and target daily total phosphorus (TP) loads for the Portneuf River at Siphon Road. Daily load estimates were calculated as the average of all 30-min estimates of discharge and TP (using Equation 4) at Siphon Road and expressed in lbs/day. Average daily target loads were developed using high (0.125 mg/L) and low (0.07 mg/L) flow TP targets proposed in Section 5 and the same 30-min estimates of discharge. The months of March through June were considered high flow months.

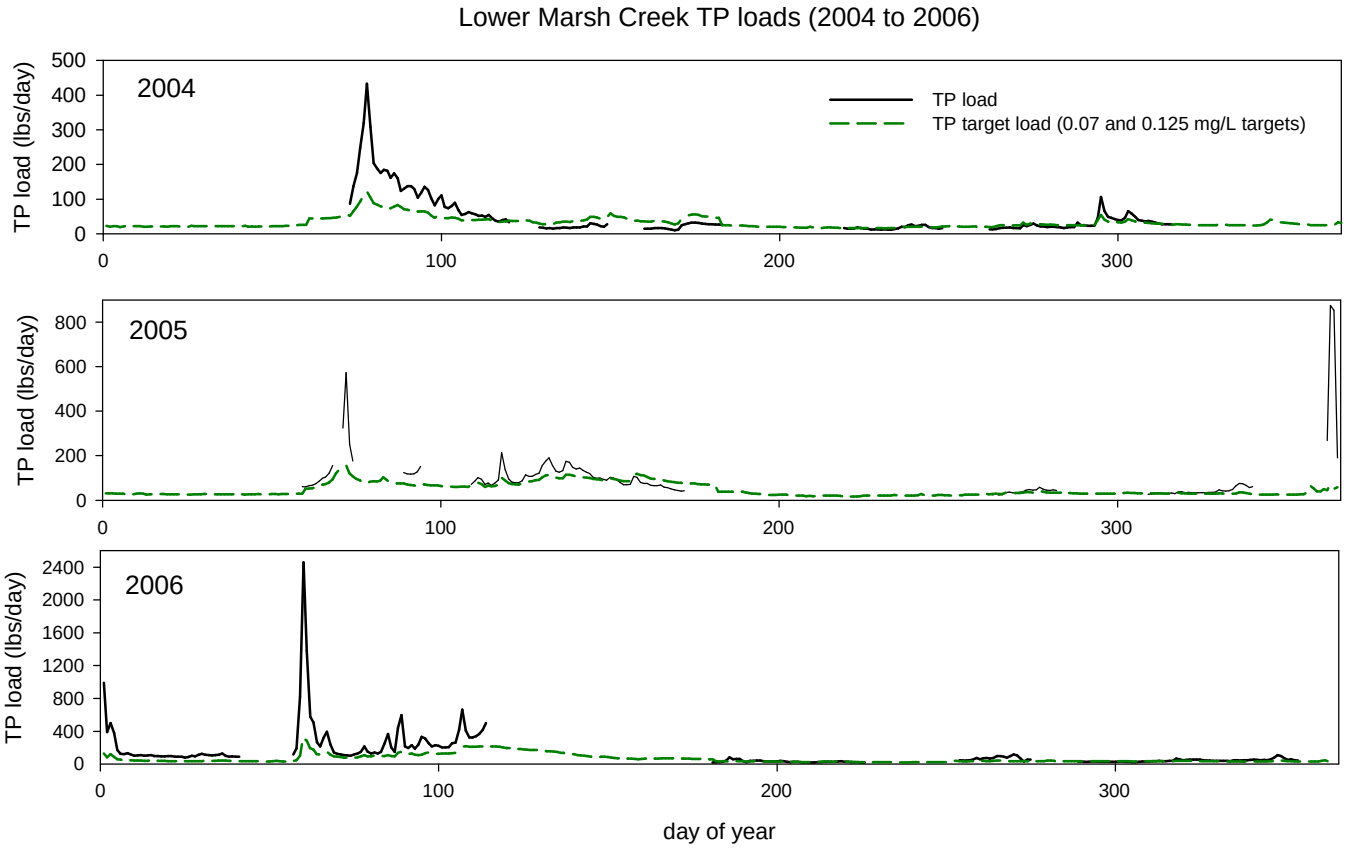


Figure 2.17. Estimated and target daily total phosphorus (TP) loads for lower Marsh Creek. Daily load estimates were calculated as the average of all 30-min estimates of discharge and measurements of turbidity (translated into TP using Equation 2) in lower Marsh Creek and expressed in lbs/day. Average daily target loads were developed using high (0.125 mg/L) and low (0.07 mg/L) flow TP targets proposed in Section 5 and the same 30-min estimates of discharge. The months of March through June were considered high flow months.

Table 2.7. Average annual and monthly total phosphorus (TP) loads calculated from 30-min discharge estimates and turbidity measurements for calendar years 2004 to 2006 and expressed as daily load in lbs/day.

Monitoring Location	Year	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Portneuf River at Topaz	2004	50	--	--	50.3	52.9	81.7	50.1	48.4	33.1	25.9	17.9	21.3	--
	2005	71	--	19.2	71.2	92.3	224.5	91.1	53.4	39.5	23.2	20.0	28.2	--
	2006	111	--	44.8	51.1	729.4	1377	--	53.4	44.4	37.7	36.7	30.4	28.9
Portneuf River above Marsh Creek	2004	31	--	--	83.3	81.4	6.7	5.1	13.7	16.6	8.0	11.0	18.4	--
	2005	72	--	--	81.4	100.3	205.8	113.0	5.5	4.7	4.1	19.4	24.3	57.3
	2006	360	47.9	34.8	90.2	1421	1258	105.1	39.8	--	12.1	40.6	38.8	40.8
Portneuf River at EFNA	2004	87	--	73.4	362.3	233.8	52.3	35.2	--	5.3	7.6	24.9	36.3	--
	2005	171	--	57.8	231.1	225.8	527.5	266.0	14.0	16.2	26.0	65.8	69.0	423.6
	2006	390	213.0	135.3	412.7	1542	1012	122.5	18.0	28.2	86.0	90.1	82.4	106.9
Portneuf River at Batiste Road	2004	107	--	85.4	318.1	275.5	60.2	37.6	36.8	--	11.0	35.2	46.1	--
	2005	194	--	68.7	281.1	270.3	611.2	286.3	17.4	14.4	23.7	76.3	70.9	300.6
	2006	473	236.3	172.1	470.6	1814	1135	218.6	32.4	17.5	70.7	136.1	106.7	72.0
Portneuf River at Siphon Road*	2004	2479	2574	2495	2775	2789	2395	2308	2221	2293	2349	2413	2571	2574
	2005	2656	2529	2509	2865	2873	3190	2832	2380	2347	2418	2575	2688	2657
	2006	2922	2801	2635	3009	3904	4103	2989	2398	2372	2659	2717	2764	2708
Lower Marsh Creek	2004	50	--	--	193.0	73.5	20.2	22.2	25.7	17.4	17.5	34.7	32.5	--
	2005	97	--	61.0	159.9	105.8	122.5	67.8	--	--	32.1	47.5	34.8	258.5
	2006	133	165.8	167.0	341.9	305.3	30.5	20.7	35.3	26.1	72.0	32.3	41.5	57.6
* Siphon Road TP estimates are from rating curves rather than expressions of turbidity.														

Storm Water Loading Estimates from the Sonde Record

For nearly two decades regulatory agencies have recognized urban storm water runoff as a form of point source pollution because of its significant, albeit episodic, contribution to the degradation of surface waters. Increasingly, evidence is presented that documents the long- and short-term effects of urban storm water runoff on stream biota (Roy et al. 2005), water quality (Lee and Bang 2000), and the physical channel (Booth and Jackson 1997). The principal influence of urbanization on runoff is the acceleration of the delivery of runoff and the rate at which peak flows form after a precipitation event (e.g., increasing flashiness; Paul and Meyer 2001, Thurston et al. 2003). However, increases in impervious surfaces also lead to an increase in the frequency with which sediment-transporting and habitat-disturbing flows move through a river corridor (Booth and Jackson 1997). Rivers influenced by urban storm water experience increases in both sediment deposition and resuspension downstream depending on flow conditions (e.g., base flow versus high flow) and channel complexity (e.g., gradient or structural complexity). However, experimental studies suggest that the resuspension of fine river bed sediments during and following storms may be more detrimental than other direct impacts of urban runoff (David and Matos 2002). Loading of nutrient or oxygen-demanding substances from urban storm water is not easily predicted and varies markedly as a result of precipitation characteristics (e.g., duration and intensity of event), antecedent conditions, and land use (Lee and Bang 2000, Taylor et al. 2005).

Relatively new regulatory monitoring requirements coupled with the documented variability in storm water loading led to the development of continuous monitoring programs (Lacour et al. 2009) and modeling techniques for characterizing storm water loading through combined sewer systems; these techniques are necessary in order to improve our confidence in wasteload estimates and establish wasteload allocations in TMDLs. Several efforts have been executed to try to describe the merits of different monitoring techniques and modeling tools (see Lee and Stenstrom 2005; Brezonik and Stadelmann 2002; Charbeneau and Barrett 1998). In the absence of real-time monitoring, many monitoring programs rely on grab samples to summarize loading. Lee and Stenstrom (2005) concluded that data summaries generated by grab samples had a high degree of variability when compared with composite samples collected from automated composite samplers over the course of a loading event. Moreover, water column monitoring alone may provide misleading results and cannot fully characterize the influence of storm water on beneficial use support (Burton and Pitt 2002). In watersheds lacking continuous or conventional monitoring, a variety of modeling approaches have been used (Kloiber 2006). Most modeling efforts predict constituent loading as a function of rainfall, the area of impervious surface, and available runoff coefficients (Brezonik and Stadelmann 2002).

All modeling efforts rely, to some extent, on standard runoff coefficients or empirically-derived values that are extrapolated to the spatial extent of impervious surfaces or to the entire network of storm sewer outfalls. For example, under MS4 Storm Water Permit No. IDS-028053 (hereafter, the MS4 Permit), the Pocatello Urbanized Area (PUA) co-permittees (City of Pocatello, City of Chubbuck, Bannock County, and Idaho Transportation Department - District #5) are required to monitor discharges from four representative outfalls. Results from these four outfalls will be used to generally

characterize storm water contributions within the PUA even though nearly 200 outfalls are known to exist within the urbanized area (Sigler 2008). In addition, continuous surface water monitoring with data sondes above the PUA (at Edson Fichter Nature Area) and below it (at Highway 30 crossing) is required to integrate all of the storm water contributions within this river segment. Due to the paucity of outfall data and the infrequency of monthly sampling activities, storm water TSS and TP contributions in this revision to the Portneuf River subbasin TMDL are described using the available turbidity record from monitoring stations above and below the PUA. Optical turbidity is a reliable surrogate for both TSS (Inouye et al. in review) and TP (Stubblefield et al. 2007) and is easily translated into TSS and TP concentrations using the empirical relationships between optical turbidity and TSS and TP concentrations described above.

For purposes of the loading analysis, storm water loading from the PUA is summarized on a daily basis by combining 30-minute turbidity measurements (converted into TSS and TP concentrations) and discharge estimates from monitoring stations above the PUA (EFNA) and below it (Batiste Road). The MS4 Permit incorporates a monitoring site located approximately one river mile upstream of Batiste Road (Highway 30 crossing); however, for purposes of analyses and discussion, the Batiste Road site was used. While this upstream-downstream approach generally brackets the PUA (Brock and Ray 2004), it also includes loading from two tributaries: Pocatello Creek (which receives storm water runoff within the PUA) and City Creek.

Storm water is estimated for years 2004 to 2006 to maintain consistency with the remainder of this document. Sonde records for these years are not complete (i.e., they did not cover the entire calendar year). Sondes were removed from the river during icing periods and in some instances, readings did not meet water quality assurance criteria described in the quality assurance project plan (QAPP) (see Inouye et al. in review). As a result, data gaps are present in the turbidity record and extent of these gaps varies by site and year. Although sonde summaries are not complete for each year, there were a sufficient number of days in the record when both EFNA and Batiste Road monitoring stations were operating to generally characterize storm water contributions from the PUA (2004, 191 days; 2005, 221 days; 2006, 235 days). Simply, loading from the PUA was estimated as the difference in the TSS and TP loads between the EFNA and Batiste Road (or above and below the PUA) as described above and in the co-permittees' MS4 Permit (IDS-028053).

To generally summarize storm water loading at each site, estimated TSS (Fig. 2.18) and TP (Fig. 2.19) loads for each site were plotted along with the precipitation record for Pocatello NE meteorological station for years 2004, 2005, and 2006. From these summaries, there appears to be a pattern in annual loading that generally tracks changes in the annual hydrograph and shows that there is greater loading during high flows (i.e., the separation between the lines is greatest; see Figs 2.18 and 2.19). There is also evidence that loading increases following rain events (see days 290 to 305 in 2004; Figures 2.18 and 2.19) or decreases during extended periods with limited or no precipitation (see days 140 to 150 in 2005).

Daily load estimates differ by day for each site and there are periods when the load at the upstream location (EFNA) exceeds the load downstream of the PUA (e.g., day 148 in

calendar year 2005 for both TSS and TP). To summarize these daily differences in loading at each site, the net difference in loads between EFNA and Batiste monitoring stations are plotted for each year. In this analysis, a positive value indicates a larger load downstream of the PUA and a negative value indicates a larger load upstream of the PUA. A larger load upstream of the PUA suggests deposition of sediment between the two sites (Figures 2.20 and 2.21). From these figures, it is apparent the loading patterns in this segment vary by day and year; however, there are significantly more days when both TSS and TP loading were greater downstream of the PUA (2004 – 92% of record, 2005 – 80%, 2006 – 81%). Moreover, when the total annual load, estimated from the number of days of available records for each year, was summed, there was a positive annual load for all constituent-year combinations (Table 2.8).

Table 2.8. Summary of the annual TSS and TP loads contributed by the Pocatello Urbanized Area. Contributions were calculated as the difference in average daily loads calculated from the Batiste and Edson Fichter (EFNA) monitoring stations. The available record (in days) differs and is shown for each year.

Year	Record (days)	Cumulative storm water TSS loading (in tons)	Cumulative storm water TP loading (in lbs)
2004	191	1,758	3,480
2005	221	3,284	6,354
2006	235	7,659	14,830

The annual variation in storm water loading was summarized daily in Figures 2.22 and 2.23 and by month and year (Table 2.9) using the difference in the load between the upstream and downstream monitoring stations. Monthly estimates represent the mean of the average daily storm water TSS or TP load (i.e., daily Batiste load – daily EFNA load) available for each month and the annual load is the average of each daily storm water load for the entire year (Table 2.9). In some months (e.g., August and September 2006), the loads are negative indicating that the upstream loads at EFNA exceeded the loads at Batiste Road for that month. This suggests that some of the load measured at EFNA was deposited on the bed or within vegetation or woody debris upstream of Batiste Road. As seen in Table 2.9, deposition of sediments and sediment-associated P seem to predominate in August and September when flow velocities are the lowest. Average daily TSS and TP loads associated with storm water from the PUA were greatest in 2006 and least in 2004 (Table 2.9). Across all years, the average storm water TSS and TP loads were 19.4 tons TSS/day and 37.7 lbs TP/day, respectively.

The target TSS and TP storm water loads were calculated using the daily difference in discharge between the EFNA and Batiste monitoring stations and the high- and low-flow TSS (35 and 80 mg/L) and TP (0.07 and 0.125 mg/L) targets endorsed by the watershed advisory group (WAG) (see Section 5 for proposed targets). Daily TSS (Figure 2.22) and TP (Figure 2.23) target loads are plotted with the estimated daily storm water loads and discharge from the USGS Pocatello gage. Storm water loads and target loads used to produce these figures are shown in Appendix C and were summarized as monthly averages (Table 2.10) to illustrate within-year variations in loading. Reductions in storm water loading necessary to achieve target loads are shown in Table 2.10 and indicate that the greatest reductions are needed October through April.

Table 2.9. Average annual and monthly total suspended solids (TSS) and total phosphorus (TP) loads calculated from 30-min discharge and turbidity estimates for calendar years 2004 to 2006 and expressed as daily load in tons TSS/day and lbs TP/day. Negative values indicate that the average daily load was greater at EFNA than Batiste and suggests that there was deposition or storage of sediment for a given month. Monthly and annual daily load estimates are based on the available sonde record (see Appendix C) for each site and each year. "--" indicates there was no turbidity data available for that month.

Monitoring Location	Year	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Portneuf River at EFNA TSS load (tons/day)	2004	29	--	21.3	128.6	79.5	15.6	10.7	--	1.5	1.7	6.1	7.5	--
	2005	57	--	15.3	78.2	74.3	185.3	89.5	3.4	5.7	7.5	18.5	17.1	152.6
	2006	134	71.4	44.5	145.1	558.5	341.8	37.8	4.1	9.5	28.3	24.5	19.2	29.7
Portneuf River at Batiste Road TSS load (tons/day)	2004	38	--	28.6	117.0	100.2	20.2	12.4	12.7	--	3.1	11.3	13.8	--
	2005	70	--	22.5	102.7	97.4	226.7	103.3	5.2	4.5	7.5	25.2	21.6	109.7
	2006	174	85.0	63.7	173.9	684.3	413.0	77.8	10.2	5.2	23.8	46.9	33.8	21.4
Storm water Contributions TSS load (tons/day)	2004	8.8	--	7.2	27.2	20.7	4.6	1.4	--	--	1.5	5.1	6.8	--
	2005	14.9	--	7.1	24.2	38.6	41.4	13.8	1.8	-1.1	2.0	8.4	5.4	24.7
	2006	32.6	13.7	11.3	28.8	125.8	71.1	10.5	3.1	-4.7	-4.0	14.0	8.5	--
Portneuf River at EFNA TP load (lbs/day)	2004	87	--	73.4	362.3	233.8	52.3	35.2	--	5.3	7.6	24.9	36.3	--
	2005	171	--	57.8	231.1	225.8	527.5	266.0	14.0	16.2	26.0	65.8	69.0	423.6
	2006	390	213.0	135.3	412.7	1542	1012	122.5	18.0	28.2	86.0	90.1	82.4	106.9
Portneuf River at Batiste Road TP load (lbs/day)	2004	107	--	85.4	318.1	275.5	60.2	37.6	36.8	--	11.0	35.2	46.1	--
	2005	194	--	68.7	281.1	270.3	611.2	286.3	17.4	14.4	23.7	76.3	70.9	300.6
	2006	473	236.3	172.1	470.6	1814	1135	218.6	32.4	17.5	70.7	136.1	106.7	72.0
Storm water Contributions TP load (lbs/day)	2004	17.5	--	12.0	58.7	41.6	7.9	2.0	--	--	3.4	10.4	11.1	--
	2005	28.7	--	10.9	48.2	48.5	83.7	20.2	3.4	-1.7	3.8	15.2	4.5	53.1
	2006	63.1	23.3	17.1	57.9	272.1	122.7	17.1	5.9	-11.5	-14.2	26.0	9.6	--

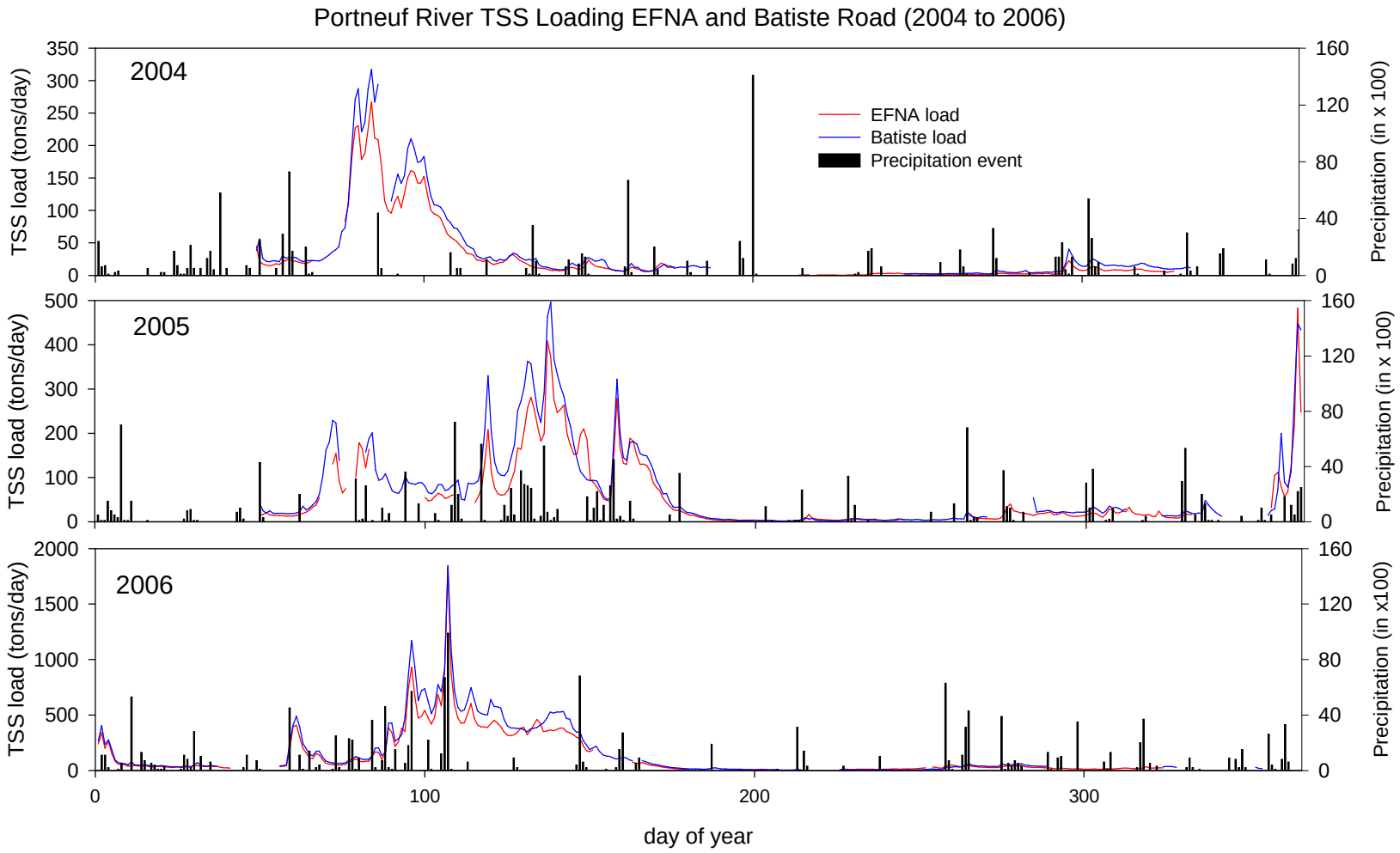


Figure 2.18. Total suspended solids (TSS) load estimates (tons/day) for the Edson Fichter Nature Area (red) and Batiste Road (blue) monitoring stations. Black bars show precipitation events recorded at the Pocatello NE meteorological station for calendar years 2004, 2005, and 2006.

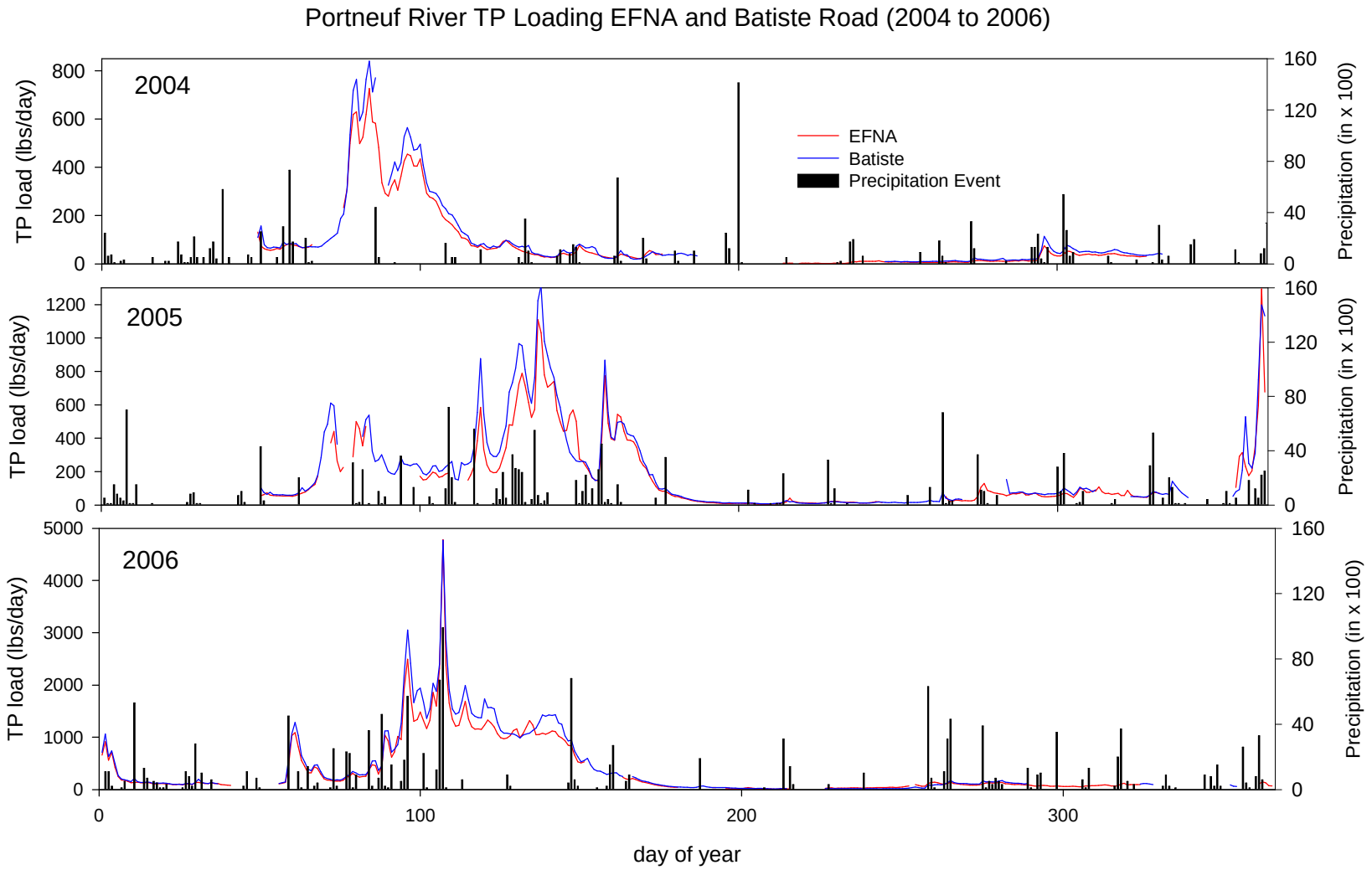


Figure 2.19. Total phosphorus load estimates (lbs/day) for the Edson Fichter Nature Area (red) and Batiste Road (blue) monitoring stations. Black bars show precipitation events recorded at the Pocatello NE meteorological station for calendar years 2004, 2005, and 2006.

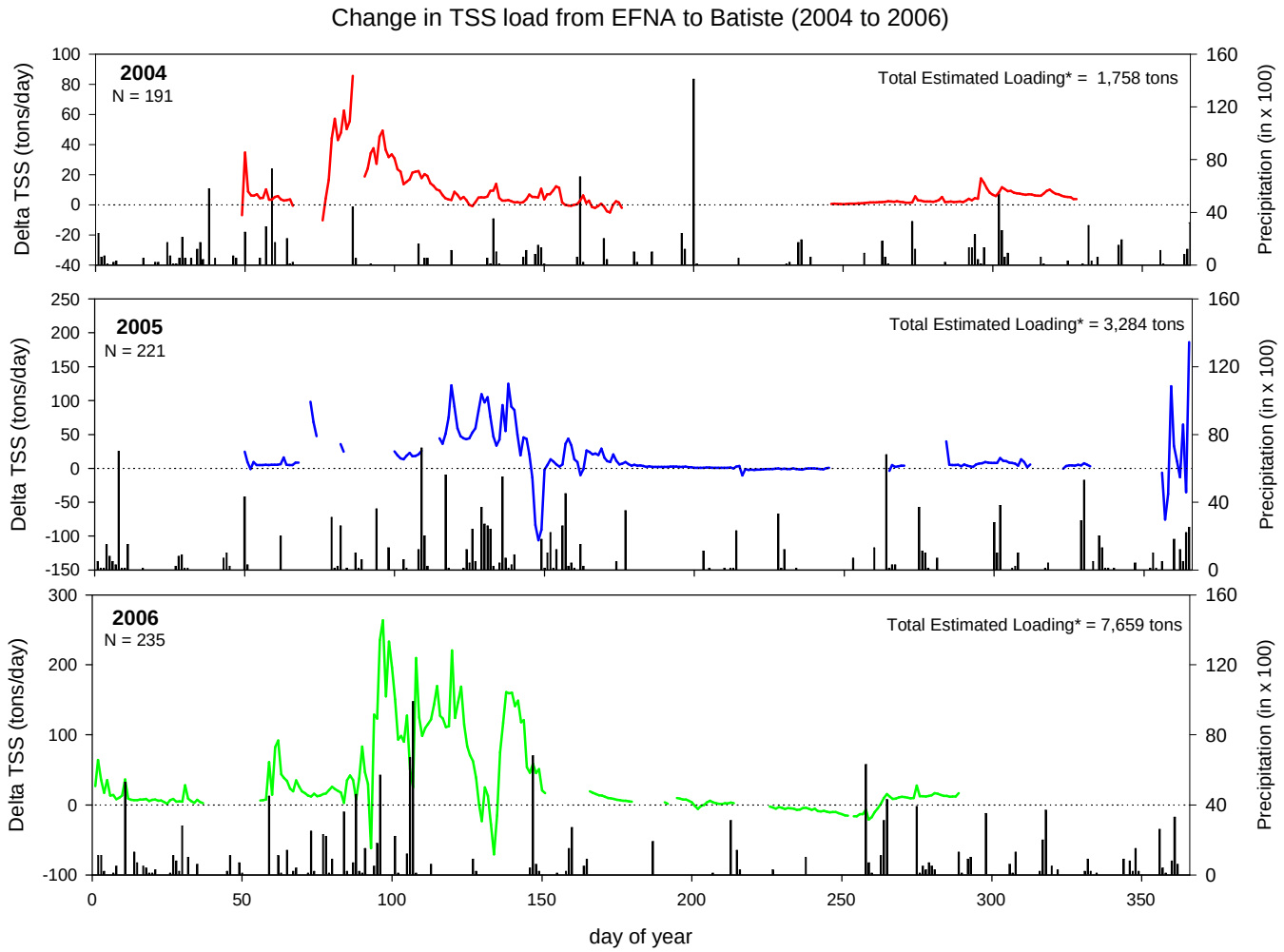


Figure 2.20. Total suspended sediment loads (tons/day) associated with the Pocatello Urbanized Area and calculated as the difference between the loads at Edson Fichter Nature Area (EFNA) and Batiste Road monitoring stations Positive values indicate a greater load at Batiste Rd and negative values indicate a greater load at EFNA. Black bars show precipitation events recorded at the Pocatello NE meteorological station for calendar years 2004 (red), 2005 (blue), and 2006 (green).

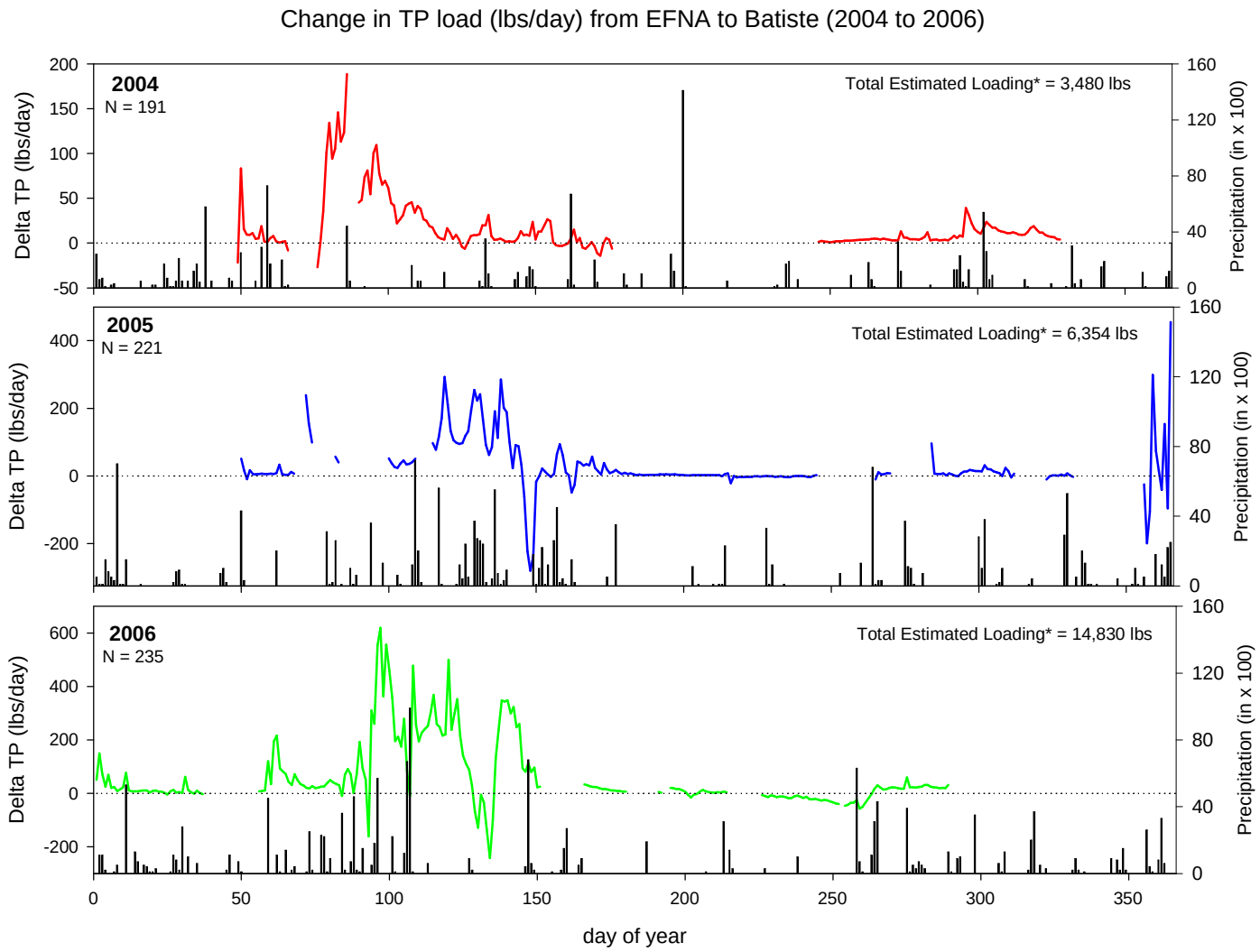


Figure 2.21. Total phosphorus loads (lbs/day) associated with the Pocatello Urbanized Area and calculated as the difference between the loads at Edson Fichter Nature Area (EFNA) and Batiste Road monitoring stations Positive values indicate a greater load at Batiste Rd and negative values indicate a greater load at EFNA. Black bars show precipitation events recorded at the Pocatello NE meteorological station for calendar years 2004 (red), 2005 (blue), and 2006 (green).

Table 2.10. Average daily total suspended solids (TSS) and total phosphorus (TP) loads from storm water within the Pocatello Urbanized Area (PUA). Wasteloads are calculated from 30-min discharge and turbidity estimates for calendar years 2004 to 2006, summarized by month, and expressed as daily loads in tons/day (TSS) or lbs/day (TP). Load estimates represent the difference in load estimates above (EFNA monitoring station) and below (Batiste Road monitoring station) the PUA. Negative load values indicate that the average daily load was greater above than below the PUA and suggests that, on average, there was deposition or storage of sediment for a given month. Monthly daily load estimates are based on the available sonde record (see Appendix C) for each site and each year. "--" indicates there was no turbidity data available for that month. Reductions represent the average load reduction necessary to achieve target loads and are expressed as percentages.

Load Description and Percent Reductions	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PUA storm water TSS target load (tons/day)	2004	1.9	1.9	6.2	6.1	3.8	3.3	1.2	1.1	1.2	1.5	1.9	2.8
	2005	2.0	1.9	6.3	6.4	8.9	6.8	1.3	1.2	1.3	2.0	2.3	2.7
	2006	2.6	2.3	7.6	16.2	18.2	6.1	1.5	1.3	1.8	2.4	2.7	2.6
Estimated PUA storm water TSS load (tons/day)	2004	--	7.2	27.2	20.7	4.6	1.4	--	--	1.5	5.1	6.8	--
	2005	--	7.1	24.2	38.6	41.4	13.8	1.8	-1.1	2.0	8.4	5.4	24.7
	2006	13.7	11.3	28.8	125.8	71.1	10.5	3.1	-4.7	-4.0	14.0	8.5	--
Average daily TSS load reductions required for storm water summarized by month and year	2004	--	74%	77%	71%	17%	0%	--	--	20%	71%	72%	--
	2005	--	73%	74%	83%	79%	51%	28%	0%	35%	76%	57%	89%
	2006	81%	80%	74%	87%	74%	42%	52%	0%	0%	83%	68%	--
PUA storm water TP target load (lbs/day)	2004	7.6	7.7	19.3	18.9	11.9	10.3	4.7	4.4	4.7	5.9	7.7	11.3
	2005	7.9	7.8	19.7	20.1	27.8	21.3	5.2	4.7	5.2	7.8	9.1	10.7
	2006	10.6	9.1	23.7	50.6	57.0	19.2	5.9	5.3	7.1	9.7	10.6	10.2
Estimated PUA storm water TP load (lbs/day)	2004	--	12.0	58.7	41.6	7.9	2.0	--	--	3.4	10.4	11.1	--
	2005	--	10.9	48.2	48.5	83.7	20.2	3.4	-1.7	3.8	15.2	4.5	53.1
	2006	23.3	17.1	57.9	272.1	122.7	17.1	5.9	-11.5	-14.2	26.0	9.6	--
Average daily TP load reductions required for storm water summarized by month and year	2004	--	36%	67%	55%	0%	0%	--	--	0%	43%	31%	--
	2005	--	28%	59%	59%	67%	0%	0%	0%	0%	49%	0%	80%
	2006	55%	47%	59%	81%	54%	0%	0%	0%	0%	63%	0%	--

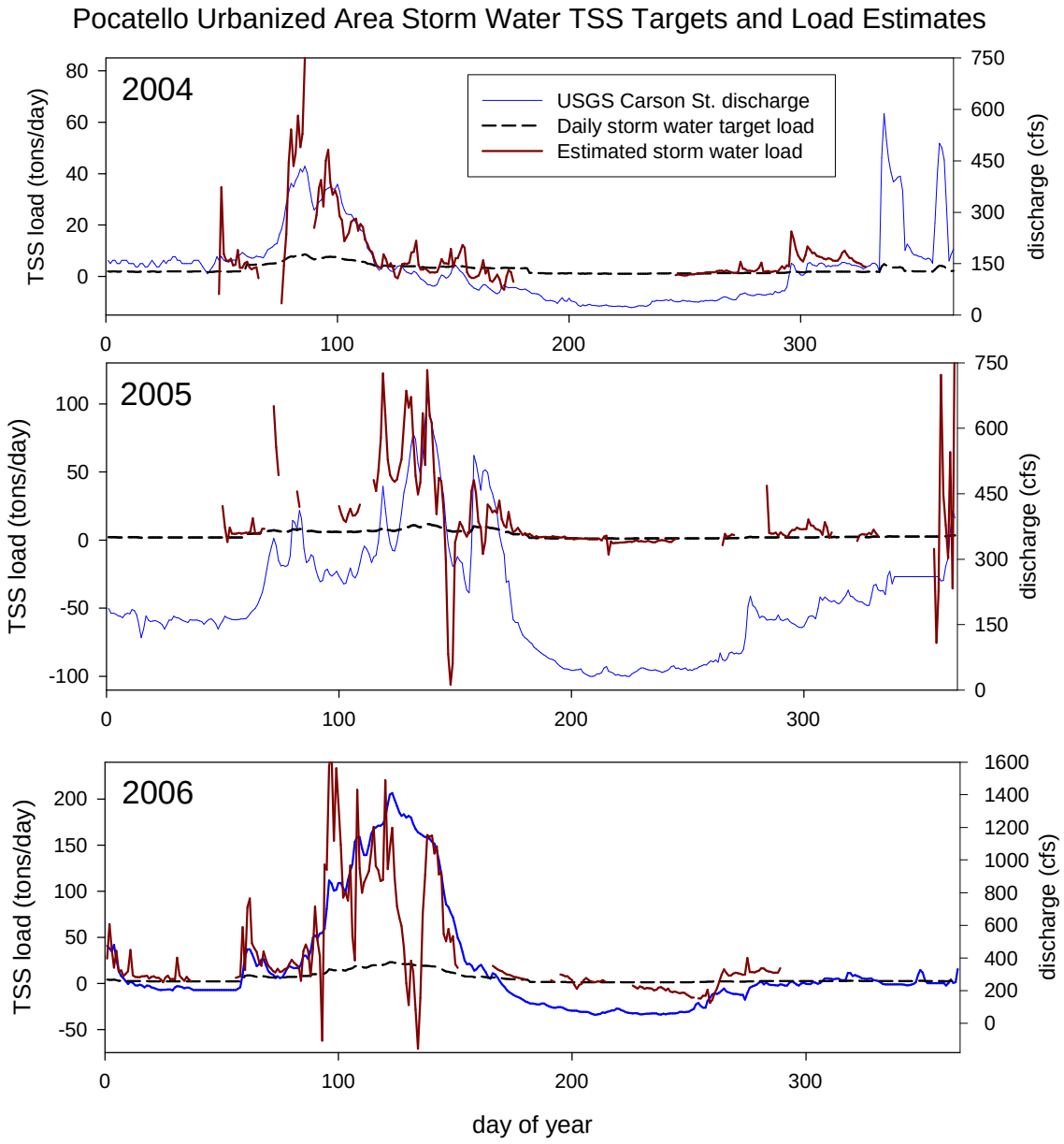


Figure 2.22 Estimated storm water TSS loading (brown) and target loading (dashed) from the Pocatello Urbanized Area for calendar years 2004, 2005, and 2006. Discharge (blue) is shown from the USGS Carson Street gage.

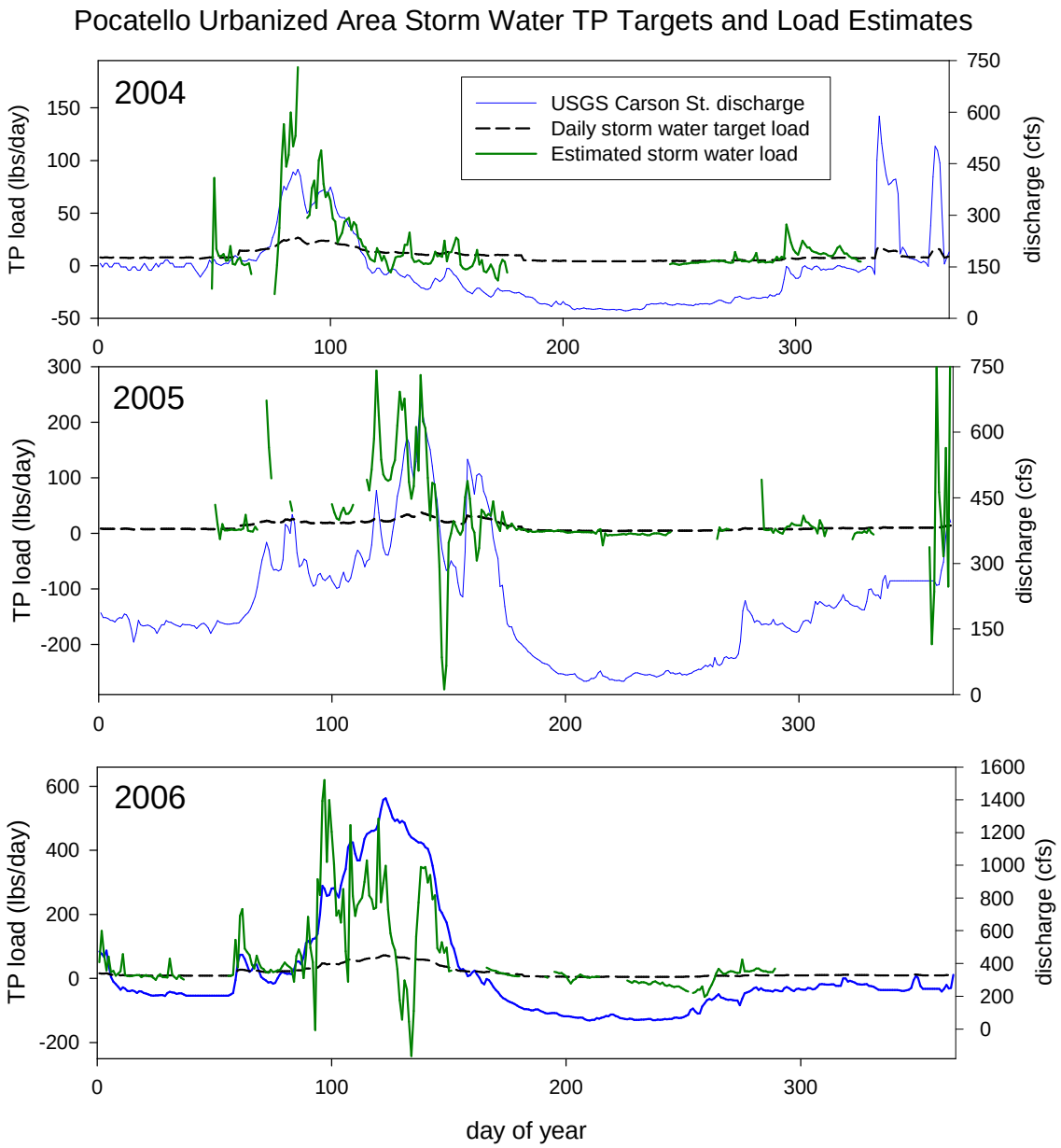


Figure 2.23. Estimated storm water TP loading (green) and target loading (dashed) from the Pocatello Urbanized Area for calendar years 2004, 2005, and 2006. Discharge (blue) is shown from the USGS Carson Street gage.

Biological and Other Data

E. coli

In the lower Portneuf River, *E. coli* concentrations are generally inversely correlated with discharge and positively correlated with water temperatures, however, in some reaches, elevated concentrations were detected in October and November after water temperatures dropped considerably. In Marsh Creek, elevated concentrations of *E. coli* were documented between May and October indicating that factors other than low discharge and high stream temperatures control *E. coli* concentrations. Recent sampling conducted by the Idaho Association of Soil Conservation Districts (IASCD) revealed protracted periods of high concentrations of *E. coli* in North Fork of Rapid Creek and Twentyfour Mile Creek. Land use is believed to play a significant role in *E. coli* concentrations in these and other surface waters in the Portneuf River subbasin.

From 2002 to 2007, 32 assessment units (AUs) were sampled for *E. coli* to determine whether recreation use status was supported. Fourteen AUs had a 5-sample geometric mean concentration of *E. coli* that exceeded Idaho's water quality criteria (126 *E. coli* organisms/100 mL) for primary and secondary contact recreation and therefore were determined not supportive of their designated contact recreation use. An additional 18 AUs were determined fully supportive of their recreational contact use during this same period (Table 2.11).

Documented contact recreation use criteria exceedances were detected across years, indicating that weather or hydrologic conditions in a given year was not responsible for the exceedances documented. Several tributaries had geometric means that were more than an order of magnitude greater than Idaho's single sample instantaneous contact recreation criteria (576 *E. coli* organisms/100 mL [e.g., Cherry Creek, Moonlight Creek, North Fork Pocatello Creek, and Yellow Dog Creek]), and additional sampling in these tributaries should be prioritized to evaluate the spatial extent and duration of exceedances.

Table 2.11. List of Portneuf River tributaries and corresponding assessment units assessed for contact recreation use between 2002 and 2007.

TRIBUTARY NAME	ASSESSMENT UNIT	SUPPORT	NOT SUPPORTING
Arkansas Creek	ID17040208SK006_02a	X	
Bell Marsh Creek (upper)	ID17040208SK008_02a	X	
Birch Creek	ID17040208SK015_03		X
Cherry Creek	ID17040208SK014_02b		X
City Creek	ID17040208SK002_02	X	
Clear Creek	ID17040208SK022_02b	X	
Cusick Creek	ID17040208SK001_02a	X	
Dempsey Creek	ID17040208SK017_03		X
East Bob Smith Creek	ID17040208SK016_02b		X
East Fork Mink Creek	ID17040208SK004_02d	X	
Garden Creek (upper)	ID17040208SK010_02a		X
Gibson Jack Creek (upper)	ID17040208SK003_02a	X	
Goodenough Creek (lower)	ID17040208SK009_02b	X	
Indian Creek	ID17040208SK005_02		X
Inman Creek	ID17040208SK023_03a	X	
Left Hand Fork Marsh Creek	ID17040208SK006_02e	X	
Middle Fork of Cherry Creek	ID17040208SK014_02a	X	
Mill Creek	ID17040208SK015_02a	X	
Mink Creek	ID17040208SK004_03a		X
Moonlight Creek	ID17040208SK023_02f		X
North Fork Pebble Creek	ID17040208SK022_02d		X
North Fork Pocatello Creek	ID17040208SK026_02a		X
Papoose Creek	ID17040208SK001_02c		X
Pebble Creek	ID17040208SK022_03	X	
Rapid Creek	ID17040208SK023_03	X	
Robber's Roost Creek	ID17040208SK016_02e	X	
South Fork Mink Creek	ID17040208SK004_03a		X
South Fork of Toponce Creek	ID17040208SK021_02d	X	
Toponce Creek	ID17040208SK021_03a	X	
West Bob Smith Creek	ID17040208SK016_02c		X
West Fork Mink Creek	ID17040208SK004_02b	X	
Yellow Dog Creek	ID17040208SK013_02b		X

Beneficial Use Reconnaissance Program Macroinvertebrate and Fish Summaries

From 2001 to 2006, DEQ's Pocatello Regional Office BURP crews bioassessed 43 assessment units in the Portneuf River subbasin. Some assessment units were sampled in multiple years or multiple times within a given year, resulting in a total of 75 assessments conducted during this six-year period. The reference sites Upper Bell Marsh Creek and the West Fork of Mink Creek were sampled annually over this period, and Webb Creek was sampled every year except 2004. Across all sites and focal years, the average stream

macroinvertebrate index (SMI) score for reference streams was 77.98. On average, Upper Bell Marsh Creek had the highest annual SMI score (83.30) and the West Fork Mink Creek had the lowest average annual SMI (73.68). Across reference sites, the lowest average SMI scores occurred in 2005 (SMI=72.02) and the highest annual SMI scores occurred in 2001 (SMI=80.51)[1]. The coefficient of variation of the SMI for all reference sites was relatively small and ranged from 0.052 (upper Webb Creek) to 0.077 (upper Bell Marsh Creek). The highest SMI measured during the study period was not from a reference site but from Inman Creek in 2002 (90.49). The lowest SMI was associated with macroinvertebrates sampled in 2003 from lower Marsh Creek (SMI=18.79); a second bioassessment of lower Marsh Creek in 2005 yielded a considerably higher SMI score (50.47). All bioassessed reference sites met the cold water aquatic life use support criteria each year. Nine assessment units sampled did not support the cold water aquatic life use (Table 2.12). An additional unit (lower Marsh Creek) sampled in 2003 and 2006 resulted in bioassessment scores that were split between not fully and fully supporting; however, the cold water aquatic life use was supported in the most recent sampling.

Only five of the 75 bioassessments conducted by DEQ's BURP crews between 2001 and 2006 included fish sampling (Table 2.12). Two reference sites were sampled for fish and stream fish index (SFI) scores for these sites were 72.38 and 50.38 for upper Bell Marsh Creek (2003) and West Fork of Mink Creek (2004), respectively. The highest SFI score was recorded in lower Garden Creek (94.37) in 2001 and the lowest SFI score was recorded in lower Marsh Creek (44.53) in 2003. Only lower Garden Creek produced an SFI score that ranked above the median reference scores used in the development of the rangeland SFI index developed by Mebane (2002). None of the SFI scores shown in Table 2.12 indicated conditions below the minimum evaluation threshold. Additional fish monitoring completed by the Idaho Department of Fish and Game and United States Department of Agriculture (USDA) Forest Service (USFS) are summarized in the BA (see Appendix F).

[1]As only two reference sites were sampled in 2004, results from those samples were not included in the reference reach comparison used here.

Table 2.12. List of Portneuf River tributaries assessed in the DEQ Beneficial Use Reconnaissance Program from 2001 to 2006. Cold water aquatic life use support (ALUS) is determined based on the integration of two or more stream indices (SMI, SHI, and SFI). ALUS support status is described as either not supporting or fully supporting. In some instances, less than two indices were available to establish support (NA = not available).

Tributary Name and **Assessment Unit**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Support Status**
Arkansas Creek ID17040208SK006_02a	31.04 - SMI 37.0 - SHI						*Not Supporting*
Beaverdam Creek ID17040208SK017_02c			26.75 - SMI 45.0 - SHI				*Not Supporting*
Bell Marsh Creek (upper) ID17040208SK008_02a	83.01*- SMI 71.0*- SHI	89.08*- SMI 72.0*- SHI	87.85 - SMI 72.0 - SHI 72.38 - SFI	88.34 - SMI 67.0 - SHI	73.55 - SMI 78.0 - SHI	77.95 - SMI 60.0 - SHI	**Fully Supporting**
Birch Creek ID17040208SK015_03		64.53[a]- SMI 65.0 - SHI		47.26 - SMI 57.0 - SHI			**Fully Supporting**
Cherry Creek ID17040208SK014_02a		62.29 - SMI 67.0 - SHI					**Fully Supporting**
City Creek ID17040208SK002_02		74.79 - SMI 76.0 - SHI					**Fully Supporting**
Dempsey Creek ID17040208SK017_03					28.47 -SMI 35.0 - SHI		*Not Supporting*
East Bob Smith Creek ID17040208SK016_02b				82.39 - SMI 57.0 – SHI			**Fully Supporting**
Garden Creek (lower) ID17040208SK010_02b	36.91 - SMI 47.0 - SHI 94.37 - SFI						*Not Supporting*
Garden Creek (upper) ID17040208SK010_02a		55.80*- SMI 54.0*- SHI					**Fully Supporting**
Gibson Jack Creek (upper) ID17040208SK003_02a		82.98 - SMI 84.0 - SHI					**Fully Supporting**
Goodenough Creek ID17040208SK009_02b		59.38 - SMI 70.0 - SHI					**Fully Supporting**

Tributary Name and **Assessment Unit**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Support Status**
Hawkins Creek ID17040208SK013_02a	59.05 - SMI 49.0 - SHI						**Fully Supporting**
Indian Creek ID17040208SK005_02		49.29*- SMI 53.5*- SHI					**Fully Supporting** †
Inman Creek (upper) ID17040208SK023_03b		90.49 - SMI 72.0 - SHI					**Fully Supporting**
Inman Creek (lower) ID17040208SK023_03a						69.46*- SMI 58.5*- SHI	**Fully Supporting** †
Marsh Creek (upper) ID17040208SK006_03a			48.67 - SMI 57.0 - SHI				**Fully Supporting**
Marsh Creek (lower middle) ID17040208SK006_04a						33.14 - SMI 53.0 - SHI	*Not Supporting*
Marsh Creek (lower) ID17040208SK006_04			18.79 - SMI 33.0 - SHI 44.53 - SFI			50.47 - SMI 54.0 - SHI	*Not Supporting ('03);* **Fully Supporting ('06)**
Middle Fork Cherry Creek ID17040208SK014_02a					78.57 - SMI 79.0 - SHI		**Fully Supporting**
Middle Fork Toponce Creek ID17040208SK021_02c				57.54 - SMI 71.0 - SHI			**Fully Supporting**
Mill Creek ID17040208SK015_02a		53.73 - SMI 70.0 - SHI			67.30 - SMI 68.0 - SHI		**Fully Supporting**
North Fork Pebble Creek ID17040208SK022_02d				60.25 - SMI 60.0 - SHI			**Fully Supporting**
North Fork Pocatello Creek ID17040208SK026_02a		57.96 - SMI 54.0 - SHI					**Fully Supporting**
North Fork Rapid Creek ID17040208SK023_03c						39.91 - SMI 49.0 - SHI	*Not Supporting*

Tributary Name and **Assessment Unit**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Support Status**
North Fork Toponce Creek ID17040208SK021_03a		50.41 - SMI 68.0 - SHI		64.21 - SMI 60.0 - SHI 58.51 - SFI			**Fully Supporting**
Papoose Creek ID17040208SK001_02c		48.21 - SMI 60.0 – SHI					**Fully Supporting**
Pebble Creek ID17040208SK022_03		73.68 - SMI 77.0 - SHI					**Fully Supporting**
Pilot Springs Creek ID17040208SK011_02					10.0 - SHI		***NA*** (<2 indexes)
Pocatello Creek (middle) ID17040208SK024_03a		29.94 - SMI 45.0 - SHI					*Not Supporting*
Pocatello Creek (lower) ID17040208SK024_03					10.0 - SHI		***NA*** (<2 indexes)
Potter Creek ID17040208SK006_02f		53.78 - SMI 37.0 - SHI					*Not Supporting*
Rapid Creek (middle) ID17040208SK023_03	54.92 - SMI 56.0 - SHI						**Fully Supporting**
Rapid Creek (lower) ID17040208SK023_03	72.53 - SMI 79.0 - SHI						**Fully Supporting**
Robbers Roost Creek ID17040208SK016_02e		76.57 - SMI 70.0 - SHI					**Fully Supporting**
South Fork Pebble Creek ID17040208SK022_02c				59.48 - SMI 83.0 - SHI			**Fully Supporting**
South Fork Toponce Creek ID17040208SK021_02d				62.79 - SMI 54.0 - SHI			**Fully Supporting**
Toponce Creek (middle) ID17040208SK021_03a		50.41 - SMI 68.0 - SHI		64.21 - SMI 60.0 - SHI			**Fully Supporting**
Twentyfour Mile Creek ID17040208SK018_02a	47.08 - SMI 48.0 - SHI					40.93 - SMI 40.0 - SHI	*Not Supporting*

Tributary Name and **Assessment Unit**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Support Status**
Webb Creek (upper) ID17040208SK023_02c	80.51*- SMI 82.5*- SHI	75.69*- SMI 82.0*- SHI	71.62 - SMI 72.0 - SHI		74.87 - SMI 80.0 - SHI	81.12 - SMI 73.0 - SHI	**Fully Supporting**
Webb Creek (lower) ID17040208SK023_02c	64.69 - SMI 86.0 - SHI						**Fully Supporting**
West Bob Smith Creek ID17040208SK016_02c				68.61 - SMI 70.0 - SHI			**Fully Supporting**
West Fork Mink Creek ID17040208SK004_02b	78.02*- SMI 70.5*- SHI	75.04*- SMI 76.0*- SHI	76.74 - SMI 74.0 - SHI	75.74*- SMI 68.0*- SHI 50.38 - SFI	67.63 - SMI 68.0 - SHI	68.90 - SMI 60.0 - SHI	**Fully Supporting**
Yago Creek ID17040208SK006_02c			44.89 - SMI 56.0 - SHI				**Fully Supporting**
Yellow Dog Creek ID17040208SK013_02b		58.90 - SMI 36.0 - SHI					**Fully Supporting**

*indicate the average of multiple samplings (see Bell Marsh Creek 2001 and 2002). †indicates that one of the two samplings indicated the aquatic life use support was below criteria necessary for full support rating, but the average of two samplings suggested full support. A superscript letter indicates a subsection of the assessment unit (e.g., Birch Creek ID17040208SK015_03a in 2002).

Status of Beneficial Uses

An evaluation of the support status for Portneuf River subbasin beneficial uses revealed the following:

- Fourteen of 32 tributary assessment units did not support secondary contact recreation uses. In addition, surface water samples from North City Park, the upstream extent of the Portneuf River concrete channel, in 2003 had *E. coli* concentrations that exceeded the secondary contact recreation criterion.
- Nine tributary AUs did not support the cold water aquatic life beneficial use (Table 2.12). The lower Marsh Creek AU sampled in 2003 and 2006 resulted in bioassessment scores that were split between not supporting and fully supporting; the CWAL use was supported in the most recent sampling.
- Results from multiple fish surveys are reported in the BA (Appendix F), but these surveys did not specifically assess salmonid spawning. In some surveys, the datasets indicate whether salmonids were wild fish or originated from a hatchery (e.g., mainstem reaches above Lava Hot Springs). While the presence or absence of wild salmonids provides some indication of salmonid habitat use, no attempt is made to directly assess the salmonid spawning use in the Portneuf River subbasin.
- Other measures of habitat quality (e.g., depth fines) which reflect stream bed conditions relevant to the salmonid spawning beneficial use are presented for a select number of AUs in Section 5. These surveys are generally restricted to smaller tributaries or assessments that were carried out on lands managed by the USFS. Other measures, including water column sediment concentrations (e.g., TSS or SSC) provide direct evidence of suspended sediment concentrations relative to sediment targets. These findings are reported by AU in Section 5.

Conclusions

The above summary offers clear evidence to support the following conclusions.

- In recent years, peak discharge in the Portneuf River's hydrograph has occurred earlier and daily discharge is lower across the calendar year relative to earlier decades.
- Median water temperatures are highest in Portneuf River at Topaz downstream of significant geothermal influences.
- The multi-year variation in optical turbidity is greatest in Portneuf River at Batiste Road and lower Marsh Creek.
- TN and TP concentrations in the mainstem Portneuf River are greatest at Siphon Road.
- TSS and TP loading in the Portneuf River exceeds TSS and TP target loads primarily during high flows. Total P loading at Siphon Road represents an exception to this statement; TP loading measured at Siphon Road exceeds TP target loads year round.
- The approach used to estimate storm water TSS and TP loading confirms that loading is most pronounced following precipitation events but also shows that deposition likely occurs during periods with limited or no precipitation and base flow conditions.

- Secondary contact recreation uses were not supported in 14 tributary AUs.
- The cold water aquatic life use was not supported in 9 tributary AUs.

2.5 Data Gaps

Review of available Portneuf River subbasin water quality and hydrologic data is presented above and in the Portneuf River Subbasin Biological Assessment (Appendix F). This review assisted in identifying additional data needs and data gaps. For purposes of this discussion, data gaps can represent monitoring topics, streams or assessment units, habitat conditions, or biological assemblage descriptions with insufficient information to inform decision making, characterize support status, or define the extent and timing of impairment.

- High flow and low flow discharge and physicochemical monitoring of tributaries throughout the subbasin is needed to better assess sediment and nutrient loading, and their contribution to impairment status in both the tributary and mainstem reaches. Tributaries with limited water quality monitoring information should be prioritized (e.g., East and West Bob Smith creeks, Dempsey Creek, City Creek). DEQ supports efforts to better characterize sediment, nutrient, and bacterial loading throughout tributary streams because loading from tributaries presents unique, but potentially manageable, situations. Tributaries offer opportunities to implement best management practices (BMPs) that can have immediate and measurable impacts on tributary water quality and beneficial use support.
- Habitat monitoring that directly characterizes stream bed conditions (e.g., depth fines and Wolman Pebble counts) relevant to the salmonid spawning beneficial use is needed throughout the subbasin.
- Regular (e.g., annual or biannual) monitoring of fish assemblages at permanent monitoring locations would supplement water quality and discharge monitoring.
- Hydrologic monitoring of unregulated tributaries would assist in charactering the magnitude of flow alteration in the subbasin and help inform selection of BMPs or water management strategies used to restore components of the hydrograph necessary to improve water quality, restore ecosystem functions, or benefit cold water aquatic communities.
- Targeted sampling of temperature, dissolved oxygen, and plant or algal biomass upstream and downstream of permitted NPDES discharges and throughout the growing season would better define timing and magnitude of their influence on water quality conditions.
- Targeted and continuous sampling of storm water discharges are needed to fully characterize the concentration of constituents introduced into the Portneuf River during storm events, but also to test the efficacy of storm water BMPs.

3. Subbasin Assessment–Pollutant Source Inventory

Pollutants in the Portneuf River subbasin originate from both point and nonpoint sources. Nonpoint sources are the largest contributor to water quality impairment.

3.1 Sources of Pollutants of Concern

The Portneuf River subbasin includes assessment units that are §303(d)-listed for sediments, nutrients (both nitrogen [N] and phosphorus [P]), *Escherichia coli*, and oil and grease. Sediments are introduced largely from nonpoint sources. Measurements of concentrations exceeding the proposed TSS targets are documented throughout the subbasin and particularly during high flows (Figures 2.6 to 2.11). Total phosphorus (TP) trends are similar to those of sediment (Figures 2.12 to 2.17), indicating that a large fraction of the TP in the subbasin is in particulate form or sorbed to suspended sediments. Not surprisingly, the relationship between TSS and TP is strongly correlated (R^2=0.927, P<0.001). Using 193 water samples collected in calendar years 2004, 2005, and 2006, the TSS concentrations the Portneuf River, including and above Batiste Road and Marsh Creek, can be used to predict TP concentrations using a linear equation ([TP] = 0.0316 + {0.00117 * [TSS]}). In addition, water quality data for these same years from all mainstem monitoring sites except Siphon Road, show that dissolved P (ortho-P) represents only 34% of the TP fraction. Combined, this information confirms that the particulate fraction or sediment-associated P is the dominant form of P in the subbasin above Batiste Road. Below Batiste Road, P concentrations are affected by P-rich ground water, and consequently, approximately 90% of the TP exists in dissolved form (Baldwin et al. 2004).

Escherichia coli is found throughout the subbasin and documented exceedances of contact recreation use criterion were detected across years, indicating that weather or hydrologic conditions in a given year was not responsible for the criterion exceedances. Several tributaries had *E. coli* geometric means that were more than an order of magnitude greater than Idaho's single-sample instantaneous contact recreation criterion. However, concentrations exceeding the primary and secondary recreation contact triggers were not widespread. Generally, *E. coli* concentrations tended to be highest in late summer and again in October. Elevated concentrations of *E. coli* in the mainstem in July and August were correlated with increases in river temperatures and decreases in discharge. Elevated concentrations in October are not likely tied to temperatures, but instead to abrupt flow regulation changes and the end of the irrigation season. In the channelized and hardened segment of the lower Portneuf River in Pocatello, exceedances of contact recreation criteria have been documented. In this segment, *E. coli* concentrations increase predictably from upstream to downstream with concentrations at the downstream monitoring location regularly exceeding the single-sample instantaneous criteria for contact recreation (Inouye *unpublished*).

The lower Portneuf River was §303(d)-listed for oil and grease in the 2001 Portneuf River TMDL, although no data was available at the time of listing to characterize

concentrations or the distribution of this constituent throughout the river. Oil and grease can originate from agricultural and municipal sources and oil and grease has been detected in a small number of water samples collected above and below the Pocatello Urbanized Area. In addition, oil and grease have been detected in discharges from storm drains during or immediately following storm events; concentrations in storm water samples exceeding the 5 mg/L oil and grease target were documented. Additional sampling is necessary to fully characterize the sources of oil and grease introduction into the Portneuf River.

Point Sources

Water chemistry data from in-stream monitoring activities above and below wastewater treatment facilities (Lava Hot Springs and Inkom) and fish hatcheries (Batise Springs and Papoose Springs) that discharge to the Portneuf River have shown little measurable effect of increasing TSS or TP from these sources. Pollutant loading is estimated as the product of discharge and concentration, and therefore, loads contributed by a wastewater treatment plant or hatchery are dependent on both the facility's effluent flow and pollutant concentration in that effluent. Effluent flows at Lava Hot Springs are intermittent, and discharge at both wastewater facilities is low, at 1.0 cfs for Lava Hot Springs and 0.1 cfs for Inkom (Table 3.1). The average effluent flow at City of Pocatello is 10.5 cfs. Total suspended solids and TP loading from Lava Hot Springs were measured at 8.2 and 10.4 lbs/day, respectively; however, they were measured on only 21 days because the facility discharged for a total of 21 days in 2007. DEQ has prescribed a 180-day loading scenario (October through March) for Lava Hot Springs, which equals TSS loading of 1.0 lbs/day and TP loading of 1.21 lbs/day outside of critical periods (June 15 to September 15 each year). Loading at Inkom is estimated at 12.8 lbs /day of TSS and 1.5 lbs/day of TP, based on 2007 Discharge Monitoring Report (DMR) data. Loading reductions are needed at Inkom, in the amount of approximately 0.84 lbs TP/day, to meet the facility's TP requirements under their NPDES permit (Table 3.1). The City of Pocatello's 2007 daily discharge summary, the median monthly TSS and TP wasteloads were 204.1 and 32.3 lbs/day, respectively. A wasteload allocation of 25.1 lbs TP/day will require a wasteload reduction of approximately 7.2 lbs TP/day for most months (Table 3.1). It is anticipated the City of Pocatello will meet this wasteload in a time frame commensurate with other large-scale P reductions proposed for the lower river (i.e., by the year 2020) that are outlined below.

Storm water loading associated with the Pocatello Urbanized Area is permitted under MS4 Permit No. IDS-028053. Wet weather loading from the PUA is highly variable (see Figures 2.22 and 2.23 and Table 2.10), and the magnitude and duration of pollutant loading is a function of the properties (i.e., intensity and duration) of the precipitation or melting event (Deletic and Maksimovic 1998) and antecedent weather conditions. In the absence of continuous outfall loading summaries, upstream (EFNA monitoring station) and downstream (Batiste Road monitoring station) loading estimates are used to integrate loading from all storm water outfalls and storm water runoff to the Portneuf River from the PUA. Specifically, storm water loads were estimated by calculating the difference between loads at the EFNA and Batiste Road monitoring sites. Following this approach, the range in storm water TSS and TP loads recorded from 2004 to 2006 were -106.1 to

263.9 tons TSS/day and -280.0 to 618.9 lbs TP/day. Negative values indicate that the average daily load was greater at EFNA than Batiste and suggest that there was deposition or storage of sediment in the reach that spans the PUA. Storm water target loads/load allocations will be estimated by taking the difference in discharge between the Batiste and EFNA monitoring stations and multiplying by the proposed TSS and TP targets (Table 3.1).

There are two permitted hatcheries (Batise Springs Trout Farm and Papoose Springs Hatchery) in the lower Portneuf River. Loading from Batise Springs Trout Farm was established from several years of field sampling (1998 to 2003) including measurements of discharge and from constituent summaries provided in the facility's 2007 Annual Report of Operations. Median discharge from Batise Springs Trout Farm was 31 cfs (range 20 to 35 cfs) from 1998 to 2003 and wasteloads for TSS and TP were estimated at 168 and 8.4 lbs/day, respectively. Papoose Springs Hatchery operates intermittently and was not listed on the General Permit for Aquaculture Facilities of Idaho (Permit No. IDG-130000). However, future operation of this facility is anticipated, and therefore, a wasteload allocation is included in Table 3.1. Loading summaries presented for Papoose Springs Hatchery are based on sampling results from 2003 and 2004, and indicate that discharge ranged from a minimum of 30 to a maximum of 75 cfs. Accordingly, the wasteload for this facility was estimated as 304.5 lbs TSS/day and 0.9 lbs TP/day (Table 3.1).

Table 3.1. Point source dischargers to the Portneuf River, with each facility's estimated wasteload and wasteload allocation for total suspended solids and total phosphorus.

Facility/Source	NPDES Permit Number	Wasteload (lbs/day)	Wasteload Allocation (lbs/day)
City of Lava Hot Springs wastewater treatment facility	ID-002182-2	TP =1.2[a] TSS =1.0[b]	TP =1.2[a] TSS =86.0[b]
City of Inkom	ID-002024-9	TP = 1.5[c] TSS =12.8 [c]	TP =0.71[c] TSS =26.0 [c]
City of Pocatello	ID-002178-4	TP = 32.3[d] TSS = 204.1[d]	TP = 25.1[d] TSS =3,000 [d]
City of Pocatello, the City of Chubbuck, Bannock County, and the Idaho Transportation Department - District #5 – MS4 Permit	IDS-028053	TP = 9.0[e] TSS = 6,275.6[e]	TP =Batiste – EFNA discharge x TP targets[e] TSS = Batiste – EFNA discharge x TSS targets[e]
Batise Springs Trout Farm	IDG-130000	TP = 8.4[f] TSS = 168.0[f]	TP = 13.0 [f] TSS = 838.2[f]
Papoose Springs Hatchery*	ID-0072-8 (expired)	**Intermittent discharge** TP = 0.9[g] TSS = 304.5[g]	TP = 0.9[g] TSS = 304.5[g]

[a]City of Lava Hot Springs' WWTP wasteloads were calculated from discharge and water quality sampling conducted in 2002 and 2003 and a total of approximately 21 days of TP loading in 2007 at a rate of 10.4 lbs/day from October to May; the total load estimate is 218 lbs of TP. To correct for average daily load under a 180-day discharge scenario that occurs from October to March, the following was used: 218 lbs TP (total wasteload) ÷ 180 day compliance period = 1.21 lbs/day. Therefore, the target load during the months October to March is set at 1.21 lb/day.

[b]Consistent with TP calculations for the City of Lava Hot Springs, an estimated TSS loading rate of 8.2 lbs/day for 21days results in a loading of 1.0 lbs/day TSS over a 180-day loading scenario.

[c]City of Inkom TP and TSS loads were estimated from 2007 averages from the discharge monitoring reports.

[d]City of Pocatello loads are based on discharge summaries for calendar years 2004 – 2006 used throughout this TMDL (average 6.8 mgd). However, DEQ recognizes that outlet TSS and TP concentrations have decreased in recent years and therefore current (2007) TSS and TP summaries were used to estimate TSS and TP loads as such: average 2004 to 2006 discharge x median 2007 (TSS or TP) concentration.

[e]MS4 Permittee's storm water wasteload estimates represent the median daily TSS and TP loads translated from daily turbidity monitoring data collected during calendar years 2004 to 2006 and from monitoring stations above and below the Pocatello Urbanized Area (PUA; total of 647 daily estimates). Storm water loads were developed by calculating the difference in loads between the upstream (EFNA) and downstream (Batiste Rd) monitoring sites. The ranges in storm water TSS and TP loads recorded from 2004 to 2006 were -106.1 to 263.9 tons TSS/day and -280.0 to 618.9 lbs TP/day. Negative values indicate that the average daily load was greater at EFNA than at Batiste Road. Storm water target loads/load allocations will be estimated using the difference in discharge between Batiste and EFNA monitoring stations and the approved TSS and TP targets.

[f]Batise Springs Trout Farm loads are based on sampling results from 1998 to 2003 measurements of discharge and TSS and TP concentrations and the 2007 Annual Report of Operations for the facility.

*[g]The Papoose Springs Hatchery is operates intermittently and is not listed on the General Permit for Aquaculture facilities of Idaho (Permit No. IDG-130000). Since future operations of this facility are anticipated, a wasteload is presented and loads are based on sampling results from 2003 and 2004 measurements of discharge and TSS and TP concentrations.

Nonpoint Sources

Agriculture is a major source of nutrient loading in the upper Snake River Basin (Clark 1994) and the Portneuf River is a major contributor of both sediment and nutrients to the upper Snake River system (Clark 1997). A considerable amount of the Portneuf River subbasin is used for agricultural purposes and currently rangeland (56% of the subbasin) and cultivated agriculture (22%) are the dominant land uses. Forest lands (17%) and rural developments and municipalities combined represent only 4% of the subbasin (USGS 2001). Approximately 53% of the subbasin is privately owned and managed as pasture or for the dryland production of crops. Moreover, two thirds of private lands are covered by highly-erodible soils, increasing the likelihood of sediment and associated P contributions from agricultural activities on private lands (ISCC 2002). The Idaho Soil Conservation Commission (2002) summarized the major causes of agricultural pollution in the Portneuf River subbasin as: 1) sheet, rill, gully, irrigation-induced, and stream channel erosion on agricultural lands; 2) nutrient runoff or leaching from fertilizer and animal waste applications on agricultural lands; 3) animal waste from facility runoff and waste applications on agricultural land; and 4) aquatic habitat degradation from human and animal activities on agricultural land.

In a previous report, DEQ (2001b) identified agriculture as the leading contributor of nitrate to ground water in the state. Agricultural sources (fertilizer, manure, legumes) contribute approximately 93% of NO_2+NO_3; septic systems and other sources were responsible for 1% and 5%, respectively. Elevated NO_2+NO_3 concentrations in ground water throughout the Portneuf River subbasin often exceed 2.0 mg/L (see Baldwin et al. 2004, Meehan 2005) and this has resulted in ground water aquifers within this region ranking among the State of Idaho's 25 Nitrate Priority Areas. Fort Hall, Pocatello, and Soda Springs/Bear River aquifers ranked 7, 17, and 18, respectively (http://www.deq.idaho.gov/water/data_reports/ground_water/nitrate/final_nitrate_priority_area_ranking.pdf).

Sediments and sediment-bound P from agricultural lands also lead to elevated concentrations of these constituents in portions of the watershed that lack other significant land uses. In the Portneuf River at Topaz, for example, TSS and TP concentrations during high flow periods exceed TSS and TP targets for the subbasin in some years (see Figures 2.6 and 2.12). Sources of sediment from agricultural lands include: sheet and rill, gully, stream channel (and bank), and irrigation-induced erosion (ISCC 2002). Sediment loading from other agricultural features, such as return flows from irrigation canals can also contribute large amounts of loading over brief time periods. Monitoring of the Sunnyside canal overflow, which discharges to the Portneuf River and receives overland runoff from agricultural land, indicates that the overflow can contribute disproportionately to Portneuf River water quality. On March 7, 2007, concentrations in samples collected from the overflow were difficult to measure analytically because of the high amount of sediment. Laboratory estimates for TSS and TP in the overflow were 34,000 mg/L and 34 mg/L and downstream concentrations for these constituents (measured in the Portneuf River at Topaz) were 2,400 mg TSS/L and 4 mg TP/L, respectively. Although these concentrations are not likely reflective of regular loading from this canal overflow, TSS and TP concentrations on May 18, 2007, were 489 mg/L and 0.7 mg/L, suggesting that intermittent loading from this conveyance is influencing downstream water quality. It is important to note that canals in the watershed

may also act to remove suspended materials. Accounts of the annual volume of sediment (and unwanted debris) that are removed as water is conveyed through the Portneuf Marsh Valley Canal indicate that measurable amounts of sediment and garbage are removed during this subwatershed transfer.

Marsh Creek, a subwatershed with land use that is predominantly agricultural, has a higher median TSS concentration (48 mg/L) than all other long-term monitoring stations in the subbasin. Marsh Creek, along with Upper Rapid Creek and the Portneuf River from Dempsey Creek to McCammon, also received a sediment priority ranking in the Portneuf River TMDL Agricultural Implementation Plan (ISCC 2002). On average, the daily TSS loads entering the Portneuf River from Marsh Creek are four times greater than sediment loads upstream of the Marsh Creek confluence. Since 65% of the P load in Marsh Creek is associated with sediments, TP trends in Marsh Creek parallel trends in sediment loading.

In the lower Portneuf River, discharge of N and P from nutrient-rich ground water affects water quality. Both N and P originate from a shallow water aquifer system that is impacted by the current operation of J.R. Simplot Company processing facility and the former FMC processing facility this ground water N and P load represents a significant portion of the total nutrient load measured in the river (Baldwin et al. 2004). In the Portneuf River segment between Batiste and Siphon roads, ground water from this shallow aquifer system contributes an estimated 225 cfs to the river. Impacted portions of ground water have concentrations of ortho-P that greatly exceed the Portneuf River TP target (Baldwin et al. 2004). Based on these findings and a mutual concern for water quality in the lower Portneuf River, DEQ and Simplot recently signed a voluntary consent order/compliance agreement (April 2008), in which Simplot agreed to implement remedial actions to reduce its contribution of P to shallow ground water and ultimately to the Portneuf River. This binding agreement calls for reductions of P concentrations in the Portneuf River from an annual median concentration of 1.250 mg/L to 0.075 mg/L by the year 2021.

Other sources of nonpoint source pollution that introduce nutrients and pathogens into the watershed include runoff carrying livestock or wildlife feces and pet waste or discharges from septic systems. As rural populations in the subbasin grow, septic system discharges will become increasingly influential on water quality.

3.2 Data Gaps

A review of the major point and nonpoint source contributors in Portneuf River subbasin are described above. From this review and the water quality characterization presented in Section 2, several data needs and data gaps emerge. These data needs and information gaps are presented under the subcategories below.

Point Sources

Targeted sampling of nutrients, temperature, dissolved oxygen, and plant or algal biomass above and below permitted NPDES discharges and throughout the growing season would assist in characterizing the timing and magnitude of their influence on water quality conditions and inform strategies to best manage pollutant loading.

Targeted and continuous sampling of storm water discharges are needed to fully characterize the concentration of constituents introduced into the Portneuf River during precipitation or melting events. Sampling of multiple storm water outfalls is recommended to characterize the range of variation detected among outfalls. Sampling should also be used to evaluate the efficacy of storm water BMPs.

Nonpoint Sources

There are several tributaries whose water quality and beneficial use support status have yet to be evaluated. Baseline physicochemical monitoring of these tributaries, especially those that directly feed the mainstem Portneuf River, should be prioritized to characterize water quality, beneficial use status, and loading potential.

Total suspended solids and TP loads in the mainstem Portneuf River and Marsh Creek regularly exceed the proposed high-flow targets. Monitoring of high-flow discharge and physicochemical properties in tributaries throughout the subbasin is needed to better assess sediment and nutrient loading, and their contributions to impairment status, in both the tributary and mainstem reaches. DEQ supports efforts to better characterize loading throughout tributary streams because loading from tributaries presents unique, but potentially manageable, situations.

Targeted sampling is needed to better understand the contribution of rural real estate developments on water quality. Rural residential land uses and septic tank densities are widely cited as a major contributor to nutrient loads in rivers. Additional information is needed to characterize the cumulative impacts of septic tanks on water quality in the Portneuf River subbasin.

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

A range of implementation strategies have been applied to ameliorate the effects of point and nonpoint pollutant sources throughout the Portneuf River subbasin. Approval of the Portneuf River TMDL in April 2001 initiated the development of an implementation plan that organized stakeholder efforts into a comprehensive set of implementation strategies for the watershed, guided by a single document (see the Portneuf River TMDL implementation plan: http://www.deq.idaho.gov/water/data_reports/surface_water/tmdls/portneuf_river/portneuf_river_implementation_plan_entire.pdf). Previous accomplishments, and the acreages/volumes of water treated, are described in detail in the implementation plan. For example, the agricultural implementation plan shows that conservation practices totaling $14 million have been applied broadly throughout the subbasin (see Table 10 of ISCC's 2002 Agricultural Implementation Plan), and over $1.7 million in State Agricultural Water Quality Projects alone have treated over 35,000 acres in Bannock and Caribou counties (Table 11 in ISCC 2002). An update and evaluation of specific implementation efforts prescribed in the implementation plan are described below.

Implementation of best management practices (BMPs) in Upper Rapid Creek resulted in the treatment of 2,842 acres (59%) of the watershed receiving a critical condition ranking in the 2002 agricultural implementation plan. Treatments in this watershed fit into the following categories: livestock exclusion, fencing, offsite watering, grazing management, and berms to contain animal waste. Pre- and post-implementation monitoring of North and West forks of Rapid Creek showed that NO_2+NO_3-N and *E. coli* concentrations were lower in West Fork Rapid Creek after livestock exclusion (Jenkins 2007). This work highlights the benefits of BMPs in a major tributary to the Portneuf River. Since 2007 over $1 million of 319 NPS grant monies have been allocated to the Marsh Creek drainage alone, assuming the minimum of 40% match for these dollars nearly $1.4 million alone will go towards reducing sediment, nutrients and bacteria in this agricultural-dominated watershed.

Treatment of 14,390 acres in the form of livestock exclusion, grazing management, and onsite animal waste containment were recently evaluated in the Twentyfour-mile Creek watershed. Similar to monitoring efforts in Upper Rapid Creek, pre- and post-implementation monitoring of sediments, nutrients (N and P), and *E. coli* were used to evaluate the efficacy of treatment prescriptions. Monitoring results suggested a trend in reduced TSS and TP concentrations after implementation. In contrast, trend monitoring suggested an increase in NO_2+NO_3-N and *E. coli* (Jenkins 2008). Results from this work are inconclusive but early indications are that the sediment and sediment associated-P response to implementation was favorable.

Effectiveness monitoring of a wetland and riparian restoration project completed at Edson Fichter Nature Area (EFNA), supported by 319 Nonpoint Source Management Program funds, was completed as part of a senior thesis project by K. Reale-Munroe, an undergraduate working with Richard Inouye at Idaho State University. This project consists of a small depressional wetland/pond that receives waters directly from the

Portneuf River by the aid of a pump; these waters then pass through the pond and a small channel before re-entering the Portneuf River. The direct impact of the 319 program-supported wetland on Portneuf River water quality was examined using samples collected from the wetland/pond inlet, pond outlet, and the return channel on four dates in 2004 (July 1, July 5, October 20, and November 4, 2004). Pond Inlet is the point where water pumped directly from the Portneuf River through a pipe enters the wetland or pond; pond inlet samples were obtained directly from the pipe. The Pond Outlet refers to the point where water from the sediment pond enters a small channel. Channel refers to the location where samples were obtained, about 30 feet from where the water returns to the Portneuf River.

On every date, the concentration of suspended solids (SSC) was highest at the Pond Inlet and lowest at the Channel (Figure 4.1). Effects of both date and location were analyzed in a two-way analysis of variance (ANOVA), which revealed significant effects of both date ($F = 2102.7$; $P < 0.001$) and location ($F = 1421.4$; $P < 0.001$) on suspended solids concentration (SSC), as well as a significant interaction between date and location ($F = 290.8$; $P < 0.001$). Separate one-way ANOVAs for each sample date also showed significant effects. On July 1 ($F = 1298.1$, $P < 0.001$), July 5 ($F = 1265.5$, $P < 0.001$), and November 4 ($F = 341.3$, $P < 0.001$) SSC was significantly different at all three locations. On October ($F = 10.9$, $P = 0.010$), SSC concentration was significantly greater at the Pond Inlet than at the other two locations, but not significantly different between the Pond Outlet and Channel (Inouye *unpublished*).

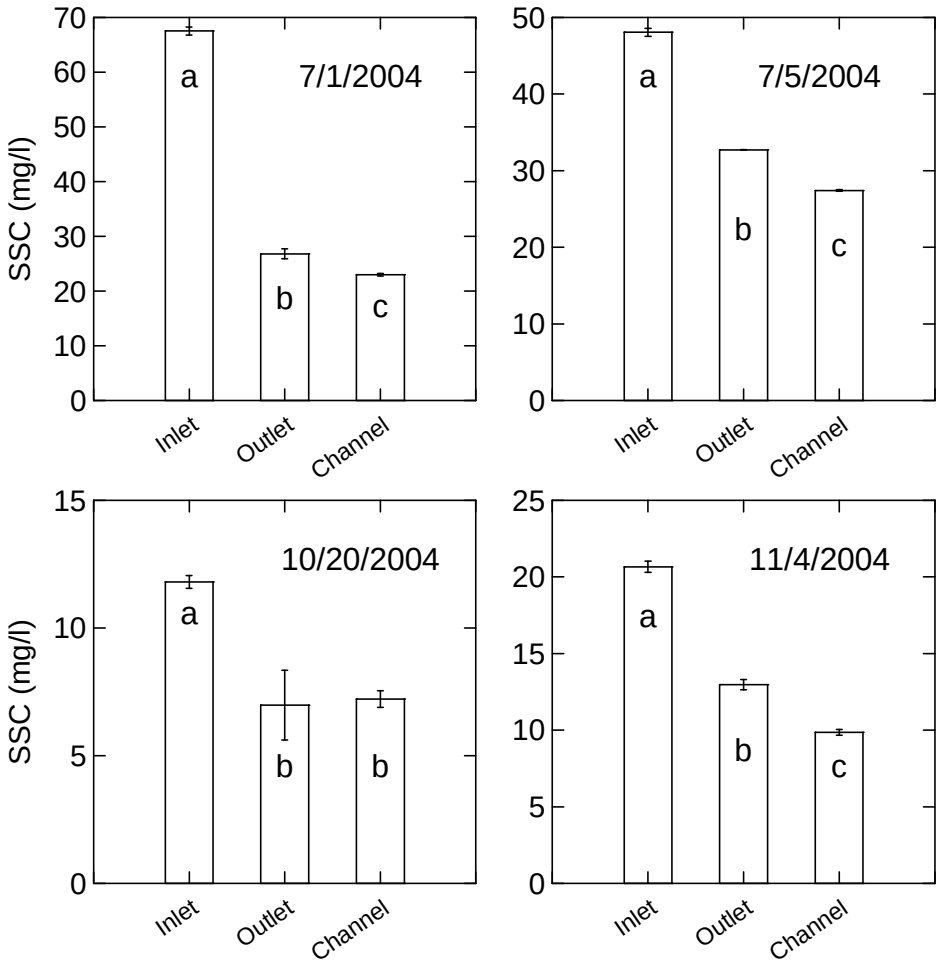


Figure 4.1. Suspended sediment concentrations (SSC) from the EFNA 319 wetland restoration project on four dates. Error bars represent standard errors. For each date, bars with different letters were significantly different.

Based on a daily SSC load estimate, approximately 110 lbs of suspended solids entered the wetland/pond during a 24 hour period on November 4, 2004. Approximately 31 lbs (29%) of that load was retained within the pond, and a further 37 lbs (34%) was retained in the discharge channel. Together, the wetland/pond and channel retained approximately 69 lbs (63%) of the suspended solids load that entered the wetland complex. Although this provided significant treatment of water pumped into the pond, the impact of this treatment on overall water quality in the Portneuf River is likely to be small or unmeasurable. Discharge in the Portneuf River at EFNA in November 2004 was approximately 132 cfs. At this river discharge, a flow of approximately 1 cfs into the wetland complex would represent less than 1% of the water in the river channel. A 63% reduction in suspended solids in that volume of water would result in only a minor reduction in suspended solids in the Portneuf River.

Two storm water basins were implemented as BMPs in the City of Pocatello to treat storm water within the Pocatello Urbanized Area (PUA). The First Street storm water retention basin was completed in 1998 to treat storm water from the PUA that formerly discharged into the Portneuf River. The retention basin receives water from approximately 740 acres of impervious surfaces. The presence of total extractable hydrocarbons (TEH) and diesel range organics (DRO) were identified in sediments sampled from within the retention basin and were greatest in the portions of the basin that were inundated most frequently (Reale-Munroe and Inouye 2005). Since the basin only discharges during high flows, it appears that the basin is effectively removing TEH and DRO from storm water. Although the Portneuf River is not §303(d)-listed for either of these contaminant suites, it is listed for oil and grease and this work suggests that this BMP is functioning to remove hydrocarbons in storm water and preventing these pollutants from reaching the Portneuf River. Construction of the Day Street-Sacajawea Park storm water retention wetland was completed in October 2008. This wetland was designed to receive and treat up to 70% of the Day Street outfall discharges. Treatment results from the Day Street-Sacajawea Park retention wetland are forthcoming, but it is believed that it will offer levels of treatment that are comparable to the First Street basin and other storm water basins in the region.

Combined, these efforts demonstrate the stakeholder commitment to improving water quality in the Portneuf River subbasin. DEQ recognizes that implementation strategies for TMDLs are ongoing and in some instances may need to be modified if monitoring shows that the TMDL goals are not being met or significant progress is not being made toward achieving the goals.

5. Total Maximum Daily Loads

This section describes TMDLs primarily for assessment units (AUs) described on the 2002 §303(d)/305(b) Integrated Report; including AUs that were carried over to the 2008 Integrated Report. It also includes a summary of existing loads in the subbasin and compares these loads to target loads. Water quality-limited segments with TMDLs are treated in Section 2 of this document, which is part of the Subbasin Assessment (see Table 2.1), and throughout this section (Section 5) (see tables C and 5.28 for AUs receiving revised TMDLs).

A TMDL is the maximum load of a pollutant that a water body can receive and still meet water quality criteria or water quality targets (Wagner et al. 2007). Therefore, a TMDL prescribes an upper limit on pollutant loads from all point and nonpoint sources, which is referred to as the load capacity (LC). If the existing load is already above the limit, the prescribed limit is the target load. A TMDL also allocates this target load among the various sources. Pollutant sources fall into two broad classes: point sources, each of which receives a wasteload allocation (WLA); and nonpoint sources, each of which receives a load allocation (LA). Natural (pollutant) background (NB), when present, is considered part of the load allocation, or it may also be described explicitly because it represents a part of the load not subject to control. Natural background conditions are usually considered in the process of establishing TMDL targets; the process of target development includes a review of reference conditions necessary to support beneficial uses (Benham et al. 2005, Wagner et al. 2007).

Because of uncertainties regarding quantification of loads and the relation of specific loads to attainment of water quality standards, the rules regarding TMDLs (Water quality planning and management, 40 CFR Part 130) require that a margin of safety (MOS) be a part of the TMDL development process. In practical terms, the MOS is a reduction in the target load that is available for allocation to pollutant sources. For this TMDL revision, the MOS and background conditions are included in each TMDL target. Symbolically, the target loads for the Portneuf River can be summarized as follows: Target Load = MOS + LA + WLA = TMDL (Benham et al. 2005). The equation is written in this order because it represents the logical order in which a load analysis is conducted. First, with the assistance of the watershed advisory group, the target concentration for each pollutant is determined. Pollutant target concentrations are then combined with discharge volumes to calculate target loads. Then each target load is broken down into its component parts: the necessary margin of safety is determined and subtracted (unless included in the target concentration); then the remainder is allocated among pollutant sources, with any point sources' WLAs accounted for first, and the LA consisting of the remainder, so that zeros is the amount not accounted for. When the breakdown and allocation are completed, the result is a TMDL, which must equal the target load.

Another step in a load analysis is the quantification of the current pollutant load contributed by each source. This allows load reductions to be specified as percentages of current loads, considers equities in responsibility for load reduction, and is necessary in order for pollutant trading to occur. The load capacity/target load must be based on

critical conditions – the conditions present when water quality standards are most likely to be violated. Examples of critical conditions are when the flow is highest (usually in the spring) or when the temperature is highest (usually in the summer). If a TMDL is protective under critical conditions, it will be more than protective under other conditions. Because both load capacity/target loads and pollutant source loads vary, and not necessarily in concert, determination of critical conditions can be more complicated than it may appear on the surface.

A load is fundamentally a quantity of a pollutant discharged over some period of time, and is the product of concentration and flow. Due to the diverse nature of various pollutants, and the difficulty of dealing only with loads, the federal rules allow for "other appropriate measures" to be used when necessary. These "other measures" must still be quantifiable, and must relate to water quality standards, but they allow flexibility to deal with determining pollutant loads in more practical and tangible ways. The rules also recognize the particular difficulty of quantifying nonpoint loads, and allow "gross allotment" as a load allocation if the ability to produce more accurate estimates is limited by available data or appropriate predictive techniques. For certain pollutants that have long term effects, such as sediment and nutrients, EPA allows for seasonal or annual loading scenarios; however, these loads must still be expressed in the form of daily loads. Daily loads summaries are required in order to comply with the recent decision by the U. S. Court of Appeals for the D.C. Circuit in Friends Earth, Inc. v. EPA, et al., No. 05-5015 (D.C. Cir. 2006). In this case, the District Circuit held that TMDLs (relating to TMDLs for the Anacostia River, Maryland) must be expressed in terms of daily loads. (EPA memo dated November 15, 2006, from Benjamin H. Grumsley, Assistant Administrator to EPA).

5.1 In-stream Water Quality Targets

Development and implementation of a TMDL is a recognized regulatory approach to estimating and allocating pollutant loads and in-stream water quality targets. Targets defined by the TMDL are the maximum pollutant loads that a water body can receive and still meet water quality criteria and support beneficial uses (EPA 1991; Wagner et al. 2007). The goal of the TMDL and the in-stream targets is to identify the loads that will lead to the restoration of "full support of designated beneficial uses" (Idaho Code 39.3611, 3615).

The Portneuf Watershed Advisory Group approved in-stream targets for total suspended solids (TSS; also identified as sediment below), total phosphorus (TP), total nitrogen (TN), oil and grease (O&G), as well as the adopted Idaho numeric criteria for *Escherichia coli* (*E. coli*) and dissolved oxygen (DO; Table 5.1). In principle, the water quality targets were designed to conform to Idaho Water Quality Standards (e.g., *E. coli*). In the case of narrative criteria or evidence of beneficial use impairment, other sources including the refereed literature or state and federal technical guidance documents were consulted to determine appropriate in-stream targets. In addition, empirical data from the subbasin were used to establish the statistical relationships between targets (e.g., TSS and TP) or targets and water quality surrogates (e.g., turbidity), as described in the section on loading estimates, which starts on page 43. Ultimately, the goal was to establish targets

that lead to restored conditions within the Portneuf River so that "surface waters shall be free from deleterious materials in concentrations that impair beneficial uses"; IDAPA §58.01.02.200.03) Table 5.1 also identifies which hydrologic units (i.e., mainstem or tributary) of the subbasin are affected by the pollutant targets. A complete description of each pollutant and how targets were established follows. Some of the water quality targets proposed are consistent with the 2001 TMDL (e.g., the high-flow TSS target) or with Idaho Water Quality Standards (IDAPA §58.01.02). Other targets (e.g., the TP target) represent revisions to the 2001 TMDL targets based on empirical evidence that was collected since the 2001 TMDL. These new targets apply broadly to the subbasin and to assessment units that have existing TMDLs and are currently §303(d)-listed in Section (4)(a) of the Integrated Report, meaning they are waters impaired by pollutants for which there is an approved TMDL.

Where pollutant targets (described in Table 5.1) are being met, the measured concentrations of a pollutant will continue to serve as the actual target. For example, if a water body is meeting the TSS target at low flow (mean TSS concentration is 25 mg/L), the current and documented concentration and load become the target concentration and load allocation. In this way, targets set equal to current concentrations result in site-specific load allocations, even though other site- or reach-specific factors (e.g., sediment characteristics, water temperatures, solar loading, frequency and duration of flooding, and resident biological assemblages) may also contribute to the water quality conditions or level of protection necessary to ensure beneficial use support. This approach that uses actual water quality conditions is consistent with the antidegradation policy for the State of Idaho (IDAPA §58.01.02.051(01)) and is necessary for the maintenance and protection of existing conditions and uses. Targets for reservoirs are examined separately from targets for lotic assessment units in this TMDL revision because the biological consequences of pollutant loading for reservoirs are entirely different than they are for lotic habitats.

Table 5.1. Portneuf River pollutant targets, target coverage, and dates that targets were endorsed by the Portneuf River Watershed Advisory Group.

Pollutant	Mainstem Target	Tributary Target	Reservoir Target
Total Suspended Solids	35 mg/L (low flow)[1] 80 mg/L (high flow)[2]	35 mg/L (low flow)[5] 80 mg/L (high flow)[2] or 80% bank stability	(4.0 mg/L)[6]
Total Phosphorus	0.07 mg/L (low flow)[3] 0.125 mg/L (high flow)[3]	0.07 mg/L (low flow)[5] 0.125 mg/L (high flow)[5]	0.03 mg/L[7]
Escherichia coli	126 organisms/100 mL[2]	126 organisms/100 mL[5]	126 organisms/ 100 mL[5]
Oil and Grease	5 mg/L[2]	5 mg/L[5]	5 mg/L
Total Nitrogen	No target[4]	1.0 mg/L as TN[5]	1.0 mg/L as TN
Dissolved Oxygen	6.0 mg/L	6.0 mg/L	6.0 mg/L[8]
Chlorophyll *a*	No target	No target	0.015 mg/L[9]

1. Endorsed by consensus at the 9/18/07 meeting.
2. This target represents no change from the 2001 TMDL and the WAG endorsed making no changes at the 9/18/07 meeting.
3. Endorsed via majority vote on 11/20/07. See appropriate meeting notes.
4. Endorsed via majority vote on 1/15/08. See appropriate meeting notes.

5. Endorsed by consensus on the 1/15/08 meeting.
6. Existing TSS concentration (average TSS concentration from 06 to 08) applied to Hawkins Reservoir. Site specific target development would be required for other reservoirs in the Subbasin.
7. Total phosphorus target for Hawkins Reservoir is 0.03 mg/L. This value was derived from empirical relationships between TP and chlorophyll *a* in Dillon and Rigler (1974).
8. Dissolved oxygen criterion for lakes and reservoirs <35 m does not apply to the bottom 20% of the water depth (58.01.02.250.02.a.i).
9. Chlorophyll a criterion recommended for Hawkins Reservoir is 0.015 mg/L (average of two photic zone samples from a single visit).

Target Selection and Applicable Criteria

Applicable criteria for the pollutants addressed, and the selection of targets for each pollutant, are discussed in the following pages for bacteria, sediment, phosphorus, phosphorus specifically in reservoirs, nitrogen, oil and grease, and dissolved oxygen.

Bacteria

The State of Idaho once used fecal coliform as the basis for its bacteria water quality standard, but has changed to an *E. coli*-based standard for both primary and secondary contact recreation. The numeric criterion for *E. coli* depends on the recreational use designation of the water body; recreational use designations are characterized as either primary or secondary contact recreation. Primary contact recreation (PCR) indicates that through the course of the recreational activity there is a moderate to high probability of prolonged and intimate contact by humans (e.g., swimming). In contrast, secondary contact recreation is described as a recreational activity that takes place on or about the water (e.g., fishing, boating, wading, or infrequent swimming) and consequently the ingestion of raw water is not anticipated (Grafe et al. 2002).

In the mainstem Portneuf River, there are two Assessment Units with the recreational use designation PCR: source (headwaters) to Chesterfield Reservoir (ID17040208SK020_03), and Chesterfield Reservoir to Marsh Creek (ID17040208SK016_03). The discussion that follows does not examine the beneficial use support status or characterize pollutant loads for the AU that covers the Portneuf River from headwaters to Chesterfield Reservoir (AU ID17040208SK020_03) because it is located on the Fort Hall Reservation. For each of the AUs that cover the Portneuf River from Marsh Creek to the Fort Hall Reservation Boundary (ID17040208SK001_05) and Marsh Creek (ID17040208SK006_03, _03a, _04, _04a) the recreation use is designated as SCR. All tributaries in the subbasin are undesignated water bodies and are provided protection for contact recreation under IDAPA §58.01.02.101.01.a. The DEQ Pocatello Regional Office determined that likely recreational activities for these tributaries would be consistent with SCR (i.e., possible activities may include fishing, wading, and infrequent swimming). Accordingly, *E. coli* targets will correspond with water quality criteria for secondary contact recreation.

Evaluation of either recreational use designation requires the most current line of evidence and DEQ indicates that evidence must be less than 5 years old. The numeric criterion used to determine whether there is an exceedance of the *E. coli* threshold for recreational use is identical for primary and secondary contact recreation; an exceedance

is a geometric mean greater than or equal to 126 *E. coli* organisms/100 ml in five samples collected within a 30-day assessment period. However, the instantaneous criterion used to trigger a 5-day sampling event is unique to each recreational use designation. An *E. coli* concentration of greater than 406 organisms/100 mL for PCR or greater than 576 organisms/100 mL for SCR is a trigger that initiates subsequent sampling (WQS § 251.01) to provide a five-sample geometric mean as described.

Sediment

In lotic systems, making precise estimates of sediment and associated pollutant loads is problematic because of spatial and temporal (i.e., diel, seasonal, annual; Inouye et al. *in review*) variation within a watershed. Further, unpredictable storm events, short-duration runoff events from land use practices or natural disturbances, and limited resources available for conventional sampling create additional challenges in accurately estimating loads (Preston et al. 1989; Lewis 1996). Still, some sediment delivery processes reoccur on an annual basis (e.g., spring runoff) and represent "infrequent but high-magnitude loading events. For these reasons, EPA and DEQ acknowledge that average sediment loading conditions cannot realistically be imposed in TMDLs for all waters. Instead, approaches that identify seasonal or flow-specific targets are encouraged (Rowe et al. 2003). The 2001 Portneuf River TMDL identified a low-flow TSS target (28-day average concentration is not to exceed 50 mg/L) and a high-flow TSS target (14-day average concentration is not to exceed 80 mg/L). This revision to the Portneuf River TMDL includes a revision to the low-flow TSS target (28-day average concentration not to exceed 35 mg/L), while maintaining the same high flow target as 2001 (14-day average not to exceed 80 mg/L). This revision recognized findings from the growing body of aquatic literature that TSS concentrations greater than 25 mg/L may lead to some (measurable) effects on fish habitat (summarized in Rowe et al. 2003, Table 5). In the Portneuf River subbasin, a lower Marsh Creek reach sampled in 2007 produced no salmonids or fish from cold water taxa (Keeley 2007) and only a single sculpin. Averaged across the years 2004 through 2006, the mean low-flow TSS concentration in Marsh Creek was 36 mg/L, and concentrations regularly exceed this value during low-flow periods. Therefore, the absence of fish from cold water taxa in Marsh Creek was used to support the establishment of a low-flow TSS target of 35 mg/L to support the cold water aquatic life beneficial use.

Other TMDL analyses have established similar flow stratified-targets. For example, the Bear River TMDL divided TSS and TP loading among four annually-occurring hydrologic periods described as lower basin runoff, upper basin runoff, summer base flow, and winter base flow (Ecosystems Research Institute [ERI] 2006). This type of approach is endorsed by federal guidance documents for sediment TMDLs, which specifically distinguish between loading events that occur during high flows or high runoff periods and those that occur during low flows (USEPA 1999). Recognition of these distinct annual hydrologic periods also acknowledges that high-flow loading events occur when waters are generally cool and prior to the start of the growing season for aquatic macrophytes, algae, and bacteria (Bowes et al. 2008).

Other sediment targets rely on channel characteristics that indicate the likelihood that a stream/river bank can withstand the erosive forces of flows. Bank stability is recognized

as an appropriate TMDL target (Rowe et al. 2003), and this type of target was recently used in the Blackfoot River TMDL (DEQ SBT USEPA 2006). Consistent with the Blackfoot River TMDL and the U.S. Bureau of Land Management's guidance for monitoring stream channels and riparian vegetation (Burton et al. 2008), the bank stability target selected for Portneuf River tributaries is greater than 80% stability.

Phosphorus

Particulate P (or TP when a small percentage of the P exists in dissolved form) and total suspended sediment (TSS; also described as suspended sediment throughout this document) are strongly correlated in rivers worldwide (Beusen et al. 2005) and the Portneuf River is no exception. Water quality data from monthly sampling activities spanning three years (2004 - 2006) at five monitoring stations in the Portneuf River (Portneuf River at Topaz, Portneuf River above Marsh Creek, lower Marsh Creek, Portneuf River at Edson Fichter Nature Area, and Portneuf River at Batiste Rd; a complete description of monitoring stations follows this section) were used to examine the relationship between TSS and TP in the mainstem Portneuf River and its major tributary, Marsh Creek. Concentrations of TSS and TP in depth and width-integrated samples were strongly correlated ($R^2 = 0.927$, $P < 0.001$, $N = 193$), indicating that a large fraction of TP in the Portneuf River exists as particulate P, occurs in close association with sediment, or is of mineralogical origin. Using sampling results from the above-referenced sites, approximately 66% of the TP in the Portneuf River occurs in particulate form (34% in dissolved form). In contrast, in the lower reaches of the Portneuf River, as measured at Siphon Road, P concentrations are affected by P-rich ground water, and consequently in this portion of the river, 92% of the TP exists in dissolved form (Baldwin et al. 2004).

The fundamental difference between P conditions in the Portneuf River at Batiste and Siphon Roads is associated with the origin of P above and below Batiste Road. Upstream of Batiste Road, TP contributions are from a variety of nonpoint sources (e.g., soil erosion, agricultural activities, septic tank contributions). Except for septic tanks, these contributions are primarily flow-dependent and tend to occur during high runoff events. Below Batiste Road, P loading is principally from ground water originating from a shallow water aquifer system that is impacted by FMC and Simplot phosphate ore processing facilities (Baldwin et al. 2004). In the river segment between Batiste and Siphon roads, ground water from this shallow aquifer system contributes an estimated 225 cfs. The second source of P in the reach between Batiste and Siphon Roads is the City of Pocatello's wastewater treatment plant (WWTP), which discharges approximately 6.8 million gallons per day (mgd) (10.5 cfs) and a TP load that is two orders of magnitude smaller than what is estimated to come from ground water. Neither ground water inputs nor the City of Pocatello's WWTP discharge appear to be flow-dependent; therefore, P loading to the lower river is relatively constant throughout the year.

Because of the statistically significant relationship between TSS and TP ($R^2 = 0.927$, $P < 0.001$, $N = 193$) described for the Portneuf River above and including Batiste Road, the revised TSS targets (as proposed in this Portneuf River TMDL revision: 35 mg/L during low flow and 80 mg/L during high flow) were used to guide the selection of TP targets in the mainstem Portneuf River above Siphon Road (and in Marsh Creek.). The

model used to determine TP targets that correspond with the proposed TSS targets is as follows:

[TP] = 0.0316 + (0.00117 * [TSS]), where TP and TSS are expressed in mg/L.

Equation 5

This linear empirical model was developed using nearly 200 measurements of TSS and TP from five monitoring locations over a period of three years. The range of concentrations used to develop this equation was 4.1 to 341 mg/ TSS and 0.005 to 0.42 mg/L TP. Using this equation, a low-flow TP target concentration of 0.0725 mg/ corresponds to a low-flow TSS target concentration of 35 mg/L. Similarly, a high-flow TP target of 0.125 mg/L corresponds to a high-flow TSS target of 80 mg/L. For the proposed low-flow TP target, a margin of safety (MOS) of ± 2.5 µg/L (0.0025 mg/L) was then included, resulting in a revised TP target of 0.07 mg/L, which represents a reduction from the 2001 TMDL target (0.075 mg/L). The explicit MOS described was applied to the low-flow target only. The high-flow target incorporated an MOS by using conservative estimates of discharge (10th percentile flows from the long-term record). The dual target scenario for TP recognizes that loading during periods of peak macrophyte, algal, and bacterial production represents a window when reductions are most critical to combat the impacts of eutrophication (Bowes et al. 2008).

To indirectly assess the seasonal manifestations of elevated TP through increased primary production and examine whether the proposed revisions (establishing a dual TP target, and establishing the low-flow target at 0.07 mg/L) were sufficient to support beneficial uses, DEQ examined DO concentrations from the Portneuf River at Batiste Road (median TP concentration for 2004 to 2006 of 0.075 mg/L). Specifically, DEQ examined whether the proposed revision from 0.075 to 0.07 mg/L TP for the Portneuf River TP target was warranted. Additionally, DEQ documented the portion of the calendar year when DO concentrations indicated that primary production would most likely be influenced by additional TP loading.

From continuous records of DO in the lower river sites, concentrations of DO were generally lowest from mid-June to mid-September, a three month period that falls almost entirely within the designated eight month low-flow window (July through February) for the lower Portneuf River. At Batiste Road, the DO record for 2004 was incomplete for analysis purposes; however, instances of failure to meet the DO cold water aquatic life criteria (6.0 mg/L) were detected in 2005 and 2006. Such failures were common at the downstream-most site, Siphon Road, which is a very productive reach with high concentrations of dissolved phosphorus and nitrogen.

During the June 15 to September 15 three month period, the average daily minimum DO concentration in the Portneuf River at Batiste Road was 6.4 and 6.5 mg/L for 2005 and 2006, respectively. As a comparison, at the nutrient-rich Siphon Road site, the average minimum daily DO concentration for the same three month period was 5.5 and 5.8 mg/L for 2005 and 2006, respectively. During this critical biological window, DO at Batiste Road failed to meet the aquatic life criteria on 29% and 30% of the days in 2005 and 2006, respectively. During this same period, DO at Siphon Road failed to meet the criteria on 85% of the days in 2005 and 76% of the days in 2006. From this analysis, it is

apparent that DO can fail to meet the cold water aquatic life criteria in a Portneuf River reach even when the median TP concentration is 0.075 mg/L, and regularly fails when median TP concentrations are 1.15 mg/L. What is not clear from this analysis is whether DO concentrations are related to TP concentrations alone, or whether elevated temperatures, low water levels, oxygen-demanding materials, ground water infusion, flow regulation (e.g., seasonal flow modification and impoundment from Bureau of Indian Affairs activities below Siphon Road), or some combination of factors, most strongly influences DO. Regardless, the Portneuf River Watershed Advisory Group (WAG) proposed, as part of this TMDL revision, a reduced TP target of 0.07 mg/L for all low-flow periods, when elevated temperatures and low water levels are present and effects of eutrophication are most pronounced.

Phosphorus and Chlorophyll a in Reservoirs

The level of phosphorus in reservoirs is often managed to control phytoplankton growth, because nuisance phytoplankton growth can have profound impacts on water quality. Chlorophyll *a* is a recognized and convenient surrogate to estimate the amount of standing stocks of phytoplankton; phytoplankton blooms are often the primary cause of impairment in eutrophic lakes (Paerl 1988). Using an empirical relationship developed for 19 lakes in southern Ontario, Dillon and Rigler (1974) produced the following equation representing the relationship between chlorophyll *a* and TP concentrations:

$$\log [\text{chl } a] = 1.583 * \log [P] - 1.134, \text{ where chl } a \text{ and P are in } \mu g/L \quad \textbf{Equation 6}$$

The EPA Ambient Water Quality Criteria found that reference chlorophyll *a* conditions (based on the 25th percentile of chlorophyll *a* concentrations in evaluated water bodies) ranged from 0 to 0.0246 mg/L (EPA 2001). For the American Falls Reservoir, the chlorophyll *a* target was set at 0.015 mg/L (DEQ SBT USEPA 2006) because 0.015 mg/L is intermediate in the range of concentrations described as part of the 25th percentile in ambient monitoring conducted by the EPA and is also consistent with Oregon Department of Environmental Quality's target recommendation for reservoirs (ODEQ Water Pollution Division 41 Water Quality Standards: Beneficial Uses, Policies, and Criteria for Oregon: Nuisance Phytoplankton Growth 340-041-0019 dated 15 December 2008). Using a target chlorophyll *a* concentration of 0.015 mg/L and the empirical relationship shown above, the resulting TP concentration necessary to manage summer nuisance phytoplankton blooms in Hawkins Reservoir is 0.03 mg/L.

The EPA (1986) "Gold Book" recommended that TP concentrations in streams discharging into lakes or reservoirs should be managed to stay below a threshold of 0.05 mg/L TP. In EPA's Ambient Water Quality Criteria summary, TP in reference stream sites (based on the 25th percentile) ranged from 0.010 to 0.055 mg/L (USEPA 2000). The TP concentration (0.03 mg/L) derived using Dillon and Rigler's (1974) equation is intermediate within the range for EPA's Ambient Water Quality Criteria reference sites and is proposed here for Hawkins Reservoir during the low -low period for the upper Portneuf River subbasin: July through March.

Nitrogen

The 2001 TMDL had a nitrogen (N) target for the Portneuf River subbasin of 0.3 mg/L as total inorganic nitrogen (TIN). As part of this TMDL revision, DEQ proposes several revisions to the nitrogen target. The first revision establishes a target for total nitrogen (TN) rather than TIN. TN includes inorganic forms of nitrogen (nitrate, nitrite, and ammonia), along with dissolved and particulate organic N. While inorganic forms of N are readily available for biological uptake, dissolved or particulate organic forms of N may also eventually become part of the biologically available fraction, through nitrogen remineralization

(Dodds 2002). Organic N has been shown to be biologically available as it moves along biogeochemical pathways (Galloway et al. 2003) and represents a significant source of the TN load at certain times of the year (e.g., during leaf senescence). This is particularly true for all of the segments of the Portneuf River that are monitored as part of the continuous monitoring network (www.portneufriver.org). Pulses of organic N associated with the annual input of leaf litter occurring from September through November are natural sources of organic N and are a necessary part of the metabolic demands of aquatic organisms. Because organic N pulses are natural parts of river ecosystems that are expected to seasonally elevate TN concentrations in the river, DEQ proposes to use the median annual TN value to assess stream conditions relative to the TN target.

The second revision establishes a new numerical target for N (expressed as TN). The previous target was based on work in Wisconsin (Sawyer 1947), in which TIN concentrations below 0.3 mg/L prevented the growth of nuisance aquatic plants in lakes.

DEQ's approach for establishing the new target generally employs the concept of nutrient limitation described as the Redfield ratio (Redfield 1958). This ratio of nitrogen to phosphorus (N:P) is used to identify nutrient limitation within aquatic ecosystems. Using empirical evidence, Redfield and others have shown that aquatic plant growth nutrient demands are met at a molecular N:P ratio of 16:1 (7.2:1 mass ratio). Based on this threshold, ratios above 16 indicate P limitation, while those below 16 suggest N limitation (Dodds 2002). In practice, it is believed that dramatic shifts in resource limitation do not occur at 16:1, but that ratios ranging from 10:1 to 20:1 suggest co-limitation by both N and P (Allan 1995). Still, following the widely accepted 16:1 ratio proposed by Redfield (1958) and the TP targets proposed here (0.07 TP during low flow and 0.125 mg/L TP during high flow), DEQ arrived at a range for the TN target from 0.5 to 0.9 mg/L (calculated as: 0.07 and 0.125 mg/L TP x 7.2 [Redfield multiplier] = 0.5 and 0.9 mg/L TN).

Recent laboratory bioassays using waters from Upper Snake River subbasins, and the free-floating macrophyte *Lemna minor* and its associated epiphytic community, revealed that macrophyte and epiphyte biomass varied little in waters with TN concentrations between 0.43 and 1.27 mg/L (Mebane *unpublished*).

Therefore, a target of 1.0 mg/L TN was adopted as a compromise between 0.9 mg/L (upper end of the range calculated from the Redfield equation) and 1.27 mg/L (upper end of the no-difference range from relevant experimental research with *Lemna minor*)."

Finally, the revised TN target of 1.0 mg/L is proposed for all tributaries, but not the mainstem Portneuf River. Mainstem reaches of the Portneuf River are strongly influenced by ground water (see Baldwin et al. 2004 and Barton 2004). While the proposed target is only 1.0 mg/L *total* N, concentrations of $NO_2 + NO_3$ in ground water throughout the Portneuf River subbasin often exceed 2.0 mg/L (see Baldwin et al. 2004, Meehan 2005). This has resulted in ground water aquifers within this region being included in the State of Idaho's 25 Nitrate Priority Areas; specifically, the Fort Hall, Pocatello, and Soda Springs/Bear River aquifers ranked 7, 17, and 18, respectively (http://www.deq.idaho.gov/water/data_reports/ground_water/nitrate/final_nitrate_priority_area_ranking.pdf). Specific reaches of the Portneuf River gain considerable flow from N-enriched ground water, including the lower river reach from Interstate 86 to Siphon Road (Siphon Road is the downstream compliance point for this TMDL) which gains an average of 225 cfs.

In contrast to mainstem reaches, tributaries to the Portneuf River are less influenced by N-enriched ground water and therefore are more directly tied to land use activities and other major forms of nonpoint source pollution. In addition, many tributaries have TN concentrations that are well above those measured in the Portneuf River. Examples of tributaries in which the proposed 1.0 mg/L TN target is exceeded include Arkansas Creek (7.04 mg/L TN), North Fork Pocatello Creek (2.94 mg/L TN), and Hawkins Creek (2.03 mg/L TN). These examples illustrate that tributary N loading is common and may represent a significant load to the Portneuf River. Accordingly, efforts to reduce N in tributaries are expected to have measurable and direct impacts to N loads in the mainstem Portneuf River.

Based on the arguments provided above, the proposed target for TN is 1.0 mg/L, for Portneuf River tributaries only. DEQ recognizes that surface water at the Siphon Road compliance point for the lower Portneuf River has median $NO_2 + NO_3$ and TN concentrations of 2.37 mg/L and 3.10 mg/L, respectively (median concentrations from January 2004 to December 2006). These concentrations of N exceed target concentrations that may be necessary to support beneficial uses and are more than twice the levels seen elsewhere in the river's mainstem. However, a long-standing paradigm has been to control one of the major limiting nutrients (N *or* P) rather than both. Consistent with this approach, nutrient control in the mainstem river (affected by ground water N inputs) will focus on P reduction to control nuisance aquatic plant growth. If, in the future, this approach fails to restore beneficial uses to the mainstem, reductions in N may be warranted. For this reason, DEQ and its monitoring partners are committed to monitoring $NO_2 + NO_3$ and TN concentrations, along with monitoring for other narrative (e.g., phosphorus) and numeric (e.g., dissolved oxygen) criteria, to better understand the relationship between nutrients and DO, and to measure improvements in water quality associated with TMDL implementation efforts in the watershed. Based on the uncertainty involving N, DEQ recommends that N levels do not increase. Any activities with the potential to increase N above existing levels in the subbasin should be carefully reviewed. DEQ will continue to regulate N (particularly in ground water) through the Ground Water Quality Rule and other State of Idaho regulatory processes.

Oil and Grease

Oil and grease is a term used to describe a pollutant family comprised of organic compounds including "nonvolatile hydrocarbons, vegetable oils, animal fats, waxes, soaps, greases, and related matter" (NCDWQ 2006). Free oil and grease is often visible as a rainbow colored film on the surface of standing or running water, but some organic compounds may also exist within the water column. Visible sheens on surface water associated with a release of petroleum are reported and corrective actions follow Idaho Code (IDAPA 58.01.02.851.04a and .04b). Even at low concentrations, such as those associated with nonpoint source inputs, oil and grease may be toxic to aquatic life, may reduce dissolved oxygen, and may alter the usability and aesthetics of a water body (Khan et al. 2006).

Although Idaho does not have a statewide standard for oil and grease, several western states do have oil and grease standards (Montana, Wyoming, Utah), and the 2001 Portneuf River TMDL established an oil and grease target of 5 mg/L. Oregon and Washington lack a statewide standard for oil and grease, but commonly list it as a pollutant in NPDES permits. Limited, but recent, monitoring indicates that oil and grease is present in the lower Portneuf River and that concentrations may increase in the mainstem as water passes through the greater Pocatello Urbanized Area (PUA). Further, the introduction of oil and grease through storm drains has been documented during or immediately following storm events. Combined, this information indicates that the segment of the Portneuf River bounded by the Edson Fichter Nature Area and Batiste Road monitoring stations may exceed the oil and grease target established in the TMDL during both runoff and non-runoff periods.

For this reason, oil and grease will remain in the Portneuf River subbasin TMDL and DEQ recommends regular and event monitoring of oil and grease to better describe background concentrations and characterize the temporal and spatial loading patterns in the lower Portneuf River. Moreover, the DEQ recommends that work be initiated to identify the relationship between oil and grease and beneficial use support.

Dissolved Oxygen

The State of Idaho has numeric criteria for DO that is based on the aquatic life use designation for a water body. Since the Portneuf River subbasin which includes Hawkins Reservoir is designated for cold water aquatic life, the DO criterion is greater than 6.0 mg/L. However, the numeric DO criterion differs between flowing waters and lakes/reservoirs. In flowing waters, the DO concentrations must be greater than 6.0 mg/L at all times. For lakes and reservoirs less than or equal to 35 meters (m) in depth, the bottom 20% of the depth is exempt from the standard (WQS § 251.02.a.i). The latter criterion applies to Hawkins Reservoir, which is on the 2008 §303(d)-list for the Portneuf River subbasin.

Monitoring Points

Seven permanent monitoring locations have been established throughout the subbasin as part of a locally-led watershed partnership (Portneuf Watershed Partnership; Table 5.2 and Figure A). The network of monitoring locations extends from the most upstream hydrologic diversion at the Portneuf Marsh Valley Canal to Siphon Road downstream of

the cities of Pocatello and Chubbuck, Idaho. Data from this network, combined with data from four U.S. Geological Survey gaging stations—three on the mainstem (USGS Gage Number 13073000 for the Portneuf River at Topaz, Idaho; USGS Gage Number 13075500 Portneuf River at Pocatello, Idaho; and USGS Gage Number 13075910 Portneuf River near Tyhee, Idaho) and one on Marsh Creek (USGS Gage Number 13075000 Marsh Creek near McCammon, Idaho) assist in characterizing water quality conditions and provide a basis for load calculations at critical locations throughout the subbasin. Of these seven stations, data from six are used here to summarize pollutant loads for the mainstem Portneuf River and Marsh Creek and are described in greater detail below.

The upstream-most monitoring station (Topaz) documents water quality conditions at the point of major hydrologic diversion through the Portneuf Marsh Valley Canal. Watermaster records indicate the diversions began on April 17, April 23, and May 3 in 2004, 2005, and 2006, respectively. Major diversions ceased on September 15 in 2004, and September 30 in the years 2005 and 2006. This significant hydrologic modification may preclude beneficial use attainment downstream in the Portneuf River. Although hydrologic diversion may influence water quality conditions, the EPA does not recognize flow (or lack of flow) as a pollutant defined by CWA Section 502(6).

The second monitoring location is in the mainstem river just above Marsh Creek and this location serves as the downstream compliance point for AU ID17040208SK016_03 (Portneuf River Chesterfield Reservoir to Marsh Creek). A lower Marsh Creek monitoring station located below Walker Creek is the compliance point for AU ID17040208SK006_04 (lower Marsh Creek). The monitoring location upstream of most of the City of Pocatello's municipal footprint (Edson Fichter Nature Area or Edson Fichter Park [EFNA]), when paired with the Batiste Road monitoring location positioned downstream of the City of Pocatello, enables estimation of storm water loads associated with the Pocatello Urbanized Area (Brock and Ray 2004; PUA's MS4 Permit No. IDS-028053; Item 5a). Similarly, the Batiste and Siphon roads monitoring locations bracket contributions from nutrient-rich ground water in the lower Portneuf River (Perry and Clark 1990, Baldwin et al. 2004) as well as the City of Pocatello's wastewater treatment facility (Brock and Ray 2004). The Siphon Road monitoring location serves as the compliance point for AU ID17040208SK001_05 (Portneuf River from Marsh Creek to the Fort Hall Reservation Boundary). Locations for each of the monitoring sites are described in Table 5.2 and shown in Figure A.

At each monitoring location, continuous monitoring equipment (currently, the equipment consists of data sondes manufactured by YSI, Inc.) captures daily, seasonal, and annual changes in the following water quality parameters: temperature, dissolved oxygen, pH, specific conductance, and optical turbidity. In addition, monthly sampling activities compliment continuous measurements in characterization of the concentrations and loads of pollutants in the Portneuf River and its largest tributary (Marsh Creek). Regular (monthly) water samples are collected from monitoring locations during ice-free periods. Chemical, physical, and biological characteristics of the samples are determined by laboratory analysis (Table 5.3; Brock and Ray 2004). Summaries of data from monthly samples taken during 2004 to 2006 are used here to develop the load estimates that follow.

Table 5.2. Description of monitoring locations and USGS gaging stations within the Portneuf River Subbasin.

A. Monitoring Station Locations

Station Name	Location	River Mile	Latitude North	Longitude West
Portneuf River at Topaz	Portneuf Marsh Valley Canal Diversion	48.9	42.624394013	-112.117096506
Lower Marsh Ck	below Walker Ck		42.782005269	-112.237091747
Portneuf River above Marsh Ck	below I-15 Bridge	33.5	42.782320331	-112.230441791
Portneuf River at Edson Fichter	Edson Fichter Nature Area	22.5	42.822078058	-112.403604500
Portneuf River at HWY 30 – Trail	Bridge	13.5	42.906959574	-112.511025319
Portneuf River at Batiste Rd.	Bridge	13.4	42.913303741	-112.519835010
Portneuf River at Siphon Rd.	Bridge	11.0	42.935166076	-112.544059610
Pocatello Wastewater Treatment Facility	Outfall	12.9	42.919574248	-112.521173484

B.1. USGS Discharge Gaging Station Locations

Station Name	Location	River Mile	Latitude North	Longitude West
Marsh Creek near McCammon, Idaho			42.63	-112.22
Portneuf River at Topaz, Idaho	upstream of Portneuf Marsh Valley Canal Diversion	55.5	42.624394013	-112.117096506
Portneuf River at Pocatello, Idaho	Carson St.	16.8	42.871676476	-112.466944669
Portneuf River near Tyhee, Idaho	downstream Siphon Road	9.8	42.944722222	-112.544166667

B.2. USGS Discharge Gaging Station Data

	Peak discharge Ranking			Average Discharge Ranking		
Station Name	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**
Marsh Creek	49th	43rd	13th	49th	39th	19th
Portneuf River at Topaz, Idaho	89th	71st	14th	87th	74th	22nd
Portneuf River at Pocatello, Idaho	85th	59th	12th	90th	70th	18th
Portneuf River at Tyhee, Idaho	12th	6th	2nd	13th	8th	2nd

Table 5.3. List of constituents analyzed as part of routine sampling at Portneuf River permanent monitoring locations. (Brock and Ray 2006)

Analysis	Method*	Detection Limit (mg/L, except where noted)	Sample Volume (ounces) & Preservative (if needed)	Sample Holding Time (days)	Laboratory**
Total Alkalinity bicarbonate, carbonate	A2320 B	2	32[a]	14	ELI
Chloride	E300.0	1	32[a]	28	ELI
Nitrogen, ammonia	E350.1	0.05	32[b]; H_2SO_4	28	ELI
Nitrogen, nitrate + nitrite	E353.2	0.05	32[b]; H_2SO_4	28	ELI
Nitrogen, total Kjeldahl	E351.2	0.05	32[b]; H_2SO_4	28	ELI
Phosphorus, orthophosphorus	E365.1	0.004	8[f]; Filter immediately	2	ELI
Phosphorus, total	E365.1	0.004	32[b]; H_2SO_4	28	ELI
Sulfate	E300.0	1	32[a]	28	ELI
Solids, total dissolved	A2540 C	10	32[c]	7	Pocatello WWTP
Solids, total suspended	SM2540D	2.5	32[c]	7	Pocatello WWTP
Suspended sediment concentration	SM2540D	2.5	Volume varies based on turbidity		Pocatello WWTP
Turbidity	A2130; E180.1	0.01 NTU	32[d]	2	Pocatello WWTP
Fecal coliform	A9222 D	cfu	8[e]	0.25	Pocatello WWTP

* A = Standard Methods; E = EPA;
** ELI =Energy Laboratories, Inc. Billings, Montana; Pocatello WWTP = Wastewater Treatment Plant Lab;
Like letters (a through f) associated with sample volumes indicate that analyses are taken from the same sample container. All sample containers are cooled to 4 °C. Additional preservative is used where indicated (i.e., H_2SO_4 to pH<2). Preservation and holding times are taken from 40 CFR Ch. 1 Section 136.3. Volume adjusted for suspended sediment sample to allow filtration of entire sample.

Design Conditions

Critical Conditions

The EPA requires that TMDLs account for critical conditions. Critical conditions are defined as periods when loading has the greatest probability to adversely impact aquatic life (EPA 2008, Zhang and Yu 2008). The rationale is that if a TMDL is protective under critical conditions, it will be more than protective under other conditions. Generally, critical conditions coincide with periods of reduced stream flow when buffering of thermal energy is minimized and effects of biological impairment (e.g., reduced DO due to nuisance aquatic macrophyte or algae production) are most pronounced. Therefore, a principle goal of load analysis is to use a representative hydrologic condition that has a high probability of capturing critical conditions (Zhang and Yu 2008). In the Portneuf River and other nutrient-impaired rivers, nutrient-related impairment is most pronounced during low-flow conditions. For this reason, low flows with a 10-year recurrence interval (10th percentile flows) are used along with a 30-day averaging period (e.g., 30Q10) to develop TMDL target loads. One-month or 30-day averaging periods are commonly accepted averaging periods used in the development of TMDLs and water pollution plans (i.e., 30Q10; Pyrce 2004). This monthly or 30-day averaging period also compliments the frequency of water quality sample collection in the Portneuf River and the monthly dataset now spans more than a decade.

Thirty-day or monthly stratification is also used in the Portneuf River TMDL to define high and low flow periods; the months of March, April, May, and June are defined as high flow months. The high-flow and low-flow periods were originally defined in the 2001 TMDL to bracket runoff periods because runoff loading represents a disproportionate amount of nonpoint source loading (DEQ 2001a). Inouye et al. (*in review*) have estimated loading during runoff and non-runoff periods using optical turbidity as a surrogate for TSS. Using the Portneuf River at Edson Fichter Nature Area as an example, the average daily sediment load during runoff periods in 2004 to 2006 was, on average, eight times as large as during non-runoff periods, and two times as large as the annual average daily load estimates. This information was considered by the Portneuf River Watershed Advisory Group when they approved high-flow and low-flow periods for load analysis used here. Recent annual hydrographs from select monitoring locations are shown in Figure 5.1. Although runoff patterns are likely to vary by elevation, hydrographs from six monitoring locations in the mainstem Portneuf River show that high-flow conditions generally occur from March 1 to June 30 (day of year 60 to 181).

Similarly, the period from mid-June to mid-September is recognized as a critical biological period, defined as the period when the combination of low flow due to irrigation withdrawals and high temperatures strongly influence in-stream conditions and cold water aquatic life. From continuous records, the critical DO period in the Portneuf River subbasin was defined as June 15 to September 15 (days 166 to 258). This period also coincides with lower discharge conditions (Fig. 5.2), higher water temperatures, and maximum aquatic macrophyte and algae production. Figure 5.2 shows the critical biological window for the Portneuf River at Batiste Road in 2005, a year when average daily discharge at the USGS Pocatello gage ranked 70th over a 93-year record. From Figure 5.2, it is apparent that stream temperatures reach maximal conditions concomitant with decreases in DO and discharge. Although temperature, DO, biological productivity, and discharge conditions likely vary throughout the subbasin, this critical biological window should be considered along with periods of nutrient loading because nutrient-related impairment is likely to be most pronounced during this critical period. The ecological integrity of flowing waters is most sensitive to nutrient loads during low-flow periods (Mainstone and Parr 2002). Accordingly, eutrophication control in nutrient-impaired rivers should attempt to limit nutrient loading during peak plant and algal production when effects on DO will be most detrimental to aquatic life (Bowes et al. 2008).

While these critical periods or windows defined above generally include multiple months, the application of the 30Q10 principle for development of the pollutant loads that follow is useful in illustrating when and where gross exceedances of pollutant targets are occurring. For this reason monthly flow summaries are used throughout this document to quantify pollutant loads and pollutant targets. A daily analysis of loading is also presented in Section 2 and provides more refined estimates of daily TSS and TP loads along with daily target loads using the actual average daily discharge values and turbidity measurements.

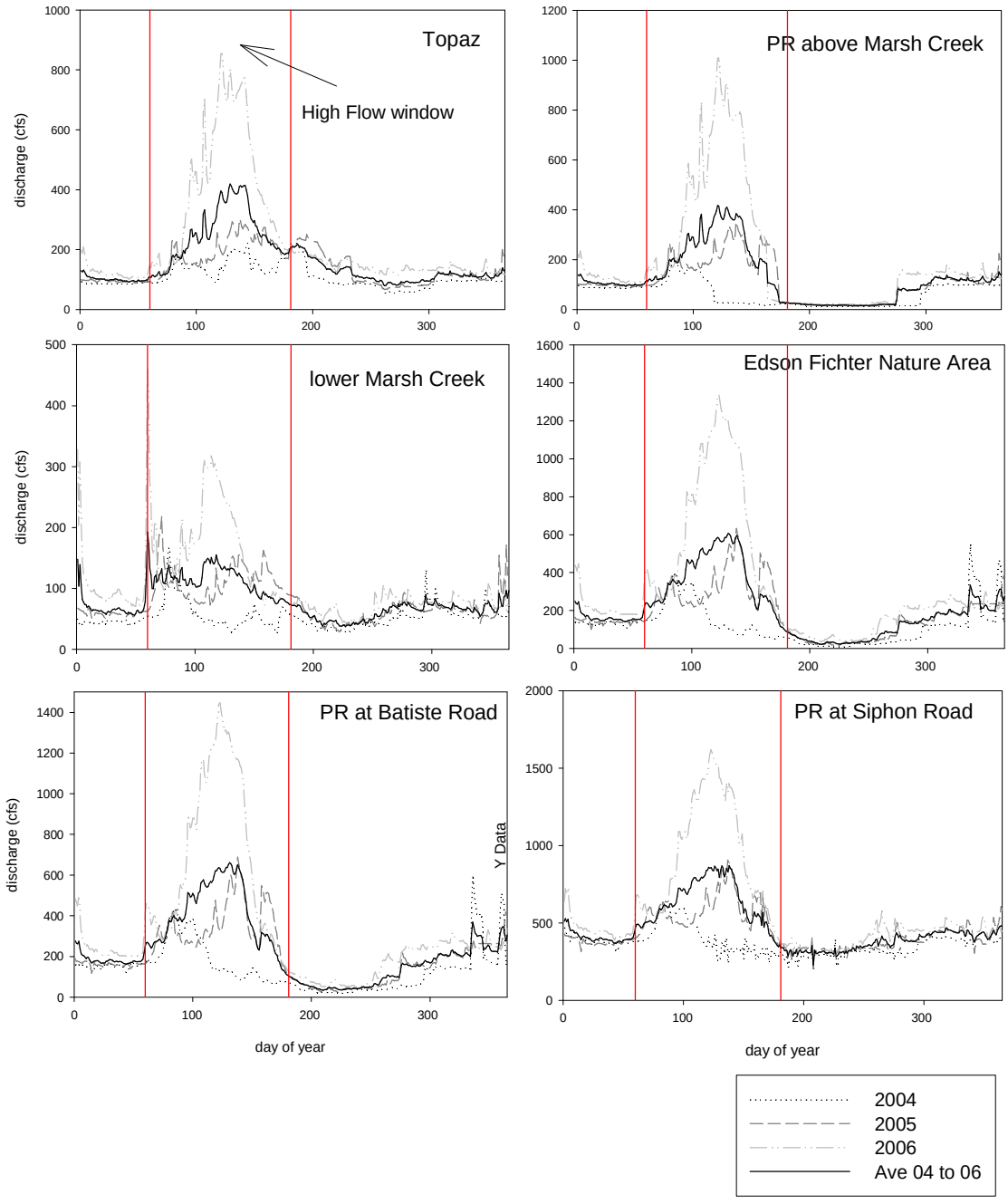


Figure 5.1. Annual average daily flow and 3-year average hydrographs (calendar years 2004 to 2006) for the Portneuf River monitoring locations. The red lines bracket the WAG-endorsed high flow periods for each location. See Table 5.2 for monitoring location descriptions. Discharge at Siphon was determined using data from the Tyhee gage combined with data from the Bureau of Indian Affairs diversion just downstream of Siphon Road.

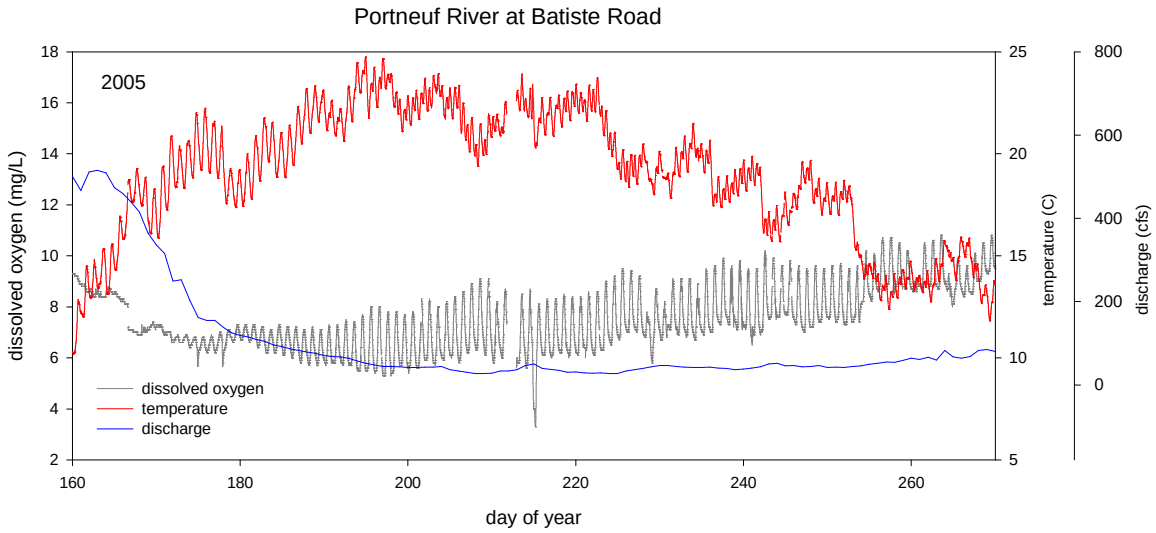


Figure 5.2. Dissolved oxygen, temperature, and discharge in the Portneuf River at Batiste Road from mid June to mid September 2005.

5.2 Estimates of Existing Pollutant Loads and Target Loads

The following sections provide the estimates of existing loads and the target loads used in this proposed TMDL revision; first for the mainstem Portneuf River, then for tributaries.

5.2a Mainstem Portneuf River

This section describes the pollutant loads from the point and nonpoint sources from monitoring locations described in the mainstem Portneuf River. The mainstem Portneuf River is listed for sediment in the segment above Chesterfield Reservoir, a segment that exists wholly within the Fort Hall Reservation, and for unknown causes in the segment below Marsh Creek. While listed as unknown, sediment and nutrients are suspected to contribute to the impairment listing for the segment below Marsh Creek. Wasteload estimates were calculated for TSS and TP for currently and historically permitted point sources. These point sources include the City of Lava Hot Springs, City of Inkom, City of Pocatello, combined permitees in the MS4 Storm Water Permit (City of Pocatello, City of Chubbuck, Bannock County, and Idaho Transportation Department - District #5), Batise Springs Trout Farm, and Papoose Springs Hatchery. Estimates of loads from these sources were calculated using their respective discharge monitoring reports, field measurements, or design capacity (e.g., discharge) estimates described in each facility's NPDES permit or permit application (Table 5.4).

The following facilities are listed as having NPDES permits in the 2001 TMDL but do not currently have permits: FMC Corporation (ID-000022-1), Idaho Lava Foundation (ID-002717-1), Meadow Gold Dairies (ID-002716-2), and Riverside Inn (ID-002519-4). FMC's NPDES permit (ID-000022-1) was officially terminated via a letter to the EPA dated October 8, 2002. Meadow Gold Dairies (permit ID-002716-2) no longer discharges

to the Portneuf River. Riverside Inn (ID-002519-4) and Idaho Lava Foundation (ID-002717-1) have applications for NPDES permits (to discharge waters used for geothermal heating) dating from April 19, 1979, and March 8, 1991, respectively. DEQ has no specific discharge data for these facilities; however, these geothermal discharges are naturally occurring and are allocated their existing load, whatever it may be.

Table 5.4. Current wasteloads from point sources in the Portneuf River subbasin.

Facility/Source	NPDES Permit #	Wasteload (lbs/day)	Wasteload Allocation (lbs/day)
City of Lava Hot Springs wastewater treatment plant (WWTP)	ID-002182-2	TP =1.2[a] TSS =1.0[b]	TP =1.2[a] TSS =86.0[b]
City of Inkom	ID-002024-9	TP = 1.5[c] TSS =12.8 [c]	TP =0.71[c] TSS =26.0 [c]
City of Pocatello	ID-002178-4	TP = 32.3[d] TSS = 204.1[d]	TP = 25.1[d] TSS =3,000 [d]
City of Pocatello, City of Chubbuck, Bannock County, and Idaho Transportation Department - District #5 – MS4 Permit	IDS-028053	TP = 9.0[e] TSS = 6,275.6[e]	TP =Batiste – EFNA discharge x TP targets[e] TSS = Batiste – EFNA discharge x TSS targets[e]
Batise Springs Trout Farm	IDG-130000	TP = 8.4[f] TSS = 168.0[f]	TP = 13.0 [f] TSS = 838.2[f]
Papoose Springs Hatchery*	ID-0072-8 (expired)	**Intermittent discharge** TP = 0.9[g] TSS = 304.5[g]	TP = 0.9[g] TSS = 304.5[g]

[a]City of Lava Hot Springs' WWTP wasteloads were calculated from discharge and water quality sampling conducted in 2002 and 2003 and reflect a total of approximately 21 days of TP loading in 2007 at a rate of 10.4 lbs/day from October to May; the total load estimate is 218 lbs of TP. To correct for average daily load under a 180-day discharge scenario that occurs from October to March, the following was used: 218 lbs TP (total wasteload) ÷ 180 day compliance period = 1.21 lbs/day. This same value was used as the target load during the months October to March.

[b]Consistent with TP calculations for the City of Lava Hot Spring, an estimated TSS loading rate of 8.2 lbs/day for 21days results in a loading of 1.0 lbs/day TSS over a 180 day loading scenario.

[c]City of Inkom TP and TSS loads were estimated from 2007 averages from the discharge monitoring reports.

[d]City of Pocatello loads are based on discharge summaries for calendar years 2004 through 2006 used throughout this TMDL (average 6.8 mgd). However, DEQ recognizes that outlet TSS and TP concentrations have decreased in recent years and therefore current (2007) TSS and TP summaries were used to estimate TSS and TP loads as follows: average 2004 to 2006 discharge x median 2007 (TSS or TP) concentration.

[e]MS4 Permittees' storm water wasteload estimates represent the median daily TSS and TP loads translated from daily turbidity monitoring data collected during calendar years 2004 through 2006 and from monitoring stations above and below the Pocatello Urbanized Area (PUA; total of 647 daily estimates). Storm water loads were developed by calculating the difference in loads between the upstream (EFNA) and downstream (Batiste Rd) monitoring sites. The ranges in storm water TSS and TP loads recorded from 2004 through 2006 were -106.1 to 263.9 tons TSS/day and -280.0 to 618.9 lbs TP/day. Negative values indicate that the average daily load was greater at EFNA than Batiste and suggest that there was deposition or storage of sediment in the reach that spans the PUA. Storm water target loads/load allocations will be estimated using the difference in discharge between Batiste and EFNA monitoring stations and the approved TSS and TP targets.

[f]Batise Springs Trout Farm loads are based on sampling results from 1998 to 2003 measurements of discharge, and TSS and TP concentrations and the 2007 Annual Report of Operations for the facility.

*[g]The Papoose Springs Hatchery operates intermittently and is not listed on the General Permit for Aquaculture facilities of Idaho (Permit No. IDG-130000). Since future operations of this facility are anticipated, a wasteload is presented and loads are based on sampling results from 2003 and 2004, measurements of discharge, and TSS and TP concentrations.

Estimated loads from both point and nonpoint sources are provided in tabular form in the tables that follow. As applicable, each table presents loads from point sources of pollutants above each monitoring location and pollutant loads contributed by nonpoint sources. For the mainstem Portneuf River, estimated pollutant loads were calculated on a monthly basis using monthly water quality measurements from field sampling activities and the average discharge for each month. For example, the measured TP concentration in the Portneuf River at Topaz on June 21, 2005, at 0830 hrs was 0.064 mg/L; this concentration was multiplied by the average discharge for June 2005 (217.2 cfs), yielding a monthly TP load estimate of 75.1 lbs TP/day after converting to common units. This approach, using a 30-day averaging period for discharge combined with measured pollutant concentrations, yielded monthly estimates of daily pollutant loads over a 3-year period for several mainstem monitoring locations. In some cases, multiple measurements were available for each month (or year) and the mean (i.e., average) concentration was used. In other cases, the mean value was not a good representative of the dataset and median values were used. Estimated loads were then compared to target loads. Target loads were calculated using pollutant concentration targets endorsed by the Portneuf River WAG (including low-flow and high-flow targets where applicable) and low-flow discharges with a 10-year recurrence interval (10th percentile flows). In-stream flow targets often rely on low-flow indices to assist in protecting aquatic resources because low-flow conditions offer reduced assimilative capacity in rivers and streams (Pyrce 2004). Combining the 30-day average discharge with a 10-year low-flow exceedance percentile is referred to as a 30Q10 low-flow index. The 30Q10 index was used to estimate target loads in the Portneuf River and lower Marsh Creek.

To capture the observed hydrologic and loading variability among years, the annual and 3-year average monthly pollutant load estimates for calendar years 2004, 2005, and 2006 were included. The 3-year average monthly load estimates were then compared with the estimated target loads described above to determine where and during which months pollutant reductions were necessary. Estimated and target loads are expressed as daily loads for each month at the following monitoring locations: Portneuf River at Topaz, above Marsh Creek, at Edson Fichter Nature Area, at Batiste Road, and at Siphon Road. Estimated load reductions required to meet target loads are also reported on a monthly basis and the reduction necessary to meet the WAG-endorsed targets is shown as a percentage of the load.

Data from calendar years 2004, 2005, and 2006 were used for the load summaries that follow. Discharge varied considerably over these calendar years and was lowest in 2004, reflecting five consecutive years of below-average precipitation in southeast Idaho (Fig. 5.1). Compared to the historical record at the USGS Pocatello gage, discharge for 2006 was above average; annual discharge summaries (peak or average) in 2005 were intermediate between discharge in 2004 and 2006. Long term hydrologic records from four USGS gaging stations provide a historical context for examining the effect of annual discharge variability on pollutant loads and the discharge record from the four USGS monitoring sites is summarized through calendar year 2006. Station records varied by gaging station (Table 5.2.) and were 98 years for peak discharge and 93 years for annual average discharge at the Pocatello gage, 13 years of peak discharge and 14 years of annual average discharge at Tyhee, 52 years of peak and average annual discharge in

Marsh Creek, and 89 years of peak and average annual discharge at Topaz. Table 5.2 summarizes the rank of the peak and average annual daily flow by site and year.

Sediment

Estimates of daily sediment (i.e., TSS) load vary considerably by location and season. TSS loads were greatest during runoff and lowest during baseflow conditions. Additionally, TSS loads generally increased downstream. This may result from cumulative habitat influences, land use impacts, or increasing pollutant sources as a function of downstream location in the watershed. While the entire drainage has anthropogenic influences, urbanization, water withdrawal, and road density are more prevalent in the lower watershed and cumulatively increase sediment delivery to the mainstem Portneuf River and its tributaries. On average, estimated TSS loads at monitoring locations closest to the mouth were considerably greater than at upstream locations.

Portneuf River at Topaz; Portneuf-Marsh Valley Canal Diversion

The segment of river represented by this monitoring location was on the 1996 and 1998 §303(d) list for sediments, not included on the 2002 list, but included on the 2008 list for temperature. This site also serves as the downstream compliance point for the City of Lava Hot Springs wastewater treatment plant (WWTP). A summary of the TSS loads and wasteloads for the Portneuf River at Topaz is provided in Table 5.5. Estimates from the Portneuf River above the Portneuf-Marsh Valley Diversion showed that, on average, TSS concentrations are below the targets established for the Portneuf River Subbasin. During all low-flow months, concentrations were below the 35 mg/L TSS target; however, average daily load estimates for the high-flow months of April and May indicate that loading in excess of targets does occur during runoff periods. TSS wasteloads from the City of Lava Hot Springs' WWTP contribute little to elevated loading during these months and TSS reductions from this facility are not required to meet their wasteload allocation (0.04 tons/day). Based on data shown in Table 5.5, it is apparent that the elevated loading associated with peak flows in 2006 contributed to higher multi-year average daily TSS load estimates for April and May. In 2006, peak discharge for the Topaz gage ranked 14th out of an 89-year record. In months when the TSS target is met, the measured concentrations of TSS serve as the actual target.

Portneuf River above Marsh Creek

The 2001 TMDL addressed the river segment represented by this monitoring station for sediment, which is reflected by this segment appearing in Section 4a (rivers with approved TMDLs) of the 2008 Integrated Report. This monitoring location also serves as the downstream compliance point for AU ID17040208SK016_03 (Portneuf River Chesterfield Reservoir to Marsh Creek). Consistent with TSS loads at the Topaz monitoring location, average daily TSS loads in this segment met 2001 TMDL target TSS loads during nine out of twelve months and were strongly influenced by above-average peak flows during runoff in 2006 (Table 5.6). In months when the TSS target is met, the measured concentrations of this pollutant serve as the actual TSS target.

Portneuf River at Edson Fichter Nature Area

This location is part of AU ID17040208SK001_05 (Portneuf River from Marsh Creek to the Fort Hall Reservation Boundary) and serves as the downstream compliance point for the City of Inkom's WWTP and the upstream monitoring site for the cities of Pocatello, and Chubbuck, Bannock County, and Idaho Transportation Department - District #5's MS4 Storm Water Permit (hereafter MS4 Storm Water Permit). On average, daily TSS loading at the Edson Fichter Nature Area (EFNA) was greatest in March, April, and May, which represent high-flow months at this site, confirming that the largest portion of the annual sediment load is delivered during these months (Table 5.7). Across all months, the average load reduction required at this monitoring location is 45%. The greatest TSS load reductions are needed in April (83%), May (88%), and June (93%). Wasteloads from the City of Inkom's WWTP contribute little to elevated loading recorded at EFNA and TSS reductions from this facility are currently meeting their wasteload allocation of 0.013 tons/day (Table 5.7).

Portneuf River at Batiste Road

The Batiste Road monitoring location occurs within AU ID17040208SK001_05 (Portneuf River from Marsh Creek to the Fort Hall Reservation Boundary) and it serves as the downstream compliance point for the MS4 Storm Water Permit and the upstream compliance point for the City of Pocatello's WWTP. Technically, the MS4 Permit incorporates a monitoring site located approximately one river mile upstream of Batiste Road (Highway 30 crossing) as the downstream compliance point for the MS4 Storm Water Permit; however, for purposes of analysis and discussion, data from the Batiste Road site was used. Similar to loads at the EFNA, TSS loading in the Portneuf River measured at Batiste Road is influenced by high flows associated with spring runoff. Accordingly, average daily TSS loads are greatest from March to May, but reductions are required during both high- and low-flow periods (Table 5.8). Across all months, the average daily TSS reduction required is 39%.

Daily storm water wasteloads for the Pocatello Urbanized Area (PUA; MS4 Storm Water Permit No. IDS-028053) were calculated from all available 30-minute discharge and turbidity estimates for calendar years 2004 to 2006 (total of 647 daily estimates), summarized by month, and expressed as daily TSS loads in tons/day. Load estimates represent the difference between load estimates above the PUA (EFNA monitoring station) and below the PUA (Batiste Road monitoring station). To generally summarize storm water loading at each monitoring station, estimated TSS loads (Figure 2.18) for each site are shown along with the precipitation record from the Pocatello northeast meteorological station for years 2004, 2005, and 2006, respectively. From these summaries, a pattern in annual loading is seen that generally tracks changes in the annual hydrograph and shows that there is greater loading during high flows (i.e., the separation between the lines is greatest during high flows; see Figure 2.18). There is also evidence that loading increases following rain events (see days 290 to 305 in 2004; Figure 2.18) and decreases during extended periods with limited or no precipitation (see days 140 to 150 in 2005).

Using the approach described for estimating storm water TSS loading, some negative storm water wasteload estimates were calculated during low-flow periods (see Figure

2.20). Negative load values indicate that the average daily load was greater above than below the PUA and suggests that, on average, there was deposition or storage of sediment for a given month within the river segment between EFNA and Batiste Road. Target load/wasteload allocations were established using the difference in discharge between the Batiste and EFNA monitoring stations and the high and low-flow TSS targets endorsed by the Portneuf River WAG. Storm water loading from the PUA was most pronounced during high flows and, on average, exceeded the target load/wasteload allocation during the months of February through May (Figure 2.22). Average daily TSS storm water loading was lowest in July, August, and September. TSS reductions necessary to meet in-stream targets and allocations are shown in Table 5.8.

Portneuf River at Siphon Road

The Siphon Road monitoring location serves as the compliance point for AU ID17040208SK001_05 (Portneuf River from Marsh Creek to the Fort Hall Reservation Boundary) and for the City of Pocatello's WWTP. Although this AU was included on the 2002 §303(d) list, the cause of impairment was listed as unknown (see Table 2.2). This assessment unit also appears in Section 4a of the 2008 Integrated Report, indicating the 2001 Portneuf River TMDL sediment applied to this segment. However, a revision to the loading analysis is presented here and incorporates the revised low-flow sediment target. Overwhelming evidence indicates that nutrient loading has led to impairment in this river segment; however, elevated sediments have also been measured at this location. Average daily TSS loading in the Portneuf River at Siphon Road was greatest in March, April, and May, and averaged 226.4 tons/day across all three years. The estimated TSS load reductions are required only in January, March, April, May, and June. In months when the TSS target is met, the measured concentrations of this pollutant serve as the actual TSS target. Wasteloads from the City of Pocatello's WWTP contribute little to loading in this river segment and represent less than 1% of the TSS load recorded at Siphon Road. As a result, TSS load reductions from this facility are meeting the wasteload allocation of 1.5 tons/day (Table 5.9).

Table 5.5. Estimated and target daily Total Suspended Solids (TSS) loads for the Portneuf River at Topaz (based on monthly averages and expressed in tons/day). Estimated loads represent the product of average monthly flow and TSS/SSC concentrations from monthly sampling activities or from predicted TSS concentrations using the average monthly discharge at the USGS Topaz gage.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004 Estimated TSS load	3.8	3.8	9.4	7.6	13.4	4.9	8.6	6.8	6.9	4.1	1.3	1.9
2004 Target load*	8.3	8.3	25.9	27.8	28.3	32.7	13.6	8.2	6.7	6.3	9.1	9.3
2005 Estimate TSS load	4.6	4.3	3.8	14	60.6	29.3	8.2	6.7	4.6	3	5.7	1.9
2005 Target load*	9	8.7	30.9	36.1	53.9	46.9	20.7	13.1	7.7	7.6	10.9	11
2006 Estimated TSS load	6.1	3.2	4.9	428	307	64.5	20.0	7.6	7.9	4.3	3.3	1.6
2006 Target load*	12.8	10.3	35.4	107.7	149.9	62.1	17	14.3	12.1	12.5	13.1	12
Average TSS load (2004 - 2006)	4.8	3.8	6	149.9	127	32.9	12.3	7	6.5	3.8	3.4	1.8
Lava HS WWTP TSS wasteload	0.004	0.004	0.004							0.004	0.004	0.004
Lava HS TSS wasteload allocation	0.04	0.04	0.04							0.04	0.04	0.04
Wasteload reduction required	0%	0%	0%							0%	0%	0%
Average Nonpoint Load (2004 – 2006)	4.796	3.796	5.996	149.9	127	32.9	12.3	7	6.5	3.796	3.396	1.796
Nonpoint Load Allocation	10.66	11.46	12.86	33.5	41.1	38.9	13.1	9.1	7.9	8.06	10.76	11.16
Nonpoint Load Reduction	0%	0%	0%	78%	68%	0%	0%	0%	0%	0%	0%	0%
Load Capacity**	10.70	11.50	12.90	33.50	41.10	38.90	13.10	9.10	7.90	8.10	10.80	11.20
Total Reduction***	0%	0%	0%	78%	68%	0%	0%	0%	0%	0%	0%	0%

*Target loads are based on 35 and 80 mg/L low- and high-flow TSS targets. The months of March, April, May, and June have been established as high flow months for the Topaz monitoring site. When annual daily load targets for the watershed are meeting their targets, loads are set at current levels. Wasteload targets are based on the City of Lava Hot Springs' NPDES permit (monthly limit of 86 lbs TSS/day). City of Lava Hot Springs' WWTP loads were calculated from discharge and water quality sampling conducted in 2002 and 2003 and reflect approximately 7 days of TSS loading each month from February through April in 2007, or a total of 21 days, at 8.2 lbs/day, for a total load estimate of 172 lbs (0.0861 tons/day). To correct for average daily load under a 180-day compliance scenario from October to March, the following was used: 0.0861 tons/day TSS (total wasteload) ÷ 180 day compliance period = 0.0004 tons/day. ** Target load using 10th percentile Q from USGS Topaz Gage. *** Reduction required based on 2004 - 2006 average loads and 10th percentile Q from USGS Topaz Gage. When annual daily load targets for the watershed are meeting their targets, loads are set at current levels.

Table 5.6. Estimated and target daily Total Suspended Solids (TSS) loads for the Portneuf River above Marsh Creek (based on monthly averages and expressed in tons/day). Estimated loads represent the product of average monthly discharge and TSS/SSC concentrations from monthly sampling activities.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004 Estimated TSS load	2.7	2.7	12.2	1.7	0.6	0.6	0.2	0.2	0.2	0.5	1.3	1.1
2004 Target load*	8.4	8.4	27.6	26.9	5.6	4.5	1.5	1.2	1.3	3.2	9.4	9.6
2005 Estimate TSS load	3.5	1.3	12.7	21.9	54.9	20	0.4	2.2	0.7	7.2	5.2	3.2
2005 Target load*	9.3	8.9	33.6	39.7	56.3	37.3	2.1	1.6	1.6	7.4	11.5	11.7
2006 Estimated TSS load	6.7	8.1	11.2	1015	542.5	37.4	2.4	0.8	0.6	8.8	7.4	7.8
2006 Target load*	13.8	10.8	38.9	125.5	159.6	31.5	2.3	2.0	2.4	12.9	14.2	12.8
Average TSS load (2004 – 2006)	4.3	4.0	12.0	346.0	199.3	19.3	1.0	1.0	0.5	5.5	4.7	4.0
Average Nonpoint Load (2004 – 2006)	4.3	4.0	12.0	346.0	199.3	19.3	1.0	1.0	0.5	5.5	4.7	4.0
Nonpoint Load Allocation	8.4	8.4	27.6	26.9	5.6	4.5	1.5	1.2	1.3	3.2	9.4	9.6
Nonpoint Load Reduction	0%	0%	0%	92%	97%	77%	0%	0%	0%	42%	0%	0%
Load Capacity**	8.4	8.4	27.6	26.9	5.6	4.5	1.5	1.2	1.3	3.2	9.4	9.6
Total Reduction***	0%	0%	0%	92%	97%	77%	0%	0%	0%	42%	0%	0%

*Target loads are based on 35 and 80 mg/L low- and high-flow TSS targets. The months of March, April, May, and June have been established as high flow months. ** Target load using 2004 Q (3rd percentile) at Portneuf River above Marsh Creek predicted from USGS Topaz and Pocatello Gages. *** Reduction required based on 2004 – 2006 average loads and 2004 Q (3rd percentile) at Portneuf River above Marsh Creek predicted from USGS Topaz and Pocatello Gages. When annual daily load targets for the watershed are meeting their targets, loads are set at current levels.

Table 5.7. Estimated and target daily Total Suspended Solids (TSS) loads for the Portneuf River at Edson Fichter Nature Area (EFNA; based on monthly averages and expressed in tons/day). Estimated loads represent the product of average monthly flow and TSS/SSC concentrations from monthly sampling activities.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004 Estimated TSS load	8.2	28.5	64.7	36.8	9.6	7.9	1.6	1.2	0.4	0.9	3.7	11.5
2004 Target load*	12.5	12.7	54.1	52.6	21.3	14.4	2.4	1.4	2.6	6.6	11.7	13.4
2005 Estimate TSS load	10.4	4.7	49.3	47.7	149.4	83.5	2.6	3.7	2.2	12.2	21.5	7.9
2005 Target load*	13.5	13.1	56.1	57.8	92	63	4	2.5	4.3	13.3	17.6	19
2006 Estimated TSS load	49.3	96.4	254.4	844.4	330.7	75	8.1	5	13.9	25.7	18.3	15.6
2006 Target load*	22.8	17.2	73.7	193.8	222.3	53.6	6.7	4.5	10.9	20	23.2	21.6
Average TSS load (2004 – 20 06)	22.6	43.2	122.8	309.6	163.2	55.5	4.1	3.3	5.5	12.9	14.5	11.6
City of Inkom WWTP TSS wasteload	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
City of Inkom wasteload allocation	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Wasteload reduction required	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average Nonpoint Load (2004 – 2006)	22.594	43.194	122.794	309.594	163.194	55.494	4.094	3.294	5.494	12.894	14.494	11.594
Nonpoint Load Allocation	16.187	17.987	54.887	52.187	20.187	9.187	1.487	1.987	3.587	6.987	12.987	16.487
Nonpoint Load Reduction	28%	58%	55%	83%	88%	83%	64%	40%	35%	46%	10%	0%
Load Capacity**	16.2	18.0	54.9	52.2	20.2	9.2	1.5	2.0	3.6	7.0	13.0	16.5
Total Reduction***	28%	58%	55%	83%	88%	83%	63%	39%	35%	46%	10%	0%

*Target loads are based on 35 and 80 mg/L low- and high-flow TSS targets. The months of March, April, May, and June have been established as high flow months for the EFNA monitoring site. Wasteload targets are based on the City of Inkom's NPDES permit (26 lbs TSS/day). City of Inkom WWTP discharge and TSS records were taken from the DEQ's Discharge Monitoring Report (DMR) database. ** Target load using 10th percentile Q at Edson Fichter predicted from Carson Street Gage. *** Reduction required based on 2004 – 2006 average loads and 10th percentile Q at Batiste predicted from USGS Pocatello Gage. When annual daily load targets for the watershed are meeting their targets, loads are set at current levels.

Table 5.8. Estimated and target daily Total Suspended Solids (TSS) loads for the Portneuf River at Batiste Road (based on monthly averages and expressed in tons/day). Estimated loads represent the product of average monthly flow and TSS/SSC concentrations from monthly sampling activities.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004 Estimated TSS load	2.1	18.4	92.6	52.8	11.0	6.7	7.3	1.9	1.1	3.2	6.2	13.6
2004 Target load*	14.4	14.7	60.2	58.7	25.2	17.4	3.5	2.5	3.8	8.1	13.6	15.4
2005 Estimate TSS load	12.4	8.6	80.4	99.6	192.9	85.6	2.7	1.2	3.7	14.8	17.0	9.2
2005 Target load*	15.4	15.0	62.4	64.3	100.8	69.8	5.3	3.6	5.6	15.3	19.9	21.4
2006 Estimated TSS load	45.5	176.3	257.9	895.3	378.9	81.3	8.5	1.8	9.8	33.0	18.5	13.3
2006 Target load*	25.5	19.5	81.3	210.0	240.6	59.7	8.1	5.8	12.7	22.4	25.8	24.2
Average TSS load (2004 – 2006)	20.0	67.8	143.6	349.2	194.2	57.9	6.2	1.6	4.9	17.0	13.9	12.0
Average (based on 2004 – 2006 daily estimates from EFNA and Batiste Rd) daily MS4 Storm Water Permit storm water TSS wasteload**	--	8.5	26.7	61.7	39.0	8.6	2.5	-2.9	-0.2	9.2	6.9	--
Average (based on 2004 – 2006 daily discharge estimates from EFNA and Batiste Rd and TSS targets) MS4 Storm Water Permit storm water TSS wasteload allocation**	2.2	2.0	6.7	9.6	10.3	5.4	1.3	1.2	1.4	2.0	2.3	2.7
Storm water TSS wasteload reduction required	NA	76%	75%	84%	74%	37%	48%	0%	0%	78%	67%	NA
Average Nonpoint Load (2004 – 2006)	20.0	59.3	116.9	287.5	155.2	49.3	3.7	1.6	4.9	7.8	7.0	12.0
Nonpoint Load Allocation	16.1	18.3	54.4	48.6	13.6	6.8	1.3	2.0	3.5	6.5	12.6	15.9
Nonpoint Load Reduction	20%	69%	53%	83%	91%	86%	65%	0%	29%	17%	0%	0%
Load Capacity***	18.3	20.3	61.1	58.2	23.9	12.2	2.6	3.2	4.9	8.5	14.9	18.6
Total Reduction****	9%	70%	57%	83%	88%	79%	58%	0%	0%	50%	0%	0%

*Target loads are based on 35 and 80 mg/L low and high-flow TSS targets. The months of March, April, May, and June have been established as high flow months for the Batiste monitoring site. Wasteloads for the City of Pocatello, the City of Chubbuck, Bannock County, and the Idaho Transportation Department - District #5's storm water are presented as the difference between daily TSS load estimates at the Batiste and the EFNA monitoring stations. Wasteload allocations were established using the daily discharge difference between Batiste and EFNA monitoring stations and the high and low-flow TSS targets.
**Storm water loading is episodic and varies widely. The loads shown represent monthly averages from years 2004 – 2006. Daily estimates of storm water TSS loading and target loads/load allocations are shown in Appendix C. -- indicates that less than two years of data was available so an average was not presented. NA indicates that a reduction estimate was not available because a wasteload estimate was lacking. ***Target load using 10th percentile Q at Batiste predicted from USGS Pocatello Gage. ****Total load and wasteload reductions required based on 2004 – 2006 average loads and 10th percentile Q at Batiste predicted from USGS Pocatello Gage. When annual daily load targets for the watershed are meeting their targets, loads are set at current levels.

Table 5.9. Estimated and target daily Total Suspended Solids (TSS) loads for the Portneuf River at Siphon Rd (based on monthly averages and expressed in tons/day). Estimated loads represent the product of average monthly flow and TSS/SSC concentrations from monthly sampling activities.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004 Estimated TSS load	58.6	42.1	106.8	82.1	11.4	8.5	20.6	3.5	3.7	4.3	5.1	15.0
2004 Target load*	36.6	84.3	111.0	109.4	75.9	68.2	25.8	24.7	26.0	30.3	35.8	37.6
2005 Estimate TSS load	36.6	23.4	147.1	99.2	272.9	57.3	7.8	2.5	2.6	7.5	10.8	47.9
2005 Target load*	37.7	85.1	113.2	115.0	151.6	120.6	27.5	25.9	27.8	37.5	42.1	43.6
2006 Estimated TSS load	64.0	119.1	102.3	818.2	396.9	102.2	21.2	5.0	7.4	25.7	25.3	30.5
2006 Target load*	47.7	95.2	132.0	260.8	291.3	110.4	30.4	28.1	34.9	44.6	48.0	46.4
Average TSS load (2004 – 2006)	53.1	61.5	118.8	333.2	227.1	56.0	16.5	3.7	4.6	12.5	13.7	31.1
City of Pocatello WWTP TSS wasteload	0.2	0.2	0.1	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.3	0.2
City of Pocatello WWTP TSS wasteload allocation	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
WWTP TSS wasteload reduction required	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Batise Springs Trout Farm wasteload	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Batise Springs Trout Farm wasteload allocation	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Batiste Springs Trout Farm wasteload reduction	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Papoose Springs Hatchery wasteload	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Papoose Springs Hatchery wasteload allocation	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Papoose Springs Hatchery wasteload reduction	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average Nonpoint Load (2004 – 2006)	52.6	61.0	118.4	332.6	226.6	55.5	16.0	3.3	4.2	12.1	13.1	30.6
Nonpoint Load Allocation	38.4	40.4	109.8	106.9	72.6	60.8	22.7	23.3	25.0	28.6	35.0	38.7
Nonpoint Load Reduction	27%	34%	7%	68%	68%	0%	0%	0%	0%	0%	0%	0%
Load Capacity**	40.5	42.5	111.9	109.0	74.7	62.9	24.8	25.4	27.1	30.7	37.1	40.8
Total Reduction***	24%	31%	6%	67%	67%	0%	0%	0%	0%	0%	0%	0%

*Target loads are based on 35 and 80 mg/L low and high-flow TSS targets. The months of March, April, May, and June have been established as high flow months for the Siphon Road monitoring site. TSS wasteload targets are based on the City of Pocatello's NPDES permit of (3,000 lbs TSS/day). City of Pocatello WWTP discharge records are from the DEQ's DMR database. Batise Springs Trout Farm TSS load estimates were based on 1998 to 2003 measurements of discharge and net (outlet – inlet) TSS concentrations and from the facility's 2007 Annual Report of Operations. TSS wasteload targets are based on Batise Springs Trout Farm NPDES permit (5 mg/L and average discharge of 31.1 cfs from the aforementioned sampling. Operation at Papoose Springs Hatchery is intermittent and the facility is not listed on the General Permit for Aquaculture facilities of Idaho (Permit No. IDG-130000). A wasteload is shown here for Papoose Spring Hatchery based on sampling results from 2003 and 2004 measurements of discharge and TSS concentrations. ** Target load using 10th percentile Q at Siphon predicted from Batiste Q + estimated average ground water gains between Batiste and Siphon Monitoring Stations. *** Reduction required based on 04 to 06 average loads and 10th percentile Q at Siphon predicted from Batiste Q + estimated average ground water gains between Batiste and Siphon Monitoring Stations. When annual daily load targets for the watershed are meeting their targets, loads are set at current levels.

Total Phosphorus

Estimates of daily total phosphorus (TP) loads vary considerably by location and season. Consistent with TSS trends, TP concentrations and loads are greatest during runoff and lowest during baseflow for most reaches of the mainstem Portneuf River. Moreover, TP concentrations and loads gradually increase downstream to Batiste Road. Below Batiste Road and measured at Siphon Road, loads were more than an order of magnitude greater than at all other monitoring locations, even though concentrations there decreased during runoff. The pattern observed at Siphon Road is characteristic of constant P loading to surface waters from ground water inputs (Bowes et al. 2008); ground water inputs in this segment of the Portneuf River are associated with P-contaminated waters from the Eastern Michaud Flats Superfund sites (Baldwin et al. 2004). As a result, surface waters from the watershed above Batiste Road reduce the fraction of loading associated with relatively constant ground water inputs and this reduction is greatest during high flows. A plot of TP concentrations and discharge by day of year illustrates this point and shows that TP concentrations are inversely correlated with discharge, demonstrating that the lowest concentrations coincide with periods of high flow (Fig. 5.3).

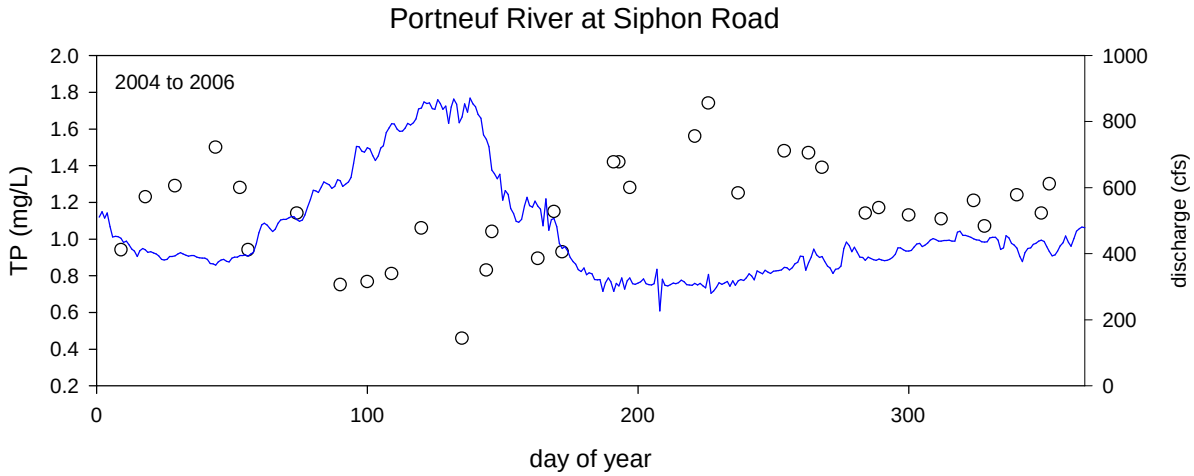


Figure 5.3. Total phosphorus concentrations (mg/L) and discharge (cfs) in the Portneuf River at Siphon Road. TP concentration data is presented by day of year for years 2004, 2005, and 2006. The hydrograph represents the average daily flow for calendar years 2004 through 2006.

Portneuf River at Topaz; Portneuf-Marsh Valley Canal Diversion

This river segment is not listed for nutrients on the 2008 §303(d) list (in the Integrated Report), but was present on the 1996 and 1998 lists (this river segment—AU ID 17040208SK016_03—is listed in Section 4a of the 2008 Integrated Report, meaning it has an approved TMDL). In the original Portneuf River TMDL (DEQ 2001a), a 15% reduction (or 3 tons/year) in the estimated TP load was necessary to meet the TP target load for this river segment. A summary of the annual TP loading (Table 5.10) indicates that average monthly loading was greatest in the designated high-flow months of April, May, and June. TP loads averaged across these three months were 39.2, 90.8, and 703.4 lbs/day in calendar years 2004, 2005, and 2006, respectively. Annual differences in TP

load were striking, and illustrate how average loads from 2004 to 2006 were influenced by loading that occurred in 2006. Based on the multi-year daily averages shown in Table 5.10, some TP reductions (April, May, July, and August) in the Portneuf River at the Portneuf-Marsh Valley canal diversion are necessary to meet the Portneuf River WAG-endorsed low-flow TP target (0.07 mg/L) and high-flow TP target (0.125 mg/L). In months when the TP target is met, the measured concentrations of TP serve as the actual target.

The Topaz monitoring location also serves as the downstream compliance point for the City of Lava Hot Springs' WWTP. This facility now batch-discharges from settling lagoons only during winter months. This strategy recognizes that controlling eutrophication in nutrient-impaired rivers requires reductions to nutrient loading during peak plant-life and algal production when effects on DO will be most detrimental to aquatic life (Bowes et al. 2008). TP wasteloads from the City of Lava Hot Springs' WWTP were calculated from discharge and water quality sampling conducted in 2002 and 2003, and a total of 21 days of TP loading (i.e., lagoon discharge) that occurred in 2007. Daily loading was estimated as 10.4 lbs TP/day for 21 loading days between October and May, yielding an estimated annual TP load of 218 lbs. The DEQ recommends that the 21-day batch discharge loading scenario be replaced with a 180-day loading scenario that occurs from October to March and avoids the critical DO window. A prescribed loading approach that reduces or eliminates P loading during biologically sensitive periods is being proposed for WWTPs elsewhere (Jarvie et al. 2006), and when applied to the City of Lava Hot Springs, results in a wasteload allocation of 1.21 lbs/day (218 lbs TP/year ÷ 180 day discharge period = 1.21 lbs/day).

Portneuf River above Marsh Creek

Average daily TP load estimates for the segment from the Topaz - Marsh Valley Canal diversion to Marsh Creek or AU ID17040208SK016_03 (Portneuf River Chesterfield Reservoir to Marsh Creek) indicate that, on average, TP load reductions are necessary in April, May, and June. However, TP load estimates were disproportionately influenced by 2006 loads (Table 5.11). Loading estimates for the critical low-flow months indicates that TP in the Portneuf River above Marsh Creek is generally below the targets endorsed by the Portneuf WAG (Table 5.1) and in these months the measured concentrations of TP will serve as the actual target.

Portneuf River at Edson Fichter Nature Area

The Portneuf River at EFNA is part of AU ID17040208SK001_05 (Portneuf River from Marsh Creek to the Fort Hall Reservation Boundary). This site serves as the downstream compliance point for the City of Inkom's wastewater treatment facility and the upstream monitoring site for the MS4 Storm Water Permit. Daily TP loading at EFNA was greatest from February through May (Table 5.12); however, nonpoint source reductions are required throughout the year to meet water quality targets. Across all months, the average reduction required at this monitoring location is 48% and monthly required reduction estimates ranged from 0% in November to 90% in June. In months when the TP target is met, the measured concentrations of TP serve as the actual target. Wasteloads from the City of Inkom's WWTP contributed to elevated loading recorded at EFNA, and TP daily

load reductions for this facility are required in most months to meet their wasteload allocation of 0.71 lbs/day (Table 5.12).

Portneuf River at Batiste Road

The Portneuf River at Batiste Road is part of AU ID17040208SK001_05 (Portneuf River from Marsh Creek to the Fort Hall Reservation Boundary) and it serves as the downstream compliance point for the MS4 Storm Water Permit. Technically, the MS4 Permit identifies the Highway 30 monitoring site as the downstream compliance point; however, for purposes of analysis and discussion, the Batiste Road site was used. The Batiste Road site also serves as the upstream compliance point for the City of Pocatello's WWTP. Daily TP loading in the Portneuf River as measured at Batiste Road is greatest from March through May (mean 649.4 lbs/day) and was considerably higher in calendar year 2006 than years 2004 and 2005. Daily TP load estimates exceeded TP targets during most months and required reductions in nonpoint source TP load range from 0% in February and November to 88% in May (Table 5.13).

Daily storm water wasteloads for the PUA (MS4 Storm Water Permit No. IDS-028053) were calculated from all available 30-minute discharge and turbidity estimates for calendar years 2004 through 2006 (total of 647 daily estimates), summarized by month, and expressed as daily TP loads in lbs/day. Load estimates represent the difference in load estimates for points above and below the PUA. To generally summarize storm water loading at each monitoring station, estimated TP loads (Figure 2.19) for each site are shown along with the precipitation record for the Pocatello northeast meteorological station for years 2004, 2005, and 2006. From these summaries, there is a pattern in annual loading that generally tracks changes in the annual hydrograph and shows that there is greater loading during high flows. As was shown with suspended sediment, TP loading tends to increase after precipitation events and decrease during extended periods with limited or no precipitation. Negative storm water wasteload estimates were observed and generally coincided with low-flow periods (see Figure 2.21). Negative load values indicate that the average daily load was greater above than below the PUA and suggests that, on average, there was deposition or storage of sediment-associated phosphorus in this river segment during a given month.

Target load/wasteload allocations were established using the difference in discharge between the Batiste and EFNA monitoring stations and the high and low-flow Portneuf River WAG endorsed TP targets. Storm water TP loading from the PUA was most pronounced during high flows and exceeded TP target loads/wasteload allocations (Figure 2.23). Average daily TP storm water loading was lowest in July, August, and September. TP reductions necessary to meet in-stream targets and allocations are shown in Table 5.13.

Portneuf River at Siphon Road

The Siphon Road monitoring location serves as the compliance point for AU ID17040208SK001_05 (Portneuf River from Marsh Creek to the Fort Hall Reservation Boundary) and for the City of Pocatello's WWTP. Although this AU was included on the 2002 §303(d) list, with the cause of impairment listed as unknown (see Table 2.2), DEQ has since added dissolved oxygen and temperature as pollutants impairing beneficial use

in this AU as part of the 2008 Integrated Report (Table B). This AU also appears in Section 4a of the 2008 Integrated Report (having an approved TMDL). Average daily TP loading in the Portneuf River at Siphon Road is strongly influenced by ground water contributions. The average 2004 to 2006 monthly TP load was 2,661 lbs/day (range 1,767 lbs TP/day in August 2004 to 5,007 lbs TP/day in April 2006). In April 2008, DEQ entered into a voluntary consent order/compliance agreement with J.R. Simplot Company, in which Simplot agreed to implement remedial actions to reduce its contribution of P to the Portneuf River. This binding agreement calls for reductions of P concentrations in the Portneuf River from an annual median concentration of 1.250 mg/L currently to 0.075 mg/L by the year 2021. Implementation of these remedial measures is anticipated to help meet the significant reductions in TP loading required to meet target loads (this is a 93% average reduction across all months). The TP wasteload from the City of Pocatello's WWTP contributes approximately 32.3 lbs TP/day (median monthly load), but this load ranged from 141.8 lbs/day to 17.6 lbs/day in 2007. The TP wasteload allocation for this facility is 25.1 lbs/day (18.6 cfs design flow x 0.250 mg/L target TP concentration). Based on a 25.1 lbs/day TP wasteload allocation, the required average daily TP load reduction is 31% (based on 2007 discharge monitoring report summary; Table 5.14). It is anticipated the City of Pocatello will meet this wasteload in a time frame commensurate with the large-scale reductions required through Simplot's remedial actions (i.e., by the year 2020). TP loads from Batise Springs Trout Farm and Papoose Springs Hatchery were estimated as 8.4 and 0.9 lbs TP/day. The TP wasteload allocation for Batise Springs Trout Farm is based on the facility's NPDES permit (Permit No. IDG-130000; 13.0 lbs TP/day). Operation at Papoose Springs Hatchery is intermittent. Although the facility is not included on the General Permit for Aquaculture facilities of Idaho (Permit No. IDG-130000), a wasteload allocation is shown here to address loading attributed to the facility.

Table 5.10. Estimated and target daily Total Phosphorus (TP) loads for the Portneuf River at Topaz (based on monthly averages and expressed in lbs/day). Estimated loads represent the product of average monthly flow and TP concentrations from monthly sampling activities or from predicted TP concentrations using the average monthly discharge at the USGS Topaz gage.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004 Estimated TP load	20.8	20.8	48.6	30.5	52.7	34.4	59.1	32.9	1.9	19.4	10.9	16.0
2004 Target load*	33.0	33.1	81.0	86.7	119.9	102.3	54.4	32.9	26.6	25.2	36.4	37.2
2005 Estimate TP load	24.3	23.0	38.6	55.9	141.4	75.1	49.7	44.1	20.2	13.7	28.0	20.8
2005 Target load*	36.2	34.9	96.6	112.7	168.3	146.6	82.8	52.3	30.8	30.4	43.6	44.2
2006 Estimated TP load	51.1	40.1	64.6	1050	858.2	201.9	74.0	64.6	37.3	21.5	21.7	43.0
2006 Target load*	51.1	41.2	110.6	336.5	468.5	194.1	68.2	57.2	48.3	50.1	52.3	47.8
Average TP load (2004 - 2006)	32.0	27.9	50.6	378.8	350.8	103.8	60.9	47.2	19.8	18.2	20.2	26.6
Lava HS WWTP TP Wasteload **	1.2	1.2	1.2							1.2	1.2	1.2
Lava HS WWTP TP Wasteload Allocation	1.2	1.2	1.2							1.2	1.2	1.2
Wasteload reduction	0%	0%	0%							0%	0%	0%
Average Nonpoint Load (2004 – 2006)	30.8	26.7	49.4	378.8	350.8	103.8	60.9	47.2	19.8	17	19	25.4
Nonpoint Load Allocation	41.8	44.6	50.3	104.6	128.4	121.7	52.2	36.2	31.8	31.1	41.9	43.7
Nonpoint Load Reduction	0%	0%	0%	72%	63%	0%	14%	23%	0%	0%	0%	0%
Load Capacity***	43.0	45.8	51.5	104.6	128.4	121.7	52.2	36.2	31.8	32.3	43.1	44.9
Total Reduction******	0%	0%	0%	72%	63%	0%	14%	23%	0%	0%	0%	0%

*Target loads are based on 0.07 and 0.125 mg/L low and high-flow TP targets. The months of March, April, May, and June have been established as high-flow months for the Topaz monitoring site. The wasteload discharge period (Oct to May 31 of each year) is based on the City of Lava's NPDES permit (ID-002182-2 approved June 1, 2005). **City of Lava's WWTP wasteloads were calculated from discharge and water quality sampling conducted in 2002 and 2003 and reflect a total of approximately 21 days, from October 2006 to May in 2007, of TP loading at a rate of 10.4 lbs/day; for a total TP load estimate of 218 lbs. To correct for average daily load under a 180-day discharge scenario (October – March), we used the following: 218 lbs TP (total wasteload) ÷ 180 day compliance period = 1.21 lbs/day. Therefore, the target load during the months October to March was set at 1.21 lb/day. *** Target load and wasteload using 10th percentile Q from USGS Topaz Gage. ****Reduction required based on 2004 – 2006 average loads and 10th percentile Q from USGS Topaz Gage. When annual daily load targets for the watershed are meeting their targets, loads are set at current levels.

Table 5.11. Estimated and target daily Total Phosphorus (TP) loads for the Portneuf River above Marsh Creek (based on monthly averages and expressed in lbs/day). Estimated loads represent the product of average monthly discharge and TP concentrations from monthly sampling activities.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004 Estimated TP load	13.9	13.9	51.4	32.2	4.7	4.8	2.6	2.2	0.4	3.7	7.5	10.5
2004 Target load*	33.5	33.6	86.2	84.0	17.6	14.1	5.9	4.6	5.0	13.0	37.5	38.6
2005 Estimate TP load	17.6	9.2	32.4	72.5	146.4	69.0	3.4	7.8	3.2	19.1	18.5	10.1
2005 Target load*	37.3	35.8	104.9	124.2	175.9	116.5	8.2	6.3	6.2	29.7	46.2	47.0
2006 Estimated TP load	59.1	31.6	65.2	1036.0	2122.0	103.9	7.4	3.7	3.3	32.3	25.1	54.1
2006 Target load*	55.1	43.3	121.7	392.3	498.6	98.4	9.1	7.9	9.7	51.4	56.7	51.2
Average TP load (2004 - 2006)	30.2	18.2	49.7	380.1	757.7	59.2	4.5	4.6	2.3	18.4	17.0	24.9
Average Nonpoint Load (2004 – 2006)	30.2	18.2	49.7	380.1	757.7	59.2	4.5	4.6	2.3	18.4	17.0	24.9
Nonpoint Load Allocation	33.5	33.6	86.2	84.0	17.6	14.1	5.9	4.6	5.0	13.0	37.5	38.6
Load Allocation Reduction	0%	0%	0%	78%	98%	76%	0%	0%	0%	29%	0%	0%
Load Capacity**	33.5	33.6	86.2	84.0	17.6	14.1	5.9	4.6	5.0	13.0	37.5	38.6
Total Reduction***	0%	0%	0%	78%	98%	76%	0%	0%	0%	29%	0%	0%

*Target loads are based on 0.07 and 0.125 mg/L low and high-flow TP targets. The months of March, April, May, and June have been established as high-flow months. ** Target load using 2004 Q (3rd percentile) at Portneuf River above Marsh Creek predicted from USGS Topaz and Pocatello Gages. *** Reduction required based on 2004 – 2006 average loads and 2004 Q (3rd percentile) at Portneuf River above Marsh Creek predicted from USGS Topaz and Pocatello Gages. When annual daily load targets for the watershed are meeting their targets, loads are set at current levels.

Table 5.12. Estimated and target daily Total Phosphorus (TP) loads for the Portneuf River at Edson Fichter Nature Area (EFNA; based on monthly averages and expressed in lbs/day). Estimated loads represent the product of average monthly flow and TP concentrations from monthly sampling activities.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004 Estimated TP load	34.7	71.1	208.6	113.1	39.5	25.8	9.2	5.3	4.7	11.7	22.1	49.9
2004 Target load*	50.1	51	169	164.4	66.7	44.4	9.5	5.7	10.4	26.5	46.9	53.7
2005 Estimate TP load	41.4	33.3	160.4	157.6	409.2	236.4	11.5	17.1	9.4	47.2	71.4	61.9
2005 Target load*	53.9	52.3	175.3	180.8	287.4	197	16.1	9.9	17.3	53.3	70.4	76
2006 Estimated TP load	208.9	777.7	978.5	2452	955.9	212.9	31.2	13.4	45	75.3	62.2	103.8
2006 Target load*	91.4	68.9	230.3	605.7	694.7	167.4	26.7	18.1	43.7	79.9	92.7	86.5
Average TP load (2004 – 2006)	95.0	294.0	449.2	907.6	468.2	158.3	17.3	11.9	19.7	44.7	51.9	71.9
City of Inkom WWTP TP Wasteload	2.43	2.46	1.47	1.47	1.56	0.95	0.71	1.71	1.02	0.68	1.97	1.45
City of Inkom Wasteload Allocation	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
Wasteload Allocation reduction required	71%	71%	52%	52%	54%	25%	0%	58%	30%	0%	64%	51%
Average Nonpoint Load (2004 – 2006)	92.57	291.54	447.73	906.13	466.64	157.35	16.59	10.19	18.68	44.02	49.93	70.45
Nonpoint Load Allocation	63.99	71.19	170.89	162.39	62.39	28.09	5.29	7.39	13.79	27.29	51.29	65.09
Load Allocation Reduction	31%	76%	62%	82%	87%	82%	68%	27%	26%	38%	0%	8%
Load Capacity**	64.7	71.9	171.6	163.1	63.1	28.8	6.0	8.1	14.5	28.0	52.0	65.8
Total Reduction***	32%	76%	62%	82%	87%	82%	65%	32%	26%	37%	0%	8%

*Target loads are based on 0.07 and 0.125 mg/L low and high-flow TP targets. The months of March, April, May, and June have been established as high-flow months for the EFNA monitoring site. Wasteload targets are based on the City of Inkom's NPDES permit (ID-002024-9; 0.71 lbs TP/day). City of Inkom WWTP discharge and TP records were taken from DEQ's DMR database for Calendar Year 2007, except the reported November 2006 load was used for the missing November 2007 load. ** Target load and wasteload using 10th percentile Q at Edson Fichter predicted from USGS Pocatello Gage. ***Reduction required based on 2004 – 2006 average loads and 10th percentile Q at Edson Fichter from USGS Pocatello Gage. When annual daily load targets for the watershed are meeting their targets, loads are set at current levels.

Table 5.13. Estimated and target daily Total Phosphorus (TP) loads for the Portneuf River at Batiste Rd (based on monthly averages and expressed in lbs/day). Estimated loads represent the product of average monthly flow and TP concentrations from monthly sampling activities.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004 Estimated TP load	28.0	81.0	298.2	154.0	331.4	30.5	38.5	17.0	7.6	21.3	31.8	57.1
2004 Target load*	57.7	58.6	188.2	183.3	78.6	54.4	14.2	10.1	15.1	32.4	54.3	61.5
2005 Estimate TP load	44.1	42.0	319.9	231.4	542.0	204.3	16.1	15.2	16.1	49.7	61.3	68.4
2005 Target load*	61.8	60.1	195.1	200.9	315.1	218.3	21.2	14.6	22.6	61.1	79.4	85.4
2006 Estimated TP load	212.6	71.2	922.6	2011.0	1034.0	244.7	35.4	16.0	37.8	140.8	79.7	117.5
2006 Target load*	102.0	77.9	254.0	656.4	751.7	186.5	32.6	23.4	50.9	89.6	103.3	96.7
Average TP load (2004 – 2006)	94.9	64.7	513.5	798.8	635.9	159.8	30.0	16.1	20.5	70.6	57.6	81.0
Average (based on 2004 – 2006 daily estimates from EFNA and Batiste Rd) daily MS4 Storm Water Permit storm water TP wasteload**	--	13.3	54.9	120.7	71.4	13.1	4.7	-6.6	-2.3	17.2	8.4	--
Average (based on 2004 – 2006 daily discharge estimates from EFNA and Batiste Rd and TP targets) MS4 Storm Water Permit storm water TP wasteload allocation**	8.7	8.2	20.9	29.9	32.2	16.9	5.3	4.8	5.7	7.8	9.1	10.7
Storm water TP wasteload reduction required	NA	39%	62%	75%	55%	0%	0%	0%	0%	55%	0	NA
Average Nonpoint Load (2004 – 2006)	94.9	51.4	458.6	678.1	564.5	146.7	25.3	16.1	20.5	53.4	49.2	81.0
Nonpoint Load Allocation	64.6	72.8	170.2	152.0	42.5	21.1	5.1	7.9	13.9	26.2	50.6	63.8
Nonpoint Load Reduction	32%	0%	63%	78%	92%	86%	80%	51%	32%	51%	0%	21%
Load Capacity**	73.3	81.0	191.1	181.9	74.7	38.0	10.4	12.7	19.6	34.0	59.7	74.5
Total Reduction***	23%	0%	63%	77%	88%	76%	65%	21%	4%	52%	0%	8%

*Target loads are based on 0.07 and 0.125 mg/L low and high-flow TP targets. March, through June have been established as high-flow months for the Batiste site. Wasteloads for City of Pocatello, City of Chubbuck, Bannock County, and Idaho Transportation Department - District #5's storm water are presented as the difference in TP load estimates from Batiste and EFNA monitoring stations. Wasteload allocations were established using the difference in discharge between the Batiste and EFNA monitoring stations multiplied by the high and low flow TP targets. **Storm water loading is episodic and varies widely. The loads shown represent monthly averages from years 2004 to 2006. Daily estimates of storm water TSS loading and target loads/load allocations are shown in Appendix C. -- indicates that less than two years of data was available so an average was not presented. NA indicates that a reduction estimate was not available because a wasteload estimate was lacking. ** Target load using 10th percentile Q at Batiste predicted from USGS Pocatello Gage. *** Total load and wasteload reductions required based on 2004 – 2006 average loads and 10th percentile Q at Batiste predicted from USGS Pocatello Gage. When annual daily load targets for the watershed are meeting their targets, loads are set at current levels.

Table 5.14. Estimated and target daily Total Phosphorus (TP) loads for the Portneuf River at Siphon Rd (based on monthly averages and expressed in lbs/day). Estimated loads represent the product of average monthly flow and TP concentrations from monthly sampling activities.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004 Estimated TP load	2700	1982	2084	2900	1974	1960	1884	1767	2064	1957	2188	2449
2004 Target load*	146.5	147.4	346.9	341.9	237.2	213.0	103.0	98.9	104.0	121.2	143.1	150.4
2005 Estimate TP load	2646	2723	3226	2333	3146	2804	2233	2305	2339	2441	2668	3087
2005 Target load*	150.6	148.9	353.7	359.5	473.8	376.9	110.1	103.4	111.4	149.9	168.3	174.3
2006 Estimated TP load	2565	3572	3037	5007	3343	2468	2463	2789	2954	2982	3321	3446
2006 Target load*	190.8	166.7	412.6	815.0	910.4	345.1	121.4	112.2	139.7	178.4	192.1	185.6
Average TP load (2004 – 2006)	2637	2759	2782	3413	2821	2411	2193	2287	2452	2460	2726	2994
City of Pocatello WWTP TP wasteload	26.6	35.2	68.0	141.8	31.2	33.5	66.9	23.2	17.6	96.4	28.4	20.7
City of Pocatello WWTP TP wasteload allocation	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1
WWTP TP wasteload reduction required	6%	29%	63%	82%	20%	25%	62%	0%	0%	74%	11%	0%
Batise Springs Trout Farm wasteload	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Batise Springs Trout Farm wasteload allocation	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Batise Springs Trout Farm wasteload reduction	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Papoose Springs Hatchery wasteload	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Papoose Springs Hatchery wasteload allocation	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Papoose Springs Hatchery wasteload reduction	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Nonpoint Load	94.9	51.4	458.6	678.1	564.5	146.7	25.3	16.1	20.5	53.4	49.2	81.0
Nonpoint Load Allocation	74.5	82.2	262.1	252.9	145.8	109.0	11.7	13.9	20.8	35.3	60.9	75.8
Nonpoint Load reduction	21%	0%	43%	63%	74%	26%	54%	14%	0%	34%	0%	6%
Groundwater Load	2506.2	2663.1	2246.1	2583.8	2216.0	2221.5	2091.5	2238.4	2404.6	2300.9	2639.1	2883.
Groundwater Load Allocation	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6
Groundwater Reduction	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
Load Capacity**	162.1	169.8	349.7	340.5	233.4	196.6	99.3	101.5	108.4	122.9	148.5	163.4
Total Reduction***	94%	94%	87%	90%	92%	92%	95%	96%	96%	95%	95%	95%

*Target loads based on 0.07 and 0.125 mg/L low and high-flow TP targets. The months of March, April, May, and June have been established as high-flow months for the Siphon monitoring site. City of Pocatello WWTP TP wasteloads are based on monthly medians of discharge and TP concentrations from DEQ's DMR database for Calendar Year 2007. TP wasteload allocations are based on the City of Pocatello's design flows (12 mgd or 18.6 cfs) and a monthly target of 0.250 mg/L TP. Batise Springs Trout Farm TP load estimates were based on 1998 to 2003 measurements of discharge and net (outlet – inlet) TP concentrations and from the facility's 2007 Annual Report of Operations. TP wasteload targets are based on Batise Springs Trout Farm NPDES permit (5 mg/L and average discharge of 31.1 cfs) from the aforementioned sampling. Operation at Papoose Springs Hatchery is intermittent and the facility is not listed on the General Permit for Aquaculture facilities of Idaho (Permit No. IDG-130000). A wasteload is shown here for Papoose Spring Hatchery based on sampling results from 2003 and 2004 measurements of discharge and TP concentrations. ** Target load and wasteload using 10th percentile Q at Siphon predicted from Batiste Q + estimated average ground water gains between Batiste and Siphon Monitoring Stations. *** Reduction required based on 2004 – 2006 average loads and 10th percentile Q at Siphon predicted from Batiste Q + estimated average ground water gains between Batiste and Siphon Monitoring Stations. When annual daily load targets for the watershed are meeting their targets, loads are set at current levels.

Oil and Grease

Sampling results from most of the recent ambient monitoring shows that oil and grease are present at measurable concentrations in the lower Portneuf River. From the sampling events when oil and grease were detected, concentrations tended to increase downstream (Table 5.15). The introduction of oil and grease through storm drains has also been documented during or immediately following storm events; concentrations in storm water often exceed the target of 5 mg/L for oil and grease (Table 5.16). Additional monitoring by the City of Pocatello detected oil and grease in the mainstem Portneuf River on April 18 and May 22, 2008, and in samples collected from several outfalls on May 22, 2008. Concentrations exceeding the oil and grease target were measured at Kraft Road bridge (6.8 mg/L) and at the Pocatello Creek confluence (5.8 mg/L; Co-permittees Pocatello Urbanized Area 2008).

Based on this information, DEQ recommends regular and event-focused monitoring of oil and grease to better describe background concentrations and characterize their temporal and spatial loading patterns in the lower Portneuf River. Where possible, BMPs should be used to minimize oil and grease loading to the Portneuf River.

Table 5.15. Ambient oil and grease monitoring in the Portneuf River. Oil and grease concentrations are reported in mg/L. Oil and grease loads and target loads are expressed in lbs/day for the dates shown. Percentage values (where shown) indicate the reductions necessary to meet target loads. EFNA = Edson Fichter Nature Area.

Monitoring Location	Oil and Grease Summary	24 April 2007	9 October 2007	14 January 2008
EFNA	measured concentration (mg/L)	4.9	1.9	*ND*
	estimated load (lbs/day)	7,577	1,232	279[a]
	target load (lbs/day)	7,577[b]	1,232[b]	279[b]
Batiste Road	measured concentration (mg/L)	7.0	8.8	*ND*
	estimated load (lbs/day)	12,011	6,626	328[a]
	target load (lbs/day)	8,580 (29%)	3,765 (43%)	328[b]

Target loads for oil and grease refers to n-Hexane Extractable Material [HEM] method E1664A. See a description of the method at: http://www.epa.gov/waterscience/methods/method/oil/ . [a]Oil and grease load estimates calculated from non-detect measurements use half the maximum detection limit (MDL) concentration. The MDL for the oil and grease method described is 1.0 mg/L. [b]Target daily loads are set at the existing daily load when oil and grease concentrations are measured at concentrations below the target concentration.

Table 5.16. Storm event Oil and Grease monitoring in the Portneuf River. Oil and grease concentrations are reported in mg/L. Oil and grease loads and target loads are expressed in lbs/day for the dates shown. Percentage values (where shown) indicate the reductions necessary to meet target loads. EFNA = Edson Fichter Nature Area. ND = non-detect. NS = not sampled.

Monitoring Location	Oil and Grease Summary	6 June 2007	24 July 2007	2 August 2007
EFNA	measured concentration (mg/L)	7.5	ND	ND
	estimated load (lbs/day)	3,035	36[a]	73[a]
	target load (lbs/day)	2,024 (33%)	36[b]	73[b]
Day Street Culvert	measured concentration (mg/L)	NS	8.1	9.3
	estimated load (lbs/day)	NS	44	126
	target load (lbs/day)	NS	27 (38%)	68 (46%)
Batiste Road	measured concentration (mg/L)	8.9	ND	1.4
	estimated load (lbs/day)	4,373	68[a]	298
	target load (lbs/day)	2,457 (44%)	68[b]	298[b]

On 6 June 2007, sampling was performed during a 24-hour rain event, approximately 12 hrs into the event. On 24 July 2007, sampling was performed approximately 2 hours after a brief microburst. On 2 August 2007, sampling was performed approximately 1 hour after a 1 to 2-hour rain event. In a blank sample collected on 2 August 2007; the concentration was reported as non-detect (< 1.0 mg/L).
[a]Oil and grease load estimates calculated from non-detect measurements use half the maximum detection limit (MDL) concentration. The MDL for the oil and grease method described is 1.0 mg/L. [b]Target daily loads are set equal to the existing daily load when oil and grease concentrations are measured below the target concentration.

The tables above present oil and grease load estimates for days when samples were taken for oil and grease in the Portneuf River or at the mouth of stormwater outfalls. Daily oil and grease load targets were calculated for all mainstem Portneuf River sites and lower Marsh Creek using the 5 mg/L target and the 30Q10 principle (Table 5.17). This summary offers a basis for comparing measured loads to target loads over the range of annual flow conditions.

Table 5.17. Oil and grease target loads for mainstem and lower Marsh Creek monitoring stations. Loads were estimated using 30Q10 principle and the 5 mg/L oil and grease target. Target loads are expressed in tons/day of oil and grease.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Portneuf River at Topaz	1.5	1.6	1.8	2.1	2.6	2.4	1.9	1.3	1.1	1.2	1.5	1.6
Portneuf River above Marsh Creek*	1.2	1.2	1.7	1.7	0.4	0.3	0.2	0.2	0.2	0.5	1.3	1.4
Portneuf River at Edson Fichter	2.3	2.6	3.4	3.3	1.3	0.6	0.2	0.3	0.5	1.0	1.9	2.4
Portneuf River at Batiste Road	2.6	2.9	3.8	3.6	1.5	0.8	0.4	0.5	0.7	1.2	2.1	2.7
Portneuf River at Siphon Road	5.8	6.1	7.0	6.8	4.7	3.9	3.5	3.6	3.9	4.4	5.3	5.8
Lower Marsh Creek	0.8	0.9	1.2	0.9	0.6	0.6	0.5	0.5	0.7	0.9	0.8	0.8

Target loads are based on discharge with a 10-year recurrence interval (10th percentile flows) and a 30-day averaging period (e.g., 30Q10).
*Routine discharge monitoring in the Portneuf River above Marsh Creek began in 2004 but is limited to monthly sampling summaries; therefore, the target loads are calculated from the most conservative discharge record (2004, approximately 3rd percentile discharge).

5.2b Tributaries

This section describes pollutant and beneficial use monitoring of §303(d)-listed tributaries in the Portneuf River subbasin. Excluding Marsh Creek, there are 22 tributary AUs and one tributary reservoir (Hawkins Reservoir) included in the 2008 Integrated Report. This is an increase from the 12 §303(d)-listed subbasin tributaries, and one tributary reservoir, included in the 2002 Integrated Report. In 2008, the source of impairment for these additional tributaries was overwhelmingly *E. coli* (Table B).

Escherichia coli

Tributary AUs listed for *E. coli* are shown in Table 5.18. Bacterial loads for tributaries were calculated using the geometric mean *E. coli* organisms/100 ml using five samples collected within a 30-day assessment period in the most recent sampling year. This concentration of *E. coli* was multiplied by the estimated 10th percentile discharge, or 1.5 year recurrence interval discharge, reported in USGS StreamStats version 2.0. This load estimation approach highlights our understanding that bacterial loads tend to be greatest when stream discharge is low. For Marsh Creek, *E. coli* loads were calculated using the 10th percentile August discharge from the USGS Marsh Creek gage. Target loads were estimated using the same approach and the State of Idaho's numeric criterion for *E. coli*. From this analysis, it is apparent that documented *E. coli* loads in the following tributaries exceed target loads by as much as 17.5 times (Cherry Creek) or as little as 1.9 times (Marsh Creek).

Marsh Creek

Marsh Creek is designated as a secondary contact recreation water and was monitored at a variety of locations over calendar years 2003 to 2008. Ambient bacterial monitoring in Marsh Creek did not conform to the prescribed criteria of the geomean from 5 samples within 30 days; however, the collective monitoring efforts from multiple agencies helped characterize annual variations in *E. coli* concentrations. Monitoring locations included: below the confluence with the Left and Right Forks of Marsh Creek, below the water retention pond near Downey, downstream of East Hawkins Road (before the confluence with Hawkins Creek), upstream of East Arimo Road, above West Portneuf Road near McCammon, and below Walker Creek. The most downstream site was sampled as part of the Portneuf River Monitoring Project and the remaining sites were sampled by the Idaho Association of Soil Conservation Districts (IASCD). Results from all of the IASCD locations are provided below but the confluence below Left and Right Forks of Marsh Creek is used as the compliance point for Marsh Creek AU ID17040208SK006_03a. Similarly, the monitoring location downstream of East Portneuf Road is used as the compliance point for lower middle Marsh Creek (ID17040208SK006_04a).

Table 5.18. Portneuf River Subbasin Tributary assessment units listed for *Escherichia coli*.

Listed Water Body Name	Assessment Unit and Date Sampled	5-sample geomean (organisms /100mL)	*E. coli* Load (organisms /day x 10^9)	Target Load (organisms/ day x 10^9)
Cherry Creek	ID17040208SK014_02a (upper Cherry Creek – Headwaters to USFS boundary); 2007	2,183	481.7	27.6
Dempsey Creek	ID17040208SK017_03 (lower Dempsey Creek – East Creek to Portneuf River); 2005	1,005	346.7	43.1
Garden Creek	ID17040208SK010_02b (lower Garden Creek –Garden Creek Gap to Marsh); 2002	558	159.7	35.8
Indian Creek	ID17040208SK005_02 (source to mouth); 2007	984	94.1	12.0
Mink Creek	ID17040208SK004_04 (USFS boundary to Portneuf River); 2007	381	146.3	48.0
Marsh Creek	ID17040208SK006_03a (confluence of Rt and Lt Forks to Red Rock Pass); 2007 and 2008	195*	160.3	102.8
Marsh Creek	ID17040208SK006_04a (Birch Creek to Cottonwood Creek); 2003 to 2005	219*	180.0	102.8
Marsh Creek	ID17040208SK006_04 (Cottonwood Creek to Portneuf River); 2007 and 2008	78**	64.1	102.8

*Marsh Creek AU ID17040208SK006_03a and ID17040208SK006_04a *E. coli* concentrations were estimated using data from IASCD July 2007 to July 2008 for _03a and December 2006 to July 2008 for _04a from bimonthly sampling activities.

** Lower Marsh Creek (ID17040208SK006_04) *E. coli* concentrations were estimated using the median monthly sampling results from concentration from July 2003 to December 2005. Therefore, the *E. coli* concentrations used for Marsh Creek assessment units do not represent a 5-sample geomean, but rather the median concentration of *E. coli* over the period of record for each of the monitoring locations. Additionally, Marsh Creek *E. coli* loads were calculated using the 10th percentile discharge (33.6 cfs) from lowest discharge month (August) from the USGS Marsh Creek gaging station for the period of record extending from 1955 to 2006.

The upstream-most location lies below the confluence with the Left and Right Forks of Marsh Creek, which was sampled from July 2007 through July 2008. Median concentrations for this period were 195 organisms/100 mL. Concentrations were lowest in samples collected in August, September, and December 2007 and May 2008. Bacterial concentrations were highest in June and July of both years when the average (n=7) was 919 organisms/100 mL. Only one sample was collected in October (126 organisms/100 mL) and November (308 organisms/100 mL), but concentrations were higher than those documented in August and September.

Below the water retention pond near Downey, Marsh Creek had higher concentrations of *E. coli* than the upstream monitoring location and regularly exceeded the single sample maxima for secondary contact recreation (576 *E. coli* organisms/100 mL). The median concentration for the 21 samples collected at this location was 461 organisms/100 mL and the range from May 2007 to July 2008 was 5 to 2,419 organisms/100 mL.

Escherichia coli concentrations in Marsh Creek downstream of East Hawkins Road were monitored bimonthly between November 2006 and July 2008. *E. coli* concentrations varied seasonally and ranged from 1 to 648 organisms/100 mL. The median concentration of *E. coli* over this period was 80 organisms/100 mL, but exceedances of single sample secondary contact recreation criteria were documented. *E. coli* concentrations in this reach tended to increase during summer months and the highest concentration measured over this period was in June 2008 (648 organisms/100 mL).

A reach of Marsh Creek located upstream of East Arimo Road near Arimo had a median concentration of *E. coli* of 136 organisms/100 mL from bimonthly sampling conducted between November 2006 and July 2008. The maximum concentration documented from November through April was 52 organisms/100 mL (median = 25 organisms/100 mL). One of the samples collected in July 2007 and June 2008 exceeded the single sample maxima for secondary contact recreation.

From December 2006 to July 2008, concentrations of *E. coli* in Marsh Creek above West Portneuf Road near McCammon were similar to concentrations from the upstream monitoring location near Arimo. Concentrations were highest from May to October (median of 219 *E. coli* organisms/100 mL) and lowest from November to April (median of 49 organisms/100 mL). None of the samples collected exceeded the single sample maxima for secondary contact recreation.

E. coli concentrations in lower Marsh Creek below Walker Creek ranged from 1 to 454 organisms per 100 mL from July 2003 to December 2005. The median *E. coli* concentration from this sampling was 78 organisms/100 mL. The annual bacterial concentration maxima occurred during the summer and was greatest in 2004; the average *E. coli* concentrations for July and August were 139, 396, and 69 organisms/100 mL for calendar years 2003, 2004, and 2005, respectively. The average annual discharge recorded at the USGS Marsh Creek gage for calendar year 2004 ranked 49th out of a 52-year record and low discharge may have contributed to elevated concentrations in 2004 relative to 2003 and 2005.

As a tributary, Marsh Creek experiences annual variations in the concentration of *E. coli*. During the months of May to October consistently higher concentrations of *E. coli* are documented and single sample exceedances of the secondary contact recreation criteria were documented at multiple locations. Additional sampling is recommended to determine whether beneficial uses are supported; monitoring for beneficial use support should support the determination of whether the geomean from 5 samples within 30 days is within criteria for recreational use.

Based on the results described above, there is insufficient evidence to remove *E. coli* as a pollutant from any of the Marsh Creek assessment units included on the 2002 §303(d) list. The lowest concentrations of *E. coli* in Marsh Creek were documented in lower Marsh Creek (ID17040208SK006_04), where the median *E. coli* concentration was below the State of Idaho's *E. coli* criterion. Despite the relatively low bacterial loads described, exceedances of the single sample secondary contact recreation threshold were documented in lower Marsh Creek.

Sediment

Portneuf River tributaries present on the 2002 §303(d) list included Beaverdam Creek, Cherry Creek, Yago Creek, Kinney Creek, North Fork of Pocatello Creek, South Fork of Pocatello Creek, Rapid Creek, and Marsh Creek. Marsh Creek is divided into multiple AUs and four of these AUs were included on the 2002 §303(d) list (Table 2.2). All but Yago Creek are now included in Section 4a (units having EPA approved TMDLs) of the 2008 Integrated Report.

Idaho's statewide Beneficial Use Reconnaissance Program (BURP) works to assess the physical and biological conditions of Idaho's aquatic resources, with annual assessment activities. BURP activities include measurement of dominant stream substrates and bank stability, combined with other physical measures, which are part of the Stream Habitat Index (SHI). The SHI is an index of habitat condition and the sum of ten individual components that represent physical measures or land use indicators. The components measured are in-stream cover, large organic debris, percent fines (< 2 mm in diameter) in the wetted channel width, embeddedness, Wolman size class, channel shape, percent bank vegetative cover, percent canopy cover, disruptive pressures, and zone of influence. Generally, the habitat measures included in the SHI are predictors of stream biological condition (Fore and Bollman 2000); therefore, results of this index and individual metrics that serve to assess sediment impacts are included in the following discussion on tributaries in the Portneuf River subbasin. The SHI alone can not be used to demonstrate impairment, but the index scoring criteria helps provide context for conditions in the tributaries described below. The SHI for the Northern Basin and Range bioregion which includes the Portneuf River subbasin is described in Table 5.19, along with the other stream indices.

Table 5.19. Index Scoring Criteria for Beneficial Use Reconnaissance Program Surveys from Grafe et al. 2002.

SMI* Condition Category	SMI (Basins)	SHI * (Northern Basin and Range)	SFI*Condition Category	SFI (Rangeland)	Condition Rating
Above 25th percentile of reference condition	≥51	≥63	Above the median of reference condition	>82	3
10th to 25th percentile of reference condition	43-50	50-62	25th percentile to median of reference condition	62-81	2
Minimum to 10th percentile of reference condition	33-42	<50	5th to 25th percentile of reference condition	39-61	1
Below minimum of reference condition	<33	N/A	Below 5th percentile of reference condition	<39	Minimum Threshold

* SMI – stream macroinvertebrate index; SHI – stream habitat index; SFI – stream fish index.
N/A – Not available.
SHI does not have a minimum threshold condition rating. A result below the minimum of reference condition is identified as being at the minimum threshold. The purpose of a minimum threshold is to identify significant impairment that may not be apparent after data index integration. DEQ uses this as a signal from individual indices to ensure protection of cold water aquatic life. DEQ concludes the water body is not fully supporting the use if a water body has even one index result below a minimum threshold.

Lower Marsh Creek

The presence of a permanent monitoring location in lower Marsh Creek provides a summary of loading for AU ID17040208SK006_04 (lower Marsh Creek), but also provides information regarding upstream assessment units by providing daily estimates of sediment loading by month and year for Marsh Creek. This major tributary does have an upstream AU that was included on the 2002 §303(d) list (i.e., Upper Marsh Creek; ID17040208SK006_03a) for sediment. Sediment loads in lower Marsh Creek were lowest during baseflow (August, September, October, and November) and below or near the target loads for these months. During the remaining low-flow months and all of the high-flow months, average TSS loads in lower Marsh Creek were considerably higher than target loads. In the months of February, March, April, and May, daily TSS load reductions greater than 70% are necessary to meet in-stream targets (Table 5.20).

Table 5.20. Estimated and target daily Total Suspended Solids (TSS) loads for Lower Marsh Creek (based on monthly averages and expressed in tons/day). Estimated loads represent the product of average monthly discharge and TSS/SSC concentrations from monthly sampling activities.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004 Estimated TSS load	**3.4**	**4.0**	**50.6**	**7.1**	**2.7**	**0.7**	**1.8**	**1.1**	**0.6**	**2.4**	**4.3**	**10.4**
2004 Target load*	4.2	4.4	19.0	11.8	9.7	10.7	3.9	3.3	4.4	6.3	5.6	5.9
2005 Estimate TSS load	**7.2**	**8.0**	**39.2**	**15.0**	**37.6**	**12.3**	**1.9**	**1.4**	**3.8**	**4.3**	**4.6**	**17.3**
2005 Target load*	5.6	5.5	25.0	18.7	27.6	24.6	5.6	3.8	5.3	6.7	6.2	7.3
2006 Estimated TSS load	**31.5**	**84.4**	**179.7**	**138.8**	**85.1**	**11.4**	**10.3**	**3.5**	**10.8**	**6.4**	**8.6**	**13.2**
2006 Target load*	11.0	8.5	35.9	50.5	40.3	18.2	6.4	5.0	7.3	7.4	7.5	7.1
Average TSS load (2004 – 2006)	**14.0**	**32.1**	**89.8**	**53.6**	**41.8**	**8.1**	**4.6**	**2.0**	**5.1**	**4.3**	**5.9**	**13.6**
Target load using 10th percentile Q at Lower Marsh Creek predicted from USGS Marsh Creek Gage	5.6	6.5	19.2	13.9	9.7	9.0	3.6	3.5	4.9	6.0	5.7	5.9
Reduction required based on 2004 – 2006 average loads and 10th percentile Q at Lower Marsh Creek predicted from USGS Marsh Creek Gage	**60%**	**80%**	**79%**	**74%**	**77 %**	**0%**	**22%**	**0%**	**4%**	**0%**	**3%**	**57%**

*Target loads are based on 35 and 80 mg/L low and high-flow TSS targets. The months of March, April, May, and June have been established as high-flow months.

Table 5.21. Tributary assessment units other than Marsh Creek that were included on the 2002 §303(d) list for sediment. All except Yago Creek now have approved TMDLs and are included in Section 4a of the 2008 Integrated Report.

Listed Water Body Name	Assessment Unit	Date Sampled	TSS concentration (mg/L) or % bank stability	TSS Load (lbs/day)	Target TSS Load (lbs/day) or % bank stability
Cherry Creek	ID17040208SK014_02a and _02	17 May 2004 18 August 2004 27 June 2006 25 September 2006 18 July 2007	21 mg/L 12 mg/L 18 mg/L 2.2 mg/L 19 mg/L	1,588 130 369 12 113	2,646* 378 718 183 202
Beaverdam Creek	ID17040208SK017_02c	2 July 2003	35%	N/A	80%
Yago Creek	ID17040208SK006_02c	1 July 2003	87%	N/A	80%*
Kinney Creek	ID17040208SK004_02a	22 July 2008 12 August 2008	51% 87%	N/A N/A	80%
North Fork Pocatello Creek	ID17040208SK026_02 and _02a	22 August 2002	95%	N/A	80%*
South Fork Pocatello Creek	ID17040208SK025_02	High flow mean 1999 to 2000 Low flow mean 1999 and 2000	75 mg/L 44 mg/L	 808	 643
Rapid Creek	ID17040208SK023_03	19 July 2001 30 March 2007	99% 23.4 mg/L	 2,186	80%* 7,474

*Where the TSS or bank stability sediment targets are met, the measured concentrations of this pollutant serve as the de-facto TSS target.

Cherry Creek

The U.S. Department of Agriculture (USDA) Forest Service (USFS) characterized riparian vegetation and stream channel condition of Cherry Creek on September 4, 2008, in accordance with field guidance from Burton et al. (2008). Results indicate that 80% of the banks assessed were stable (criterion 80%) and 84% of the banks were covered by vegetation (BLM criterion 85%). Moreover, the Vegetation Erosion Resistance Rating, which indicates the ability of riparian vegetation to resist erosive forces of water, for the assessed reaches was 5.81. This rating score is below the BLM's vegetation erosion resistance rating criterion (7.0) considered necessary to protect the streambanks from erosion and to support proper stream function (Burton et al. 2008).

In 2004, the USFS sampled suspended sediments and measured the amount of fine sediments in Cherry Creek. Total suspended solids concentrations on May 17 and August 18, 2004, were 21 mg/L (discharge = 14 cfs; 1,588 lbs TSS/day) and 12 mg/L (discharge 2 cfs; 130 lbs TSS/day), respectively. Depth fines measurements from three reaches indicated that, on average, sediment materials with diameter less than 0.85 mm and less than 6.25 mm represented 7.8% and 24.4% of the bed, respectively. The 2001 Portneuf River TMDL had depth fines targets of 10% for materials smaller than 0.85 mm and 25% for materials smaller than 6.25 mm.

Upper Cherry Creek (ID17040208SK014_02a) was included in the BURP assessment of the Portneuf River Subbasin in 2005 and 2002. Both assessments indicated that upper Cherry Creek was fully supporting cold water aquatic life (78.57 SMI and 79.0 SHI in 2005, and 62.29 SMI and 62.0 SHI in 2002). In 2002, fines smaller than 2.0 mm in the wetted perimeter represented only 9.6 % of the total substrates. On average, 7 sediment classes were present in each of three riffles within upper Cherry Creek. Additionally, 93.5% of a representative 100 meter (m) reach was described as stable during this assessment. Results presented from the 2002 assessment indicate that upper Cherry Creek is meeting the current Portneuf River WAG-endorsed sediment targets.

Water quality samples collected in 2006 and 2007 showed that TSS concentrations in Cherry Creek were below the high and low-flow TSS targets for tributaries. On June 27 and September 25, 2006, TSS concentrations were 18 mg/L and 2.2 mg/L. Similarly, TSS concentrations on July 18, 2007 were 19 mg/L. The estimated TSS loads and target loads for these dates are shown in Table 5.21.

Collectively, the aforementioned assessments of the bed and banks, along with measurements of suspended sediment concentrations indicate that Cherry Creek is supporting the cold water aquatic life use and meeting the Portneuf River sediment targets and this warrants a delisting of Cherry Creek for sediments. DEQ recommends continued sampling of Cherry Creek to determine whether physical conditions in Cherry Creek continue undiminished.

Beaverdam Creek

Beaverdam Creek (ID17040208SK017_02c) was assessed in 2003 as part of DEQ's BURP assessment of tributaries to the Portneuf River. The SMI and SHI from this assessment were 26.75 and 45.0, indicating that the cold water aquatic life use was not supported. Based on the results of the 2003 BURP sampling, Beaverdam Creek does not support cold water aquatic life

beneficial use. The SHI for a representative reach sampled in 2003 was 45.0, indicating it ranks among sites that received the lowest habitat condition rating. Fines (sediment materials < 2.0 mm in diameter) predominate the wetted substrate at 54.6%, but on average, 6 sediment classes were detected from the three focal reaches. Unstable banks were documented for more than 65% of a representative 100 m reach.

The evidence described above shows that Beaverdam Creek is impaired by sediment and future efforts in the subwatershed should focus on reducing fine sediments and increasing bank stability as strategies to reduce sediment loading.

Lower Yago Creek

Lower Yago Creek (ID17040208SK006_02c) was assessed as part of the BURP assessment of the Portneuf River subbasin in 2003. These biological and habitat assessments indicated that lower Yago Creek was fully supporting the cold water aquatic life use (44.89 SMI and 56.0 SHI in 2003). At the time, the SHI indicated that its habitat condition rating was intermediate among Idaho streams (condition score = 2). The average percentage of fines smaller than 2.0 mm in the wetted width was 55.0%, indicating that a disproportionate amount of available substrate was silts or sands. The average number of sediment size classes was 6 and ranged from silt to small boulders. The estimated bank stability for a 100 m reach indicated that 86.5% of the sample reach had stable banks.

Based on the results of the 2003 BURP sampling, lower Yago Creek appears to fully support the cold water aquatic life use. Additionally, the high bank stability estimates from 2003 support the claim that the sediment target is being met. The percentage of fines smaller than 2.0 mm indicates that riffles sampled in 2003 had a higher than expected sediment load for a tributary with stable banks. Regardless, the recommendation is that lower Yago Creek be removed from the §303(d) list, but that sampling continues to clearly characterize annual loading from suspended sediments and substrate conditions in this subwatershed.

Kinney Creek

The USFS characterized riparian vegetation and stream channel condition of Kinney Creek on July 22, 2008, in accordance with field guidance from Burton et al. (2008). Results indicate that 51% of the banks assessed were stable (criterion 80%) and 55% of the banks were covered by vegetation (BLM criterion 85%). Moreover, the Vegetation Erosion Resistance Rating, or the ability of the riparian vegetation to resist erosive forces of water, for the assessed reaches was 6.20. This rating score is below the BLM's vegetation erosion resistance rating criterion (7.0) considered necessary to protect the streambanks from erosion and to support proper stream function (Burton et al. 2008).

Three riffles of lower Kinney Creek were also included in the 2008 BURP assessment of the Portneuf River subbasin. Although biological samples are still being processed, physical measures of Kinney Creek collected from the August 12, 2008, sampling effort provide additional evidence of the substrate conditions. From these three riffles, the average percentage of fines smaller than 2.5 mm was 22.7% and the average number of sediment size classes was 6. Moreover, the bank stability for a 100 m reach was 87% stable (45% covered stable and 42% uncovered stable).

The above summaries of the physical assessments of Kinney Creek indicate that conditions varied between the two sampling reaches and show that some portions of Kinney Creek are susceptible to erosion. This is not surprising, given the protocols used by the USFS for selecting designated monitoring areas (DMAs) for multiple indicator monitoring. Following Burton et al. (2008), DMAs for riparian grazing are placed at locations that best represent the major activities or influences (i.e., grazing) to be monitored, that show vegetation is the controlling factor for stability, that are sensitive to grazing, and that have the ability to recover quickly from changing management strategies. Accordingly, the USFS may have selected locations that exhibited more pronounced grazing impacts and the measurements described above (predominance of unstable banks) support this hypothesis.

Macroinvertebrates collected as part of the 2008 BURP survey have yet to be identified and characterized, and therefore, CWAL support cannot be determined at this time. For this reason, Kinney Creek will remain on the §303(d) list pending further evaluation of BURP data and additional sampling to better characterize the annual variations in suspended sediment loads. Moreover, future surveys of bank stability should be completed to determine whether land management changes in this watershed result in improved bed and bank conditions.

North Fork of Pocatello Creek

The North Fork of Pocatello Creek (ID17040208SK026_02a) was assessed in 2007 and 2002 as part of DEQ's BURP assessments in the Portneuf River subbasin, and received SHI scores of 55 and 54, respectively, indicating an intermediate habitat condition. In 2002, fines (sediment materials < 2.0 mm) represented 44.5% of the wetted substrate and an average of 5 sediment classes were detected from the three study reaches. Stable banks were documented along 95% and 100% of 100 m representative reaches in 2002 and 2007, respectively, and results from both years met the bank stability target. Bimonthly monitoring of TSS in 1999 and 2000 showed that low-flow TSS concentrations exceeded the 35 mg/L low-flow sediment (TSS) target (average 64 mg/L; IASCD 2001). Still, when the 2002 habitat summaries were combined with the SMI score, the 2002 BURP assessment indicated that North Fork of Pocatello Creek fully supports cold water aquatic life use. Moreover, 2007 estimates of bank stability met the bank stability sediment target. Combined, this evidence indicates that North Fork of Pocatello Creek should be delisted for sediment.

South Fork of Pocatello Creek

The South Fork of Pocatello Creek (AU ID17040208SK025_02) was not assessed during recent BURP assessments in the Portneuf River subbasin. The most recent sampling conducted on the South Fork of Pocatello Creek was conducted by the Idaho Association of Soil Conservation Districts (IASCD). From 1999 and 2000, the mean high-flow TSS concentration was 75 mg/L and for low–flow, it was 44 mg/L. These results indicate that TSS concentrations in the South Fork of Pocatello Creek exceeded the low-flow target established for tributaries in the Portneuf River Subbasin. Using the estimated 10th percentile discharge (3.4 cfs) from USGS StreamStats (see tributary E. coli section above), the estimated low-flow average TSS load for the South Fork of Pocatello Creek was 807.8 lbs TSS/day. This estimated TSS load exceeds the low-flow TSS target load of 642.6 lbs/day by approximately 160 lbs/day and suggests that the South Fork of Pocatello Creek should remain on the §303(d) list for sediments. Further, DEQ recommends that

assessments of physical substrate and suspended sediment load are conducted to assess whether targets are met and beneficial uses are supported in this tributary and whether changes in sediment loads have occurred since the last comprehensive assessment was conducted by the IASCD.

Rapid Creek

Two reaches of lower Rapid Creek (ID17040208SK023_03) were assessed in 2001 and indicated full support for the cold water aquatic life use (54.93 and 72.53 SMI and 56 and 79 SHI). Fines (sediment materials < 2.0 mm) represented only 16.2% of the wetted substrates and on average 8 sediment classes were detected in each of three reaches. Stability estimates from a representative reach indicate 99% bank stability in lower Rapid Creek.

Duplicate grab samples were taken from the mouth of Rapid Creek at 0900, 1200, and 1500 hrs on March 30, 2007 and analyzed for suspended sediment concentration (SSC; an estimate of the suspended sediment concentration that is comparable to TSS). Mean concentrations were 29.8, 18.2, and 22.3 mg/L, respectively, for the aforementioned times. From bimonthly sampling completed in 1999 and 2000, the mean annual low and high-flow TSS concentrations in lower Rapid Creek were 8 and 58 mg/L, respectively, and met the TSS sediment targets (IASCD 2001). Determinations of beneficial use support, estimates of bank stability, and measurements of suspended sediment concentrations provide sufficient evidence for delisting Rapid Creek for sediment.

Nutrients

The 2002 §303(d) list included three AUs listed for nutrients: Cherry Creek (ID17040208SK014_04), Marsh Creek (ID17040208SK006_03a), and Hawkins Reservoir (ID17040208SK012L_0L). Targets for TP (0.07 mg/L low-flow and 0.125 mg/L high-flow) and TN (1.0 mg/L) apply to Portneuf River subbasin tributaries. A summary of TP and TN loads associated with Cherry and Marsh creeks are summarized in Table 5.22 and in the following narrative.

Cherry Creek

Upper Cherry Creek (ID17040208SK014_02a) was included in the BURP assessment of the Portneuf River subbasin in 2005 and 2002. Both assessments indicated that upper Cherry Creek was fully supporting cold water aquatic life (78.57 SMI and 79.0 SHI in 2005 and 62.29 SMI and 62.0 SHI in 2002). Nutrient loading was assessed in Cherry Creek at the USFS boundary five times from 2004 to 2007 (Table 5.22). The median TN and TP concentrations from Cherry Creek were 0.31 mg/L and 0.04 mg/L, respectively. Load estimates were developed using discharge measurements completed during each sampling visit (Table 5.22). All five TN loads at Cherry Creek were below the target loads and four of five TP load estimates were below the target loads. Therefore, Cherry Creek is consistently meeting targets for both TN and TP and should be delisted for nutrients.

Table 5.22. Total nitrogen and total phosphorus concentrations and load estimates for Cherry Creek.

Date and Discharge (cfs)	TN Concentration (mg/L)	TN Load (lbs/day)	TN Target Load (lbs/day)	TP Concentration (mg/L)	TP Load (lbs/day)	TP Target Load (lbs/day)
17 May 2004 14.0	0.34	25.7	75.6	0.035	2.6	9.45
18 August 2004 2.0	0.32	3.5	10.8	0.043	0.5	0.8
27 June 2006 3.8	0.31	6.4	20.5	0.040	0.8	1.4
25 September 2006 1.0	0.21	1.1	5.4	0.024	0.1	0.4
18 July 2007 1.1	0.93	5.5	5.9	0.088	0.5	0.4

Lower Marsh Creek

The lower Marsh Creek monitoring location serves as the compliance point for AU ID17040208SK006_04 (lower Marsh Creek), but also provides information for other Marsh Creek assessment units including lower middle Marsh Creek ID17040208SK006_03a, which is included in Section 4a of the 2008 Integrated Report, and was listed for nutrients on the 2002 §303(d) list. The summaries that follow provide daily load estimates for TN and TP by month and year for lower Marsh Creek.

Recent BURP assessments of lower Marsh Creek indicate that the cold water aquatic life use was not supported in both years (50.47 SMI and 54 SHI in 2006 and 18.9 SMI, 33 SHI, and 44.53 SFI in 2003). Additionally, a 2007 fish survey detected common carp, speckled dace, redside shiner, and a mottled sculpin; no salmonids or other native cold water taxa or sensitive taxa were documented.

Total Nitrogen

Total N loads were generally highest in March, April, and May, corresponding to high-flow periods for this subwatershed. In all years, however, loads increased during the fall. This late season increase was attributed to considerable increases in the concentration of nitrogen (NO2+NO3-N shown in Fig. 5.4) in lower Marsh Creek relative to late season changes in discharge. From the TN summaries shown in Table 5.23, it is clear that substantial reductions in TN are required in Marsh Creek for all months except August. It is recommended that Marsh Creek nitrogen TMDLs are revised to reflect the revised TN and target and loading information presented in Table 5.23.

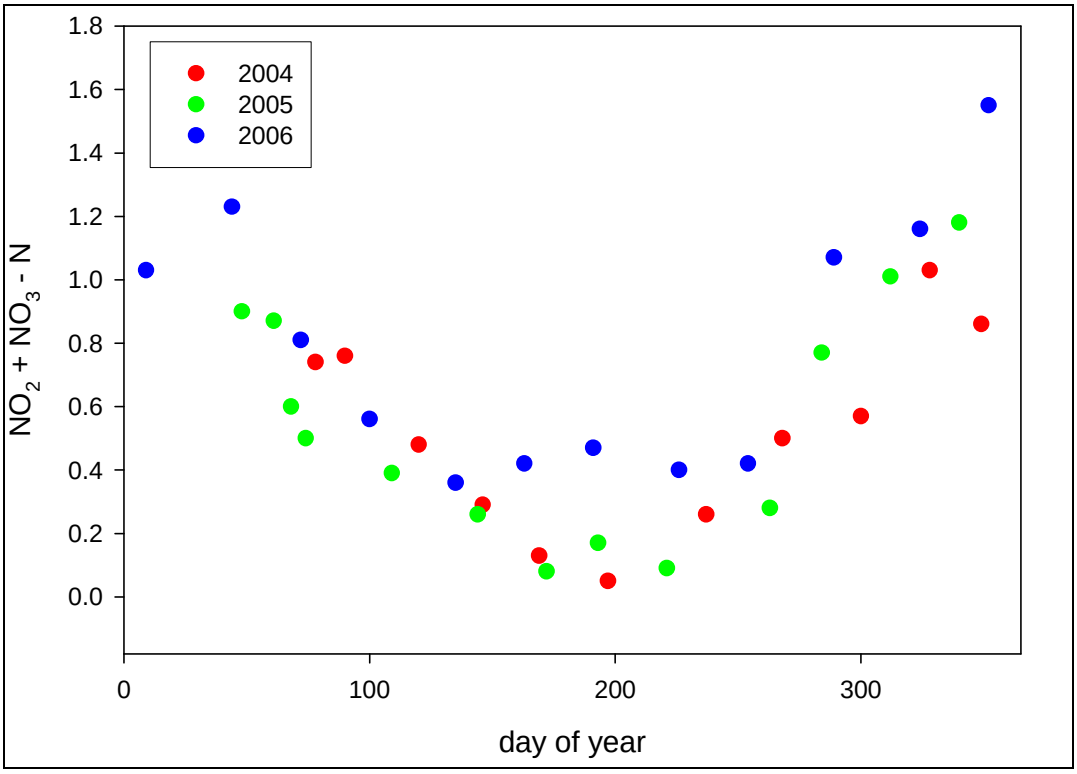


Figure 5.4. Nitrogen (expressed as $NO_2 + NO_3$-N) concentrations in lower Marsh Creek for calendar years 2004 to 2006 plotted by day of year.

Total Phosphorus

Total phosphorus loads in lower Marsh Creek were lowest during baseflow (July, August, and September), but exceeded the TP target loads in most months. Across all months, required daily TP load reductions necessary to meet the TP targets ranged from 0 to 85% and averaged 43% (Table 5.24). Marsh Creek phosphorus TMDLs currently in Section 4a of the 2008 Integrated Report should be revised to reflect the load analysis presented in Table 5.24.

Table 5.23. Estimated and target daily Total Nitrogen (TN) loads for lower Marsh Creek (based on monthly averages and expressed in lbs/day). Estimated loads represent the product of average monthly discharge and TN concentrations from monthly sampling activities.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004 Estimated TN load	**NS**	**NS**	**1069**	**495.2**	**94.2**	**276.2**	**212.9**	**182.2**	**150.0**	**460.5**	**488.5**	**591.4**
2004 Target load*	238.1	252.8	475.2	294.8	241.6	268.2	224.1	189.8	250.0	362.6	319.3	336.0
2005 Estimate TN load	**NS**	**597.3**	**724.1**	**697.7**	**1144**	**665.1**	**279.0**	**173.2**	**297.8**	**566.0**	**641.2**	**490.6**
2005 Target load*	318.6	314.4	624.2	468.3	689.3	615.8	320.7	219.2	303.9	385.0	354.2	415.8
2006 Estimated TN load	**1586**	**1133**	**3247**	**2474**	**1572**	**646.0**	**497.8**	**424.3**	**715.2**	**791.9**	**802.0**	**1117**
2006 Target load*	627.0	486.4	897.1	1262	1008	455.0	363.3	282.9	415.8	423.5	431.2	406.0
Average TN load (2004 – 2006)	**1586**[a]	**865.3**[b]	**1680**	**1222**	**936.8**	**529.1**	**329.9**	**259.9**	**387.6**	**606.1**	**643.9**	**732.8**
Target load using 10th percentile Q at Lower Marsh Creek predicted from USGS Marsh Creek Gage	322.8	369.7	479.7	347.0	242.9	224.5	207.3	200.5	279.5	342.9	324.4	337.3
Reduction required based on 2004 – 2006 average loads and 10th percentile Q at Lower Marsh Creek predicted from USGS Marsh Creek Gage	**80%**	**57%**	**71%**	**72%**	**74%**	**58%**	**37%**	**0%**	**28%**	**43%**	**50%**	**54%**

Target loads are based on a 1.0 mg/L low-flow TN target.
NS = Not Sampled.
[a]Note that the 3-year average is based only on 2006 loads due to no total Kjeldahl N sampling in other years.
[b]Note that the 3-year average is based on 2005 and 2006 loads only due to no total Kjeldahl N sampling in other years.

Table 5.24. Estimated and target daily Total Phosphorus (TP) loads for Lower Marsh Creek (based on monthly averages and expressed in lbs/day). Estimated loads represent the product of average monthly discharge and TP concentrations from monthly sampling activities.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004 Estimated TP load	**17.4**	**20.0**	**148.3**	**26.5**	**14.5**	**12.9**	**14.1**	**12.3**	**11.0**	**21.4**	**22.7**	**46.0**
2004 Target load*	16.7	17.7	59.4	36.8	30.2	33.5	15.7	13.3	17.5	25.4	22.3	23.5
2005 Estimate TP load	**32.8**	**35.2**	**149.8**	**50.1**	**101.3**	**43.7**	**15.4**	**9.4**	**13.7**	**24.3**	**28.7**	**65.7**
2005 Target load*	22.3	22.0	78.0	58.5	86.2	77.0	22.4	15.3	21.3	27.0	24.8	29.1
2006 Estimated TP load	**126.7**	**91.9**	**866.6**	**295.4**	**226.7**	**39.6**	**33.4**	**17.3**	**37.4**	**38.5**	**37.9**	**57.7**
2006 Target load*	43.9	34.1	112.1	157.8	125.9	56.9	25.4	19.8	29.1	29.6	30.2	28.4
Average TP load (2004 – 2006)	**59.0**	**49.0**	**388.2**	**124.0**	**114.2**	**32.1**	**21.0**	**13.0**	**20.7**	**28.1**	**29.8**	**56.5**
Target load using 10th percentile Q at Lower Marsh Creek predicted from USGS Marsh Creek Gage	22.6	25.9	60.0	43.4	30.4	28.1	14.5	14.0	19.6	24.0	22.7	23.6
Reduction required based on 2004 – 2006 average loads and 10th percentile Q at Lower Marsh Creek predicted from USGS Marsh Creek Gage	**62%**	**47%**	**85%**	**65%**	**73%**	**12%**	**31%**	**0%**	**5%**	**14%**	**24%**	**58%**

*Target loads are based on 0.07 and 0.125 mg/L low and high-flow TP targets. The months of March, April, May, and June have been established as high-flow months.

Hawkins Reservoir

Hawkins Reservoir is positioned on Hawkins Creek in the Marsh Creek subwatershed. The Reservoir is approximately 66 acres at full pool and this equates to approximately 567 acre-feet of storage. Hawkins Reservoir was first listed for dissolved oxygen and nutrients on the 1996 §303(d) list.

Nutrient concentrations in Hawkins Reservoir and in Hawkins Creek above and below the reservoir were measured multiple times between 2006 and 2008. Although Hawkins Creek is included in Section 4a of the 2008 Integrated Report for the Portneuf River subbasin (meaning it has an approved TMDL), nutrient concentrations in Hawkins Reservoir reflect the balance between loading from and discharge to Hawkins Creek. The resulting loads in Hawkins Creek measured above and below the reservoir are summarized in Tables 5.25 and 5.26.

Table 5.25. Total nitrogen and total phosphorus loading from Hawkins Creek to Hawkins Reservoir.

Date and Discharge (cfs)	TN Conc. (mg/L)	TN Load (lbs/day)	TN Target Load (lbs/day)	TP Conc. (mg/L)	TP Load (lbs/day)	TP Target Load (lbs/day)
21 June 2006 2.2	2.50	29.7	11.9	0.242	2.9	1.5
27 July 2006 1.2	2.21	14.3	6.5	0.182	1.2	0.2
31 August 2006 0.7	1.91	7.2	3.8	0.129	0.5	0.1
27 September 2006 1.0	2.03	11.0	5.4	0.183	1.0	0.2
23 January 2007 0.8	3.40	14.7	4.3	0.380	1.6	0.1
9 April 2007 1.9	1.91	19.6	10.3	0.110	1.1	1.3
18 July 2007 0.5	1.39	3.8	2.7	0.100	0.3	0.1
3 March 2008 1.5 (estimated)	2.16	17.5	8.1	0.243	2.0	0.2
Loads are estimated using TN target of 1.0 mg/L and a TP target of 0.03 mg/L low-flow and 0.125 mg/L high-flow (April, May, and June) for Hawkins Creek above Hawkins Reservoir.						

Loading to Hawkins Reservoir exceeded the targets for both TN and TP on all sampling occasions. Total nitrogen concentrations entering Hawkins Reservoir averaged 2.19 mg/L for the period of record and were more than 2 times the target concentrations. Hawkins Creek waters entering Hawkins Reservoir had an average TP concentration of 0.196 mg/L. There was no apparent pattern indicating concentrations of TP varied predictably during low-flow periods (low-low samples included 0.242 mg/L in June 2006 and 0.110 mg/L in April 2007).

Concentrations of TP during low-flow months (average 0.203 mg/L) were nearly 7 times greater than the TP target of 0.03 mg/L proposed to prevent nuisance phytoplankton blooms (Table 5.26).

Table 5.26. TN and TP Loads from Hawkins Reservoir to Hawkins Creek

Date and Discharge (cfs)	TN Conc. (mg/L)	TN Load (lbs/day)	TN Target Load (lbs/day)	TP Conc. (mg/L)	TP Load (lbs/day)	TP Target Load (lbs/day)
21 June 2006 6.9	1.02	38.0	37.3	0.346	12.9	4.7
27 July 2006 2.7	1.32	19.2	14.6	0.446	6.5	1.0
31 August 2006 2.2	1.62	19.2	11.9	0.169	2.0	0.8
27 September 2006 <0.1	0.66	0.4	0.5	0.273	0.1	0.1
23 January 2007 <0.1	0.42	0.2	0.5	0.222	0.1	0.04
9 April 2007 0.2	0.51	0.6	1.1	0.221	0.2	0.1
18 July 2007 4.8	0.85	22.0	25.9	0.320	8.3	1.8
3 March 2008 0.5 (estimated)	0.4	1.1	2.7	0.267	0.7	0.2
Loads are estimated using a target of 1.0 mg/L TN concentration and a TP target of 0.07 mg/L low-flow and 0.125 mg/L high-flow (April, May, and June) for Hawkins Creek above Hawkins Reservoir.						

Total nitrogen and TP loading from Hawkins Reservoir to Hawkins Creek is largely influenced by discharge. Estimated discharge in Hawkins Creek below the reservoir outlet varied from 6.9 cfs to less than 0.1 cfs. Total nitrogen concentrations in Hawkins Creek measured below Hawkins Reservoir averaged 0.85 mg/L and were significantly lower than inlet concentrations. In contrast, TP concentrations in Hawkins Creek averaged 0.283 mg/L and were 1.4 times higher than inlet concentrations (Tables 5.25 and 5.26). From these results, it would appear that Hawkins Reservoir acts as a source of TP loading to Hawkins Creek; on the contrary, the reservoir serves to remove nitrogen from Hawkins Creek, presumably through denitrification. Support for this claim is based on seasonal changes in the NO_2+NO_3-N measured in both bottom and water column samples from Hawkins Reservoir (DEQ data not shown). In all cases, nitrate concentrations were at or below detection limits during summer and elevated during cool seasons.

Table 5.27. Maximum depths, secchi depths, and concentrations of TN and TP and chlorophyll *a* from sampling conducted within Hawkins Reservoir.

Date and Water Depth (m)	Secchi Depth (m)	TN Concentration (mg/L)	TP Concentration (mg/L)	Chl *a* (µg/L)
21 June 2006 7.1	4.9	1.46[b] 1.06[c]	0.550[b] 0.143[c]	14.0
27 July 2006 5.5	4.7	2.51[b] 1.00[c]	0.850[b] 0.155[c]	0.5
31 August 2006 4.2	1.5	1.81[b] 1.81[c]	0.161[b] 0.155[c]	NS
27 September 2006 4.6	4.2	1.37[b] 1.27[c]	0.177[b] 0.179[c]	1.8
23 January 2007 6.2	6.1	1.33[b] 1.27[c]	0.223[b] 0.178[c]	0.5
9 April 2007 7.2	2.5	1.51[c]	0.270[c]	66.0
18 July 2007 5.1	3.4	1.11[b] 0.87[c]	0.440[b] 0.250[c]	8.4
3 March 2008 5.5	Ice	2.48[b] 1.67[c]	0.446[b] 0.190[c]	0.4

b=bottom sample; c=column sampled which is a composite of a bottom, middle, and upper water column sample. Ice indicates that the depth could not be estimated because of ice. NS = not sampled.

A summary of the nutrient concentrations from bottom samples (approximately 0.2 m above the bottom) and column samples (composite of bottom, middle, and upper waters) are provided from eight sampling events conducted at Hawkins Reservoir between 2006 and 2008 (Table 5.27). Total nitrogen and TP samples from all sampling dates exceeded the targets for this assessment unit. Estimates of phytoplankton biomass from chlorophyll *a* concentrations (Table 5.27) show that chlorophyll *a* concentrations (66.0 µg/L) on April 9, 2007, were more than 4 times the target concentration of 15 µg/L.

Dissolved Oxygen

Hawkins Reservoir is included on the 2008 §303(d) list for DO and TP. This listing is a carryover from the 2002 and 1998 §303(d) lists, which included listings for nutrients (TP and TN) and DO. No loading analysis was completed for Hawkins Reservoir in the previous TMDL (approved April 2001) due to a paucity of data.

Hawkins Reservoir DO profiles were developed using field oxygen measurements taken during each of the eight sampling visits from 2006 to 2008. Oxygen profiles are used to characterize concentrations of DO as a function of depth and these profiles facilitate the interpretation of Idaho's DO criterion for lakes and reservoirs. Recall that for reservoirs in which the depth is greater than or equal to 35 m the DO criterion applies only to the upper 80% of the water column. Summaries of data from each site visit are shown in Figure 5.5, documenting failure to meet the DO criterion in July 2006, January 2007, July 2007, and

March 2008. On March 3, 2008, an auger was used to punch through approximately 20 inches of ice at the reservoir surface and subsequent sampling revealed failure to meet the DO criterion extending throughout the entire 5.5-m water column (Fig. 5.5). These profiles and the documented failures to meet the DO criterion show that Hawkins Reservoir does not meet DO criteria for cold water aquatic life and require that this assessment unit remain listed for dissolved oxygen. It is anticipated that implementation of BMPs in the watershed aimed at reducing influent sediment and nutrient loads will improve dissolved oxygen conditions in the reservoir.

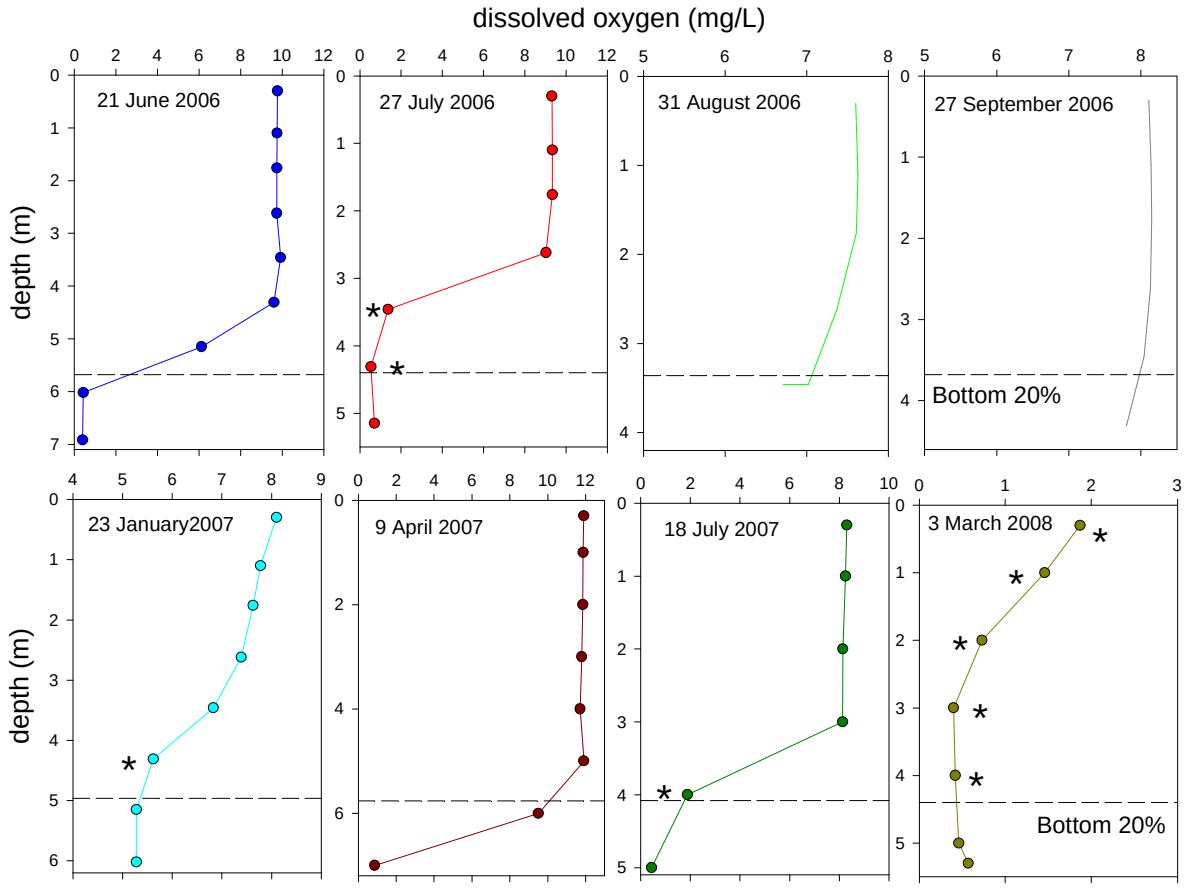


Figure 5.5. Dissolved oxygen profiles for Hawkins Reservoir between 2006 and 2008. Note differences in x-axis scales. Asterisks indicate failures to meet criteria.

Construction Storm Water and TMDL Wasteload Allocations

Construction Storm Water

The Clean Water Act requires operators of construction sites to obtain permit coverage to discharge storm water to a water body or to a municipal storm sewer. In Idaho, EPA has issued a general permit for storm water discharges from construction sites. In the past storm water was treated as a nonpoint source of pollutants. However, because storm water can be managed on site through management practices or when discharged through a discrete

conveyance such as a storm sewer, it now requires a National Pollution Discharge Elimination System (NPDES) Permit.

The Construction General Permit (CGP)

If a construction project disturbs more than one acre of land (or is part of larger common development) that will disturb more than one acre), the operator is required to apply for permit coverage from EPA after developing a site-specific Storm Water Pollution Prevention Plan.

Storm Water Pollution Prevention Plan (SWPPP)

In order to obtain the Construction General Permit operators must develop a site-specific Storm Water Pollution Prevention Plan. The operator must document the erosion, sediment, and pollution controls they intend to use, inspect the controls periodically and maintain the best management practices (BMPs) through the life of the project

Construction Storm Water Requirements

When a stream is on Idaho's §303(d) list and has a TMDL developed, DEQ now incorporates a gross wasteload allocation (WLA) for anticipated construction storm water activities. TMDLs developed in the past that did not have a WLA for construction storm water activities will also be considered in compliance with provisions of the TMDL if they obtain a CGP under the NPDES program and implement the appropriate Best Management Practices.

Typically there are specific requirements you must follow to be consistent with any local pollutant allocations. Many communities throughout Idaho are currently developing rules for post-construction storm water management. Sediment is usually the main pollutant of concern in storm water from construction sites. The application of specific best management practices from *Idaho's Catalog of Storm Water Best Management Practices for Idaho Cities and Counties* is generally sufficient to meet the standards and requirements of the General Construction Permit, unless local ordinances have more stringent and site-specific standards that are applicable.

5.2c Reasonable Assurance

The U. S. Environmental Protection Agency (EPA) requires that Total Maximum Daily Loads (TMDL's), with a combination of point and nonpoint sources and with wasteload allocations dependent on nonpoint source controls, provide reasonable assurance that nonpoint source controls will be implemented and effective in achieving the load allocation (EPA 1991). If reasonable assurance that nonpoint source reductions will be achieved is not provided, the entire pollutant load will be assigned to point sources. Nonpoint source reductions listed in the Portneuf River TMDL Revision will be achieved through state authority within the Idaho Nonpoint Source Management Program and through the State's authority under the Idaho Environmental Protection and Health Act, Idaho Code §39-116A via a Voluntary Consent Order/Compliance Agreement with the J. R. Simplot Company signed on April 11, 2008, outlining activities, milestones and timeframes for remedial activities to address phosphorus loading to the groundwater and subsequently the Portneuf River. This enforceable agreement is attached as part of this TMDL as Appendix J. This binding agreement calls for reductions of P concentrations in the Portneuf River from an

annual median concentration of 1.250 mg/L currently to 0.075 mg/L by the year 2021. Another proposed milestone for this segment of river is the City of Pocatello's commitment to meet a wasteload allocation of 25.1 lbs TP/day at its WWTP outfall. This will be accomplished by the following actions: a) beginning with NPDES final permit issuance (year 2010) an initial engineering study completed in 1.5 – 2 years, b) selector basin final engineering in year 3, c) selector basin construction and upgrades in year 4-5), d) final engineering to meet the phosphorus WLA in year 6, and e) complete plant upgrades and optimize operation ending by year end 2019. The time frame for this action by the City of Pocatello is commensurate (actually 2-years ahead of) the large-scale reductions required through Simplot's remedial actions (i.e., by year-end 2021). Implementation of these nutrient reduction measures is anticipated to help meet the significant reductions in TP loading required to achieve the target loads for the lower river, and realize reductions described in Table 5.14 of this TMDL. In addition, implementation of the Pocatello Urbanized Area (PUA) Phase II Stormwater Permit is in its fourth year and is geared toward decreasing the impact of urban stormwater on the Portneuf River and select tributaries. It is anticipated that through implementation of the provisions in the Federal Phase II Stormwater permit that sediment, nutrients, bacteria and oil and grease will be reduced to the maximum extent practicable and move the river towards compliance with the pollutant reductions detailed in this TMDL revision.

Section 319 of the Federal Clean Water Act requires each state to submit to EPA a management plan for controlling pollution from nonpoint sources to waters of the state. The plan must: identify programs to achieve implementation of best management practices (BMPs); furnish a schedule containing annual milestones for utilization of program implementation methods; provide certification by the attorney general of the state that adequate authorities exist to execute the plan for implementation of best management practices; and, include a listing of available funding sources for these programs. The current Idaho Nonpoint Source Management Plan has been approved by EPA (December 1999) as meeting the intent of section 319 of the Clean Water Act.

As described in the Idaho Nonpoint Source Management Plan, Idaho Water Quality Standards require that if monitoring indicates water quality standards are not met due to nonpoint source impacts, even with the use of current best management practices, the practices will be evaluated and modified as necessary by the appropriate agencies in accordance with provisions of the Administrative Procedure Act (IDAPA). If necessary, injunctive or other judicial relief may be initiated against the operator of a nonpoint source activity, in accordance with authority of the Director of Environmental Quality provided in Section 39-108, Idaho Code (IDAPA 58.01.02.350). Idaho Water Quality Standards list designated agencies responsible for reviewing and revising nonpoint source BMPs based on water quality monitoring data generated through the state's water quality monitoring program. Designated agencies are: Department of Lands for timber harvest activities, oil and gas exploration and development, and mining activities; Soil Conservation Commission for grazing and agricultural activities; Transportation Department for public road construction; Department of Agriculture for aquaculture; and the Department of Environmental Quality for all other activities (Idaho Code 39-3602). Existing authorities and programs for assuring implementation of BMPs to control nonpoint sources of pollution in Idaho are as follows:

- Nonpoint Source 319 Grant Program
- State Water Quality Program for Agriculture
- Wetlands Reserve Program
- Resource Conservation and Development
- Conservation Reserve Program
- Environmental Quality Improvement Program
- Idaho Forest Practices Act
- Agricultural Pollution Abatement Plan
- Stream Channel Protection Act
- Water Quality Certification for Dredge and Fill

Idaho Water Quality Standards direct appointed advisory groups to recommend specific actions needed to control point and nonpoint sources affecting water quality limited water bodies. Upon approval of this TMDL by EPA Region 10, the existing Portneuf River Watershed Advisory Group, with the assistance of appropriate local, state, tribal, and federal agencies, will continue to review and continue to implement the Portneuf River TMDL Implementation Plan (2003) which was completed for the Portneuf River TMDL approved by EPA in April 2001 (see Section 4 of this document for implementation activities to-date). Specific pollution control actions for achieving water quality targets listed in the Portneuf River Total Maximum Daily Load plan and the Portneuf River TMDL Revision and Addendum is ongoing and will continue as time and available resources allow.

5.3 Implementation Strategies

Meeting load and wasteload allocations discussed in this TMDL requires implementation of various policies, programs, and projects aimed at improving water quality in Portneuf River subbasin. Like the TMDL, the goal of the existing Portneuf River subbasin implementation plan is to reduce pollutant loading and restore beneficial use support. DEQ also recognizes implementation strategies for TMDLs may need to be modified if monitoring shows that TMDL goals are not being met or if substantial progress is not being made toward achieving those goals. Conversely, if monitoring shows beneficial uses are being supported before TMDL targets are attained, less restrictive load and wasteload allocations will be considered as part of future TMDL revisions. Implementation strategies will continue to focus on reducing bacteria, nutrients, and sediment throughout the subbasin, in addition to developing a better understanding of the timing and extent of oil grease loading in the lower river. Point source discharges (i.e., NPDES permit holders) that are not meeting the allocations proposed herein will be required to achieve reductions in pollutant loads (i.e., phosphorus) that exceed the wasteload allocation. Reduction in pollutant loadings for nonpoint sources will most likely require a combination of strategies including: changes to both current policy and practice, program initiatives, and implementation of proven Best Management Practices.

Time Frame

No time frame is proposed for the overarching goal of restoring beneficial uses throughout the Portneuf River subbasin. Changes in programs and policies and implementation of practices are necessary to realize this goal is highly dependent on many factors. Modifications in current agency operations often require amending current government policies, which in turn may necessitate some type of legislative action. Once appropriate legislation is passed, diffusion down to the local level, where programs resulting from such policies are determined and carried out, may not be immediate. Similarly, the continued implementation of BMPs may not be rapid as on-the-ground projects, in addition to proper planning, require willing landowners and, often, some type of financial assistance. Adding to the problem of predicting when beneficial uses might be obtained are the natural fluctuations in annual weather patterns that influenced loading throughout this TMDL. For example, 2004 and 2006 sediment loading varied widely and was a function of differences in precipitation and runoff that manifested in the flow and loading patterns for those two years.

Still, there are specific milestones that have been included in this document. These milestones are specifically communicated to demonstrate the commitment of various stakeholders to reducing P loading in the lower river, American Falls Reservoir, and the larger Snake River system. The first strategy was formalized through a voluntary consent order/compliance agreement with J.R. Simplot Company, in which Simplot agreed to implement remedial actions to reduce its contribution of P to the Portneuf River. This binding agreement calls for reductions of P concentrations in the Portneuf River from an annual median concentration of 1.250 mg/L currently to 0.075 mg/L by the year 2021. Another proposed milestone for this segment of river is the City of Pocatello's commitment to meet a wasteload allocation of 25.1 lbs TP/day at its WWTP outfall; the time frame for this action is commensurate with the large-scale reductions required through Simplot's remedial actions (i.e., by year 2020). Implementation of these nutrient reduction measures is anticipated to help meet the significant reductions in TP loading required to achieve the target loads for the lower river, and realize reductions described in Table 5.14 of this TMDL. Finally, substantial progress towards the reduction of current pollutant loads is expected to occur within the next 10 years as strategies prescribed in the implementation plan come on-line. Development of appropriate monitoring programs is vital to understanding the success of individual BMPs and to quantify the benefits to subwatersheds and the larger subbasin.

Approach

Idaho Water Quality Standards list designated agencies responsible for reviewing and revising nonpoint source BMPs based on water quality monitoring data generated through the state's water quality monitoring program (Idaho Code 39-3602). Idaho Department of Lands is responsible for timber harvest activities, oil and gas exploration and development, and mining activities. Grazing and agricultural aspects of the implementation plan will be written and developed by the Idaho Soil Conservation Commission. Public road construction activities fall under the auspices of the Idaho Transportation Department. The Idaho State Department of Agriculture has responsibility for aquaculture. All other activities are under the purview of DEQ.

The Portneuf TMDL is designed to be implemented in phases. According to the February 2001 Supplement to Final TMDL Plan for the Portneuf River, phase I of implementation consists of the collection and analysis of additional water quality data and the implementation of short term control measures. Based on the additional water quality data and the evaluation of control measures and progress towards water quality goals, new load and wasteload allocations are intended to be submitted to EPA. Final Supplement at page 4. The allocation of pollutant loads for the Portneuf will be refined taking into account several principles: 1. Future growth; 2. Seasonal or climatic variations; 3 Temporal aspects; 4. Antibacksliding requirements; 5. Antidegradation requirements; 6. Margin of safety; 7. Allocation refinement; and 8. Principles of fairness.

With the cooperation of Portneuf River stakeholders, DEQ has collected additional data regarding Portneuf River water quality. DEQ has begun to meet with the Portneuf River WAG to refine allocations and appropriate pollution control strategies. DEQ intends to evaluate the Portneuf TMDL as a Phased TMDL and will continue to follow the staged approach for implementation of the Portneuf TMDL. Implementation of the Portneuf TMDL will function as the means of implementing the American Falls TMDL for the sources on the Portneuf River. The American Falls TMDL will not set load or waste load allocations for sources on the Portneuf River. Those load and waste load allocations will be set in the Portneuf TMDL.

Responsible Parties

The implementation of a plan to improve water quality in the Portneuf River subbasin will require the cooperation of many entities. These may include, but not be limited to, the following:

- Federal Government – U.S.D.A. Natural Resources Conservation Service and Forest Service, U.S. Bureau of Land Management
- State Government – Departments of Environmental Quality, Lands, Transportation, Fish and Game, and Agriculture, Soil Conservation Commission
- County Government – Bannock and Caribou counties
- Local Government – Cities of Lava Hot Spring, Inkom, Pocatello, and Chubbuck
- Quasi-Government – Portneuf Soil Conservation District and Caribou County Soil Conservation District
- Irrigation Companies – Portneuf-Marsh Valley Canal Company, Portneuf River Water Users District # 29, Portneuf Irrigating Company, McCammon Ditch Company, and Farmers Land & Irrigation Company
- Fish Hatcheries – Batise Springs Trout Farm and Papoose Springs Hatchery
- Numerous private individuals

Monitoring Strategy

DEQ will assess BMP implementation through the review of annual reports submitted as part of any implementation program. However, because of budgetary constraints, coupled with time and personnel limitations, DEQ does not expect to directly monitor all BMPs implemented in the subbasin. Instead, funding agencies should include monitoring as part of project funding requests. Tributary and subwatershed monitoring (e.g., Jenkins 2007 and

2008) will help determine BMP effectiveness. DEQ is responsible for monitoring both mainstem and tributaries for compliance with TMDL allocations and progress toward restoring beneficial use support. The Beneficial Use Reconnaissance Program monitoring will help determine support of beneficial uses for cold water aquatic life and contact recreation throughout the subbasin. Ambient water quality monitoring activities will be dependent on the budget, time, and staff available to DEQ. Point sources will be monitored through their Discharge Monitoring Reports submitted monthly to DEQ.

5.4 Conclusions

The data included in this section (section 5 of this TMDL revision document) support new and revised bacteria, nutrient, sediment, and oil and grease TMDLs for Portneuf River mainstem and tributary assessment units (AUs). Target loads were developed for nonpoint sources and summarized for permanent monitoring locations throughout the mainstem Portneuf River and lower Marsh Creek and also for select tributaries. Wasteload allocations were recommended for point sources (Lava, Inkom, and Pocatello WWTPs, as well as, Batise Springs Trout Farm, Papoose Springs Hatchery and Pocatello Urbanized Area [storm water]) for both sediments and phosphorus.

Data examined indicate that sediment loading in the mainstem Portneuf River and lower Marsh Creek exceeds the total suspended sediment (TSS) target load primarily during high flows. Sediment loading in tributaries is difficult to generalize, so the reader is directed to Section 5.2b of the document for tributary-specific findings. Assessments of the bed and bank conditions and/or suspended sediment concentrations show that Cherry Creek, Yago Creek, North Fork of Pocatello Creek and Rapid Creek are supporting the cold water aquatic life use and meeting the Portneuf River sediment targets and this warrants their delisting for sediments.

There is a total phosphorus (TP) target for both mainstem and tributary reaches and a total nitrogen (TN) target for tributaries. Summaries of TP loading in the mainstem Portneuf River and lower Marsh Creek are similar to those for TSS, and show that TP exceeds the TP target load primarily during high flows. Total P loading at Siphon Road represents an exception to this statement; TP loading measured at Siphon Road exceeds TP target loads throughout the year. Results summarized in Section 5.2b indicate that Cherry Creek should be delisted for nutrients.

Surface water samples from North City Park, the upstream extent of the Portneuf River concrete channel, in 2003 had *E. coli* concentrations that exceeded the secondary contact recreation criterion. In addition, a four-year study of *E. coli* concentrations in the hardened channel segment of the lower Portneuf River showed that *E. coli* concentrations tended to increase downstream. In the downstream-most portion of the channel, instantaneous primary and secondary contact recreation criteria were often exceeded in late summer. Bacterial loads for tributaries were calculated using the 5-sample 30-day geometric mean approach and showed that all assessment units listed for *E. coli* except lower Marsh Creek (Cottonwood Creek to Portneuf River) exceeded the secondary contact recreation criterion.

Recent monitoring of oil and grease in the mainstem Portneuf River and from outfalls indicates oil and grease are detected in the lower Portneuf River. The introduction of oil and grease through storm drains has also been documented during or immediately following storm events and concentrations in storm water often exceed the 5 mg/L oil and grease target. From these results, DEQ recommends regular and event-focused monitoring of oil and grease to better describe background concentrations and characterize the temporal and spatial loading patterns in the lower Portneuf River.

Eight sampling events in Hawkins Reservoir between 2006 and 2008 were used to characterize dissolved oxygen, nutrient, and chlorophyll *a* concentrations in Hawkins

Reservoir. Dissolved oxygen (DO) profiles show that the reservoir does not meet DO criteria for cold water aquatic life and therefore this assessment unit should remain listed for DO. In addition, TN and TP concentrations from all sampling dates exceeded the targets for this assessment unit. Estimates of phytoplankton biomass from chlorophyll *a* indicate that the proposed chlorophyll *a* target is exceeded on some dates. A tabular summary of the assessment outcomes is provided in Table 5.28.

Table 5.28. Summary of assessment outcomes.

Water Body Segment/ AU	2002/2008 Pollutant Review	TMDL(s) Completed/ Revised	Recommended Action	Justification
Cherry Creek – ephemeral tributaries/ ID17040208SK014_02	Bacteria	*E. coli*	No change	Documented criterion exceedance
Cherry Creek – Headwaters to USFS boundary/ ID17040208SK014_02a	Bacteria, Nutrients, Sediment	*E. coli*	Delist for nutrients and sediment	Documented *E. coli* criterion exceedance; CWAL use supported; bank stability, TSS, TN, and TP targets met
Cherry Creek – Headwaters to USFS boundary/ ID17040208SK014_02b	Bacteria, Nutrients, Sediment	*E. coli*	Delist for nutrients and sediment	Documented *E. coli* criterion exceedance; CWAL use supported; bank stability, TSS, TN, and TP targets met
Dempsey Creek (lower) – East Creek to Portneuf River/ ID17040208SK017_03	Pathogens	*E. coli*	No change	Documented criterion exceedance
Beaverdam Creek/ ID17040208SK017_02c	Sediment	Sediment	Revise TMDL in Section 4a	CWAL use was not supported and bank stability scores were exceeded
Garden Creek (lower) – Garden Cr Gap to Marsh Creek/	Bacteria	*E. coli*	No change	Documented criterion exceedance
Indian Creek - source to mouth/ ID17040208SK005_02	Unknown (*Presumed E. coli*)	*E. coli*	No change	Documented criterion exceedance
Marsh Creek (lower middle)– Birch Creek to Cottonwood Creek/ ID17040208SK006_04a	Pathogens	*E. coli*	No change	Documented criterion exceedance
Marsh Creek (upper) - Confluence of Rt and Lt Fks to Red Rock Pass/ ID17040208SK006_03a	Bacteria, Nutrients, Sediment	*E. coli*, TN, TP, and sediment	Revise TMDLs in Section 4a	Elevated *E. coli*, TN, TP, and sediment documented
Yago Creek	Sediment	None	Delist for sediment	CWAL use supported and bank stability target met

Water Body Segment/ AU	2002/2008 Pollutant Review	TMDL(s) Completed/ Revised	Recommended Action	Justification
Kinney Creek – headwaters to Mink Creek/ ID17040208SK004_02a	Sediment	Sediment	Revise TMDL in Section 4a	Bank stability scores exceeded
Mink Creek (lower) – USFS boundary to Portneuf River/ ID17040208SK004_04	Pathogens	*E. coli*	No change	Documented criterion exceedance
North Fork Pocatello Creek – Unnamed Tributaries	Sediment	None	Delist for sediment	CWAL use supported and bank stability target met
North Fork Pocatello Creek	Sediment	None	Delist for sediment	CWAL use supported and bank stability target met
Portneuf River - Marsh Creek to the Fort Hall Reservation Boundary/ ID17040208SK001_05	Unknown (*Presumed sediment, nutrients, oil and grease*)	Sediment, TP, *E. coli*, oil and grease	Revise TMDLs in Section 4a; change nutrient pollutant category to TP	TSS, TP, and oil and grease targets exceeded; *E. coli* criterion exceedance
Lower Rapid Creek/ ID17040208SK023_03	Sediment	None	Delist for sediment	CWAL use supported; bank stability and TSS targets met
South Fork Pocatello Creek – headwaters to Pocatello Creek/ ID17040208SK025_02	Sediment	Sediment	Revise TMDL in Section 4a	TSS targets exceeded
Hawkins Reservoir/ ID17040208SK012L_0L	DO, TP (2008) DO, nutrients (2002)	DO, TP, TN, chl *a*	Change nutrients to TN and TP and add chl *a*	DO criterion exceeded; TN, TP, and chl *a* targets exceeded
Portneuf River - Chesterfield Reservoir Dam to Marsh Creek ID17040208SK016_03	*2008 Section 4a**	Sediment, TP	Revise existing TMDLs in Section 4a	Updated TSS, TP data available
Portneuf River – Toponce Creek to Twenty-four Mile Creek ID17040208SK016_04	*2008 Section 4a**	Sediment, TP	Revise existing TMDLs in Section 4a	Updated TSS, TP data available

CWAL = cold water aquatic life

* Portneuf River AUs ID17040208SK016_03 and ID17040208SK016_04 were not included in Section 5 of either the 2008 or 2002 Integrated Reports; however, loading summaries for both TSS and TP were reported in Section 5 of this document and provide sufficient information to revise the approved TMDLs for these pollutant-AU combinations included in Section 4a of the 2008 Integrated Report.

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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.
Acre-foot	A volume of water that would cover an acre to a depth of one foot. Often used to quantify reservoir storage and the annual discharge of large rivers.
Adsorption	The adhesion of one substance to the surface of another. Clays, for example, can adsorb phosphorus and organic molecules
Aeration	A process by which water becomes charged with air directly from the atmosphere. Dissolved gases, such as oxygen, are then available for reactions in water.
Aerobic	Describes life, processes, or conditions that require the presence of oxygen.
Adfluvial	Describes fish whose life history involves seasonal migration from lakes to streams for spawning.
Adjunct	In the context of water quality, adjunct refers to areas directly adjacent to focal or refuge habitats that have been degraded by human or natural disturbances and do not presently support high diversity or abundance of native species.

Alevin	A newly hatched, incompletely developed fish (usually a salmonid) still in nest or inactive on the bottom of a water body, living off stored yolk.
Algae	Non-vascular (without water-conducting tissue) aquatic plants that occur as single cells, colonies, or filaments.
Alluvium	Unconsolidated recent stream deposition.
Ambient	General conditions in the environment (Armantrout 1998). In the context of water quality, ambient waters are those representative of general conditions, not associated with episodic perturbations or specific disturbances such as a wastewater outfall (EPA 1996).
Anadromous	Fish, such as salmon and sea-run trout, that live part or the majority of their lives in the saltwater but return to fresh water to spawn.
Anaerobic	Describes the processes that occur in the absence of molecular oxygen and describes the condition of water that is devoid of molecular oxygen.
Anoxia	The condition of oxygen absence or deficiency.
Anthropogenic	Relating to, or resulting from, the influence of human beings on nature.
Anti-Degradation	Refers to the U.S. Environmental Protection Agency's interpretation of the Clean Water Act goal that states and tribes maintain, as well as restore, water quality. This applies to waters that meet or are of higher water quality than required by state standards. State rules provide that the quality of those high quality waters may be lowered only to allow important social or economic development and only after adequate public participation (IDAPA 58.01.02.051). In all cases, the existing beneficial uses must be maintained. State rules further define lowered water quality to be 1) a measurable change, 2) a change adverse to a use, and 3) a change in a pollutant relevant to the water's uses (IDAPA 58.01.02.003.61).

Aquatic	Occurring, growing, or living in water.
Aquifer	An underground, water-bearing layer or stratum of permeable rock, sand, or gravel capable of yielding 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.
Batholith	A large body of intrusive igneous rock that has more than 40 square miles of surface exposure and no known floor. A batholiths usually consists of coarse-grained rocks such as granite.
Bedload	Material (generally sand-sized or larger sediment) that is carried along the streambed by rolling or bouncing.

Beneficial Use	Any of the various uses of water, including, but not limited to, aquatic life, recreation, water supply, wildlife habitat, and aesthetics, which are recognized in water quality standards.
Beneficial Use Reconnaissance Program (BURP)	A program for conducting systematic biological and physical habitat surveys of water bodies in Idaho. BURP protocols address lakes, reservoirs, and wadeable streams and rivers
Benthic	Pertaining to or living on or in the bottom sediments of a water body
Benthic Organic Matter.	The organic matter on the bottom of a water body.
Benthos	Organisms living in and on the bottom sediments of lakes and streams. Originally, the term meant the lake bottom, but it is now applied almost uniformly to the animals associated with the lake and stream bottoms.
Best Management Practices (BMPs)	Structural, nonstructural, and managerial techniques that are effective and practical means to control nonpoint source pollutants.
Best Professional Judgment	A conclusion and/or interpretation derived by a trained and/or technically competent individual by applying interpretation and synthesizing information.
Biochemical Oxygen Demand (BOD)	The amount of dissolved oxygen used by organisms during the decomposition (respiration) of organic matter, expressed as mass of oxygen per volume of water, over some specified period of time.
Biological Integrity	1) The condition of an aquatic community inhabiting unimpaired water bodies of a specified habitat as measured by an evaluation of multiple attributes of the aquatic biota (EPA 1996). 2) The ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the natural habitats of a region (Karr 1991).

Biomass	The weight of biological matter. Standing crop is the amount of biomass (e.g., fish or algae) in a body of water at a given time. Often expressed as grams per square meter.
Biota	The animal and plant life of a given region.
Biotic	A term applied to the living components of an area.
Clean Water Act (CWA)	The Federal Water Pollution Control Act (commonly known as the Clean Water Act), as last reauthorized by the Water Quality Act of 1987, establishes a process for states to use to develop information on, and control the quality of, the nation's water resources.
Coliform Bacteria	A group of bacteria predominantly inhabiting the intestines of humans and animals but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms (also see Fecal Coliform Bacteria, *E. Coli*, and Pathogens).
Colluvium	Material transported to a site by gravity.
Community	A group of interacting organisms living together in a given place.
Conductivity	The ability of an aqueous solution to carry electric current, expressed in micro (μ) mhos/centimeter at 25 °C. Conductivity is affected by dissolved solids and is used as an indirect measure of total dissolved solids in a water sample.
Cretaceous	The final period of the Mesozoic era (after the Jurassic and before the Tertiary period of the Cenozoic era), thought to have covered the span of time between 135 and 65 million years ago.
Criteria	In the context of water quality, numeric or descriptive factors taken into account in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels, and to limit the number of violations per year. The U.S. Environmental Protection Agency develops criteria guidance; states establish criteria.

Cubic Feet per Second	A unit of measure for the rate of flow or discharge of water. One cubic foot per second is the rate of flow of a stream with a cross-section of one square foot flowing at a mean velocity of one foot per second. At a steady rate, once cubic foot per second is equal to 448.8 gallons per minute and 1,984 acre-feet per day.
Cultural Eutrophication	The process of eutrophication that has been accelerated by human-caused influences. Usually seen as an increase in nutrient loading (also see Eutrophication).
Culturally Induced Erosion	Erosion caused by increased runoff or wind action due to the work of humans in deforestation, cultivation of the land, overgrazing, and disturbance of natural drainages; the excess of erosion over the normal for an area (also see Erosion).
Debris Torrent	The sudden down slope movement of soil, rock, and vegetation on steep slopes, often caused by saturation from heavy rains.
Decomposition	The breakdown of organic molecules (e.g., sugar) to inorganic molecules (e.g., carbon dioxide and water) through biological and nonbiological processes.
Depth Fines	Percent by weight of particles of small size within a vertical core of volume of a streambed or lake bottom sediment. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 6.5 millimeters depending on the observer and methodology used. The depth sampled varies but is typically about one foot (30 centimeters).
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.
Endangered Species	Animals, birds, fish, plants, or other living organisms threatened with imminent extinction. Requirements for declaring a species as endangered are contained in the Endangered Species Act.
Environment	The complete range of external conditions, physical and biological, that affect a particular organism or community.

Eocene	An epoch of the early Tertiary period, after the Paleocene and before the Oligocene.
Eolian	Windblown, referring to the process of erosion, transport, and deposition of material by the wind.
Ephemeral Stream	A stream or portion of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no long continued supply from melting snow or other sources. Its channel is at all times above the water table (American Geological Institute 1962).
Erosion	The wearing away of areas of the earth's surface by water, wind, ice, and other forces.
Eurythermal	Able to tolerate a wide temperature range.
Eutrophic	From Greek for "well nourished," this describes a highly productive body of water in which nutrients do not limit algal growth. It is typified by high algal densities and low clarity.
Eutrophication	1) Natural process of maturing (aging) in a body of water. 2) The natural and human-influenced process of enrichment with nutrients, especially nitrogen and phosphorus, leading to an increased production of organic matter.
Exceedance	A violation (according to DEQ policy) of the pollutant levels permitted by water quality criteria.
Existing Beneficial Use or Existing Use	A beneficial use actually attained in waters on or after November 28, 1975, whether or not the use is designated for the waters in Idaho's *Water Quality Standards and Wastewater Treatment Requirements* (IDAPA 58.01.02).
Exotic Species	A species that is not native (indigenous) to a region.
Extrapolation	Estimation of unknown values by extending or projecting from known values.

Fauna	Animal life, especially the animals characteristic of a region, period, or special environment.
Fecal Coliform Bacteria	Bacteria found in the intestinal tracts of all warm-blooded animals or mammals. Their presence in water is an indicator of pollution and possible contamination by pathogens (also see Coliform Bacteria, *E. coli*, and Pathogens).
Fecal Streptococci	A species of spherical bacteria including pathogenic strains found in the intestines of warm-blooded animals.
Feedback Loop	In the context of watershed management planning, a feedback loop is a process that provides for tracking progress toward goals and revising actions according to that progress.
Fixed-Location Monitoring	Sampling or measuring environmental conditions continuously or repeatedly at the same location.
Flow	See *Discharge*.
Fluvial	In fisheries, this describes fish whose life history takes place entirely in streams but migrate to smaller streams for spawning.
Focal	Critical areas supporting a mosaic of high quality habitats that sustain a diverse or unusually productive complement of native species.
Fully Supporting	In compliance with water quality standards and within the range of biological reference conditions for all designated and exiting beneficial uses as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).
Fully Supporting Cold Water	Reliable data indicate functioning, sustainable cold water biological assemblages (e.g., fish, macroinvertebrates, or algae), none of which have been modified significantly beyond the natural range of reference conditions.
Fully Supporting but Threatened	An intermediate assessment category describing water bodies that fully support beneficial uses, but have a declining trend in

	water quality conditions, which if not addressed, will lead to a "not fully supporting" status.
Geographical Information Systems (GIS)	A geo-referenced database.
Geometric Mean	A back-transformed mean of the logarithmically transformed numbers often used to describe highly variable, right-skewed data (a few large values), such as bacterial data.
Grab Sample	A single sample collected at a particular time and place. It may represent the composition of the water in that water column.
Gradient	The slope of the land, water, or streambed surface.
Ground Water	Water found beneath the soil surface saturating the layer in which it is located. Most ground water originates as rainfall, is free to move under the influence of gravity, and usually emerges again as stream flow.
Growth Rate	A measure of how quickly something living will develop and grow, such as the amount of new plant or animal tissue produced per a given unit of time, or number of individuals added to a population.
Habitat	The living place of an organism or community.
Headwater	The origin or beginning of a stream.
Hydrologic Basin	The area of land drained by a river system, a reach of a river and its tributaries in that reach, a closed basin, or a group of streams forming a drainage area (also see Watershed).
Hydrologic Cycle	The cycling of water from the atmosphere to the earth (precipitation) and back to the atmosphere (evaporation and plant transpiration). Atmospheric moisture, clouds, rainfall, runoff, surface water, ground water, and water infiltrated in soils are all part of the hydrologic cycle.
Hydrologic Unit	One of a nested series of numbered and named watersheds arising from a national standardization of watershed delineation. The initial 1974 effort (USGS 1987) described

	four levels (region, subregion, accounting unit, cataloging unit) of watersheds throughout the United States. The fourth level is uniquely identified by an eight-digit code built of two-digit fields for each level in the classification. Originally termed a cataloging unit, fourth field hydrologic units have been more commonly called subbasins. Fifth and sixth field hydrologic units have since been delineated for much of the country and are known as watershed and subwatersheds, respectively.
Hydrologic Unit Code (HUC)	The number assigned to a hydrologic unit. Often used to refer to fourth field hydrologic units.
Hydrology	The science dealing with the properties, distribution, and circulation of water.
Impervious	Describes a surface, such as pavement, that water cannot penetrate.
Influent	A tributary stream.
Inorganic	Materials not derived from biological sources.
Instantaneous	A condition or measurement at a moment (instant) in time.
Intergravel Dissolved Oxygen	The concentration of dissolved oxygen within spawning gravel. Consideration for determining spawning gravel includes species, water depth, velocity, and substrate.
Intermittent Stream	1) A stream that flows only part of the year, such as when the ground water table is high or when the stream receives water from springs or from surface sources such as melting snow in mountainous areas. The stream ceases to flow above the streambed when losses from evaporation or seepage exceed the available stream flow. 2) A stream that has a period of zero flow for at least one week during most years.
Interstate Waters	Waters that flow across or form part of state or international boundaries, including boundaries with Native American nations.

Irrigation Return Flow	Surface (and subsurface) water that leaves a field following the application of irrigation water and eventually flows into streams.
Key Watershed	A watershed that has been designated in Idaho Governor Batt's *State of Idaho Bull Trout Conservation Plan* (1996) as critical to the long-term persistence of regionally important trout populations.
Knickpoint	Any interruption or break of slope.
Land Application	A process or activity involving application of wastewater, surface water, or semi-liquid material to the land surface for the purpose of treatment, pollutant removal, or ground water recharge.
Limiting Factor	A chemical or physical condition that determines the growth potential of an organism. This can result in a complete inhibition of growth, but typically results in less than maximum growth rates.
Limnology	The scientific study of fresh water, especially the history, geology, biology, physics, and chemistry of lakes.
Load Allocation (LA)	A portion of a water body's load capacity for a given pollutant that is given to a particular nonpoint source (by class, type, or geographic area).
Load(ing)	The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. Loading is the product of flow (discharge) and concentration.
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.
Lotic	An aquatic system with flowing water such as a brook, stream, or river where the net flow of water is from the headwaters to the mouth.
Luxury Consumption	A phenomenon in which sufficient nutrients are available in either the sediments or the water column of a water body, such that aquatic plants take up and store an abundance in excess of the plants' current needs.
Macroinvertebrate	An invertebrate animal (without a backbone) large enough to be seen without magnification and retained by a 500µm mesh (U.S. #30) screen.
Macrophytes	Rooted and floating vascular aquatic plants, commonly referred to as water weeds. These plants usually flower and bear seeds. Some forms, such as duckweed and coontail (*Ceratophyllum sp.*), are free-floating forms not rooted in sediment.
Margin of Safety (MOS)	An implicit or explicit portion of a water body's loading capacity set aside to allow the uncertainly about the relationship between the pollutant loads and the quality of the receiving water body. This is a required component of a total maximum daily load (TMDL) and is often incorporated into conservative assumptions used to develop the TMDL (generally within the calculations and/or models). The MOS is not allocated to any sources of pollution.
Mass Wasting	A general term for the down slope movement of soil and rock material under the direct influence of gravity.
Mean	Describes the central tendency of a set of numbers. The arithmetic mean (calculated by adding all items in a list, then dividing by the number of items) is the statistic most familiar to most people.
Median	The middle number in a sequence of numbers. If there are an even number of numbers, the median is the average of the two

	middle numbers. For example, 4 is the median of 1, 2, 4, 14, 16; 6 is the median of 1, 2, 5, 7, 9, 11.
Metric	1) A discrete measure of something, such as an ecological indicator (e.g., number of distinct taxon). 2) The metric system of measurement.
Milligrams per Liter (mg/L)	A unit of measure for concentration. In water, it is essentially equivalent to parts per million (ppm).
Million Gallons per Day (MGD)	A unit of measure for the rate of discharge of water, often used to measure flow at wastewater treatment plants. One MGD is equal to 1.547 cubic feet per second.
Miocene	Of, relating to, or being an epoch of, the Tertiary between the Pliocene and the Oligocene periods, or the corresponding system of rocks.
Monitoring	A periodic or continuous measurement of the properties or conditions of some medium of interest, such as monitoring a water body.
Mouth	The location where flowing water enters into a larger water body.
National Pollutant 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.
Nodal	Areas that are separated from focal and adjunct habitats, but serve critical life history functions for individual native fish.
Nonpoint Source	A dispersed source of pollutants, generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint

	sources are without a discernable point or origin. They include, but are not limited to, irrigated and non-irrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.
Not Assessed (NA)	A concept and an assessment category describing water bodies that have been studied, but are missing critical information needed to complete an assessment.
Not Attainable	A concept and an assessment category describing water bodies that demonstrate characteristics that make it unlikely that a beneficial use can be attained (e.g., a stream that is dry but designated for salmonid spawning).
Not Fully Supporting	Not in compliance with water quality standards or not within the range of biological reference conditions for any beneficial use as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).
Not Fully Supporting Cold Water	At least one biological assemblage has been significantly modified beyond the natural range of its reference condition.
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.
Partitioning	The sharing of limited resources by different races or species; use of different parts of the habitat, or the same habitat at different times. Also the separation of a chemical into two or more phases, such as partitioning of phosphorus between the water column and sediment.
Pathogens	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.
Pesticide	Substances or mixtures of substances intended for preventing, destroying, repelling, or mitigating any pest. Also, any substance or mixture intended for use as a plant regulator, defoliant, or desiccant.
pH	The negative $\log_{10}$ of the concentration of hydrogen ions, a measure which in water ranges from very acid (pH=1) to very

	alkaline (pH=14). A pH of 7 is neutral. Surface waters usually measure between pH 6 and 9.
Phased TMDL	A total maximum daily load (TMDL) that identifies interim load allocations and details further monitoring to gauge the success of management actions in achieving load reduction goals and the effect of actual load reductions on the water quality of a water body. Under a phased TMDL, a refinement of load allocations, wasteload allocations, and the margin of safety is planned at the outset.
Phosphorus	An element essential to plant growth, often in limited supply, and thus considered a nutrient.
Physiochemical	In the context of bioassessment, the term is commonly used to mean the physical and chemical factors of the water column that relate to aquatic biota. Examples in bioassessment usage include saturation of dissolved gases, temperature, pH, conductivity, dissolved or suspended solids, forms of nitrogen, and phosphorus. This term is used interchangeable with the term “physical/chemical.”
Plankton	Microscopic algae (phytoplankton) and animals (zooplankton) that float freely in open water of lakes and oceans.
Point Source	A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable “point” of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.
Pollutant	Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.
Pollution	A very broad concept that encompasses human-caused changes in the environment which alter the functioning of natural processes and produce undesirable environmental and health effects. This includes human-induced alteration of the physical, biological, chemical, and radiological integrity of water and other media.

Population	A group of interbreeding organisms occupying a particular space; the number of humans or other living creatures in a designated area.
Pretreatment	The reduction in the amount of pollutants, elimination of certain pollutants, or alteration of the nature of pollutant properties in wastewater prior to, or in lieu of, discharging or otherwise introducing such wastewater into a publicly owned wastewater treatment plant.
Primary Productivity	The rate at which algae and macrophytes fix carbon dioxide using light energy. Commonly measured as milligrams of carbon per square meter per hour.
Protocol	A series of formal steps for conducting a test or survey.
Qualitative	Descriptive of kind, type, or direction.
Quality Assurance (QA)	A program organized and designed to provide accurate and precise results. Included are the selection of proper technical methods, tests, or laboratory procedures; sample collection and preservation; the selection of limits; data evaluation; quality control; and personnel qualifications and training (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 effect from human activity and represents the highest level of support attainable. 2) A benchmark for populations of aquatic ecosystems used to describe desired conditions in a biological assessment and acceptable or unacceptable departures from them. The reference condition can be determined through examining regional reference sites, historical conditions, quantitative models, and expert judgment (Hughes 1995).
Reference Site	A specific locality on a water body that is minimally impaired and is representative of reference conditions for similar water bodies.
Representative Sample	A portion of material or water that is as similar in content and consistency as possible to that in the larger body of material or water being sampled.
Resident	A term that describes fish that do not migrate.
Respiration	A process by which organic matter is oxidized by organisms, including plants, animals, and bacteria. The process converts organic matter to energy, carbon dioxide, water, and lesser constituents.
Riffle	A relatively shallow, gravelly area of a streambed with a locally fast current, recognized by surface choppiness. Also an area of higher streambed gradient and roughness.
Riparian	Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a water body.
Riparian Habitat Conservation Area (RHCA)	A U.S. Forest Service description of land within the following number of feet up-slope of each of the banks of streams: ▪ 300 feet from perennial fish-bearing streams ▪ 150 feet from perennial non-fish-bearing streams ▪ 100 feet from intermittent streams, wetlands, and ponds in priority watersheds.

River	A large, natural, or human-modified stream that flows in a defined course or channel or in a series of diverging and converging channels.
Runoff	The portion of rainfall, melted snow, or irrigation water that flows across the surface, through shallow underground zones (interflow), and through ground water to creates streams.
Sediments	Deposits of fragmented materials from weathered rocks and organic material that were suspended in, transported by, and eventually deposited by water or air.
Settleable Solids	The volume of material that settles out of one liter of water in one hour.
Species	1) A reproductively isolated aggregate of interbreeding organisms having common attributes and usually designated by a common name. 2) An organism belonging to such a category.
Spring	Ground water seeping out of the earth where the water table intersects the ground surface.
Stagnation	The absence of mixing in a water body.
Stenothermal	Unable to tolerate a wide temperature range.
Stratification	A Department of Environmental Quality classification method used to characterize comparable units (also called classes or strata).
Stream	A natural water course containing flowing water, at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.
Stream Order	Hierarchical ordering of streams based on the degree of branching. A first-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher order streams result from the joining of two streams of the same order.

Storm Water Runoff	Rainfall that quickly runs off the land after a storm. In developed watersheds the water flows off roofs and pavement into storm drains that may feed quickly and directly into the stream. The water often carries pollutants picked up from these surfaces.
Stressors	Physical, chemical, or biological entities that can induce adverse effects on ecosystems or human health.
Subbasin	A large watershed of several hundred thousand acres. This is the name commonly given to 4th field hydrologic units (also see Hydrologic Unit).
Subbasin Assessment (SBA)	A watershed-based problem assessment that is the first step in developing a total maximum daily load in Idaho.
Subwatershed	A smaller watershed area delineated within a larger watershed, often for purposes of describing and managing localized conditions. Also proposed for adoption as the formal name for 6th field hydrologic units.
Surface Fines	Sediments of small size deposited on the surface of a streambed or lake bottom. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 605 millimeters depending on the observer and methodology used. Results are typically expressed as a percentage of observation points with fine sediment.
Surface Runoff	Precipitation, snow melt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants in rivers, streams, and lakes. Surface runoff is also called overland flow.
Surface Water	All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors that are directly influenced by surface water.
Suspended Sediments	Fine material (usually sand size or smaller) that remains suspended by turbulence in the water column until deposited in

	areas of weaker current. These sediments cause turbidity and, when deposited, reduce living space within streambed gravels and can cover fish eggs or alevins.
Taxon	Any formal taxonomic unit or category of organisms (e.g., species, genus, family, order). The plural of taxon is taxa (Armantrout 1998).
Tertiary	An interval of geologic time lasting from 66.4 to 1.6 million years ago. It constitutes the first of two periods of the Cenozoic Era, the second being the Quaternary. The Tertiary has five subdivisions, which from oldest to youngest are the Paleocene, Eocene, Oligocene, Miocene, and Pliocene epochs.
Thalweg	The center of a stream's current, where most of the water flows.
Threatened Species	Species, determined by the U.S. Fish and Wildlife Service, which are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.
Total Dissolved Solids	Dry weight of all material in solution in a water sample as determined by evaporating and drying filtrate.
Total Maximum Daily Load (TMDL)	A TMDL is a water body's load capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual bases. A TMDL is equal to the load capacity, such that load capacity = margin of safety + natural background + load allocation + wasteload allocation = TMDL. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.
Total Suspended Solids (TSS)	The dry weight of material retained on a filter after filtration. Filter pore size and drying temperature can vary. American Public Health Association Standard Methods (Franson et al. 1998) call for using a filter of 2.0 microns or smaller; a 0.45 micron filter is also often used. This method calls for drying at a temperature of 103-105 °C.

Toxic Pollutants	Materials that cause death, disease, or birth defects in organisms that ingest or absorb them. The quantities and exposures necessary to cause these effects can vary widely.
Tributary	A stream feeding into a larger stream or lake.
Trophic State	The level of growth or productivity of a lake as measured by phosphorus content, chlorophyll *a* concentrations, amount (biomass) of aquatic vegetation, algal abundance, and water clarity.
Turbidity	A measure of the extent to which light passing through water is scattered by fine suspended materials. The effect of turbidity depends on the size of the particles (the finer the particles, the greater the effect per unit weight) and the color of the particles.
Vadose Zone	The unsaturated region from the soil surface to the ground water table.
Wasteload Allocation (WLA)	The portion of receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. Wasteload allocations specify how much pollutant each point source may release to a water body.
Water Body	A stream, river, lake, estuary, coastline, or other water feature, or portion thereof.
Water Column	Water between the interface with the air at the surface and the interface with the sediment layer at the bottom. The idea derives from a vertical series of measurements (oxygen, temperature, phosphorus) used to characterize water.
Water Pollution	Any alteration of the physical, thermal, chemical, biological, or radioactive properties of any waters of the state, or the discharge of any pollutant into the waters of the state, which will or is likely to create a nuisance or to render such waters harmful, detrimental, or injurious to public health, safety, or welfare; to fish and wildlife; or to domestic, commercial, industrial, recreational, aesthetic, or other beneficial uses.

Water Quality	A term used to describe the biological, chemical, and physical characteristics of water with respect to its suitability for a beneficial use.
Water Quality Criteria	Levels of water quality expected to render a body of water suitable for its designated uses. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, or industrial processes.
Water Quality Limited	A label that describes water bodies for which one or more water quality criterion is not met or beneficial uses are not fully supported. Water quality limited segments may or may not be on a §303(d) list.
Water Quality Limited Segment (WQLS)	Any segment placed on a state's §303(d) list for failure to meet applicable water quality standards, and/or is not expected to meet applicable water quality standards in the period prior to the next list. These segments are also referred to as "§303(d) listed."
Water Quality Management Plan	A state or area-wide waste treatment management plan developed and updated in accordance with the provisions of the Clean Water Act.
Water Quality Modeling	The prediction of the response of some characteristics of lake or stream water based on mathematical relations of input variables such as climate, stream flow, and inflow water quality.
Water Quality Standards	State-adopted and U.S. Environmental Protection Agency-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.
Water Table	The upper surface of ground water; below this point, the soil is saturated with water.
Watershed	1) All the land which contributes runoff to a common point in a drainage network, or to a lake outlet. Watersheds are infinitely nested, and any large watershed is composed of smaller

	"subwatersheds." 2) The whole geographic region which contributes water to a point of interest in a water body.
Water Body Identification Number (WBID)	A number that uniquely identifies a water body in Idaho and ties in to the Idaho water quality standards and GIS information.
Wetland	An area that is at least some of the time saturated by surface or ground water so as to support with vegetation adapted to saturated soil conditions. Examples include swamps, bogs, fens, and marshes.
Young of the Year	Young fish born the year captured, evidence of spawning activity.

Appendix A. Unit Conversion Chart

able 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.

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Appendix B. State and Site-Specific Standards and Criteria

Water Quality Standards Applicable to Salmonid Spawning Temperature

Water quality standards for temperature are specific numeric values not to be exceeded during the salmonid spawning and egg incubation period, which varies with species. Spawning salmonid periods for the Portneuf River subbasin are described by species in Table B-1. As described in IDAPA 58.01.02.250.02.f.i. and .02.f.ii., the water quality criteria that need to be met during these time periods are:

- one day dissolved oxygen minimum of ≥ 6.0 mg/L or 90% saturation which ever is greater, and

- thirteen (13) degrees C as a daily maximum water temperature, nine (9) degrees C as a daily average water temperature.

For the purposes of a temperature TMDL, the highest recorded water temperature in a recorded data set (excluding any high water temperatures that may occur on days when air temperatures exceed the 90th percentile of highest annual mean weekly [7-day] maximum air temperatures) is compared to the daily maximum criterion of 13ºC . The difference between the two water temperatures represents the temperature reduction necessary to achieve compliance with temperature standards.

Water Quality Standards Applicable to Cold Water Aquatic Life Temperature

Waters designated for cold water aquatic life (IDAPA 58.01.02.250.02.a and .02b.) are not to vary from the following characteristics due to human activities:

- dissolved oxygen concentrations ≥ six (6) mg/l at all times. In lakes and reservoirs this standard does not apply to: the bottom twenty percent (20%) of water depth in natural lakes and reservoirs where depths are thirty-five (35) meters or less.

- water temperatures of twenty-two (22) degrees C or less with a maximum daily average of no greater than nineteen (19) degrees C.

Water Quality Standards Applicable to Primary Contact Recreation

Waters designated for recreation are not to contain *Escherichia coli* bacteria (IDAPA 58.01.02.251.01), used as indicators of human pathogens, in concentrations exceeding:

- a geometric mean of one hundred twenty-six (126) *E. coli* organisms per one hundred (100) ml based on a minimum of five (5) samples taken every three (3) to seven (7) days over a thirty (30) day period.

A water sample exceeding the *E. coli* single sample maximums below indicates likely exceedance of the geometric mean criterion, but is not alone a violation of water quality standards. If a single sample exceeds the maximums set forth in Subsections 251.01.b.i.,

251.01.b.ii., and 251.01.b.iii., then additional samples must be taken as specified in Subsection 251.01.c.

For waters designated as secondary contact recreation, a single sample maximum of five hundred seventy-six (576) *E. coli* organisms per one hundred (100) ml.

For waters designated as primary contact recreation, a single sample maximum of four hundred six (406) *E. coli* organisms per one hundred (100) ml.

Table B-1. Salmonid spawning windows for introduced and native salmonids in the Portneuf River subbasin.

Salmonid Species	Common Name	Spawning Window in Portneuf River
Oncorhynchus clarki bouvieri	Yellowstone cutthroat trout	May 15 – June 20
Oncorhynchus mykiss	rainbow trout	April 1 – May 20
Prosopium williamsoni	mountain whitefish	Fall; *October 15 to March 15 (WBAG)*
Salmo trutta	brown trout	*October 1 to April 1 (WBAG)*
Summaries shown were developed from consultation with David Teuscher, Regional Fisheries Manager, Idaho Department of Fish and Game and Ernest Keeley, Fish Ecologist Idaho State University. Italicized dates followed by WBAG were taken from Table F-1 Grafe et al. 2002.		

Appendix C. Daily Storm Water TSS and TP Load Estimates

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2004	1				1.9				7.78
2004	2				1.9				7.52
2004	3				1.9				7.78
2004	4				1.9				7.78
2004	5				1.9				7.52
2004	6				1.9				7.52
2004	7				1.9				7.78
2004	8				1.9				7.78
2004	9				1.9				7.78
2004	10				1.9				7.52
2004	11				1.9				7.52
2004	12				1.9				7.52
2004	13				1.8				7.26
2004	14				1.8				7.26
2004	15				1.9				7.52
2004	16				1.9				7.52
2004	17				1.8				7.26
2004	18				1.8				7.26
2004	19				1.9				7.52
2004	20				1.9				7.78
2004	21				1.9				7.52
2004	22				1.8				7.26
2004	23				1.8				7.26
2004	24				1.9				7.52
2004	25				1.9				7.78
2004	26				1.9				7.52
2004	27				1.9				7.78
2004	28				1.9				7.78
2004	29				2.0				8.04
2004	30				2.0				8.04
2004	31				1.9				7.78
2004	32				1.9				7.78
2004	33				1.9				7.52
2004	34				1.9				7.52
2004	35				1.9				7.52
2004	36				1.9				7.52
2004	37				1.9				7.52
2004	38				1.9				7.78
2004	39				1.9				7.78
2004	40				1.9				7.78
2004	41				1.9				7.52
2004	42				1.8				7.26
2004	43				1.7				7.00
2004	44				1.7				6.73
2004	45				1.7				7.00

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2004	46				1.8				7.26
2004	47				1.9				7.52
2004	48				2.0				8.04
2004	49	45.2	38.3	-6.8	1.9	131.5	109.7	-21.8	7.78
2004	50	21.5	56.2	34.7	2.0	74.4	157.8	83.4	8.06
2004	51	17.5	26.3	8.7	1.9	63.3	79.1	15.8	7.78
2004	52	15.9	22.1	6.1	1.9	58.7	68.1	9.4	7.67
2004	53	15.0	21.0	6.0	1.9	56.0	65.1	9.1	7.62
2004	54	15.9	22.8	6.9	1.9	58.8	69.9	11.1	7.73
2004	55	17.9	22.3	4.4	2.0	64.1	68.9	4.8	7.80
2004	56	16.7	21.3	4.6	1.9	61.0	66.3	5.3	7.75
2004	57	20.6	30.9	10.3	2.0	72.4	91.1	18.7	8.04
2004	58	23.1	26.5	3.4	2.0	79.2	80.8	1.7	8.17
2004	59	24.6	28.0	3.4	2.1	84.0	85.1	1.1	8.35
2004	60	22.2	27.3	5.1	2.1	77.4	83.1	5.7	8.22
2004	61	22.1	27.8	5.7	4.6	76.0	83.8	7.8	14.40
2004	62	20.3	23.8	3.5	4.6	71.4	73.4	2.0	14.26
2004	63	18.9	21.6	2.8	4.5	67.3	67.7	0.5	14.17
2004	64	18.8	22.0	3.2	4.5	67.4	68.8	1.4	14.21
2004	65	19.7	23.3	3.6	4.6	70.1	72.3	2.2	14.45
2004	66	23.4	22.7	-0.7	4.6	78.9	70.8	-8.1	14.35
2004	67		22.6		4.6		70.6		14.31
2004	68		22.3		4.5		69.6		14.21
2004	69		23.9		4.7		74.5		14.77
2004	70		27.9		4.9		85.6		15.29
2004	71		31.5		5.0		95.0		15.52
2004	72		36.0		5.0		106.9		15.71
2004	73		39.3		5.1		116.0		16.03
2004	74		43.8		5.2		127.0		16.12
2004	75		67.2		5.6		189.0		17.38
2004	76	83.9	73.5	-10.5	5.8	232.9	205.9	-27.0	18.08
2004	77	108.9	113.1	4.2	6.2	308.8	309.3	0.6	19.48
2004	78	182.2	198.7	16.5	6.9	498.5	534.5	36.0	21.57
2004	79	227.4	271.7	44.2	7.4	618.5	719.2	100.7	23.16
2004	80	230.8	287.9	57.1	7.8	629.5	763.9	134.4	24.32
2004	81	178.4	221.4	43.0	7.6	497.7	591.9	94.2	23.86
2004	82	187.7	235.4	47.8	7.9	523.7	628.9	105.2	24.69
2004	83	225.3	287.9	62.6	8.1	618.7	764.4	145.7	25.30
2004	84	267.0	317.3	50.2	8.4	726.3	839.7	113.4	26.28
2004	85	211.5	267.0	55.5	8.3	587.6	711.2	123.5	25.86
2004	86	209.1	294.7	85.6	8.5	582.4	771.1	188.7	26.65
2004	87	170.4			8.2	483.1			25.77
2004	88	114.8			7.6	336.1			23.62
2004	89	99.7			7.0	292.7			21.76
2004	90	96.0	114.8	18.8	6.6	280.4	325.7	45.3	20.69

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2004	91	112.3	136.3	23.9	6.8	322.7	371.0	48.3	21.11
2004	92	121.8	156.1	34.3	7.0	348.5	422.2	73.7	21.81
2004	93	104.1	141.6	37.5	7.1	305.3	386.3	81.0	22.04
2004	94	126.4	153.6	27.2	7.2	362.7	417.5	54.8	22.64
2004	95	150.8	195.9	45.1	7.5	426.3	526.6	100.2	23.48
2004	96	161.5	210.8	49.3	7.6	454.2	563.8	109.6	23.67
2004	97	158.6	195.2	36.5	7.6	447.5	525.2	77.7	23.86
2004	98	142.6	174.3	31.7	7.5	406.3	471.5	65.3	23.53
2004	99	142.0	175.4	33.5	7.5	404.9	474.2	69.3	23.53
2004	100	152.7	183.4	30.7	7.7	434.2	495.9	61.8	24.18
2004	101	126.4	150.0	23.6	7.4	364.6	409.3	44.7	23.25
2004	102	100.3	122.1	21.9	6.9	293.3	335.5	42.2	21.62
2004	103	94.9	108.6	13.7	6.6	277.7	299.9	22.2	20.69
2004	104	92.9	108.1	15.2	6.5	270.9	297.7	26.8	20.18
2004	105	88.5	105.5	17.0	6.4	259.7	290.9	31.2	20.08
2004	106	77.0	98.3	21.3	6.4	230.5	272.4	41.8	20.08
2004	107	64.7	86.7	22.0	6.3	197.9	241.9	44.0	19.57
2004	108	59.0	81.4	22.4	6.1	182.4	227.9	45.5	18.92
2004	109	55.9	73.7	17.8	6.0	173.5	207.6	34.1	18.69
2004	110	51.8	72.2	20.3	5.8	161.4	202.9	41.5	17.99
2004	111	45.8	64.9	19.2	5.7	145.6	184.0	38.4	17.75
2004	112	41.4	55.7	14.3	5.5	133.0	159.7	26.7	17.29
2004	113	33.9	46.6	12.7	5.0	108.8	133.6	24.8	15.57
2004	114	33.4	43.6	10.2	4.8	106.7	125.4	18.7	15.15
2004	115	31.1	40.5	9.4	4.7	98.4	116.1	17.6	14.63
2004	116	23.5	29.8	6.4	4.3	75.6	86.8	11.2	13.28
2004	117	23.0	27.4	4.4	4.1	73.8	80.4	6.6	12.96
2004	118	21.6	25.2	3.6	4.0	68.8	74.0	5.2	12.54
2004	119	24.3	27.5	3.2	4.1	76.2	80.2	4.0	12.72
2004	120	20.0	28.6	8.6	4.2	67.2	84.0	16.7	13.24
2004	121	16.8	23.5	6.7	4.2	59.2	70.7	11.5	13.24
2004	122	18.2	21.9	3.7	4.1	61.1	65.9	4.8	12.72
2004	123	20.0	25.1	5.2	4.0	64.6	73.9	9.3	12.40
2004	124	20.5	23.6	3.1	4.0	65.7	69.7	4.0	12.35
2004	125	23.9	23.9	-0.1	4.0	74.9	70.7	-4.1	12.63
2004	126	30.4	29.6	-0.8	4.2	92.5	86.3	-6.2	13.05
2004	127	32.2	34.1	1.9	4.2	97.0	97.7	0.7	13.14
2004	128	28.0	32.8	4.8	4.2	86.1	94.1	8.0	13.00
2004	129	23.6	28.6	5.0	4.0	73.6	82.5	8.8	12.54
2004	130	21.0	25.9	4.9	3.9	66.4	75.2	8.8	12.26
2004	131	18.4	23.7	5.3	3.9	59.8	69.6	9.8	12.12
2004	132	15.6	25.0	9.4	3.8	52.5	72.5	19.9	11.98
2004	133	13.7	23.2	9.5	4.0	49.0	68.8	19.8	12.35
2004	134	12.3	26.1	13.9	3.9	44.9	76.3	31.4	12.21
2004	135	11.2	15.8	4.6	3.8	41.0	48.8	7.8	11.75

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2004	136	10.8	13.5	2.7	3.6	38.4	42.1	3.7	11.33
2004	137	10.4	13.1	2.7	3.6	37.0	40.9	3.9	11.19
2004	138	8.5	11.6	3.1	3.5	31.4	36.5	5.1	10.91
2004	139	7.6	9.9	2.4	3.4	28.4	31.9	3.6	10.58
2004	140	8.1	9.7	1.5	3.4	29.4	31.0	1.6	10.54
2004	141	7.3	9.0	1.7	3.3	27.0	29.1	2.2	10.35
2004	142	7.4	8.9	1.4	3.3	27.2	28.7	1.6	10.35
2004	143	8.1	9.9	1.8	3.4	29.8	31.8	2.1	10.58
2004	144	11.9	15.5	3.6	3.6	41.4	47.3	5.8	11.28
2004	145	12.4	19.2	6.8	3.8	44.4	57.8	13.3	11.89
2004	146	10.8	15.9	5.1	3.7	39.9	48.9	9.0	11.70
2004	147	9.4	14.5	5.1	3.7	35.5	45.0	9.5	11.42
2004	148	10.9	15.7	4.8	3.7	40.1	48.4	8.4	11.65
2004	149	14.2	24.8	10.6	3.9	49.5	73.2	23.7	12.07
2004	150	24.0	27.6	3.6	4.2	77.1	81.3	4.2	13.19
2004	151	17.9	25.0	7.1	4.2	61.9	74.6	12.6	13.19
2004	152	14.9	22.0	7.1	4.1	53.3	66.4	13.0	12.86
2004	153	13.1	22.6	9.5	4.0	47.6	67.2	19.5	12.40
2004	154	12.6	24.8	12.3	3.9	45.5	72.2	26.7	12.17
2004	155	11.2	22.3	11.2	3.8	40.7	65.3	24.6	11.75
2004	156	10.4	12.0	1.6	3.6	37.3	38.2	0.9	11.23
2004	157	9.1	9.1	0.0	3.4	32.2	29.9	-2.3	10.68
2004	158	8.2	7.7	-0.5	3.3	29.0	25.8	-3.3	10.35
2004	159	7.6	7.0	-0.6	3.2	26.7	23.6	-3.2	10.07
2004	160	7.0	6.9	-0.1	3.2	24.8	23.2	-1.7	9.98
2004	161	6.5	6.9	0.4	3.1	23.2	22.9	-0.4	9.79
2004	162	9.1	11.9	2.7	3.3	30.7	35.8	5.0	10.21
2004	163	12.4	18.6	6.2	3.4	40.1	55.1	15.0	10.54
2004	164	11.5	12.6	1.2	3.4	37.5	38.6	1.2	10.54
2004	165	9.5	12.3	2.8	3.3	31.6	37.1	5.5	10.21
2004	166	9.0	7.5	-1.5	3.2	29.6	24.5	-5.1	9.98
2004	167	7.9	5.9	-2.1	3.1	26.2	20.0	-6.2	9.70
2004	168	6.9	6.1	-0.8	3.0	23.0	20.2	-2.8	9.46
2004	169	6.4	7.1	0.7	3.0	21.5	22.6	1.2	9.32
2004	170	8.7	7.5	-1.2	3.1	27.4	24.1	-3.4	9.56
2004	171	14.7	10.5	-4.3	3.3	44.0	32.6	-11.3	10.16
2004	172	19.0	13.9	-5.2	3.4	55.5	41.5	-14.0	10.54
2004	173	17.4	17.4	0.0	3.3	50.6	50.5	-0.1	10.26
2004	174	12.6	14.9	2.4	3.2	38.7	44.3	5.6	10.12
2004	175	12.5	14.1	1.6	3.3	39.0	42.7	3.7	10.16
2004	176	13.4	11.3	-2.1	3.3	41.1	34.6	-6.5	10.16
2004	177		12.0		3.3		36.5		10.16
2004	178		13.0		3.2		38.9		10.02
2004	179		12.5		3.2		37.3		9.88
2004	180		12.3		3.2		36.8		9.88

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2004	181		14.6		3.2		42.8		9.98
2004	182		15.3		3.1		44.2		9.79
2004	183		14.3		1.3		41.3		5.38
2004	184		11.9		1.3		34.8		5.25
2004	185		13.3		1.3		38.4		5.25
2004	186		12.5		1.3		36.2		5.22
2004	187		11.6		1.3		33.4		5.17
2004	188				1.3				5.04
2004	189				1.2				4.83
2004	190				1.2				4.73
2004	191				1.2				4.70
2004	192				1.2				4.73
2004	193				1.2				4.67
2004	194				1.2				4.62
2004	195				1.1				4.49
2004	196				1.2				4.73
2004	197				1.2				4.91
2004	198				1.2				4.70
2004	199				1.2				4.65
2004	200				1.2				4.88
2004	201				1.2				4.67
2004	202				1.2				4.62
2004	203				1.1				4.54
2004	204				1.1				4.33
2004	205				1.1				4.26
2004	206				1.1				4.36
2004	207				1.1				4.31
2004	208				1.1				4.36
2004	209				1.1				4.41
2004	210				1.1				4.33
2004	211				1.1				4.33
2004	212				1.1				4.31
2004	213				1.1				4.28
2004	214	0.9			1.1	3.4			4.31
2004	215	0.9			1.1	3.5			4.33
2004	216	1.0			1.1	3.7			4.36
2004	217	1.1			1.1	3.6			4.31
2004	218				1.1				4.28
2004	219	0.6			1.1	2.5			4.26
2004	220	0.8			1.1	2.8			4.26
2004	221	0.8			1.1	3.0			4.28
2004	222	0.9			1.1	3.2			4.28
2004	223	0.7			1.1	2.5			4.23
2004	224	0.8			1.1	2.9			4.28
2004	225	0.8			1.1	2.7			4.26

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2004	226	0.6			1.1	2.0			4.20
2004	227	0.5			1.0	1.8			4.18
2004	228	0.6			1.1	2.0			4.20
2004	229	0.6			1.1	2.4			4.23
2004	230	0.8			1.1	3.1			4.31
2004	231	1.0			1.1	3.6			4.31
2004	232	0.9			1.1	3.3			4.31
2004	233	0.8			1.1	2.7			4.26
2004	234	1.0			1.1	3.5			4.31
2004	235	1.4			1.1	5.2			4.41
2004	236	2.7			1.2	9.4			4.65
2004	237	2.7			1.2	9.1			4.65
2004	238	3.2			1.2	10.8			4.73
2004	239	3.1			1.2	10.5			4.70
2004	240	3.0			1.2	10.5			4.70
2004	241	3.3			1.2	11.1			4.73
2004	242	3.3			1.2	11.3			4.75
2004	243	3.1			1.2	10.4			4.70
2004	244	3.7			1.2	12.5			4.78
2004	245	3.0			1.2	10.1			4.67
2004	246	2.5	3.0	0.5	1.2	8.7	10.2	1.4	4.62
2004	247	1.9	2.7	0.8	1.1	7.1	9.3	2.2	4.60
2004	248	2.1	2.8	0.6	1.2	8.0	9.8	1.8	4.62
2004	249	2.5	3.0	0.5	1.2	9.2	10.5	1.3	4.73
2004	250	2.4	2.7	0.3	1.2	8.9	9.8	0.9	4.70
2004	251	2.0	2.5	0.5	1.2	7.8	9.2	1.4	4.65
2004	252	2.0	2.8	0.8	1.2	7.9	9.9	2.0	4.67
2004	253	1.9	2.6	0.7	1.2	7.4	9.4	2.0	4.62
2004	254	1.7	2.5	0.8	1.1	6.8	9.0	2.2	4.60
2004	255	1.5	2.5	1.0	1.1	6.3	9.0	2.7	4.60
2004	256	1.4	2.4	1.0	1.1	6.0	8.7	2.7	4.57
2004	257	1.7	2.8	1.1	1.2	7.1	9.8	2.8	4.67
2004	258	1.4	2.7	1.3	1.2	6.6	9.6	3.0	4.65
2004	259	1.3	2.8	1.5	1.2	6.7	10.2	3.5	4.73
2004	260	1.3	2.9	1.6	1.2	6.4	10.2	3.8	4.70
2004	261	1.3	2.9	1.6	1.2	6.7	10.4	3.7	4.73
2004	262	1.3	3.0	1.7	1.2	6.6	10.5	3.9	4.73
2004	263	1.1	2.8	1.7	1.2	5.9	9.9	4.0	4.67
2004	264	1.2	3.2	2.1	1.2	6.4	11.3	4.9	4.73
2004	265	1.1	3.4	2.3	1.2	6.9	12.0	5.0	4.80
2004	266	1.1	3.3	2.2	1.2	7.3	12.1	4.7	4.91
2004	267	1.5	3.5	2.0	1.2	8.5	12.6	4.1	4.99
2004	268	1.6	3.9	2.4	1.2	8.5	13.6	5.1	4.96
2004	269	1.4	3.5	2.0	1.2	7.9	12.3	4.4	4.88
2004	270	1.3	2.9	1.7	1.2	7.1	10.7	3.6	4.80

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2004	271	1.2	2.6	1.4	1.2	6.7	9.7	3.0	4.75
2004	272	1.3	2.6	1.4	1.2	6.8	9.8	3.0	4.75
2004	273	2.2	3.8	1.6	1.2	10.4	13.5	3.1	4.99
2004	274	2.7	8.4	5.7	1.3	12.5	25.7	13.1	5.20
2004	275	3.1	6.1	3.0	1.3	13.7	20.0	6.2	5.22
2004	276	3.2	6.1	2.9	1.3	14.1	20.0	6.0	5.27
2004	277	2.9	5.0	2.2	1.3	12.8	17.1	4.4	5.17
2004	278	2.5	4.7	2.2	1.3	11.8	16.2	4.4	5.12
2004	279	2.3	4.5	2.1	1.3	11.2	15.5	4.4	5.09
2004	280	2.3	4.3	2.0	1.3	11.1	15.0	3.9	5.09
2004	281	2.3	4.8	2.5	1.3	11.6	16.6	5.0	5.17
2004	282	2.4	5.7	3.3	1.3	11.8	18.9	7.1	5.20
2004	283	2.3	7.6	5.3	1.3	11.3	23.5	12.2	5.14
2004	284	2.1	3.8	1.7	1.3	10.7	13.8	3.1	5.12
2004	285	2.3	4.2	1.9	1.3	11.2	14.9	3.7	5.12
2004	286	2.4	4.6	2.1	1.3	11.9	16.0	4.1	5.20
2004	287	2.7	4.4	1.8	1.3	12.6	15.8	3.1	5.22
2004	288	2.4	4.3	1.9	1.3	11.9	15.4	3.6	5.17
2004	289	3.2	5.4	2.1	1.4	15.1	18.8	3.7	5.40
2004	290	2.9	4.7	1.8	1.3	13.7	16.8	3.1	5.30
2004	291	2.1	4.8	2.7	1.3	11.8	17.1	5.3	5.30
2004	292	2.3	6.3	4.0	1.4	13.0	21.3	8.3	5.43
2004	293	2.3	5.3	3.0	1.4	12.9	18.6	5.7	5.43
2004	294	3.1	7.4	4.4	1.4	16.4	24.8	8.4	5.72
2004	295	14.8	18.8	4.0	1.6	48.3	55.4	7.1	6.55
2004	296	22.9	40.4	17.5	1.9	75.2	114.2	39.0	7.54
2004	297	17.2	31.6	14.4	1.9	60.4	91.9	31.5	7.41
2004	298	11.7	22.4	10.7	1.7	44.5	66.7	22.2	7.00
2004	299	8.7	16.8	8.1	1.7	36.5	52.2	15.7	6.86
2004	300	7.5	14.2	6.6	1.7	32.5	44.9	12.4	6.66
2004	301	7.9	13.7	5.8	1.7	33.2	43.6	10.4	6.63
2004	302	9.5	17.7	8.3	1.7	37.8	54.3	16.4	6.79
2004	303	14.0	25.7	11.6	1.9	53.1	76.8	23.7	7.49
2004	304	13.4	23.9	10.5	1.9	52.1	72.4	20.3	7.60
2004	305	11.5	20.6	9.1	1.9	46.5	63.7	17.2	7.44
2004	306	8.8	18.0	9.2	1.8	39.6	56.8	17.3	7.39
2004	307	7.1	15.1	8.0	1.8	34.8	49.1	14.3	7.31
2004	308	7.7	15.4	7.6	1.9	37.5	50.5	12.9	7.52
2004	309	8.3	15.8	7.5	1.9	39.4	51.8	12.4	7.57
2004	310	8.9	15.8	6.9	1.9	40.3	51.5	11.3	7.46
2004	311	8.2	14.9	6.6	1.8	37.4	48.5	11.1	7.26
2004	312	8.2	15.3	7.1	1.8	38.0	50.0	12.0	7.36
2004	313	7.4	14.1	6.8	1.8	35.4	46.7	11.3	7.28
2004	314	7.4	13.6	6.2	1.8	35.8	45.4	9.6	7.36
2004	315	8.5	14.5	6.0	1.8	38.8	47.9	9.1	7.36

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2004	316	9.8	15.9	6.1	1.8	41.8	51.4	9.6	7.36
2004	317	9.5	16.9	7.4	1.9	41.7	54.2	12.5	7.46
2004	318	9.7	18.9	9.2	1.9	43.0	59.8	16.8	7.60
2004	319	8.1	18.1	10.0	1.9	39.0	57.8	18.8	7.60
2004	320	7.0	15.5	8.4	1.9	35.8	50.8	15.0	7.52
2004	321	6.8	14.0	7.2	1.9	35.2	47.0	11.8	7.52
2004	322	6.2	13.3	7.1	1.9	33.3	45.0	11.7	7.41
2004	323	6.2	12.3	6.0	1.8	33.1	42.3	9.2	7.39
2004	324	6.0	11.5	5.4	1.8	32.6	40.2	7.6	7.36
2004	325	5.2	10.5	5.2	1.8	30.3	37.4	7.1	7.31
2004	326	5.0	9.9	4.9	1.8	29.4	35.9	6.5	7.23
2004	327	5.8	9.6	3.9	1.8	30.4	34.7	4.2	7.10
2004	328	6.0	9.9	3.8	1.8	31.7	35.6	3.9	7.20
2004	329		10.4		1.8		37.1		7.31
2004	330		10.5		1.8		37.7		7.36
2004	331		11.4		1.9		40.5		7.54
2004	332		12.9		1.9		44.4		7.54
2004	333		11.5		1.9		40.0		7.41
2004	334				1.7				6.94
2004	335				3.9				15.60
2004	336				4.7				18.94
2004	337				4.2				16.88
2004	338				3.9				15.45
2004	339				3.6				14.45
2004	340				3.4				13.75
2004	341				3.5				13.88
2004	342				3.5				14.09
2004	343				3.5				14.17
2004	344				3.3				13.05
2004	345				2.1				8.51
2004	346				2.3				9.00
2004	347				2.2				8.74
2004	348				2.1				8.35
2004	349				2.0				8.17
2004	350				2.0				8.14
2004	351				2.0				8.06
2004	352				2.0				8.04
2004	353				2.0				7.91
2004	354				2.0				7.83
2004	355				2.0				7.93
2004	356				2.0				7.83
2004	357				1.9				7.54
2004	358				2.7				10.62
2004	359				3.6				14.35
2004	360				4.2				16.67

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2004	361				4.1				16.33
2004	362				3.8				15.39
2004	363				2.9				11.64
2004	364				1.9				7.73
2004	365				2.0				8.20
2004	366				2.2				8.64
2005	1				2.1				8.5
2005	2				2.0				8.2
2005	3				2.0				8.2
2005	4				2.0				8.1
2005	5				2.0				8.0
2005	6				2.0				8.0
2005	7				2.0				7.9
2005	8				2.0				8.1
2005	9				2.0				8.2
2005	10				2.0				8.2
2005	11				2.1				8.4
2005	12				2.1				8.4
2005	13				2.0				8.1
2005	14				1.9				7.5
2005	15				1.7				6.7
2005	16				1.8				7.3
2005	17				2.0				8.0
2005	18				1.9				7.8
2005	19				1.9				7.7
2005	20				1.9				7.7
2005	21				1.9				7.8
2005	22				1.9				7.7
2005	23				1.9				7.6
2005	24				1.9				7.5
2005	25				1.8				7.3
2005	26				1.9				7.5
2005	27				1.9				7.8
2005	28				1.9				7.8
2005	29				2.0				8.0
2005	30				2.0				7.9
2005	31				2.0				7.9
2005	32				2.0				7.8
2005	33				1.9				7.8
2005	34				1.9				7.7
2005	35				1.9				7.6
2005	36				2.0				7.8
2005	37				1.9				7.8
2005	38				1.9				7.8
2005	39				1.9				7.8

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2005	40				1.9				7.7
2005	41				1.9				7.7
2005	42				1.9				7.5
2005	43				1.9				7.7
2005	44				2.0				7.8
2005	45				2.0				7.9
2005	46				1.9				7.8
2005	47				1.9				7.6
2005	48				1.8				7.3
2005	49				1.9				7.5
2005	50	15.9	40.8	24.9	1.9	55.3	106.9	51.6	7.7
2005	51	16.1	25.2	9.1	2.0	61.0	77.1	16.1	8.0
2005	52	21.1	19.8	-1.3	2.0	73.0	63.1	-9.9	7.9
2005	53	15.8	25.1	9.3	2.0	59.4	75.9	16.5	7.9
2005	54	14.8	19.5	4.8	2.0	56.6	62.0	5.5	7.8
2005	55	14.7	19.3	4.6	2.0	56.1	61.4	5.2	7.8
2005	56	14.2	19.1	4.9	2.0	55.0	60.9	5.8	7.8
2005	57	13.8	19.1	5.3	2.0	54.4	61.1	6.7	7.8
2005	58	13.4	18.3	4.9	2.0	53.3	59.0	5.7	7.9
2005	59	13.4	18.4	5.0	2.0	53.4	59.2	5.8	7.9
2005	60	13.0	18.4	5.4	4.5	52.5	59.3	6.8	14.1
2005	61	14.7	19.9	5.3	4.6	57.4	63.6	6.2	14.3
2005	62	16.7	23.0	6.4	4.7	63.3	71.9	8.5	14.6
2005	63	19.2	35.3	16.0	4.8	70.6	103.8	33.2	14.9
2005	64	21.7	26.7	5.0	4.8	77.6	82.5	4.9	15.1
2005	65	26.9	31.6	4.6	5.0	91.8	95.3	3.6	15.6
2005	66	33.8	38.5	4.6	5.2	110.9	114.0	3.2	16.2
2005	67	37.9	46.1	8.3	5.4	123.0	134.8	11.7	16.9
2005	68	55.1	63.4	8.4	5.7	173.6	180.1	6.5	17.9
2005	69		103.3		6.2		283.6		19.4
2005	70		163.0		6.7		438.0		20.8
2005	71		180.4		6.9		484.2		21.7
2005	72	130.6	229.0	98.4	7.2	370.9	609.9	239.0	22.6
2005	73	154.9	223.2	68.3	7.0	440.0	594.9	154.9	21.9
2005	74	90.6	138.3	47.8	6.5	264.4	363.2	98.9	20.3
2005	75	65.0			6.3	199.7			19.7
2005	76	75.4			6.3	225.2			19.8
2005	77				6.3				19.6
2005	78				6.3				19.8
2005	79	100.8			6.7	288.8			20.8
2005	80	179.1			7.9	500.3			24.6
2005	81	164.6			7.8	457.3			24.3
2005	82	121.5	157.2	35.8	7.6	353.2	410.8	57.6	23.6
2005	83	164.1	188.4	24.3	8.2	470.7	510.9	40.2	25.6
2005	84		201.4		7.9		539.0		24.7

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2005	85		116.8		6.9		321.9		21.5
2005	86		93.9		6.4		261.3		20.0
2005	87		97.2		6.5		270.2		20.3
2005	88		108.7		6.7		300.4		20.9
2005	89		89.4		6.6		251.0		20.7
2005	90		71.1		6.2		202.3		19.4
2005	91		65.9		5.9		187.6		18.5
2005	92		64.5		5.8		183.3		18.0
2005	93		76.5		5.8		213.9		18.1
2005	94		103.2		6.1		284.3		19.2
2005	95		88.1		6.2		245.5		19.3
2005	96		86.5		6.0		240.6		18.8
2005	97		84.3		5.9		234.6		18.6
2005	98		88.4		6.0		245.3		18.8
2005	99		88.7		6.1		246.7		19.1
2005	100	55.4	80.4	25.0	5.9	172.1	224.5	52.4	18.6
2005	101	47.0	66.1	19.1	5.8	149.9	187.6	37.6	18.2
2005	102	48.8	63.4	14.6	5.7	153.2	179.9	26.8	17.8
2005	103	57.0	70.4	13.5	5.7	173.8	198.1	24.2	17.8
2005	104	64.7	83.6	19.0	6.0	196.2	233.1	36.9	18.7
2005	105	61.2	84.1	22.9	6.2	189.2	235.4	46.2	19.5
2005	106	53.2	71.2	18.0	6.0	166.5	201.2	34.7	18.6
2005	107	55.0	73.3	18.2	5.9	170.5	206.2	35.6	18.4
2005	108	60.3	81.0	20.7	6.0	185.7	226.7	41.0	18.9
2005	109	60.6	86.7	26.1	6.4	192.0	243.3	51.3	20.0
2005	110		94.2		6.8		260.6		21.2
2005	111		51.7		7.0		156.7		21.8
2005	112		49.2		6.9		150.6		21.5
2005	113		87.8		6.7		254.4		20.9
2005	114		85.3		6.4		239.8		20.0
2005	115	43.1	87.3	44.1	6.6	148.7	245.5	96.8	20.6
2005	116	56.7	92.7	36.0	6.7	182.5	259.6	77.1	20.8
2005	117	74.5	125.6	51.0	7.2	231.9	347.2	115.3	22.4
2005	118	132.6	207.7	75.1	8.1	383.7	554.3	170.5	25.3
2005	119	208.2	330.6	122.4	9.0	584.0	877.0	293.0	28.2
2005	120	111.3	202.6	91.4	8.3	333.4	545.1	211.7	25.8
2005	121	76.4	135.4	59.0	7.5	239.9	372.8	132.9	23.5
2005	122	63.2	111.0	47.7	7.1	202.5	308.3	105.8	22.1
2005	123	60.5	104.8	44.3	6.8	193.6	291.5	98.0	21.3
2005	124	61.5	104.4	42.9	6.8	195.9	290.3	94.4	21.3
2005	125	70.6	115.1	44.5	7.1	221.8	319.1	97.3	22.2
2005	126	92.7	145.7	53.1	7.6	281.1	399.6	118.6	23.8
2005	127	114.6	174.0	59.3	8.1	341.5	473.4	131.8	25.3
2005	128	167.0	251.7	84.7	8.8	481.2	675.2	194.0	27.5
2005	129	164.1	273.7	109.6	9.2	477.8	732.6	254.9	28.7

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2005	130	208.9	306.2	97.4	9.7	595.8	818.5	222.6	30.4
2005	131	257.6	362.6	105.0	10.4	724.1	966.3	242.2	32.5
2005	132	281.3	357.5	76.3	10.8	788.6	954.7	166.1	33.8
2005	133	254.2	301.4	47.2	10.6	718.4	810.8	92.3	33.2
2005	134	216.8	250.4	33.5	9.8	614.6	676.8	62.3	30.7
2005	135	181.9	224.3	42.4	9.4	524.0	608.9	85.0	29.4
2005	136	199.0	292.0	93.1	10.0	571.2	762.4	191.2	31.3
2005	137	408.5	463.6	55.0	11.3	1,109.3	1,222.0	112.7	35.2
2005	138	371.9	496.6	124.7	12.1	1,030.1	1,314.8	284.7	37.8
2005	139	275.0	366.2	91.3	11.6	779.0	980.3	201.3	36.2
2005	140	246.7	332.9	86.1	11.1	704.1	893.0	188.9	34.8
2005	141	254.6	304.4	49.8	10.7	719.5	819.5	100.0	33.5
2005	142	264.0	283.1	19.0	10.4	739.5	763.0	23.5	32.5
2005	143	196.6	242.3	45.7	9.9	565.6	656.6	90.9	30.8
2005	144	172.7	215.9	43.2	9.2	497.6	585.7	88.1	28.7
2005	145	152.5	173.4	20.9	8.7	442.0	475.3	33.3	27.2
2005	146	154.2	140.6	-13.6	7.8	447.4	387.1	-60.3	24.4
2005	147	197.7	114.0	-83.7	7.0	538.6	315.8	-222.8	22.0
2005	148	210.1	104.1	-106.1	6.6	568.3	288.2	-280.0	20.6
2005	149	185.6	94.9	-90.7	6.3	501.4	263.4	-238.1	19.7
2005	150	94.9	92.9	-1.9	6.4	275.5	258.8	-16.7	19.9
2005	151	88.6	93.8	5.2	6.6	261.8	262.0	0.2	20.7
2005	152	78.6	92.0	13.4	6.5	234.9	256.9	22.1	20.2
2005	153	66.3	76.4	10.1	6.4	204.1	217.0	12.8	20.0
2005	154	51.7	57.5	5.8	5.9	161.8	165.8	4.0	18.3
2005	155	48.3	51.0	2.6	5.5	149.9	147.2	-2.7	17.1
2005	156	46.1	52.0	5.9	5.4	143.5	149.4	5.9	16.8
2005	157	145.6	181.9	36.3	6.9	390.7	455.5	64.8	21.6
2005	158	278.6	322.5	44.0	10.1	773.5	867.3	93.8	31.5
2005	159	167.3	201.6	34.3	9.8	490.1	552.4	62.3	30.7
2005	160	132.1	145.4	13.3	9.4	397.4	407.6	10.2	29.3
2005	161	129.9	139.3	9.4	8.9	387.9	389.9	2.0	27.8
2005	162	189.2	179.1	-10.1	9.5	543.3	494.4	-49.0	29.8
2005	163	182.2	181.4	-0.8	9.6	526.9	500.7	-26.2	30.0
2005	164	149.4	175.6	26.2	9.5	442.4	484.9	42.5	29.7
2005	165	129.9	153.9	24.0	9.0	388.9	427.7	38.8	28.1
2005	166	130.2	150.5	20.3	8.8	387.6	417.9	30.3	27.4
2005	167	127.4	149.0	21.6	8.5	377.7	412.4	34.8	26.5
2005	168	115.1	135.0	19.8	8.1	343.3	374.8	31.5	25.4
2005	169	87.9	116.9	29.0	7.4	267.2	324.6	57.3	23.2
2005	170	77.3	92.7	15.3	7.0	237.1	261.2	24.1	21.9
2005	171	70.9	81.7	10.8	6.7	218.2	231.8	13.6	20.9
2005	172	54.1	63.3	9.2	5.7	175.5	179.8	4.3	17.9
2005	173	43.0	63.7	20.7	5.8	142.7	181.3	38.6	18.1
2005	174	34.7	45.6	10.9	5.1	111.2	131.3	20.0	15.8

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2005	175	27.8	33.5	5.7	4.5	88.7	97.5	8.8	14.0
2005	176	25.7	32.6	6.9	4.4	82.5	94.7	12.3	13.7
2005	177	25.7	34.8	9.0	4.4	82.3	100.2	17.9	13.7
2005	178	21.6	27.9	6.3	4.1	70.0	81.2	11.2	12.9
2005	179	17.9	21.7	3.8	3.9	59.0	64.7	5.7	12.3
2005	180	15.1	20.2	5.1	3.8	51.4	60.4	9.0	12.0
2005	181	15.3	19.2	3.9	3.8	51.4	57.7	6.4	11.8
2005	182	12.1	16.6	4.5	1.6	42.4	50.5	8.1	6.5
2005	183	10.7	14.0	3.3	1.6	38.4	43.5	5.1	6.4
2005	184	9.4	11.6	2.2	1.5	34.0	36.8	2.8	6.2
2005	185	7.0	9.9	2.9	1.5	27.7	32.2	4.4	6.1
2005	186	6.1	8.2	2.1	1.5	24.6	27.5	2.8	5.9
2005	187	5.4	7.4	2.0	1.5	22.4	25.1	2.7	5.8
2005	188	4.7	7.0	2.3	1.4	20.2	23.8	3.6	5.7
2005	189	3.8	6.1	2.2	1.4	17.8	21.2	3.4	5.6
2005	190	3.0	5.2	2.2	1.4	15.1	18.6	3.5	5.5
2005	191	2.8	5.1	2.2	1.4	14.4	18.1	3.7	5.5
2005	192	2.9	5.6	2.7	1.4	14.5	19.5	5.0	5.4
2005	193	2.5	4.8	2.4	1.3	12.6	17.0	4.4	5.3
2005	194	1.9	4.4	2.4	1.3	10.7	15.4	4.8	5.2
2005	195	1.6	3.6	2.0	1.3	9.1	13.0	3.9	5.0
2005	196	1.6	3.6	2.0	1.2	8.7	12.8	4.2	4.9
2005	197	1.7	4.2	2.5	1.2	8.4	14.0	5.7	4.9
2005	198	2.0	3.7	1.7	1.2	9.0	12.7	3.7	4.9
2005	199	2.3	3.9	1.6	1.2	9.6	13.2	3.6	4.8
2005	200	2.8	3.8	0.9	1.2	10.4	12.8	2.4	4.8
2005	201	2.7	3.3	0.6	1.2	10.2	11.7	1.4	4.8
2005	202	2.2	3.1	0.8	1.2	9.2	11.0	1.8	4.8
2005	203	2.4	3.4	1.0	1.2	9.5	11.8	2.3	4.8
2005	204	2.6	3.8	1.3	1.2	10.3	13.1	2.8	4.9
2005	205	1.6	2.7	1.1	1.2	6.6	9.5	2.9	4.6
2005	206	1.4	2.4	1.0	1.1	6.0	8.6	2.6	4.6
2005	207	1.1	1.9	0.7	1.1	4.9	7.1	2.2	4.5
2005	208	1.0	1.6	0.6	1.1	4.2	6.3	2.0	4.4
2005	209	1.1	1.8	0.7	1.1	4.4	6.6	2.2	4.4
2005	210	1.3	1.9	0.7	1.1	5.0	7.1	2.2	4.4
2005	211	1.9	2.6	0.7	1.1	7.1	9.1	2.0	4.6
2005	212	2.0	3.2	1.1	1.1	7.4	9.6	2.2	4.6
2005	213	3.0	2.7	-0.3	1.2	10.0	9.7	-0.3	4.6
2005	214	3.0	5.4	2.5	1.2	12.3	18.2	5.9	4.9
2005	215	6.1	9.4	3.3	1.3	19.0	26.6	7.6	5.0
2005	216	16.9	6.3	-10.6	1.2	40.5	19.0	-21.5	4.7
2005	217	8.7	7.8	-0.9	1.2	22.5	22.6	0.1	4.7
2005	218	7.1	4.6	-2.5	1.2	18.5	14.3	-4.2	4.6
2005	219	5.6	3.6	-2.0	1.1	14.3	11.5	-2.9	4.5

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2005	220	5.5	3.3	-2.1	1.1	14.1	10.9	-3.3	4.5
2005	221	4.7	2.9	-1.8	1.1	12.3	9.7	-2.6	4.5
2005	222	4.4	2.5	-1.9	1.1	11.3	8.5	-2.8	4.4
2005	223	4.2	2.6	-1.6	1.1	11.0	8.7	-2.3	4.5
2005	224	3.7	2.5	-1.2	1.1	9.7	8.4	-1.3	4.4
2005	225	3.4	2.4	-1.0	1.1	9.2	8.2	-1.0	4.4
2005	226	4.6	3.3	-1.2	1.1	12.8	11.0	-1.8	4.6
2005	227	4.8	4.1	-0.7	1.2	13.8	13.2	-0.6	4.6
2005	228	5.4	5.1	-0.2	1.2	15.8	16.0	0.1	4.7
2005	229	7.5	6.6	-1.0	1.2	21.3	20.1	-1.2	4.8
2005	230	7.6	6.9	-0.7	1.2	21.9	21.0	-0.9	4.9
2005	231	7.3	6.2	-1.2	1.2	21.4	19.2	-2.2	4.9
2005	232	6.4	5.4	-1.1	1.2	19.0	17.0	-2.0	4.9
2005	233	5.6	5.2	-0.4	1.2	16.9	16.6	-0.3	4.8
2005	234	5.5	4.3	-1.1	1.2	16.4	14.2	-2.1	4.8
2005	235	5.9	4.2	-1.7	1.2	17.3	13.9	-3.3	4.8
2005	236	6.0	4.3	-1.7	1.2	17.7	14.1	-3.6	4.8
2005	237	4.8	4.1	-0.7	1.2	14.6	13.4	-1.2	4.8
2005	238	4.2	4.0	-0.2	1.2	13.0	13.1	0.1	4.7
2005	239	3.6	3.4	-0.1	1.2	11.3	11.6	0.3	4.6
2005	240	3.9	3.8	-0.1	1.2	12.3	12.6	0.2	4.7
2005	241	4.6	3.9	-0.7	1.2	14.3	13.2	-1.1	4.8
2005	242	5.3	4.0	-1.2	1.2	16.3	13.6	-2.7	4.8
2005	243	6.6	5.2	-1.4	1.3	20.7	17.3	-3.5	5.0
2005	244	5.9	6.1	0.2	1.3	18.9	19.4	0.5	5.0
2005	245	4.5	5.4	0.8	1.2	14.9	17.1	2.2	4.9
2005	246		4.8		1.2		15.8		4.9
2005	247		4.3		1.2		14.2		4.8
2005	248		5.0		1.2		16.0		4.9
2005	249		5.6		1.2		17.9		4.9
2005	250		4.6		1.2		14.7		4.8
2005	251		4.1		1.2		13.6		4.8
2005	252		3.9		1.2		13.0		4.8
2005	253		4.7		1.2		15.5		4.9
2005	254		5.0		1.2		16.3		4.9
2005	255		4.7		1.2		15.7		5.0
2005	256		4.4		1.3		15.2		5.0
2005	257		5.1		1.3		17.0		5.1
2005	258		5.5		1.3		18.1		5.1
2005	259		7.1		1.3		22.5		5.2
2005	260		8.9		1.3		27.4		5.4
2005	261		6.7		1.3		21.7		5.3
2005	262		6.8		1.4		22.2		5.4
2005	263		6.5		1.3		21.0		5.2
2005	264		24.3		1.5		75.3		5.8

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2005	265	17.8	14.0	-3.8	1.4	51.0	40.7	-10.4	5.4
2005	266	6.3	10.9	4.6	1.3	21.9	32.7	10.8	5.4
2005	267	6.1	8.3	2.2	1.4	22.2	26.5	4.3	5.5
2005	268	8.0	11.1	3.1	1.5	29.0	34.7	5.7	5.8
2005	269	7.3	11.5	4.2	1.5	27.4	35.7	8.3	5.9
2005	270	6.7	10.3	3.7	1.4	25.2	32.5	7.3	5.8
2005	271	6.9			1.5	26.1			5.8
2005	272	6.3			1.4	24.3			5.8
2005	273	6.4	9.3	2.9	1.4	24.9	30.5	5.6	5.8
2005	274	7.9			1.5	29.9			6.0
2005	275	15.7			1.7	51.7			6.8
2005	276	33.1			2.2	106.6			8.6
2005	277	40.0			2.3	128.7			9.2
2005	278	25.0			2.2	86.9			8.7
2005	279	23.0			2.1	81.0			8.5
2005	280	20.6			2.1	73.7			8.3
2005	281	19.8			2.0	69.4			7.9
2005	282	18.3			2.0	66.3			8.0
2005	283	17.0			2.0	62.8			8.0
2005	284	14.7	54.6	40.0	1.9	56.0	152.6	96.6	7.8
2005	285	16.9	22.2	5.3	2.0	61.9	68.8	6.9	7.8
2005	286	19.1	23.8	4.8	2.0	67.3	73.0	5.7	7.8
2005	287	18.8	23.7	4.9	1.9	66.2	72.3	6.1	7.8
2005	288	20.2	25.6	5.4	2.0	70.0	77.7	7.7	7.8
2005	289	22.5	25.7	3.2	2.0	77.1	78.5	1.4	8.1
2005	290	16.5	22.2	5.7	2.0	60.8	68.7	7.9	7.8
2005	291	16.5	20.6	4.1	1.9	60.4	64.4	4.0	7.8
2005	292	18.8	21.7	2.9	2.0	66.7	67.7	1.0	7.8
2005	293	21.0	23.3	2.3	2.0	72.1	71.6	-0.5	7.9
2005	294	16.5	22.2	5.6	1.9	60.1	68.3	8.2	7.7
2005	295	13.8	21.1	7.3	1.9	53.1	65.5	12.4	7.6
2005	296	12.3	19.9	7.5	1.9	49.0	62.2	13.2	7.5
2005	297	12.6	21.7	9.1	1.9	48.9	67.1	18.1	7.4
2005	298	13.3	21.8	8.4	1.8	50.7	66.4	15.7	7.4
2005	299	13.9	21.8	7.9	1.8	51.8	66.3	14.5	7.3
2005	300	14.7	22.8	8.1	1.9	54.6	69.2	14.6	7.4
2005	301	17.3	25.3	8.0	1.9	62.2	76.3	14.1	7.7
2005	302	19.8	35.0	15.2	2.0	70.0	101.9	31.9	8.0
2005	303	18.8	29.7	10.9	2.0	67.8	88.7	20.9	8.0
2005	304	14.3	24.9	10.5	2.0	56.5	76.0	19.5	8.0
2005	305	10.7	19.0	8.3	2.0	46.5	60.7	14.2	7.9
2005	306	17.2	24.9	7.8	2.1	66.1	77.5	11.4	8.5
2005	307	28.6	35.6	7.0	2.3	97.9	106.9	8.9	9.2
2005	308	27.4	31.3	3.9	2.2	95.3	95.3	0.0	9.0
2005	309	19.7	32.8	13.1	2.3	76.1	99.9	23.8	9.2

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2005	310	20.3	29.7	9.5	2.3	77.1	91.7	14.5	9.1
2005	311	23.7	25.3	1.6	2.2	84.8	80.1	-4.7	8.9
2005	312	23.4	29.1	5.7	2.2	83.7	90.3	6.6	8.9
2005	313	33.0			2.2	108.4			9.0
2005	314	21.6			2.2	79.1			8.8
2005	315	17.5			2.2	68.5			8.7
2005	316	17.5			2.2	69.1			8.8
2005	317	14.8			2.3	63.5			9.1
2005	318	15.7			2.3	66.6			9.3
2005	319	16.4			2.4	70.2			9.6
2005	320	12.2			2.3	57.6			9.2
2005	321	11.7			2.3	56.6			9.2
2005	322	24.2			2.3	86.8			9.0
2005	323	14.2	13.6	-0.6	2.2	61.2	50.5	-10.7	8.9
2005	324	10.3	13.9	3.6	2.2	51.3	50.9	-0.4	8.9
2005	325	9.4	13.8	4.4	2.2	49.1	50.8	1.7	8.9
2005	326	9.4	13.7	4.3	2.2	48.2	49.8	1.6	8.7
2005	327	9.0	13.0	4.0	2.2	46.9	47.9	1.0	8.7
2005	328	8.5	13.7	5.2	2.2	45.7	49.7	4.0	8.7
2005	329	12.8	17.1	4.3	2.3	57.9	59.0	1.0	9.2
2005	330	17.1	24.8	7.7	2.5	73.5	81.7	8.2	9.9
2005	331	17.4	22.5	5.1	2.5	74.6	75.9	1.3	9.9
2005	332	16.4	19.5	3.1	2.4	69.6	67.3	-2.3	9.6
2005	333		18.0		2.4		63.4		9.5
2005	334		19.8		2.4		68.2		9.6
2005	335		18.4		2.3		63.7		9.3
2005	336		48.3		2.6		142.0		10.4
2005	337		38.0		2.7		117.7		10.7
2005	338		29.0		2.5		92.5		9.9
2005	339		22.3		2.6		72.8		10.4
2005	340		17.0		2.6		57.9		10.4
2005	341		12.2		2.6		44.9		10.4
2005	342				2.6				10.4
2005	343				2.6				10.4
2005	344				2.6				10.4
2005	345				2.6				10.4
2005	346				2.6				10.4
2005	347				2.6				10.4
2005	348				2.6				10.4
2005	349				2.6				10.4
2005	350				2.6				10.4
2005	351				2.6				10.4
2005	352				2.6				10.4
2005	353				2.6				10.4
2005	354				2.6				10.4

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2005	355		15.0		2.6		52.9		10.4
2005	356	32.0	25.5	-6.6	2.6	105.0	80.2	-24.8	10.4
2005	357	104.6	29.1	-75.4	2.6	291.8	92.6	-199.2	10.4
2005	358	111.6	73.7	-37.9	2.6	312.6	207.7	-104.9	10.4
2005	359	79.1	200.3	121.2	2.5	229.7	528.6	298.9	10.1
2005	360	57.0	90.3	33.3	2.5	175.1	249.4	74.3	10.2
2005	361	67.6	78.5	10.8	2.8	205.1	220.1	15.0	11.0
2005	362	126.3	113.1	-13.2	2.9	351.3	310.3	-41.0	11.5
2005	363	217.1	281.6	64.5	3.3	596.1	749.6	153.5	13.1
2005	364	483.6	448.1	-35.5	3.6	1,293.1	1,197.5	-95.6	14.3
2005	365	247.2	433.4	186.2	3.5	675.7	1,130.9	455.2	13.9
2006	1	239.1	266.0	27.0	4.0	660.8	710.9	50.2	16.0
2006	2	341.1	405.3	64.2	3.9	916.0	1,064.6	148.6	15.6
2006	3	199.9	235.7	35.8	3.8	561.9	634.4	72.6	15.1
2006	4	258.6	275.9	17.3	4.0	714.5	739.9	25.4	16.1
2006	5	150.9	186.3	35.4	3.5	428.8	497.3	68.5	13.9
2006	6	82.4	95.6	13.2	3.0	247.3	267.5	20.2	12.0
2006	7	57.4	71.6	14.3	2.8	181.2	204.5	23.3	11.2
2006	8	56.8	64.9	8.1	2.7	177.9	186.4	8.5	10.8
2006	9	50.5	60.8	10.3	2.6	159.4	174.7	15.3	10.3
2006	10	38.9	52.1	13.2	2.5	128.1	151.0	22.9	9.9
2006	11	42.3	78.6	36.3	2.6	138.6	214.7	76.0	10.3
2006	12	43.8	52.5	8.7	2.5	141.5	152.8	11.3	10.1
2006	13	40.7	47.8	7.1	2.4	131.5	139.7	8.2	9.7
2006	14	38.4	45.2	6.8	2.4	125.5	132.8	7.3	9.7
2006	15	43.5	50.4	6.9	2.4	138.9	146.4	7.5	9.8
2006	16	37.9	45.6	7.7	2.4	124.1	133.7	9.6	9.6
2006	17	31.4	39.2	7.8	2.3	106.2	116.4	10.2	9.3
2006	18	32.9	41.3	8.4	2.4	111.8	122.8	11.0	9.7
2006	19	34.8	40.1	5.4	2.4	116.1	119.8	3.6	9.6
2006	20	35.5	42.6	7.1	2.3	116.5	125.1	8.7	9.3
2006	21	32.0	39.8	7.7	2.3	107.4	117.8	10.4	9.2
2006	22	30.5	36.7	6.1	2.3	102.8	109.4	6.6	9.1
2006	23	27.4	33.7	6.3	2.2	94.3	101.5	7.2	9.0
2006	24	28.8	33.0	4.2	2.2	97.2	99.6	2.4	8.9
2006	25	32.1	33.4	1.3	2.2	105.2	100.3	-4.9	9.0
2006	26	25.6	32.1	6.5	2.2	89.1	97.0	8.0	9.0
2006	27	31.3	39.7	8.4	2.3	104.1	117.1	13.0	9.0
2006	28	33.5	38.3	4.7	2.3	109.7	113.3	3.5	9.0
2006	29	28.6	33.6	5.0	2.2	96.8	100.9	4.2	8.9
2006	30	43.3	47.9	4.6	2.3	132.7	135.3	2.5	9.3
2006	31	42.8	70.8	28.0	2.4	135.9	197.8	61.9	9.5
2006	32	39.5	48.1	8.7	2.4	127.2	139.8	12.6	9.5
2006	33	35.5	41.0	5.5	2.3	116.7	121.4	4.7	9.4
2006	34	35.9	38.8	2.9	2.3	116.9	115.3	-1.6	9.2

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2006	35	38.3	45.6	7.3	2.3	123.4	132.8	9.4	9.3
2006	36	35.9	39.9	4.0	2.3	117.3	118.4	1.1	9.3
2006	37	35.1	37.4	2.2	2.3	114.3	111.1	-3.2	9.1
2006	38	27.8			2.2	94.8			8.9
2006	39	25.0			2.2	87.6			8.9
2006	40	24.2			2.2	84.0			8.9
2006	41	22.4			2.2	78.2			8.9
2006	42				2.2				8.9
2006	43				2.2				8.9
2006	44				2.2				8.9
2006	45				2.2				8.9
2006	46				2.2				8.9
2006	47				2.2				8.9
2006	48				2.2				8.9
2006	49				2.2				8.9
2006	50				2.2				8.9
2006	51				2.2				8.9
2006	52				2.2				8.9
2006	53				2.2				8.9
2006	54				2.2				8.9
2006	55				2.2				8.9
2006	56	34.0	40.2	6.2	2.2	108.9	116.6	7.7	8.9
2006	57	37.3	44.2	6.8	2.3	119.5	128.5	9.0	9.1
2006	58	42.9	50.7	7.7	2.3	134.6	145.7	11.1	9.3
2006	59	189.7	250.8	61.1	2.9	471.0	591.2	120.2	11.4
2006	60	394.0	408.5	14.6	8.1	1,035.9	1,070.4	34.4	25.4
2006	61	407.8	490.1	82.3	8.8	1,087.4	1,282.3	194.9	27.5
2006	62	301.4	393.5	92.1	8.8	818.3	1,034.5	216.2	27.5
2006	63	199.3	242.8	43.6	8.4	556.2	649.4	93.2	26.4
2006	64	157.9	196.3	38.5	7.9	445.2	527.4	82.2	24.6
2006	65	109.5	143.6	34.1	7.3	319.7	392.3	72.5	22.7
2006	66	108.7	131.9	23.2	7.4	319.9	363.1	43.2	23.3
2006	67	152.6	171.7	19.2	7.9	435.1	466.7	31.6	24.6
2006	68	140.5	175.3	34.8	7.9	405.5	476.5	71.1	24.7
2006	69	98.3	124.0	25.7	7.4	292.3	341.9	49.6	23.0
2006	70	66.3	85.5	19.3	6.8	207.8	242.1	34.3	21.3
2006	71	57.5	74.0	16.6	6.6	183.4	212.2	28.8	20.6
2006	72	54.5	67.7	13.2	6.5	174.9	195.0	20.1	20.2
2006	73	49.9	62.0	12.0	6.3	162.0	179.8	17.8	19.7
2006	74	49.8	65.6	15.8	6.4	162.3	189.2	26.8	19.9
2006	75	50.7	63.3	12.5	6.2	162.9	182.4	19.5	19.3
2006	76	56.6	70.1	13.4	6.3	178.5	199.9	21.5	19.6
2006	77	74.7	90.1	15.4	6.7	227.4	252.4	24.9	20.8
2006	78	87.7	104.0	16.3	7.1	264.0	290.4	26.4	22.1
2006	79	104.7	125.9	21.2	7.3	309.0	347.4	38.4	22.7

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2006	80	87.5	113.2	25.7	7.2	264.6	314.6	49.9	22.4
2006	81	77.4	99.8	22.4	7.1	238.6	280.0	41.4	22.1
2006	82	81.7	101.7	20.0	7.1	249.4	285.0	35.5	22.2
2006	83	83.6	101.5	17.9	7.1	254.0	284.2	30.2	22.1
2006	84	128.9	131.7	2.8	7.5	371.6	362.1	-9.5	23.3
2006	85	167.0	201.9	35.0	8.2	474.7	544.7	70.1	25.6
2006	86	162.1	204.1	42.1	8.2	461.6	551.9	90.4	25.7
2006	87	97.3	132.7	35.5	7.9	296.6	368.0	71.4	24.8
2006	88	159.2	167.2	7.9	8.6	453.7	455.1	1.3	26.9
2006	89	386.8	424.3	37.5	9.9	1,045.6	1,119.1	73.6	30.9
2006	90	344.5	427.9	83.4	10.1	935.0	1,127.0	192.0	31.6
2006	91	217.7	264.5	46.8	9.8	618.2	713.5	95.2	30.7
2006	92	255.9	285.5	29.7	10.2	718.9	769.3	50.3	32.0
2006	93	383.9	321.7	-62.1	10.3	1,019.9	859.4	-160.5	32.2
2006	94	350.7	479.6	129.0	10.7	955.3	1,265.1	309.9	33.5
2006	95	727.4	850.6	123.2	12.5	1,930.3	2,190.4	260.1	39.1
2006	96	934.7	1,170.2	235.5	15.1	2,496.8	3,050.8	554.0	47.2
2006	97	665.9	929.8	263.9	14.8	1,797.0	2,415.9	618.9	46.4
2006	98	472.3	627.3	154.9	14.2	1,301.4	1,664.6	363.3	44.3
2006	99	486.7	719.9	233.2	14.3	1,341.4	1,897.9	556.5	44.5
2006	100	541.1	737.0	195.9	14.9	1,484.1	1,942.3	458.2	46.4
2006	101	475.8	626.5	150.6	14.9	1,319.2	1,675.9	356.7	46.5
2006	102	417.8	510.8	93.1	14.4	1,166.6	1,362.1	195.5	45.0
2006	103	482.3	580.9	98.6	14.0	1,326.9	1,538.6	211.7	43.9
2006	104	685.1	775.1	90.0	15.1	1,858.1	2,033.3	175.2	47.2
2006	105	581.9	709.7	127.8	16.0	1,599.2	1,878.2	279.0	49.9
2006	106	866.2	917.1	50.8	16.6	2,319.8	2,404.8	85.0	51.9
2006	107	1,821.9	1,847.0	25.1	18.6	4,778.2	4,768.6	-9.6	58.1
2006	108	876.7	1,086.6	209.9	19.1	2,378.0	2,856.0	478.1	59.5
2006	109	592.8	717.6	124.9	19.1	1,655.0	1,912.5	257.5	59.5
2006	110	474.2	572.7	98.5	18.0	1,344.0	1,538.8	194.7	56.3
2006	111	425.5	535.3	109.8	17.4	1,215.8	1,443.3	227.5	54.4
2006	112	431.0	546.5	115.5	17.4	1,230.5	1,471.4	240.9	54.4
2006	113	511.2	633.0	121.8	18.3	1,442.7	1,694.4	251.7	57.2
2006	114	604.0	747.4	143.4	19.3	1,690.6	1,992.6	301.9	60.5
2006	115	468.6	638.5	169.9	19.8	1,349.3	1,717.7	368.4	61.9
2006	116	409.7	536.9	127.2	19.9	1,201.4	1,460.2	258.8	62.3
2006	117	392.2	515.2	123.0	20.1	1,158.0	1,405.3	247.2	62.8
2006	118	393.2	504.3	111.1	20.1	1,160.8	1,377.5	216.7	62.8
2006	119	388.8	501.0	112.2	20.2	1,151.0	1,371.7	220.7	63.3
2006	120	419.6	640.0	220.3	20.8	1,235.9	1,735.3	499.4	65.1
2006	121	452.0	575.9	123.9	22.0	1,329.4	1,566.9	237.5	68.8
2006	122	427.8	574.4	146.5	22.9	1,274.5	1,572.0	297.5	71.6
2006	123	396.3	565.1	168.8	23.1	1,196.4	1,548.3	352.0	72.1
2006	124	348.1	462.8	114.7	22.5	1,067.2	1,281.7	214.5	70.2

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2006	125	319.8	403.4	83.6	21.9	989.8	1,130.5	140.6	68.4
2006	126	313.6	384.6	71.0	21.3	969.5	1,079.1	109.6	66.5
2006	127	321.6	383.9	62.4	21.0	987.8	1,076.5	88.7	65.6
2006	128	340.2	379.1	38.8	21.1	1,035.5	1,064.5	28.9	66.1
2006	129	378.1	378.5	0.4	20.8	1,130.0	1,061.6	-68.4	65.1
2006	130	391.0	367.7	-23.3	21.0	1,163.6	1,035.2	-128.4	65.6
2006	131	324.2	348.9	24.7	20.8	991.6	985.8	-5.8	65.1
2006	132	359.0	372.0	13.0	20.2	1,075.6	1,041.6	-34.0	63.3
2006	133	409.4	381.3	-28.1	19.8	1,197.5	1,062.5	-135.0	61.9
2006	134	459.5	388.8	-70.7	19.5	1,322.8	1,080.5	-242.2	60.9
2006	135	425.1	409.5	-15.6	19.3	1,233.0	1,131.9	-101.1	60.5
2006	136	352.0	427.2	75.2	19.2	1,047.1	1,176.7	129.6	60.0
2006	137	355.0	472.3	117.3	19.1	1,053.8	1,290.4	236.7	59.5
2006	138	365.4	526.4	161.0	19.1	1,079.4	1,427.2	347.8	59.5
2006	139	358.0	517.1	159.1	18.9	1,059.6	1,403.8	344.2	59.1
2006	140	367.8	528.2	160.4	18.6	1,082.4	1,430.8	348.4	58.1
2006	141	384.1	525.0	140.9	18.5	1,120.9	1,420.6	299.7	57.7
2006	142	382.2	531.0	148.7	17.9	1,110.5	1,433.3	322.7	55.8
2006	143	352.1	470.1	118.0	16.9	1,025.6	1,273.0	247.4	52.9
2006	144	341.7	462.7	121.0	15.7	988.2	1,248.1	259.8	49.1
2006	145	327.0	380.7	53.7	14.1	936.4	1,030.3	93.9	44.2
2006	146	298.2	344.0	45.9	12.9	850.7	932.1	81.4	40.3
2006	147	291.4	350.5	59.1	12.7	831.8	944.9	113.1	39.6
2006	148	224.3	269.6	45.3	12.2	657.4	738.0	80.5	38.1
2006	149	176.9	228.1	51.2	11.7	533.1	629.5	96.4	36.7
2006	150	169.6	190.2	20.6	10.9	507.1	530.0	22.9	34.0
2006	151	185.7	202.5	16.8	9.8	531.5	556.1	24.5	30.7
2006	152		219.1		9.4		595.5		29.3
2006	153		172.3		8.6		471.4		26.8
2006	154		141.2		7.8		388.7		24.4
2006	155		129.5		7.5		357.5		23.3
2006	156		127.5		7.5		352.6		23.4
2006	157		115.9		7.3		322.1		22.9
2006	158		103.8		6.9		288.9		21.5
2006	159		108.9		7.0		302.5		21.8
2006	160		116.2		7.2		322.0		22.6
2006	161		114.7		7.4		319.3		23.1
2006	162		95.3		7.0		268.0		21.9
2006	163	75.5	89.1	13.6	6.7	231.6	247.8	16.2	21.0
2006	164	66.7			6.3	204.0			19.7
2006	165	61.7			6.1	190.2			19.2
2006	166	69.7	89.0	19.3	6.6	214.7	248.3	33.6	20.7
2006	167	61.7	78.9	17.2	6.5	193.3	223.8	30.5	20.4
2006	168	52.4	67.6	15.2	6.2	167.5	193.6	26.2	19.5
2006	169	45.1	59.0	13.9	5.9	145.6	169.7	24.1	18.4

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2006	170	41.1	54.3	13.2	5.6	133.3	156.6	23.4	17.6
2006	171	37.3	48.9	11.6	5.4	121.5	141.5	20.0	16.9
2006	172	31.5	41.3	9.8	5.1	103.9	120.5	16.6	15.9
2006	173	26.3	35.7	9.4	4.9	89.3	105.4	16.1	15.3
2006	174	22.9	31.3	8.5	4.8	79.5	93.6	14.1	14.9
2006	175	20.1	27.4	7.2	4.6	71.4	82.8	11.4	14.5
2006	176	17.1	24.0	6.9	4.5	63.0	73.8	10.8	14.2
2006	177	14.8	20.9	6.1	4.4	56.3	65.3	9.0	13.9
2006	178	12.9	18.6	5.7	4.3	50.5	58.8	8.3	13.5
2006	179	11.7	16.7	5.0	4.2	46.4	53.5	7.1	13.1
2006	180	11.0	15.6	4.6	4.1	43.0	49.7	6.7	12.7
2006	181		15.3		4.0		48.6		12.4
2006	182		14.1		1.7		45.1		6.8
2006	183		13.7		1.7		44.1		6.8
2006	184		12.7		1.7		41.4		6.7
2006	185		12.1		1.7		39.4		6.6
2006	186		13.6		1.7		43.4		6.6
2006	187		21.6		1.7		63.8		6.7
2006	188		24.5		1.7		71.0		6.7
2006	189		18.1		1.6		54.5		6.5
2006	190		15.4		1.6		47.0		6.3
2006	191	10.0	13.6	3.6	1.5	36.1	42.0	5.9	6.2
2006	192	10.6	12.3	1.8	1.5	36.5	38.5	1.9	6.1
2006	193		11.3		1.5		35.9		6.1
2006	194		12.7		1.5		39.6		6.2
2006	195	2.5	12.2	9.7	1.5	17.5	38.3	20.9	6.2
2006	196	1.7	10.7	9.0	1.5	15.2	34.4	19.2	6.1
2006	197	1.4	9.1	7.7	1.5	13.3	29.7	16.5	5.9
2006	198	1.3	9.0	7.7	1.4	12.2	28.8	16.6	5.7
2006	199	1.7	7.3	5.6	1.4	12.6	24.2	11.7	5.6
2006	200	3.4	7.0	3.6	1.4	16.6	23.3	6.8	5.6
2006	201	8.0	6.5	-1.4	1.4	27.5	22.3	-5.2	5.6
2006	202	12.6	6.9	-5.8	1.4	38.4	23.1	-15.3	5.6
2006	203	7.9	6.4	-1.6	1.4	26.4	21.4	-5.0	5.5
2006	204	5.3	5.1	-0.2	1.4	20.0	18.0	-2.1	5.4
2006	205	2.4	6.0	3.5	1.4	13.1	20.2	7.1	5.4
2006	206	1.6	7.4	5.8	1.4	11.4	23.8	12.5	5.4
2006	207	1.9	5.9	4.0	1.3	11.8	19.9	8.1	5.4
2006	208	2.1	4.4	2.3	1.3	11.0	15.4	4.4	5.2
2006	209	2.1	3.7	1.6	1.3	10.4	13.5	3.1	5.0
2006	210	2.0	3.2	1.2	1.2	9.7	11.9	2.2	5.0
2006	211	1.8	4.1	2.4	1.3	9.7	14.6	4.9	5.1
2006	212	2.4	4.4	2.0	1.3	11.3	15.2	3.9	5.1
2006	213	3.6	7.0	3.4	1.3	15.6	22.7	7.0	5.3
2006	214	2.7	5.0	2.3	1.3	13.2	17.6	4.4	5.3

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2006	215	2.6			1.4	13.7			5.4
2006	216				1.4				5.5
2006	217				1.4				5.7
2006	218				1.4				5.6
2006	219				1.5				6.0
2006	220				1.5				5.9
2006	221				1.4				5.7
2006	222				1.4				5.6
2006	223				1.3				5.4
2006	224				1.3				5.3
2006	225				1.3				5.2
2006	226	7.2	4.8	-2.4	1.3	23.0	16.7	-6.3	5.2
2006	227	10.1	6.2	-3.9	1.3	30.1	20.5	-9.6	5.2
2006	228	11.7	6.1	-5.6	1.3	33.5	19.8	-13.7	5.2
2006	229	8.0	4.8	-3.2	1.3	24.1	16.2	-7.9	5.1
2006	230	9.1	4.9	-4.2	1.3	26.6	16.6	-10.1	5.1
2006	231	10.1	4.3	-5.8	1.3	29.1	15.0	-14.1	5.1
2006	232	10.0	5.3	-4.7	1.3	28.9	17.6	-11.3	5.1
2006	233	10.4	5.4	-5.0	1.3	29.9	17.9	-12.0	5.1
2006	234	10.7	5.2	-5.5	1.3	31.0	17.5	-13.6	5.2
2006	235	11.8	4.4	-7.4	1.3	33.8	15.5	-18.2	5.2
2006	236	11.7	4.8	-6.9	1.3	33.4	16.6	-16.8	5.2
2006	237	9.6	4.9	-4.7	1.3	27.3	16.3	-11.0	5.0
2006	238	9.5	5.6	-3.9	1.3	27.0	17.9	-9.1	5.0
2006	239	11.0	5.5	-5.5	1.3	31.4	18.1	-13.3	5.1
2006	240	12.2	4.9	-7.3	1.3	33.8	16.6	-17.2	5.1
2006	241	11.5	6.1	-5.4	1.3	32.6	19.7	-12.9	5.1
2006	242	13.4	4.4	-9.0	1.3	37.4	15.6	-21.8	5.2
2006	243	13.3	4.0	-9.4	1.3	37.2	14.4	-22.8	5.2
2006	244	13.2	4.6	-8.5	1.3	37.0	16.2	-20.8	5.2
2006	245	14.1	4.2	-9.9	1.3	39.4	15.3	-24.2	5.2
2006	246	15.3	4.6	-10.8	1.4	43.6	16.7	-26.9	5.4
2006	247	15.2	5.2	-10.0	1.4	43.2	18.2	-25.0	5.4
2006	248	14.8	4.6	-10.2	1.3	41.9	16.6	-25.4	5.4
2006	249	16.8	4.7	-12.1	1.4	47.1	17.0	-30.0	5.4
2006	250	18.4	5.0	-13.5	1.4	51.5	17.9	-33.5	5.5
2006	251	21.4	6.4	-15.0	1.4	60.0	22.2	-37.8	5.7
2006	252	23.9	8.5	-15.4	1.5	68.5	28.3	-40.2	5.9
2006	253		12.1		1.7		39.8		6.6
2006	254	31.4	15.1	-16.3	1.7	93.8	47.9	-45.9	6.9
2006	255	28.5	12.3	-16.1	1.6	81.7	39.1	-42.6	6.4
2006	256	22.4	9.0	-13.4	1.5	65.0	29.9	-35.1	6.1
2006	257	22.2	9.0	-13.2	1.5	64.7	30.0	-34.7	6.1
2006	258	39.5	32.9	-6.7	1.8	113.8	89.0	-24.8	7.2
2006	259	47.2	26.3	-21.0	1.9	136.1	78.7	-57.3	7.7

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2006	260	48.2	30.6	-17.6	2.1	142.2	91.3	-50.9	8.2
2006	261	42.9	32.5	-10.4	2.1	129.6	96.7	-32.9	8.4
2006	262	35.6	30.7	-4.8	2.1	110.7	91.9	-18.8	8.3
2006	263	31.6	33.3	1.8	2.1	102.0	99.3	-2.7	8.5
2006	264	35.3	44.9	9.6	2.2	113.3	129.5	16.2	8.8
2006	265	47.0	62.3	15.2	2.3	143.7	174.4	30.7	9.1
2006	266	36.5	47.8	11.4	2.2	115.0	136.4	21.5	8.6
2006	267	33.8	42.2	8.4	2.1	107.7	121.8	14.0	8.5
2006	268	30.7	39.5	8.9	2.1	99.1	114.6	15.5	8.4
2006	269	29.2	39.8	10.6	2.1	94.9	115.0	20.1	8.3
2006	270	27.9	39.5	11.6	2.1	91.7	114.2	22.5	8.3
2006	271	25.6	36.7	11.1	2.1	85.8	107.0	21.2	8.2
2006	272	25.4	35.6	10.2	2.0	84.8	103.9	19.1	8.2
2006	273	26.1	35.4	9.3	2.0	86.6	103.5	16.9	8.2
2006	274	26.8	36.4	9.7	1.8	88.9	106.5	17.5	7.4
2006	275	33.7	61.2	27.5	2.1	109.3	168.4	59.1	8.4
2006	276	39.1	51.3	12.2	2.3	124.6	147.0	22.4	9.3
2006	277	40.1	52.5	12.4	2.4	127.7	150.4	22.6	9.5
2006	278	39.3	51.3	12.0	2.4	126.1	147.4	21.3	9.6
2006	279	38.5	51.5	13.0	2.4	124.5	148.2	23.7	9.8
2006	280	42.2	56.0	13.8	2.5	135.5	160.7	25.2	10.1
2006	281	43.4	60.0	16.5	2.6	138.9	170.5	31.6	10.2
2006	282	33.3	49.3	16.1	2.5	111.6	142.6	31.1	9.8
2006	283	31.8	45.9	14.1	2.5	109.7	135.1	25.4	10.1
2006	284	28.8	41.6	12.9	2.5	100.5	123.2	22.7	9.8
2006	285	27.4	40.1	12.6	2.4	96.9	119.2	22.2	9.7
2006	286	27.8	39.4	11.6	2.4	97.9	117.5	19.6	9.7
2006	287	26.3	38.2	11.8	2.4	94.2	114.3	20.1	9.7
2006	288	23.8	35.5	11.7	2.4	87.6	107.3	19.7	9.6
2006	289	23.6	40.1	16.5	2.5	88.0	118.9	30.9	9.8
2006	290	20.9			2.4	80.8			9.8
2006	291	17.3			2.4	71.6			9.7
2006	292	15.7			2.4	67.4			9.6
2006	293	20.6			2.5	82.0			10.1
2006	294	20.2			2.6	82.0			10.3
2006	295	17.2			2.5	73.6			10.1
2006	296	15.3			2.5	67.4			9.8
2006	297	14.8			2.4	65.5			9.6
2006	298	15.8			2.5	69.3			10.0
2006	299	13.6			2.5	64.2			10.0
2006	300	12.5			2.5	60.8			9.9
2006	301	12.6			2.5	61.0			9.9
2006	302	13.0			2.5	62.0			9.9
2006	303	13.3			2.5	64.1			10.2
2006	304	11.6			2.5	59.8			10.1

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2006	305	10.3			2.5	55.7			9.9
2006	306	10.0			2.5	55.2			10.0
2006	307	16.0			2.6	71.8			10.3
2006	308	14.7			2.7	71.0			10.8
2006	309	15.4			2.7	73.1			10.8
2006	310	16.6			2.7	75.7			10.7
2006	311	19.0			2.7	81.5			10.7
2006	312	21.3			2.7	87.0			10.6
2006	313	22.4			2.7	90.2			10.7
2006	314	19.3			2.7	82.5			10.8
2006	315	15.7			2.6	72.1			10.5
2006	316	15.7			2.6	72.3			10.5
2006	317	14.7			2.6	69.7			10.5
2006	318	25.2			2.9	102.7			11.7
2006	319	32.8			2.9	121.0			11.7
2006	320	20.6			2.8	88.3			11.1
2006	321	22.3			2.8	93.1			11.3
2006	322	23.3			2.8	95.0			11.2
2006	323	23.0			2.8	93.3			11.0
2006	324	24.7	33.2	8.5	2.7	96.3	105.9	9.6	10.8
2006	325		36.9		2.7		114.5		10.7
2006	326		36.9		2.7		114.2		10.7
2006	327		33.0		2.7		104.6		10.7
2006	328		29.2		2.7		94.4		10.8
2006	329				2.6				10.5
2006	330				2.6				10.4
2006	331				2.6				10.3
2006	332				2.5				10.1
2006	333				2.5				9.9
2006	334				2.5				9.8
2006	335				2.5				9.8
2006	336				2.5				9.8
2006	337				2.5				9.8
2006	338				2.5				9.8
2006	339				2.5				9.8
2006	340				2.5				9.8
2006	341				2.5				9.8
2006	342				2.4				9.8
2006	343				2.4				9.7
2006	344				2.4				9.7
2006	345				2.4				9.8
2006	346				2.5				9.9
2006	347				2.5				10.2
2006	348				2.9				11.4
2006	349				3.0				12.1

Year	Day	Fichter TSS load (tons/day)	Batiste TSS load (tons/day)	PUA Estimated TSS storm water load (tons/day)	PUA Target TSS storm water load (tons/day)	Fichter Total P (lbs/day)	Batiste Total P (lbs/day)	PUA Estimated Total P storm water load (lbs/day)	PUA Target TP storm water load (lbs/day)
2006	350				2.9				11.7
2006	351				2.6				10.4
2006	352		28.3		2.5		90.5		10.0
2006	353		18.6		2.5		64.2		10.0
2006	354		17.4		2.5		61.4		10.0
2006	355				2.5				10.0
2006	356				2.5				10.0
2006	357				2.5				10.0
2006	358				2.5				10.0
2006	359				2.5				10.0
2006	360				2.4				9.6
2006	361	30.9			2.5	109.2			10.0
2006	362	43.9			2.7	148.9			10.6
2006	363	38.4			2.5	131.2			10.1
2006	364	18.1			2.5	74.6			10.2
2006	365	17.1			3.1	70.7			12.3

Appendix D. Pollutant Trading Framework

I. WHAT IS POLLUTANT TRADING?

Pollutant trading (aka water quality trading) is a contractual agreement to exchange pollution reductions between two parties. Pollutant trading is a business-like way of helping to solve water quality problems by focusing on cost effective, local solutions to problems caused by pollutant discharges to surface waters. Pollutant trading is voluntary. Parties trade only if both are better off as a result of the trade. Trading allows parties to decide how to best reduce pollutant loadings within the limits of certain requirements. The appeal of trading emerges when pollutant sources face substantially different pollutant reduction costs. Typically, a party facing relatively high pollutant reduction costs compensates another party to achieve an equivalent, though less costly, pollutant reduction.

Pollutant trading is recognized in Idaho's Water Quality Standards at IDAPA 58.01.02.054.06. Currently, the Department of Environmental Quality's policy is to allow for pollutant trading as a means to meet total maximum daily loads (TMDLs) thus restoring water quality limited water bodies to compliance with water quality standards. The Pollutant Trading Guidance document sets forth the procedures to be followed for pollutant trading.

II. TRADING COMPONENTS

The major components of pollutant trading are trading parties (buyers and sellers) and credits (the commodity being bought and sold). Additionally, ratios are used to ensure environmental equivalency of trades on water bodies covered by a TMDL. All trading activity must be recorded in the trading database through the Idaho Clean Water Cooperative, Inc.

Both point and nonpoint sources may create marketable credits. Credits are a reduction of a pollutant beyond a level set by a TMDL. Point sources create credits by reducing pollutant discharges below NPDES effluent limits which are set initially by the waste load allocation. Nonpoint sources create credits by implementing approved best management practices (BMPs) that reduce the amount of pollutant run-off. Nonpoint sources must follow specific design, maintenance, and monitoring requirements for that BMP, apply discounts to credits generated if required, and provide a water quality contribution to ensure a net environmental benefit. The water quality contribution also ensures the reduction (the marketable credit), is surplus to the reductions the TMDL assumes the nonpoint source is achieving to meet the water quality goals of the TMDL.

III. WATERSHED SPECIFIC ENVIRONMENTAL PROTECTION

Trades must be implemented so that the overall water quality of the water bodies covered by the TMDL are protected. To do this, hydrologically-based ratios are developed to provide that trades between sources distributed throughout the TMDL water bodies result in environmentally equivalent or better outcomes at the point of environmental concern. In addition, localized adverse impacts to water quality are not allowed.

IV. TRADING FRAMEWORK

In order for pollutant trading to be authorized it must be specifically mentioned within a TMDL document. After adoption of an EPA approved TMDL, DEQ in concert with the Watershed Advisory Group (WAG) must develop a pollutant trading framework document as part of an implementation plan for the watershed that is the subject of the TMDL. The elements of a trading document are described in DEQ's Pollutant Trading Guidance (currently November 2003 Draft) available on the DEQ website at http://www.deq.idaho.gov/water/prog_issues/waste_water/pollutant_trading/pollutant_trading_guidance_entire.pdf. As of this writing there are few watersheds that have developed a pollutant trading framework; the Lower Boise River watershed and the Upper Snake Rock/Mid Snake TMDL watershed have developed such a framework. DEQ believes pollutant trading may be a viable option and tool for implementation of the Portneuf River TMDL. Should DEQ and the Portneuf River WAG determine that trading is indeed a viable tool for implementing necessary load reductions to achieve the goals of the TMDL, the entities can move forward to develop the necessary pollutant trading framework.

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Appendix E. Portneuf River Watershed Advisory Group Working Charter

Portneuf Watershed Advisory Group
Working Charter

Background
The Idaho Department of Environmental Quality (DEQ) must revise the Total Maximum Daily Load (TMDL) for the Portneuf River Subbasin. As part of its process for revising the existing TMDL, DEQ is required to convene a Watershed Advisory Group composed of people who have an interest in how the watershed is managed. The membership of the Watershed Advisory Group includes voting and non-voting members who represent agencies, communities, industries, other interested parties or individuals, and the Shoshone-Bannock Tribes, all of whom affect or are affected by the management of the watershed. This Watershed Advisory Group will provide advice to the DEQ throughout the process, which is expected to take approximately one year.

Mission
The mission of the Portneuf Watershed Advisory Group is to advise DEQ in its efforts to develop a revised Total Maximum Daily Load (TMDL) for the Portneuf River Subbasin.

Vision for the Portneuf Watershed Advisory Group
The Portneuf Watershed Advisory Group envisions a final product that will have the following characteristics:

- Defensible
- Clean
- Credible
- Workable
- Revised
- Agreement
- Improved
- Beneficial
- Implementable
- Restore
- Attainable
- Noticeable
- Acceptable
- Fair
- Useful
- Swimmable

Portneuf Watershed Advisory Group's Planning Area
The Portneuf Watershed Advisory Group will focus its attention on the Portneuf Watershed as illustrated in Attachment 1.

Membership of the Portneuf Watershed Advisory Group
The following individuals are the voting members of the Portneuf Watershed Advisory Group:

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It was noted at the April 17, 2007 meeting that Candon Tanaka expects that he will not be a voting member of the Watershed Advisory Group. He will inquire with Tribal officials and let the Watershed Advisory Group know who the official representative of the Shoshone-Bannock Tribes will be. Non-voting members of the Portneuf Watershed Advisory Group include:

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Additional members may be added in the future.

Proposed Process for Developing the Portneuf Watershed Advisory Group's Final Product

The original schedule was approved by the WAG on April 17, 2007. That schedule was followed until August, 2007. At that point in time, discussions required more time that had been allowed. One meeting was added to the schedule (for December). At the January 2008 meeting, additional changes were made. The following schedule was approved by the WAG in January of 2008:

April 17, 2007:
- Working Charter
- Clean Water Act and Section 303(d) of the Clean Water Act
- Load estimates and targets from the 2001 TMDL

May 15, 2007:
- Review EPA guidance for reporting "daily loads"
- Review current estimates of sediment and TP loads against the 2001 TMDL
- Discuss process used to estimate loads

June 19, 2007:
- Review results of beneficial use reconnaissance program collections
- Discuss interpretation of beneficial use reconnaissance program assessment results
- Discuss and agree on pollutants for inclusion in the TMDL

July 17, 2007:
- Review impaired reaches of the mainstem Portneuf
- Review causes of impairment of the mainstem Portneuf

August 21, 2007:
- Discuss pollutant targets for the mainstem Portneuf
- Discuss load allocation for the mainstem Portneuf

September 18, 2007:
- Review impaired reaches of the Portneuf River tributaries
- Review causes of impairment of the Portneuf River tributaries
- Discuss other pollutants in the Portneuf Watershed and review of the process by which pollutants could be added to the scope of the Portneuf TMDL

October 16, 2007:
- Consider recommendation by the Technical Subcommittee for total phosphorus target on the mainstem
- Discuss load allocation for the mainstem Portneuf
- Review impaired reaches of the Portneuf River tributaries
- Review causes of impairment of the Portneuf River tributaries
- Review other pollutants in the Portneuf Watershed and review of the process by which pollutants could be added to the scope of the Portneuf TMDL

November 20, 2007:
- Review discussion related to the total phosphorus target on the mainstem
- Review of technical basis for TP levels in the Portneuf River
- Discuss proposed TP target

December 18, 2007:
- Consider how to communicate minority perspectives in final recommendation for total phosphorus target
- Review impaired reaches of the Portneuf River tributaries
- Review causes of impairment of the Portneuf River tributaries

January 15, 2008:
- Discuss which targets should be included in the revised TMDL
- Discuss whether approved mainstem targets should apply to the tributaries
- Discuss proposed target for nitrogen developed by TAC
- Develop recommendation regarding nitrogen targets

February 19, 2008:
- Discuss the target for oil and grease
- Discuss TSS waste load allocations (WLA) for point sources and load allocations (LA) for non-point sources

March 18, 2008:
- Discuss WLA/LA for TP

April 15, 2008:
- Discuss WLA/LA for TN, E-coli, and Oil and Grease

May 2008 – No WAG meeting scheduled

May 27, 2008 – WAG to receive Preliminary Draft TMDL from DEQ

June 17, 2008:
- Explore the potential for a WAG recommendation on the Preliminary Draft TMDL

June 24, 2008 – Deadline for comments by individual WAG members on the Preliminary Draft TMDL

July 8, 2008 – WAG to received Draft TMDL (incorporating comments from the WAG members)

July 15, 2008 :
- Discuss and approve the Draft TMDL for release to the public for a public comment period

Ground Rules for Meetings of the Portneuf Watershed Advisory Group

The Portneuf Watershed Advisory Group has agreed to the following ground rules:

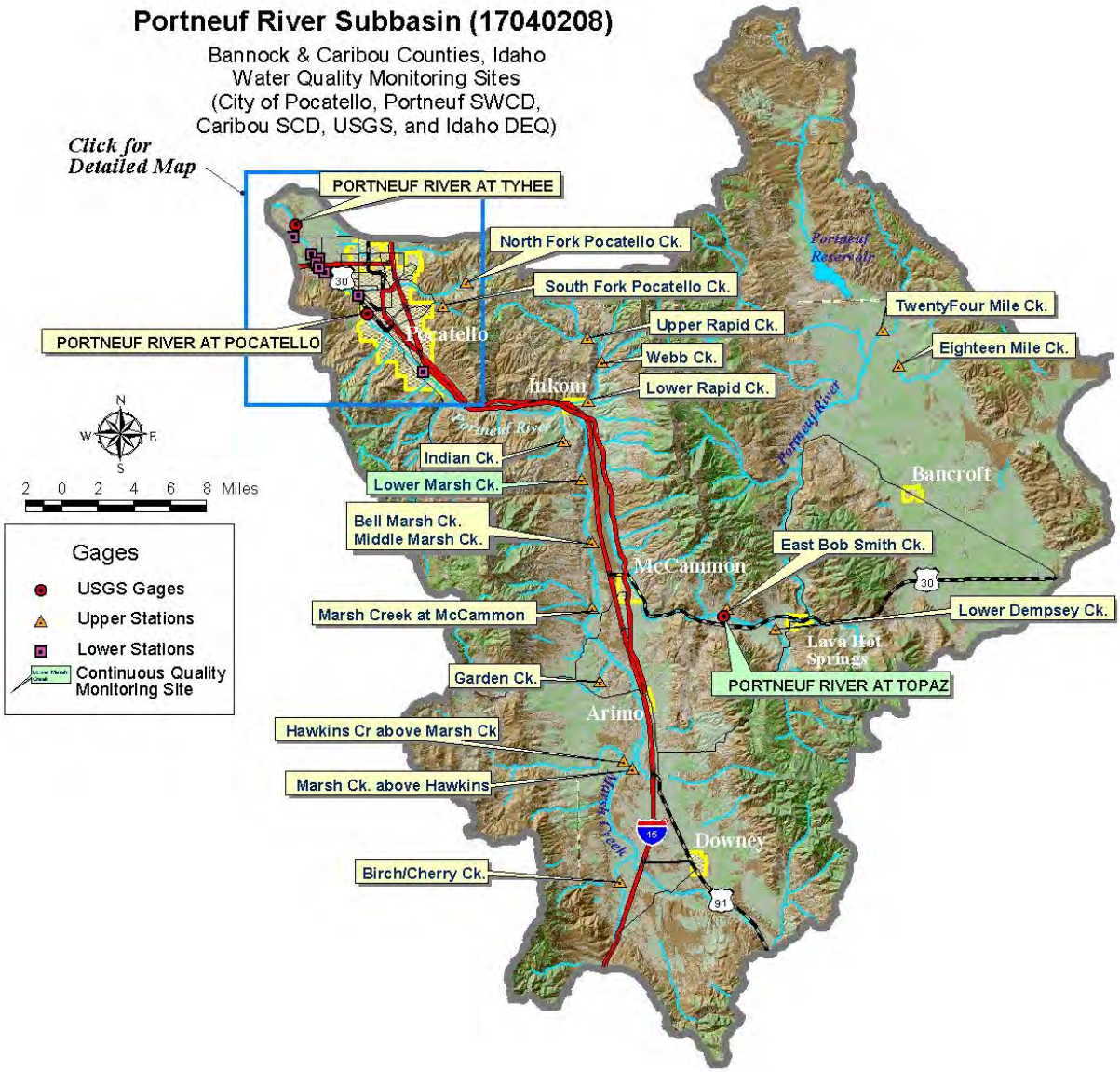
No side conversations
Speak one at a time
No personal attacks
Stay on task
Abide by time limits
No rhetorical questions
Identify proxy if not here
Easy on people, hard on issues
Speak up
Offer solutions (frame in the positive)
Everyone participate
Treat all with respect

Process for Portneuf Watershed Advisory Group Decision-Making

The Portneuf Watershed Advisory Group agreed to work by consensus, if possible, within the schedule outlined in this Working Charter. Consensus is defined as "Everyone understands,

agrees with, and will support the decision." This definition means that when people leave the room following a decision, they should not voice a lack of support to others.
If consensus is not possible within the schedule outlined in this Working Charter, the Portneuf Watershed Advisory Group may elect to resort to a majority of voting members at the scheduled meeting. A quorum will be defined as 7 voting members.
Non-voting members will actively participate in all discussions leading up to decisions.
If a vote is taken, the minority perspective will be respectfully communicated in addition to the majority decision.

Attachment 1.



Appendix F. Portneuf River Subbasin Biological Assessment

The Portneuf River Subbasin Biological Assessment is a separate, previously published report. The numbers on its pages here are not the same as in the originally published report.

Portneuf River Subbasin Biological Assessment



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16 December 2008

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1.0 Executive Summary

A goal of the Clean Water Act is to assess the biological integrity of the Nation's water and maintain or restore this integrity where waters have been compromised by anthropogenic impacts. Characterization of the biological condition and identification of ecological stressors and their associating loading properties resulting in degradation is a necessary step in the road to restore biological integrity. The Portneuf River Biological Assessment includes available biological information from the Portneuf River Subbasin and has been used to provide an overview of the biological assemblages and ecological condition of mainstem reaches and select tributaries. The Portneuf River Biological Assessment has been prepared as a companion document to the revised Portneuf River Total Maximum Daily Load.

This assessment benefits from an abundance of contemporary and historic characterizations of the biota and biological processes of mainstem and select tributaries of the Portneuf River. While many of these efforts were not intended to assess for regulatory purposes (e.g. 303d-listing), they do help to establish a "snap shot" of the Portneuf River Subbasin and offer evidence of river condition often from surveys of multiple assemblages. The assessment contains summaries of the concentrations of microbial fecal indicators, as well as, descriptions of the diatom, macrophyte, and fish assemblages of mainstem reaches and individual tributaries. Finally, two process-based summaries are included from field and laboratory efforts designed to understand the relationship between land use, nutrient concentrations, and primary production.

The biological monitoring revealed secondary contact recreational impairment in the lower Portneuf River near the City of Pocatello and in fourteen assessment units associated with tributary streams. In addition, discrete sampling efforts showed that upper reaches of Marsh Creek regularly exceed the single sample instantaneous secondary contact recreation criteria.

Some of the most common and widely distributed macrophyte species (e.g. *Potamogeton pectinatus*) in the Portneuf River and Marsh Creek are indicators of eutrophic waters. In addition, the abundance of macrophytes was highest in gaining reaches and particularly in the lower Portneuf River where groundwater is rich in both N and P. Elevated nutrients in the lower Portneuf River are translated into additional plant biomass and promote luxury uptake of N and P by macrophytes. High macrophyte abundance in the lower Portneuf River was associated with export of nutrient rich macrophytes to the American Falls Reservoir and to higher daily fluctuations in dissolved oxygen in the lower Portneuf River during summer months.

Macroinvertebrate assemblage metrics (e.g. River Macroinvertebrate Index; RMI) in the mainstem Portneuf River indicate that reaches downstream of Lava Hot Springs wastewater treatment plant, near McCammon, and below Pocatello wastewater treatment plant, are below the minimum evaluation threshold for cold water aquatic life. Although RMI scores alone do not determine the support status for the cold water aquatic life use,

these scores warrant more focused monitoring of these reaches to fully characterize the cold water aquatic life use. Of the 43 assessment units associated with Portneuf River tributaries and evaluated during Beneficial Use Reconnaissance Program surveys from 2001 to 2006, nine AUs sampled did not support the cold water aquatic life use.

Salmonids in the mainstem Portneuf River are found in the river above major flow diversions or reaches supplemented by significant groundwater flows. Wild populations of salmonids exist in Portneuf River above and below Lava Hot Springs. However, below the Portneuf Marsh Valley Canal, salmonids represent a smaller component of the fishery, although cool-water fish species still predominate. In Marsh Creek, salmonids were not present in two reaches sampled in 2007. In the lower Portneuf River downstream of Batiste Road, a complex of 27 springs contributes approximately 225 cfs year round, and salmonids contributed disproportionate to the fishery. These findings indicate that the distribution and abundance of fish in the mainstem Portneuf River are tightly coupled with localized hydrologic conditions. USDA Forest Service surveys of 25 tributaries indicate that salmonids are widespread in tributaries within the Caribou-Targhee National Forest and speculated that fishless tributaries were affected most by low flow conditions. DEQ Beneficial Use Reconnaissance Program surveys of tributaries to the Portneuf River and Marsh Creek documented fish assemblages that were above the minimum condition threshold.

The Portneuf River biological assessment examined summaries of multiple river assemblages from DEQ and other agency or university sponsored surveys. This multi-assemblage approach included resident organisms representing different trophic positions and life spans. These natural history distinctions are offered because each assemblage integrates water quality conditions over different lengths of time. Bacterial assemblages for example provide clues to the most recent land use activities. In contrast, the presence or absence of fish species or groups are tied to seasonal changes in hydrology and water quality or multi-year trends in reach or segment integrity. From this review, it is apparent that select mainstem and tributary reaches offer clear indications of biological impairment but, as a whole, biological impairment in the Portneuf River is not wide spread. From the review of biological evidence, biological impairment does not correspond to longitudinal or cumulative changes in land use. Instead, local land use activities or dramatic hydrologic alterations most strongly influence biological assemblages in the Portneuf River Subbasin.

Organization of this Assessment

In this assessment, reviews of biological information are presented for distinct biological assemblages separately for the mainstem Portneuf River (including Marsh Creek) and the tributaries. When multiple surveys are conducted, summaries of each unique monitoring effort are presented under the appropriate assemblage subheading. The first assemblage subheading details the summary of microbiological sampling. Subheadings of diatoms, macrophytes, macroinvertebrates, fish, and biological processes follow. Mainstem Portneuf River summaries are presented first and tributaries follow in latter part of this document.

1.1 Purpose of the Biological Assessment

In April 2001, the U.S. Environmental Protection Agency (EPA) approved the Idaho Department of Environmental Quality's (DEQ) Portneuf River TMDL Water Body Assessment and Total Maximum Daily Load. Based on a schedule agreed upon by DEQ, EPA and the City of Pocatello, a draft revision to the Portneuf River TMDL was to be completed in 2006. As part of this revision, the Portneuf River Biological Assessment has been prepared as a companion document to the revised TMDL. The assessment includes available biological information from the Portneuf River Subbasin and has been used to provide an overview of the biological assemblages and ecological condition of mainstem reaches and select tributaries.

1.2 Portneuf River

The Portneuf River Subbasin (HUC 17040208) is part of the Upper Snake River Basin and is a major drainage area (1,360 square miles) in southeast Idaho. The Portneuf River is affected by a suite of anthropogenic impacts that range from local to global in scale. These include impacts linked to nutrient enrichment, invasive species introductions, hydrologic alterations, and climate change (Hopkins 2007). The Portneuf River is a 5th order, approximately 100 mile long river originating on Fort Hall Indian Reservation, flowing south to Chesterfield Reservoir, bypassing the pre-existing river channel via the Toponce canal, and rejoining the river approximately 8 miles downstream of Chesterfield Reservoir. Beyond Chesterfield, the river continues flowing south to Lava Hot Springs, where numerous thermal inflows along with effluents from this upstream-most municipality enter the river. The river then turns west for approximately 10 miles before flowing north approximately 40 miles to its confluence with Snake River at American Falls Reservoir (Fig. 1).

In the City of Pocatello, the most permanent and arguably conspicuous river alteration is apparent; in this river segment, approximately 1.5 miles of river was routed through a vertical-walled concrete channel as part of a U.S. Army Corps of Engineers (USACE) flood protection project completed in 1968 (Section 204, paragraph "Columbia River Basin", Flood Control Act of 1950). The construction of the channel resulted in the loss of approximately 4.1 miles of natural river channel and approximately 144 acres of riparian habitat. Moreover, the channel acts as a barrier for trout and other fish to City Creek (USACE 1992, DEQ 2001) and has other significant, albeit indirect, effects on aquatic organisms by the disruption of energy fluxes between the stream and [lost] riparian habitats (*sensu* Laeser et al. 2005).

There are at least two major gaining reaches in the river (Perry and Clark 1990, Barton 2004). One gaining reach extends from approximately 2 miles above the confluence with Pebble Creek to Fish Creek and results in approximately 136 cfs increase in discharge. Another gaining reach includes a complex of 27 springs in the lower Portneuf River. This lower spring complex is roughly bounded by I-86 to the south and Siphon Road to the north (Perry and Clark 1990) and contributes approximately 225 cfs. Both gaining reaches have elevated concentrations of total inorganic nitrogen (TIN; >1.0 mg/L) and

the lower reach contains concentrations of soluble reactive phosphorus (SRP) concentrations that are over an order of magnitude higher than all upstream reaches. Consequently, these gaining nutrient rich reaches support large standing stocks of macrophytes during summer months (Boeger 1992, Wilhelm 2006) that can lead to daily sags in dissolved oxygen (Ray and Beardsley 2008).

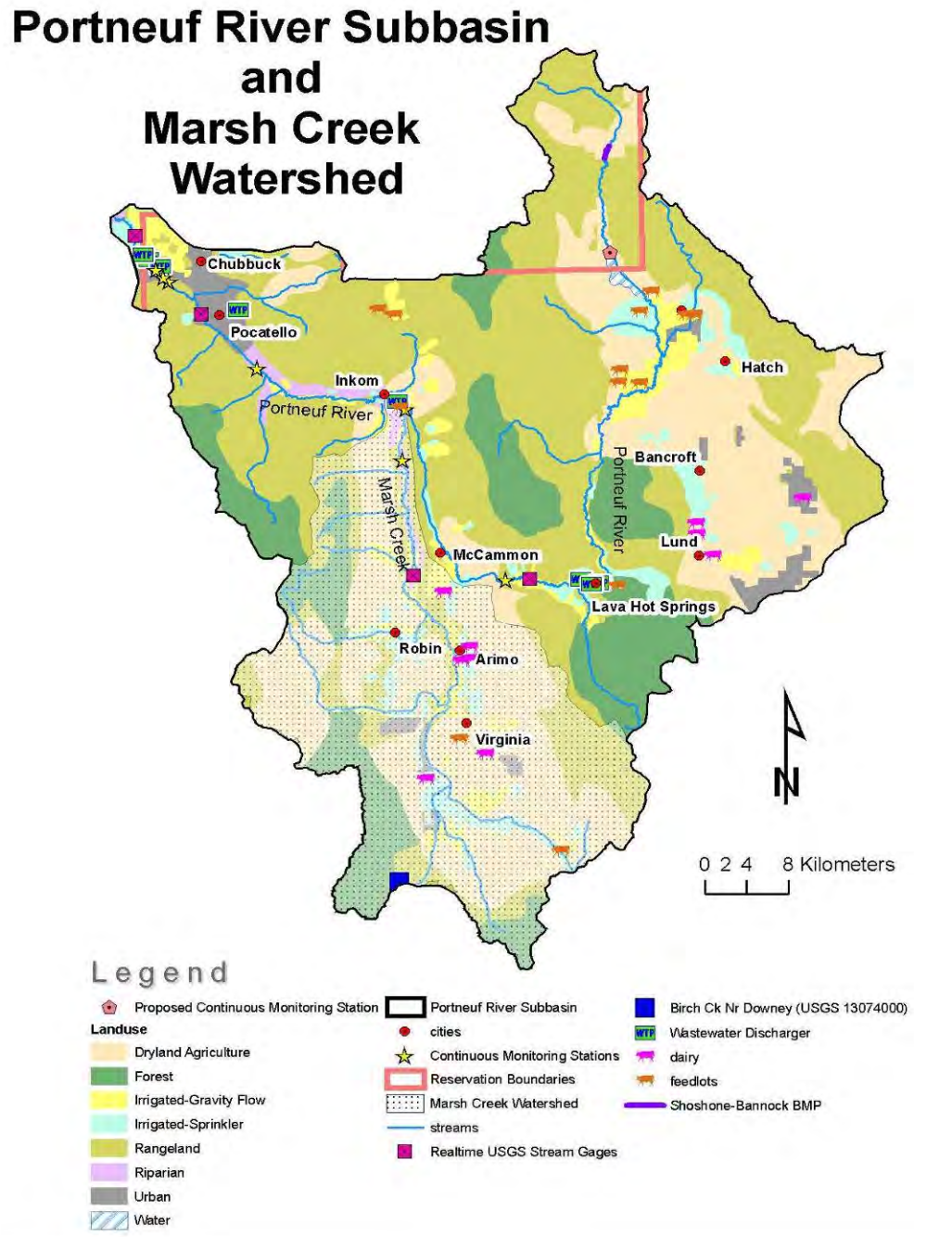


Figure 1. Portneuf River Subbasin and Marsh Creek watershed.

Geothermal springs in reaches near Lava Hot Springs have been shown to influence the abundance and composition of diatom communities (Vinson and Rushforth 1989) and likely affect the structure of other aquatic communities in the Portneuf River. In addition to thermal influences, preliminary analytical results indicate that geothermal activity near Lava Hot Springs may lead to elevations in the concentration of mercury in surface waters; reaches downstream of the geothermal contributions located near Lava Hot Springs have concentrations of mercury that are 33X greater than reaches upstream of geothermal introductions. Despite these differences in surface water mercury, trout sampled above (Croney Road) and below (Topaz) Lava Hot Springs, on average, had similar concentrations of mercury in tissues (DEQ 2007). Geothermal springs have been shown to influence stream communities elsewhere through localized changes in stream temperature and water chemistry (Pringle et al. 2000). Combined, the natural and anthropogenic influences described above represent just a few of the structuring agents that influence biological assemblages and processes in the Portneuf River subbasin.

2.0 Portneuf River and Marsh Creek Biological Assessments

The goals and intent of the Clean Water Act (CWA) are described in Section 101(a) and explicitly identify the goal of maintaining and restoring the biological integrity of waters[2]. After passage of the CWA, biological assessments were largely neglected in favor of chemical and physical characterizations of aquatic ecosystem integrity. The apparent focus on chemical and/or physical assessments was based on a belief that aquatic stressors were largely chemical in nature and an appreciation for the defensibility of physicochemical information. Unfortunately, chemical and physical assessments failed to characterize the complex nature of aquatic ecosystem health or integrity (Karr 1991, Hughes et al. 2000).

Since the 1990s, there has been a growing appreciation for the miscellany of environmental stressors (e.g. elevated temperatures, UV radiation, eutrophication, invasion of exotic species, and dewatering) in aquatic ecosystems, and assessment tools required to characterize the interactive effects of multiple stressors have been developed (Adams 2001, Vinebrooke et al. 2004). Today, biological assessments and indicators have gained acceptance as a means of characterizing the effects of multiple stressors on aquatic ecosystems and confirm that organisms serve as integrators of ecosystem stress and provide a quantifiable measure of ecosystem health (Adams and Greeley 2000, Resh 2008). Significant research has led to the development of approaches to assess the integrity of water resources by sampling and summarizing resident communities/assemblages as biological indices (Karr 1991, Resh 2008), conducting biological assays (Kelly and Whitton 1998), or using molecular and physiological indicators as biomarkers (Adams 2001). Biological indices and indicators address information gaps by documenting water quality degradation arising from multiple and in some cases undocumented or unregulated pollution sources. Additionally, standardized statewide monitoring programs like the DEQ's Beneficial Use Reconnaissance Program (BURP) enable the direct assessment of designated use support (Yagow et al. 2006).

Standardized monitoring programs like the DEQ's BURP were established to better assess the biological integrity of aquatic resources within a region, territory, or state. Some states have also adopted statewide biological water quality criteria (Karr 1991, Yagow et al. 2006). The DEQ BURP was established in 1993 and combined biological monitoring and habitat assessment protocols generally used to assess the condition of the state's water resources, but also to provide direct evidence of beneficial use support.

For state and federal assessment purposes, the Portneuf River Subbasin is divided into 26 water body units; units are cataloged with their designated beneficial uses (WQS § 150.10). Four units define the mainstem Portneuf River and Marsh Creek and the remainder include select tributaries. The Portneuf River above Chesterfield Reservoir is

[2] Clean Water Act. Section 101. Declaration of Goals and Policy. (a). *The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters*

listed for cold water aquatic life (CWAL), salmonid spawning (SS), primary contact recreation (PCR), domestic water supply (DWS), and as a special resource water (SRW). The second unit extends from Chesterfield Reservoir Dam downstream to the confluence with Marsh Creek (US-16). The designated uses for this unit are CWAL, SS, PCR, DWS, and SRW. The third reach extends from the confluence with Marsh Creek to American Falls Reservoir and is designated for CWAL, SS, and secondary contact recreation (SCR). Marsh Creek (source to mouth) is designated for CWAL and SCR (Table 1).

The cold water aquatic life designation is evaluated using available biological information such as macroinvertebrate, fish, and habitat summaries. The salmonid spawning designation, a subcategory of the criteria for cold water aquatic life use, has specific evaluation criteria described by the DEQ (see WQS § 250.02.f). Specifically, surveys of sites must be completed during core spawning windows (described in the Water Body Assessment Guidance Table 5-2; Grafe et al. 2002). Although fish surveys reported here did not specifically assess salmonid spawning, the datasets do indicate whether salmonids (trout, salmon, and whitefish) were detected in select reaches and some surveys noted whether salmonids were wild fish or originated from a hatchery (e.g. mainstem reaches above Lava Hot Springs). While the presence or absence of wild salmonids provides some indication of salmonid habitat use, no attempt is made to assess the salmonid spawning use in the Portneuf River Subbasin.

Recreational use designations are evaluated based on the designation of a water body unit as either primary or secondary contact recreation. Primary contact recreation indicates that through the course of the recreational activity there is a moderate to high probability of prolonged and intimate contact by humans (e.g. swimming). In contrast, secondary contact recreation is described as a recreational activity that takes place on or about the water (e.g. fishing, boating, wading, or infrequent swimming) and consequently the ingestion of raw water is not anticipated (Grafe et al. 2002). Evaluation of the recreational use designation requires the most current line of evidence and DEQ indicates that evidence must be < 5 years old. The numeric *Escherichia coli* criterion used to establish an exceedance of the recreational use is identical for primary and secondary contact recreation; an exceedance is a geometric mean ≥ 126 *E. coli* organisms/100 ml using five samples collected within a 30-day assessment period. The instantaneous criterion used to trigger a 5-day sampling event is unique to each recreational use designation. It requires > 406 organisms/100 mL for primary and > 576 organisms/100 mL for secondary contact recreation to initiate subsequent sampling (WQS § 251.01).

Table 1. Water body units and beneficial uses for the Portneuf River Subbasin. Aquatic life, recreation, and other designations are from IDAPA 58.01.02. COLD = cold water aquatic life; SS = salmonid spawning; PCR and SCR = primary and secondary contact recreation; DWS = domestic water supply; and SRW = special resource waters.

Unit	Water	Aquatic Life	Recreation	Other
US-1	Portneuf River - Marsh Cr. to American Falls Res.	COLD SS	SCR	
US-2	City Creek - source to mouth			
US-3	Gibson Jack Creek - source to mouth			
US-4	Mink Creek - source to mouth			
US-5	Indian Creek - source to mouth			
US-6	Marsh Creek - source to mouth	COLD	SCR	
US-7	Walker Creek – source to mouth			
US-8	Bell Marsh Creek – source to mouth			
US-9	Goodenough Creek - source to mouth			
US-10	Garden Creek - source to mouth			
US-11	Hawkins Creek - Hawkins Res. Dam to mouth			
US-12	Hawkins Reservoir			
US-13	Hawkins Creek - source to Hawkins Res.			
US-14	Cherry Creek - source to mouth			
US-15	Birch Creek - source to mouth			
US-16	Portneuf River - Chesterfield Res. Dam to Marsh Cr.	COLD SS	PCR	DWS SRW
US-17	Dempsey Creek - source to mouth			
US-18	Twentyfourmile Creek - source to mouth			
US-19	Chesterfield Reservoir			
US-20	Portneuf River - source to Chesterfield Res/	COLD SS	PCR	DWS SRW
US-21	Toponce Creek - source to mouth			
US-22	Pebble Creek - source to mouth			
US-23	Rapid Creek - source to mouth			
US-24	Pocatello Creek - confluence of North and South Fork Pocatello Creeks to mouth			
US-25	South Fork Pocatello Creek - source to mouth			
US-26	North Fork Pocatello Creek - source to mouth			

For this report, *E. coli* datasets are evaluated in two ways. For DEQ datasets which conform to the sampling outlined in Idaho's Water Quality Standards (IDAPA 58.01.02 § 251.01) exceedances are reported as the geometric mean of 5 samples collected within 30 days. Other datasets simply provide *E. coli* concentrations from regular (i.e. monthly or bimonthly) sampling and therefore summary statistics are provided along with a comment on whether the single sample instantaneous triggers were exceeded. If single sample instantaneous triggers are regularly exceeded, there is a moderate to high potential risk for a numeric criteria exceedance and in all cases additional monitoring is recommended to determine the actual support status of a water body or assessment unit.

Two water body units in the Portneuf River Subbasin are listed as having special resource water designations (see Table 1). The DEQ defines special resource waters as waters with unique characteristics. Unique characteristics include: outstanding water quality, ecological significance, outstanding recreational or aesthetic qualities, protection that is vital to Idaho's public, National Wild and Scenic River designated waters or those located within a State or National Park or wildlife refuge, or waters that require intensive protection to maintain an existing, but jeopardized use (WQS § 056.01). Special resource uses are not evaluated as part of this biological assessment. There are two water body units that are designated as domestic water supplies (Table 1). The domestic water supply use support determination is beyond the scope of this assessment.

This biological assessment for the Portneuf River includes multi-assemblage information on bacteria, algae, macrophytes, macroinvertebrates, and fish collected from a number of different individuals and organizations since 2000[3]. General ecological condition, as well as cold water aquatic life and recreational use support are considered using appropriate datasets including DEQ BURP data, but all data described here conforms to DEQ's Tier I standard. In brief, Tier I data, like that used here, is: 1. rigorously reviewed and carried out by professionals with a significant amount of biological and water quality training, 2. processed by EPA-certified laboratories or professional taxonomists, 3. related directly to Idaho water quality criteria, 4. generally less than five years old[2], and 5. reported or summarized in the peer-reviewed literature, university dissertations and theses, or published reports. The distinction between DEQ BURP data and other relevant Tier I data is made because DEQ multimetric indices are used to summarize BURP data only. Consistent with Water Body Assessment Guidance (Grafe et al. 2002), all other data provided by the Idaho Association of Soil Conservation Districts (IASCD), DEQ surface water programs, Idaho Department of Fish and Game (IDFG), and Idaho State University is evaluated using standard biological metrics, indicator species, and recognized impairment indices for specific taxonomic groups (e.g. Hilsenhoff Biotic Index for macroinvertebrates). The locations of sampling sites and focal reaches differ by study and by year, but the combined assemblage information was used to generally characterize the biological condition of reaches in the mainstem Portneuf River, Marsh Creek, and select tributaries. Section 2.0 describes biological assemblages or process information from the mainstem Portneuf River and its major tributary Marsh Creek. Section 3.0 describes available biological data from select tributaries that were sampled as part of the annual BURP bioassessment process or from streams sampled by the IASCD scientists. Taken together, biological information reported here provides insight into the current biological condition of the Portneuf River and its tributaries.

2.1 Bacteria

Bacteria are very sensitive to and profoundly affected by environmental change. In terms of biomass, microbes dominate in aquatic ecosystems and are disproportionately responsible for the productivity and elemental processing that occurs. Their attractiveness

[3] Some pre-2000 and >5 year old data is included where relevant or to contrast contemporary studies with historic inventories of the same reach or for the entire watershed (e.g. Hopkins 2007 and Minshall and Andrews 1973).

for use in biomonitoring is also due to their rapid growth and nearly immediate response to relatively low levels of pollution and nutrient enrichment. These traits make them appropriate for use in the detection of specific forms of contamination or to monitor and quantify changes in important ecosystem processes (Paerl et al. 2003).

Bacteria are also commonly used as microbial indicators of water quality. Indicator organisms can be further divided into three recognized groups: general or process indicators (e.g. N-fixation and *Cylindrospermopsis raciborskii,* a cyanobacterial indicator species for eutrophying waters; Paerl et al. 2003), fecal indicators (e.g. *Escherichia coli*), and index or model organisms (e.g. *E. coli as* an index for *Salmonella* and F-RNA coliphages as model organisms of human enteric viruses; Ashbolt et al. 2001). The DEQ uses *E. coli* as an indicator of fecal contamination. In Idaho, surface waters designated for primary (e.g. swimming) or secondary (e.g. wading) contact recreation are not to contain a geometric mean *E.coli* concentration ≥ 126 organisms per 100 mL of sample water within a 30-day period (IDAPA 58.01.02.251.01)[4]**.**

The discussion of microbial indicators of fecal contamination in the Portneuf River that follows is separated in two sections. The first section is a targeted assessment of *E. coli* in the channelized portion of the lower Portneuf River that spans calendar years 2003 to 2006. The second section uses available reach specific summaries collected as part of focused monitoring efforts in the Portneuf River Subbasin. Neither of the sampling strategies discussed below were designed to conform to DEQ's geometric mean criteria, but rather to develop predictive models of *E. coli* concentrations in a given reach using single discrete samples collected from common sites over multiple years. Despite repeated sampling from fixed locations, elevated concentrations do not provide proof of

[4] 58.01.02 Water Quality Standards, Section 251.01. *E. Coli* Bacteria. Waters designated for recreation are not to contain *E.coli* bacteria, used as indicators of human pathogens, in concentrations exceeding:
a. Geometric Mean Criterion. Waters designated for primary or secondary contact recreation are not to contain *E. coli* bacteria in concentrations exceeding a geometric mean of one hundred twenty-six (126) *E. coli* organisms per one hundred (100) ml based on a minimum of five (5) samples taken every three (3) to seven (7) days over a thirty (30) day period.
b. Use of Single Sample Values. A water sample exceeding the *E. coli* single sample maximums below indicates likely exceedance of the geometric mean criterion, but is not alone a violation of water quality standards. If a single sample exceeds the maximums set forth in Subsections 251.01.b.i., 251.01.b.ii., and 251.01.b.iii., then additional samples must be taken as specified in Subsection 251.01.c.:

i. For waters designated as secondary contact recreation, a single sample maximum of five hundred seventy-six (576) E. coli organisms per one hundred (100) ml; or
ii. For waters designated as primary contact recreation, a single sample maximum of four hundred six (406) E. coli organisms per one hundred (100) ml; or
iii. For areas within waters designated for primary contact recreation that are additionally specified as public swimming beaches, a single sample maximum of two hundred thirty-five (235) E. coli organisms per one hundred (100) ml. Single sample counts above this value should be used in considering beach closures.

c. Additional Sampling. When a single sample maximum, as set forth in Subsections 251.01.b.i., 251.01.b.ii., and 251.01.b.iii., is exceeded, additional samples should be taken to assess compliance with the geometric mean E. coli criteria in Subsection 251.01.a. Sufficient additional samples should be taken by the Department to calculate a geometric mean in accordance with Subsection 251.01.a. This provision does not require additional ambient monitoring responsibilities for dischargers.

exceedances of water quality criteria. Instead, samples regularly exceeding the *E. coli* single sample maxima indicate that there is a moderate to high potential risk for a numeric criteria exceedance and warrant further monitoring to assess recreational use criteria.

2.1.a E. coli in an urban channelized segment of the Portneuf River

Targeted bacterial sampling conducted within the channelized segment of the Portneuf River was examined to document *E. coli* trends in this highly modified urban river segment (Inouye *unpublished*). Generally, *E. coli* concentrations increased with distance downstream in the channel and these increases are most pronounced in July and August when water temperatures are high and river discharge is low (2003 results shown; Fig. 2).

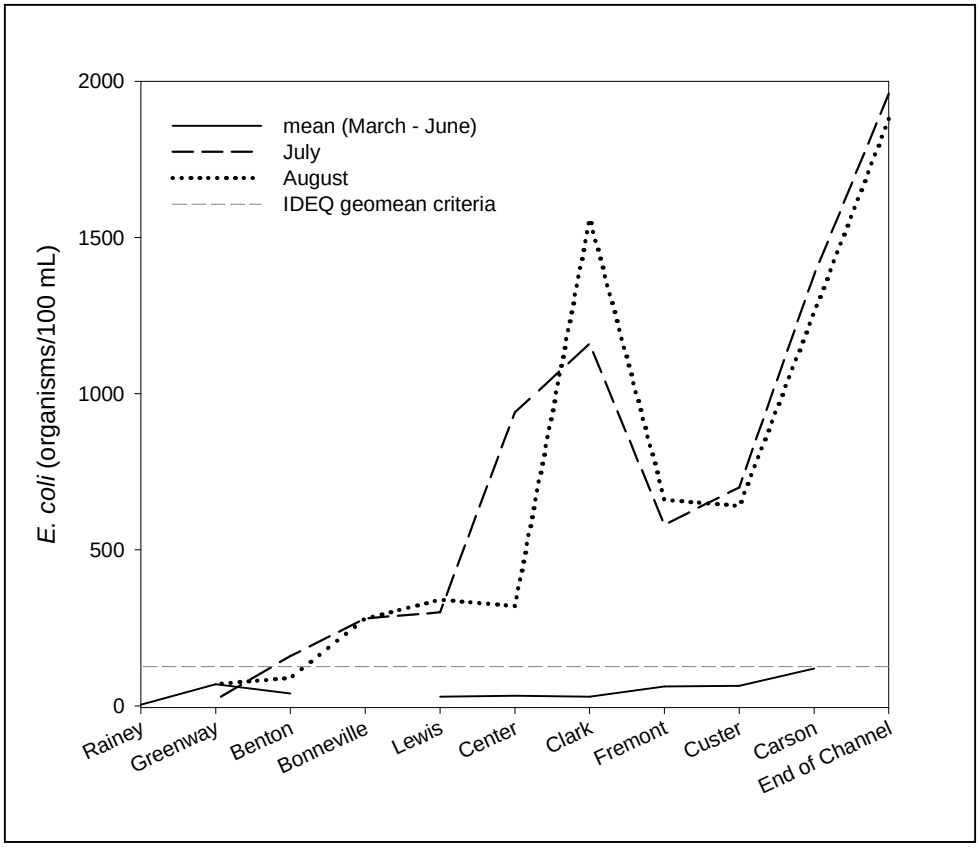


Figure 2. *E. coli* concentrations in the channelized segment of the mainstem Portneuf River in Pocatello from 2003. Place names along the x-axis refer to road/bridge crossings where sampling was conducted. The intervals between names are not to scale. Data provided by R. Inouye.

The downstream trends shown in Figure 2 document an abrupt reduction in concentration downstream of Clark Street; this reduction is followed by further increases in concentration. Although this reduction in concentration has been documented on multiple dates (Fig. 2), it has not been formally evaluated. It is possible that inputs of water with reduced concentrations of *E. coli* produced a marked and measurable reduction in *E. coli*.

In 2003, the DEQ collected surface water samples from North City Park, the upstream extent of the channel, and documented a geometric mean of 1,518 *E. coli* organisms/100 mL of sample water.

Over a four year study using single sample discrete collections, Inouye (*unpublished*) showed that *E. coli* concentrations tended to increase downstream. In the downstream-most portion of the channel, instantaneous primary and secondary contact recreation criteria were often exceeded in late summer.

A targeted analysis of three locations (immediately upstream of channel [Greenway], midway through channel [Fremont], and at the end of the channel [Carson]) over a four year period (2003 to 2006) indicated that different conditions control the variation in *E. coli* concentrations observed at each location. Immediately, upstream of the channel, *E. coli* concentrations were most strongly correlated with a 2-day water temperature average measured at the USGS Pocatello gage (R=0.407, *P*=0.001). In contrast, the primary predictor of *E. coli* concentrations was a summary of discharge (e.g. 5-day discharge average) and temperature was secondarily loaded into a multiple regression model. The combined model at Fremont Street explained 39% of the variation in *E. coli* concentrations (R^2_{adj}=0.390, *P*<0.001); the combined model at Carson Street explained 50% of the variation (R^2_{adj}=0.509, P<0.001; Inouye *unpublished*). This work suggests that factors controlling concentrations of microbial indicators of fecal contamination are different upstream than within the concrete channel that conveys the Portneuf River through the City of Pocatello. The work also highlights that *E. coli* concentrations in the channelized segment of the lower Portneuf River predictably vary with distance downstream and regularly exceed single sample secondary contact recreation maxima.

2.1.b Focused assessments of E. coli *in the Portneuf River Subbasin*

Microbiological samples were collected as part of regular water quality sample collection from permanent monitoring sites in the Portneuf River (Brock and Ray 2004). *E. coli* concentrations are reported below for calendar years 2001 to 2008, however, data availability differs by site. Regular sampling is conducted to provide a basis for the estimation of bacterial loads in the mainstem Portneuf River and Marsh Creek. What follows is a description of the reach specific results from single samples collected during regular sampling efforts.

2.1.b.1 Portneuf River at the Topaz-Marsh Valley Diversion

From July 2003 to November 2005 monthly samples were collected from the Portneuf River at the Topaz-Marsh Valley Diversion. Over this 28-month period, the median *E. coli* concentration was 141 organisms/100 mL (range 15 to 654 organisms/100 mL). Concentrations were generally lowest in the spring and winter however, concentrations from single discrete samples were regularly higher than the DEQ 5 sample/30day geomean criteria of 126 organisms/100 mL from April through November and exceedances of the single sample primary contact recreation criteria were detected three times during the 28-month sampling program.

2.1.b.2 Portneuf River above Marsh Creek

Bacteria samples were collected from the Portneuf River above Marsh Creek from July 2003 to December 2005. The range of *E. coli* concentrations measured over this period was 3 to 218 organisms/100 mL and highest concentrations were detected in July and August each year. The average concentration for July and August for these three years was 164 organisms/100 mL and contrasts markedly with the average *E. coli* concentration for all other months during this same time period (26 organisms/100 mL). Neither primary nor secondary contact recreation criteria were exceeded in the Portneuf River above Marsh Creek during the three years of monitoring.

2.1.b.3 Marsh Creek

2.1.b.3.a IASCD Monitoring

Marsh Creek, designated as a secondary contact recreation water, was sampled at multiple locations in 2006, 2007, and 2008 including: below the confluence with the Right Hand and Left Hand Forks of Marsh Creek, below the water retention pond near Downey, downstream of East Hawkins Road (before confluence with Hawkins Creek), upstream of East Arimo Road, and above West Portneuf Road near McCammon.

The upstream-most location below the confluence with the Right Hand and Left Hand Forks of Marsh Creek was sampled from July 2007 through July 2008. Median concentrations for this period were 195 organisms/100 mL. Concentrations were lowest in samples collected in August, September, and December 2007 and May 2008. Bacterial concentrations were highest in June and July of both years when the average (n=7) was 919 organisms/100 mL. Only one sample was collected in October (126 organisms/100 mL) and November (308 organisms/100 mL), but concentrations were higher than was documented in August and September.

Below the water retention pond near Downey, Marsh Creek had higher concentrations of *E. coli* than the upstream monitoring location and regularly exceeded the single sample maxima for secondary contact recreation (576 *E. coli* organisms/100 mL). The median concentration for the 21 samples collected from this location was 461 organisms/100 mL and the range from May 2007 to July 2008 was 5 to 2,419 organisms/100 mL.

Escherichia coli concentrations in Marsh Creek downstream of East Hawkins Road were monitored bimonthly between November 2006 and July 2008. *E. coli* concentrations varied seasonally and ranged from 1 to 648 organisms/100 mL of sample water. The median concentration of *E. coli* over this period was 80 organisms/100 mL, but exceedances of single sample secondary contact recreation criteria were documented. *E. coli* concentrations in this reach tended to increase during summer months and the highest concentrations measured over this period were in June 2008 (648 organisms/100 mL).

A reach of Marsh Creek located upstream of East Arimo Road near Arimo had a median concentration of *E. coli* of 136 organisms/100 mL between November 2006 and July 2008. The maximum concentrations documented from November through April was 52 organisms/100 mL (median = 25 organisms/100 mL). One of the samples collected in

July 2007 and June 2008 exceeded the single sample maxima for secondary contact recreation.

From December 2006 to July 2008, concentrations of *E. coli* in Marsh Creek above West Portneuf Road near McCammon were similar to concentrations from the upstream monitoring location near Arimo. Concentrations were highest May to October (median = 219 *E. coli* organisms/100 mL) and lowest from November to April (median = 49 organisms/100 mL). None of the samples collected exceeded the single sample maxima for secondary contact recreation.

2.1.b.3.b Portneuf River Monitoring Project Monthly Monitoring

E. coli concentrations in lower Marsh Creek ranged from 1 to 454 organisms per 100 mL of sample water over a period from July 2003 to December 2005. The median *E. coli* concentration from this sampling was 78 organisms/100 mL. The annual bacterial concentration maxima occurred in summer and was greatest in 2004; the average *E. coli* concentrations for July and August were 139, 396, and 69 organisms/100 mL for calendar years 2003, 2004, and 2005, respectively. The average annual discharge recorded at the USGS Marsh Creek gage for calendar year 2004 ranked 49th out of a 52-year record and low discharge may have contributed to elevated concentrations in 2004 relative to 2003 and 2005.

As a tributary, Marsh Creek experiences annual variations in the concentration of *E. coli*. During the months of May to October consistently higher concentrations of *E. coli* are documented and single sample exceedances of the secondary contact recreation criteria were documented at multiple locations. Additional sampling is recommended to determine whether beneficial uses are supported; monitoring for beneficial use support should determine the 5 sample/30 day geometric mean criteria for recreational use determination. Concurrently, best management strategies should be implemented to minimize the introduction of fecal material into Marsh Creek, particularly in reaches where regular exceedances of the instantaneous single sample criteria were documented (e.g. below the water retention pond near Downey).

2.1.b.4 Portneuf River at Edson Fichter Nature Area

Microbiological samples were collected from the Portneuf River at the Edson Fichter Nature Area (EFNA) for approximately four years from September 2001 to October 2005. The median concentration of *E. coli* from this location was 44 organisms/100 mL of sample water and results ranged from 3 to 354 organisms/100 mL. The highest concentrations of *E. coli* were detected from July through October when discharge at this location is at its annual low and water temperatures are relatively high. This period also coincides with heavy recreational use from the public including relatively heavy use by swimmers, anglers, and pet owners; during the summer months dogs are regularly observed in or near the Portneuf River at EFNA. A recent pedestrian monitoring program by the IDFG indicated that some 21,000 visitors used the EFNA between January and August 2007 and over 6,000 visits were detected in July alone (D. Rose *pers. comm.*). Despite the relatively heavy recreational use, neither the instantaneous primary nor secondary contact recreation criteria were exceeded during this period of study.

2.1.b.5 Portneuf River at Batiste Road

E. coli concentrations ranged from 3 to 2,700 organisms per 100 mL of sample water in the Portneuf River at Batiste Road. The median *E. coli* concentration from sampling conducted over a six-year period at Batiste Road was 197 organisms/100 mL. On average, the highest annual concentrations of *E. coli* were detected in July (mean 1,004 organisms/100 mL) and the low annual concentrations occurred in December (Fig 3). It should also be noted that an annual trend in *E. coli* concentrations at this location exhibits a bimodal distribution with elevated concentration in late summer and again in late Fall. The largest peak in *E. coli* concentrations generally occurs in July followed by a secondary peak in October as seen in calendar years 2002, 2005, and 2006 (Fig. 3). Targeted sampling in the City of Pocatello indicates that *E. coli* concentrations increase dramatically over the 2.4 km segment of channelized river. It is not known whether the elevated concentrations detected in the Portneuf River at Batiste Road are recruited from elevated concentrations upstream or whether the bimodal distribution is more reflective of sources connected to the irrigation cycle which typically ends in October. Over six years, the single sample secondary contact recreation maximum was exceeded in July, August, and October of at least one year. However, these exceedances represented a relatively small portion of the total microbiological data record from 2001 to 2006.

2.1.b.6 Portneuf River at Siphon Road

The greatest range in *E. coli* concentrations was detected in the Portneuf River at Siphon Road. From January 2001 to December 2006, concentrations ranged from 0 to >6,000 organisms/100 mL. Despite this range and the location of this site downstream of the City of Pocatello Water Pollution Control (WPC) facility, median concentrations were relatively low (32 organisms/100 mL) and the single sample secondary contact recreation criterion was exceeded only twice. Bacterial concentrations during the two exceedance events did not appear to be influenced by WPC operations. *E. coli* concentrations measured from the outfall during those events (>6,000 and >4,000 organisms/100 mL) were 4 and 14 organisms/100 mL (several orders of magnitude less than values detected in the Portneuf River at Siphon Road on those same days in July and August 2004).

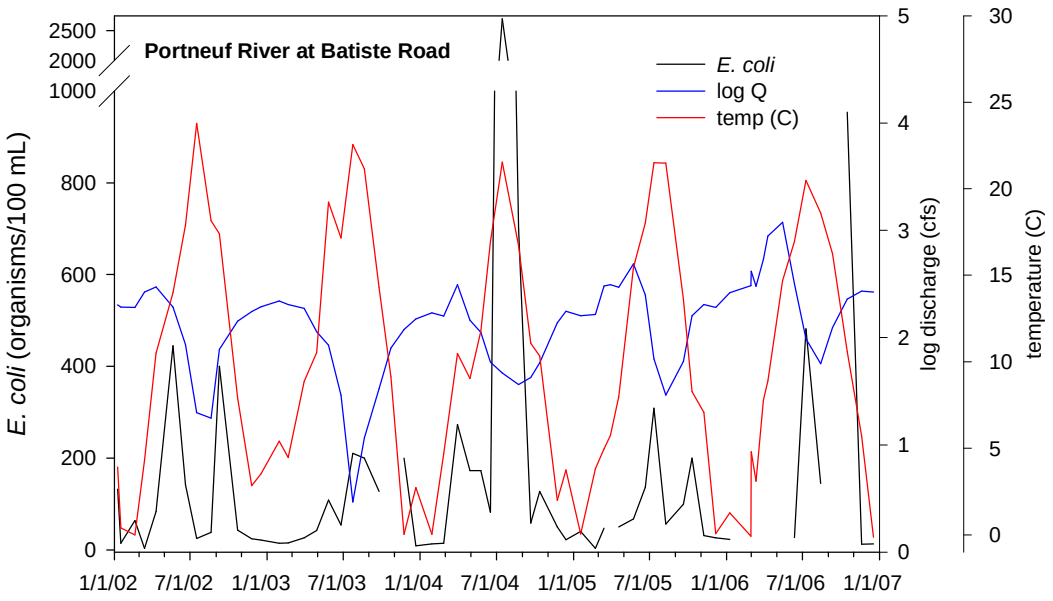


Figure 3. *E. coli* concentrations, river discharge (from USGS Pocatello Gage), and water temperatures in the Portneuf River at Batiste Road from January 2002 to December 2006.

2.2 Algae

Algae are major contributors to the productivity of running waters and therefore the productivity and composition of algae are considered vital to the assessment of aquatic habitats. Moreover, the abundance, diversity, and widespread distribution of algal species make them attractive biological indicator candidates (McCormick and Cairns 1997). In a watershed survey of macrophytes (including microalgae), Hopkins (2007) determined *Cladophora glomerata* was present at eight and *Spirogyra communis* at three of the ten mainstem Portneuf River monitoring sites. *Cladophora glomerata* is among the most common and widely distributed freshwater macroalga (Higgins et al. 2008). Additionally, *C. glomerata* is commonly described as an indicator of excessive nutrient enrichment (Briggs and Price 1987) that forms monotypic mats that often lead to dramatic swings in dissolved oxygen or pH or odor issues upon decay (Whitton 1970; Higgins et al. 2008). The near dominance of *C. glomerata* in the Portneuf River (present at 8 of 10 sites), is likely characteristic of nutrient enrichment and a subsequent loss of algal diversity (Lewis and Wang 1997).

2.2.b Diatoms

Diatoms have been recommended over other biological assemblages to evaluate water quality because they are ubiquitous, have a richness of species with a variety of responses to environmental change, respond quickly to perturbations, and are sensitive to human disturbance (Fore and Grafe 2002a, Kelly et al. 1995). In Idaho, diatoms are disproportionately represented in river algal assemblages (Fore and Grafe 2002a). Therefore, the composition (and corresponding natural history traits) of diatom

assemblages has been adopted by the DEQ as one method of assessing the biological condition of Idaho rivers (Fore and Grafe 2000b). Eight rivers in Idaho were used to develop the River Diatom Index (RDI) used by the DEQ; in the Portneuf River, diatoms were collected from two reaches (above Lava Hot Springs and upstream of the City of Pocatello) in 1997 and 1998 (Fore and Grafe 2002b). From the combined monitoring of these two reaches, the biological condition of the Portneuf River ranked fair and was intermediate among the other seven rivers (Bruneau, Jarbidge, Priest, Snake, South Fork of the Clearwater, Teton, Weiser) used to develop the RDI (Fore and Grafe 2002a).

Recently, Bechtold (*unpublished*) used species composition and other diatom community metrics from two mainstem reaches and one tributary reach to evaluate diatom assemblages across reaches differing in their degree of impairment and dominant land use. Sites included Gibson Jack Creek representing a relatively unimpaired stream, the Upper Portneuf Sportsman's Access representing a minimally impaired mainstem site, and Portneuf River at Siphon Road representing a nutrient impaired mainstem site. Artificial substrates were used to collect diatoms and collections were synchronized with studies examining biofilm responses to nutrient and carbon enrichment on nutrient diffusing substrates. As a result, this study documented the resident diatom assemblages colonizing artificial substrates (using control treatments) and determined the response of diatom assemblages to carbon, nutrient, or combinations of carbon and nutrient enrichment (Bechtold *unpublished*). For the purposes of this biological assessment, the focus is mostly on the general diatom assemblage patterns of each site for unamended or control treatments. The method of collection used for this study has limitations. Namely, the diatom assemblage colonizing introduced substrates does not provide an adequate sample of the resident community. Diatom community composition was summarized from taxa identification based on a 600 count (EcoAnalysts, Inc., Neosho, MO).

The autotrophic index (ratio of biofilm dry mass to chlorophyll *a*) of colonizing biofilms was greater for Gibson Jack Creek and Siphon Road indicating a greater heterotrophic community at those locations relative to the Upper Sportsman's Access. Diatom richness and diversity was highest for the Portneuf River at Siphon Road. There was a total of 87 species identified on unamended substrates from Siphon Road. In contrast, assemblage richness at Upper Sportsman's Access was 47 species and Gibson Jack Creek had 54 species. Similarly, Shannon's diversity index was 2.9, 3.1, and 3.5 for the Upper Portneuf Sportsman's Access, Gibson Jack Creek, and the Portneuf River at Siphon Road. Generally, higher community richness is associated with a better biological condition of freshwater habitats and this is true for many taxa including fish and invertebrates (Karr and Chu 1999). However, in a comprehensive assessment of Idaho rivers, Fore and Grafe (2002) showed that the total number of diatom taxa increased with increasing measures of human disturbance (except mining disturbance). Given this relationship, the rich diatom assemblage in the Portneuf River at Siphon Road may reflect a site that has a higher degree of disturbances relative to the other Portneuf River sites.

A list of the 27 most common diatom species identified (out of the total 175) across all sites and treatments is included as Table 2. The three most abundant taxa sampled across sites and treatments were *Cocconeis placentula* var. *lineate*, *Rhoicosphenia curvata*, and

Cocconeis pediculus; all three of these species are characterized as eutrophic and alkaliphilic and described as indicators of human disturbance (Fore and Grafe 2002a). Other taxa common in the Portneuf River include species from the genera *Navicula* (42 total species detected across all sites and treatments), *Nitzschia* (34 total species), and *Surirella* (6 total species); these genera are highly motile and tolerant to siltation (Stevenson and Bahls 1999). The fourth most abundant species found in this investigation of the diatoms was *Achnathes minutissima*; this widely distributed species was found at every site sampled in an assessment of river diatoms in Idaho (Fore and Grafe 2002a).

The most common taxon identified at the Upper Portneuf Sportsman's Access was *C. pediculus*, while *C. placentula* var. *lineate* predominated at Siphon Road. The dominant taxa in Gibson Jack Creek was *Navicula viridula* var. *avenacea*. Many diatom taxa found in the Portneuf River Subbasin (Table 2) are characteristic of nutrient impairment. For example, *C. pedicululs* common at the Upper Portneuf Sportsman's Access and Siphon Road is characteristic of eutrophic conditions and agricultural pollution (Lavoie et al. 2006), high phosphorus (P), and high turbidity (Rott et al. 1998). *Cocconeis placentula* var. *lineate*, the dominant taxa at Siphon Road, was found only on nitrogen (N) enrichment or N and P coenrichment treatments in a nutrient enrichment experiment of Douglas Lake, Michigan (Fairchild et al. 1985). *Cyclotella meneghiniana* was the second most dominant taxa at the Upper Portneuf River Sportman's Access and common at Siphon Road. *C. meneghiniana* is characterized as a N heterotroph indicative of eutrophic, alkaline, organic rich conditions in Idaho (Fore and Grafe 2002). Munn et al. (2002) showed that *C. meneghiniana* was associated with elevated ortho-P and dissolved inorganic N in Washington State. Several diatom taxa detected in the Portneuf River had multiple negative attributes (e.g. *C. meneghiniana*; eutrophic, saprobic, and nitrogen heterotroph), and from the statewide work completed by Fore and Grafe (2002a), these species most often occurred at sites with moderate to high levels of human disturbance and rarely occurred at sites with lower levels of disturbance. All of the sites sampled in the Portneuf River subbasin contained at least one species characterized by multiple negative attributes, but several diatom taxa characterized by multiple negative attributes were present only at Siphon Road (e.g. *Amphora veneta, N. sigmoidea)*. Finally, *Navicula viridula* was among the most common taxa at Gibson Jack Creek. Pan et al. (1996) noted that *N. viridula* was common to waters with elevated TP (110 ug/L TP) in the Mid Atlantic Highlands of the eastern U. S.

Non-metric dimensional scaling (NMDS) is a multivariate approach that partitions biological data (e.g. diatom species) in non-dimensional or ordination space. The overlap, separation, or relative distance between species or sites is used to visually assess differences among sites or species sets. Based on the NMDS ordination, diatoms in the Portneuf River appear to be more strongly influenced by watershed location than by local, short term nutrient enrichments from artificial substrates (Bechtold *unpublished*).

Table 2. List of diatom taxa sampled at three locations in the Portneuf River Subbasin. The relative abundance of each taxa is shown along with species attributes, water quality indicator scores, and sensitivity values for select taxa.

Species	Relative Abundance	Species Attributes[‡]	Water Quality Zone*	Sensitivity[†]
Cocconeis placentula var. *lineate*	16.81	EU, AL	--	--
Rhoicosphenia curvata	10.96	EU, AL	--	--
Cocconeis pediculus	10.63	EU, AL	--	4
Achnanthes minutissima	7.56	OX	3	2
Planothidium frequentissimum	6.97	--	--	--
Navicula viridula var. *avenacea*	4.13	--	--	--
Fragilaria construens var. *venter*	2.33	OX, AL	--	--
Cymbella minuta	1.97	--	--	3
Navicula rhynchocephala var. *germainii*	1.85	--	--	--
Navicula tripunctata	1.69	EU, AL	--	4
Cyclotella meneghiniana	1.60	EU, AL, NH, SP	--	--
Gomphonema parvulum	1.52	EU, NH, SP	4 and 5	5
Cocconeis placentula	1.49	EU, AL	3	3
Fragilaria vaucheriae	1.39	EU, AL	--	3
Nitzschia fonticola	1.30	MO	--	--
Surirella ovata	1.30	MO	--	3
Nitzschia palea	1.23	MO, EU, NH, SP	5	4
Navicula viridula	1.22	--	--	--
Synedra rumpens	1.10	--	--	--
Diatoma moniliformis	1.09	--	--	--
Synedra ulna	1.06	--	--	3
Amphora pediculus	1.05	EU, AL	--	5
Cyclotella distinguenda	1.05	--	--	--
Nitzschia gracilis	0.94	MO	--	--
Diatoma vulgaris	0.94	--	--	5
Nitzschia angustata	0.88	--	--	--
Melosira varians	0.78	EU, AL, NH	--	4

[‡]Species attributes include: OX = high oxygen, MO = motile/sediment tolerant, AL = alkaliphilic, EU = eutrophic/nutrient tolerant, NH = nitrogen heterotrophs, SP = saprobic (from Fore and Grafe 2002). *Water quality zones (1 to 5): 1. clean water in upper most reaches and low pH, 2. nutrient richer and somewhat higher pH, 3. Nutrient rich, 4. Eutrophic with restricted flora due to detrimental influx of materials, 5. flora grossly restricted due to detrimental influx of materials (from Round 1993 cited in Kelly et al. 1995). †Sensitivity values (1 to 5) correspond to ambient P concentrations in mg/L: 1. <0.01 mg/L, 2. ≥ 0.01 and < 0.035 mg/L, 3. ≥ 0.035 and < 0.1 mg/L, 4. ≥ 0.1 and < 0.3 mg/L, and 5. ≥ 0.3 mg/L (Kelly and Whitton 1995). -- indicates the indicator status of the species was not provided.

This may indicate that dissolved inorganic nutrients are available in excess of physiological needs at each site or that other features of habitat are selecting for colonizing taxa. Overall, *C. placentula* var. *lineata* explained 83.5% of the variation of the NMDS ordination. *Cocconeis pediculus* (79.2%), *Cymbella minuta* (70.9%), *Fragilaria construens* var. *venter* (70.7%), *Navicula viridula* var. *avenacea* (68.1%) and *Navicula tripunctata* (54.4%) additionally explained variation in diatom assemblages among sites. Dimension 1 of the NMDS ordination was most strongly separated by *Planothidium frequentissimum* and *C. pediculus*, while dimension 2 was most strongly separated by *R. curvata* and *Navicula rhynchocephala* var. *germainii*. Upper Sportsman's Access sites clustered near *F. construens* var. *venter* which requires high oxygen and prefers alkaline conditions (Fore and Grafe 2002), *C. minuta*, and *C. pediculus*; *C. pedicululs* is characteristic of eutrophic conditions (Lavoie et al. 2006, Rott et al. 1998). Siphon clustered with *C. placentula* var. *lineate* which tolerates eutrophic, prefers alkaline conditions (Fore and Grafe 2002), and is common to N enriched sites (Fairchild et al. 1985). Gibson Jack was pulled toward *Navicula viridula*, and *Navicula tripunctata*; both genera are considered motile and tolerant of eutrophic conditions (Fore and Grafe 2002). Both Gibson and Siphon clusters intersected in an area that is most likely related to *P. frequentissimum* (Fig. 4). Despite the fact that this study was initiated to examine changes in the composition of the diatom community following enrichment, differences in diatom composition were greatest among sites.

Sixteen of the 27 most common diatoms (Table 2) identified from Bechtold's recent work were observed in Portneuf River above Lava Hot Springs in 1987. The diatoms common to both investigations vary in their temperature preferences, though Vinson and Rushforth (1989) provide empirical evidence indicating that many species abundant in the Portneuf River (e.g. *C. placentula* var. *lineate, C. pediculus, A. minutissima*) are eurythermal. Two taxa common to cooler waters in the 1987 study (*Navicula tripunctata* and *Nitzschia palea*) were clustered with Gibson Jack Creek taxa (Fig. 4)

Taken together, the diatom assemblages from three locations in the Portneuf River include flora common to nutrient enriched and alkaline rivers in Idaho. Some of the species detected in this experiment were common among a nutrient impaired mainstem site (Portneuf River at Siphon Road) and a relatively unimpacted tributary (Gibson Jack Creek). For this and other reasons, care should be exercised when evaluating the biological condition of these reaches using only this dataset. In particular, attention should be paid to the sampling strategy employed; short term deployment of artificial substrates may select for relatively motile species (e.g. genera *Nitzschia*, *Navicula*,, and *Surirella*). Moreover, diatom species in the Portneuf River may be separated along other environmental gradients including stream temperature (see Vinson and Rushforth 1989) that may be equally important in selecting for individual taxa (Walker and Pan 2006). Regardless of these limitations, diatom richness for the Portneuf River at Siphon Road was almost 2X higher than the Upper Portneuf River Sportsman's Access and Gibson Jack Creek. In Idaho, the total number of diatom taxa present in a given reach was shown to increase with forms of disturbance other than mining (Fore and Grafe 2002).

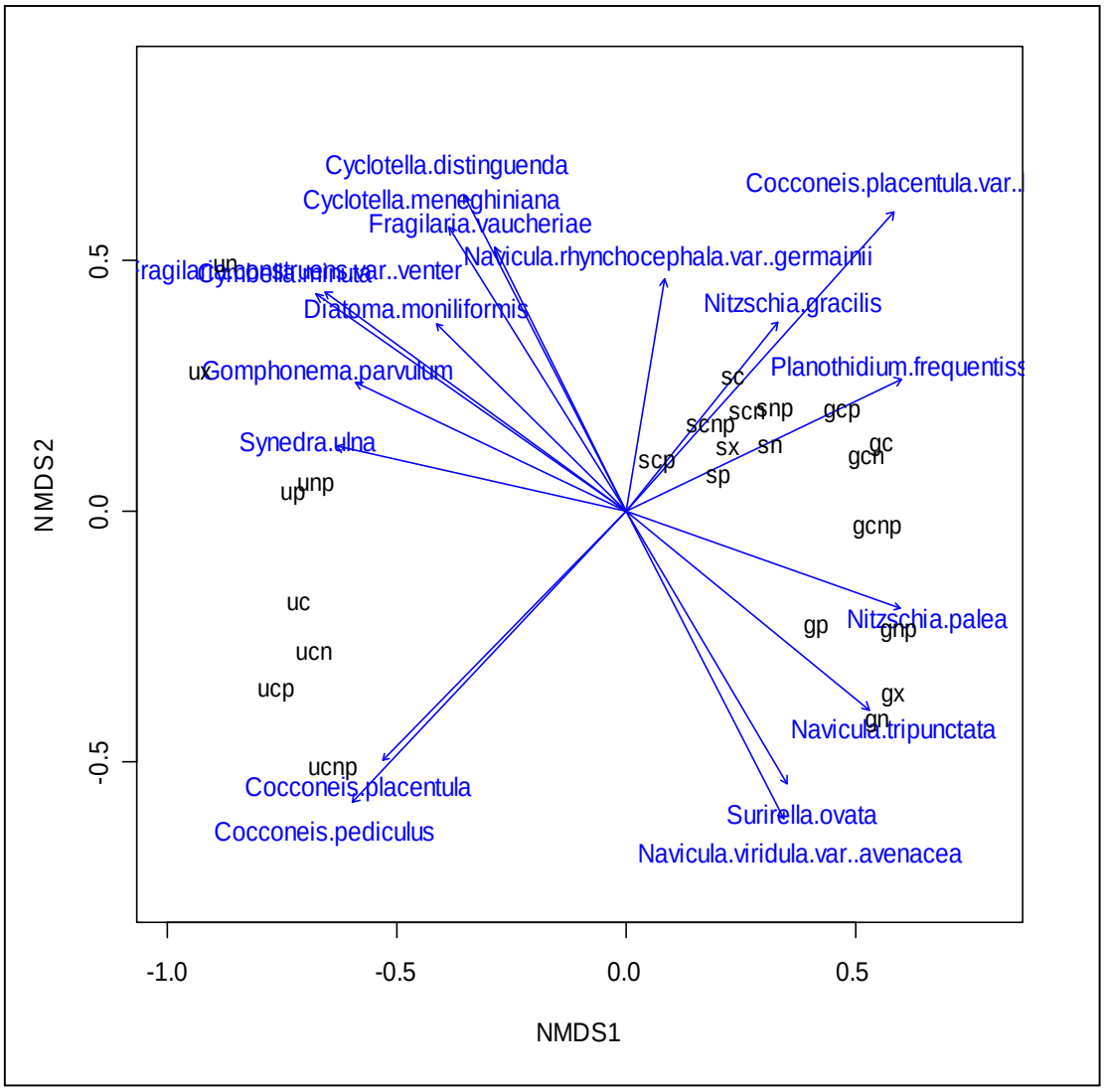


Figure 4. NMDS ordination of diatioms from the mainstem Portneuf River from the upper Portneuf River (Upper Portneuf River Sportsman's Access above Lava Hot Springs), Portneuf River at Siphon Road, and Gibson Jack Creek. Ordination includes diatom species and site codes (u = upper Portneuf River, s = Portneuf River at Siphon Road, and g = Gibson Jack Creek). Further abbreviations to the site codes include: c = carbon enrichment, n = nitrogen enrichment, p = phosphorus enrichment, or x = control). NMDS shown explains the variation observed for 85% of the diatom taxa sampled at these three locations in the Portneuf River Subbasin.

2.3 Macrophytes

As a result of their widespread distribution and abundance in aquatic ecosystems, macrophytes have been recommended as indicators of water quality (Kelly and Whitton 1998, Ali et al. 1999), and several taxa are now regarded as biological indicators of the trophic status of running waters (Grasmück et al. 1995, Robach et al. 1996). The use of

macrophytes in biological assessments of running waters has been promoted because rooted macrophytes are relatively sessile perennial organisms and evidence from European studies suggest that they are good predictors of the trophic status in temperate rivers (Ali et al. 1999). Several studies of macrophytes have been conducted in the Portneuf River, but the assessment that covered the longest river length and largest geographical extent was conducted by Hopkins (2007) and the summary of this effort is described below. In addition to this effort the DEQ Pocatello Region Office has conducted repeated sampling of macrophytes at nine permanent transects in the lower Portneuf River over a period from 2000 to 2006. Additional studies are also described in the summary of macrophytes of the Portneuf River that follows.

2.3.a Subbasin Assessment of Macrophytes

The most common rooted macrophyte species detected in Hopkins' (2007) survey of mainstem Portneuf River was *Potamogeton pectinatus* L., occurring at six of ten monitoring sites. This species has been described as an indicator of eutrophic conditions elsewhere (Grasmück et al. 1995, Robach et al. 1996). Other common taxa in the Portneuf River (present at ≥ 4 of 10 sites) were *Veronica anagallis-aquatica*, *P. foliosus*, *Elodea canadensis*, *P. crispus,* and *Lemna minor* (Hopkins 2007). *Potamogeton crispus*, *L. minor*, and *Ceratophyllum demersum* (present at 3 of 10 sites) are considered indicators of eutrophication. In contrast, *E. canadensis* is thought to be an indicator of intermediate trophic conditions (Robach et al. 1996). Collectively, the common species present are representatives of nutrient rich waters and these occurred primarily in the upper reaches above McCammon and then again in the lower Portneuf River at Siphon Road. Similarly, the total biomass of macrophytes was greatest at sites above McCammon and at Siphon Road. These patterns in biomass and species distributions may also reflect reach conditions that are more suitable for growth and reproduction of macrophytes (e.g. spring influences leading to clear waters with relatively low velocities) in addition to the trophic status or other water quality conditions in a particular reach.

P. pectinatus was present at all mainstem and Marsh Creek sites (10 total) in a 2007 study of the tissue nutrient concentrations of *P. pectinatus* across a range of nutrient concentrations in the Portneuf River Subbasin (Raben et al. *unpublished*). This work, combined with Hopkins' (2007) investigation indicates that *P. pectinatus*, an indicator of nutrient rich waters, is a common plant throughout the subbasin. The dataset generated from the work by Raben et al. (*unpublished*) suggests that macrophyte tissue nutrients could not keep pace with increases in available surface water nutrients present in the Portneuf River Subbasin. Over the range of surface water N and P in the Portneuf River, there is preliminary evidence that *P. pectinatus* reached saturation conditions above 0.69 mg/L N (expressed as $NO_2 + NO_3$). Increases in tissue P were a function of increases in surface water TP; however, the relationship between tissue P and surface water TP was nonlinear as surface water TP concentrations exceeded approximately 100 µg/L. The percentage of P in *P. pectinatus* tissues varied from 0.15 to 0.38% as TP concentrations in Portneuf River and Marsh Creek reaches increased from 23 to 107 µg/L. Above 107 µg/L, the slope of the relationship changed and at surface water concentrations of 1.98 mg/L, the percentage of P in plant tissues was 0.69% and only double the concentration found at 107 µg /L TP. Based on this work, it is apparent that above certain nutrient thresholds aquatic macrophytes offer no additional or limited assimilation.

2.3.b Aquatic vegetation in the Lower Portneuf River

Wilhelm (2006) showed that the biomass of the detached macrophyte community which consisted largely of *V. anagallis-aquatica, Cladophora golmerata, E. canadensis, P. crispus,* and *P. pectinatus* is an order of magnitude greater in a reach influenced by nutrient rich groundwater relative to an upstream reach with significantly lower concentrations of P. This increased biomass, coupled with the increased content of P in plant tissues, leads to a macrophyte P load in the lower nutrient-rich reach that is approximately 250X greater than a less nutrient impaired reach only 1 km upstream (Wilhelm 2006). Two of the ecological consequences of nuisance aquatic macrophyte growth in the lower Portneuf River are dramatic swings in water column dissolved oxygen (>7 mg/L over 24 hrs) and pH (Ray and Beardsley 2008). In her survey of the mainstem Portneuf River, Hopkins (2007) reported that daily fluctuations in dissolved oxygen concentrations were most pronounced in the Portneuf River at Siphon Road and attributed this to the high abundance of aquatic macrophytes documented at that location.

Table 3. Permanent transect locations for aquatic vegetation monitoring in the lower Portneuf River. Transect length (in ft), percent of stream occluded, and percentage of transect points with aquatic macrophytes or filamentous algae. Values represent averages of years 2000, 2001, 2005, and 2006. *Percent occluded indicates the percentage of emergent vegetation. **Percent transect with aquatic vegetation includes emergent and submerged macrophytes, filamentous algae, and epilithic algae. Data provided by DEQ PRO.

Transect	Reach Description	Transect length	Percent occluded*	Percent transect with aquatic vegetation**
1	Above Interstate (FMC & Swanson springs complex)	44.3	0.9	39.1
2	Below FMC & Swanson springs complex	60.5	11.8	40.1
3	Above Pocatello WPC	81.1	4.5	74.0
4	Below Pocatello WPC	92.8	21.8	73.2
6	Above Batiste Springs Trout Farm discharge	61.1	14.7	50.1
7	Below Batiste Springs Trout Farm discharge	96.5	16.2	77.8
8	Between Batiste and Papoose Springs	97.5	5.6	61.5
9	Above Papoose Springs	88.4	1.6	85.2
10	Below Papoose Springs	111.2	8.1	81.9

Between 2000 and 2006, the DEQ surveyed aquatic vegetation (including macrophytes and filamentous algae) in the lower Portneuf River along nine permanent transects (Table 3). These transects span a river segment beginning in the Portneuf River upstream of Interstate I-86 (T1) to a reach below Papoose Springs and upstream of Siphon Road (T10; transect locations described in Baldwin et al. 2004); this segment includes all of the springs described by Perry and Clark (1990). The goal of the regular surveys was to document vegetation abundance trends and the extent of the river that is occluded by macrophytes over various flow years. Average daily discharge for calendar years 2000, 2001, and 2005 ranked 66th, 70th, and 89th out of a 93-year record at the USGS Portneuf River at Pocatello Gage (13075500). The survey conducted in 2006 occurred in a

relatively high water year; average daily discharge ranked 18th over that same flow record. Since the study segment receives approximately 225 cfs (6.37 m^3/s) from groundwater inputs associated with a complex of 27 springs, discharge in low water years (i.e. 2005) is mitigated most at downstream transects (e.g. T10) and least at upstream transects (e.g. T1).

The DEQ estimated the abundance of macrophytes using a point-intercept approach along permanent transects established perpendicular to the river channel. Each transect was stratified into regularly spaced intervals (e.g. every 1.0 to 2.0 feet) and the presence or absence of submerged or emergent vegetation was noted at each interval. Since emergent vegetation was common, the percentage of river occluded by emergent vegetation was also estimated. This estimate of obstruction, however, should be considered conservative because emergent vegetation combined with submerged macrophyte beds influence properties of flow and sediment transport in rivers (Madsen et al. 2001). Accordingly, the extent of the channel cross-section with vegetation can also be used to understand the impacts of nutrient additions, hydrologic modifications, and nutrient retention from macrophyte abundance in the lower Portneuf River.

Upstream most sites had the smallest cross-sectional widths and the lowest percentage of vegetation as the dominant substrate (Table 3). Channel width at T10 was approximately 3X the width of T1. When averaged across years, the percentage of the river bed that supported aquatic vegetation was greatest above and below Papoose Springs (T9 and T10) where vegetation represented 85.2 and 81.9% of the transects. The reach above I-86 had the lowest percentage of aquatic vegetation and averaged 39.1% across all four study years (Table 3). The coefficient of variation for the percentage of river bed occupied by aquatic vegetation ranged from 0.14 to 0.76 and was highest for uppermost reach and lowest for the most downstream reaches where vegetation abundance varied little over the study. The percentage of river occluded by emergent macrophytes varied considerably by site and by year, but was greatest in the sites downstream of Pocatello's WPC (T4, T6, and T7). Averaged across sites, calendar year 2000 (17.9% occluded) had the greatest percentage of river occlusion and 2006 (3.2%) had the least. The coefficient of variation associated with percent of river occluded with emergent vegetation ranged from 0.64 to 2.0 and was lowest between Batiste and Papoose Springs (T8) and greatest above I-86.

Like many rivers, large macrophyte beds are common in the Portneuf River and the presence of these beds are thought to reduce flow velocities, increase sedimentation, decrease resuspension, and increase light penetration (Madsen et al. 2001). These physical changes to aquatic ecosystems improve habitat for rooted macrophytes and epilithic algae and provide additional areas for macrophyte expansion. The abundance of macrophyte beds and their combined photosynthetic and respiratory activities also influence pH and dissolved oxygen concentrations on a daily basis (Ray and Beardsley 2008). In the lower Portneuf River two continuous monitoring stations (Batiste Road and Siphon Road) nearly bracket the segment that has been repeatedly sampled for aquatic vegetation. Dissolved oxygen concentrations from these stations are presented during periods of peak macrophyte abundance for two sampling years (2005 and 2006; Fig. 5).

Macrophyte abundance tended to increase with distance downstream from T1 and at the downstream most reaches in excess of 80% of the cross-sections supported aquatic vegetation.

The Batiste Road monitoring station located just downstream of T1 recorded the magnitude of daily fluctuations in dissolved oxygen upstream of the major spring inputs; daily dissolved oxygen fluctuations averaged 2.45 (2005) and 2.67 mg/L (2006) from 15 July to 15 September. In contrast, the average daily fluctuations in dissolved oxygen downstream of T10 at Siphon Road were 7.42 and 4.29 mg/L for 2005 and 2006, respectively. The maximum daily fluctuation in dissolved oxygen measured at Siphon Road was 9.2 mg/L and almost 2X the maximum fluctuation of the upstream site. In addition, daily minimum dissolved oxygen concentrations at Siphon Road regularly drop below the designated oxygen threshold for the cold water aquatic life criteria. Over the biologically critical period shown in Figure 5 (15 July to 15 September), dissolved oxygen at Siphon Road dropped below the aquatic life criteria on 82% of days in 2005 and 93% of the days in 2006.

The interannual variation in macrophyte abundance measured between 2005 and 2006 may explain some of the difference in the magnitude of the average daily fluctuations in dissolved oxygen at Siphon between 2005 and 2006. In a manipulative study of aquatic plant management, Kaenel et al. (2000) demonstrated that modest but measurable increases in nocturnal dissolved oxygen concentrations (+ 1 mg/L) were documented following the removal of macrophytes in a small stream. Hopkins (2007) hypothesized that a higher peak discharge in 2006 may have contributed to a decline in the abundance of macrophytes in the Portneuf River by directly removing bed materials including rooted macrophytes and epilithic algae. Along with a higher peak flow and reduction in macrophytes measured in 2006, there was a concomitant reduction in the amplitude of daily fluctuations in dissolved oxygen relative to 2005. This interannual variation in discharge and macrophyte abundance measured suggests that aquatic vegetation has an impact on water quality (dissolved oxygen shown and pH presumed) in the lower Portneuf River. In hydrologically modified rivers like the Portneuf River, scouring peak flows may assist in mobilizing fine materials and removing nuisance stands of aquatic vegetation. The removal of aquatic vegetation in the lower Portneuf River may have had profound impacts on water quality, but also indirectly affected the macroinvertebrate community that was dominated by New Zealand Mud Snails prior to the 2006 floods (Hopkins 2007). Restoration of peak flows in regulated rivers represents a viable strategy to restore native biota and control the abundance of non-native taxa (Van Kirk and Jenkins 2005) that may, in turn, affect water quality.

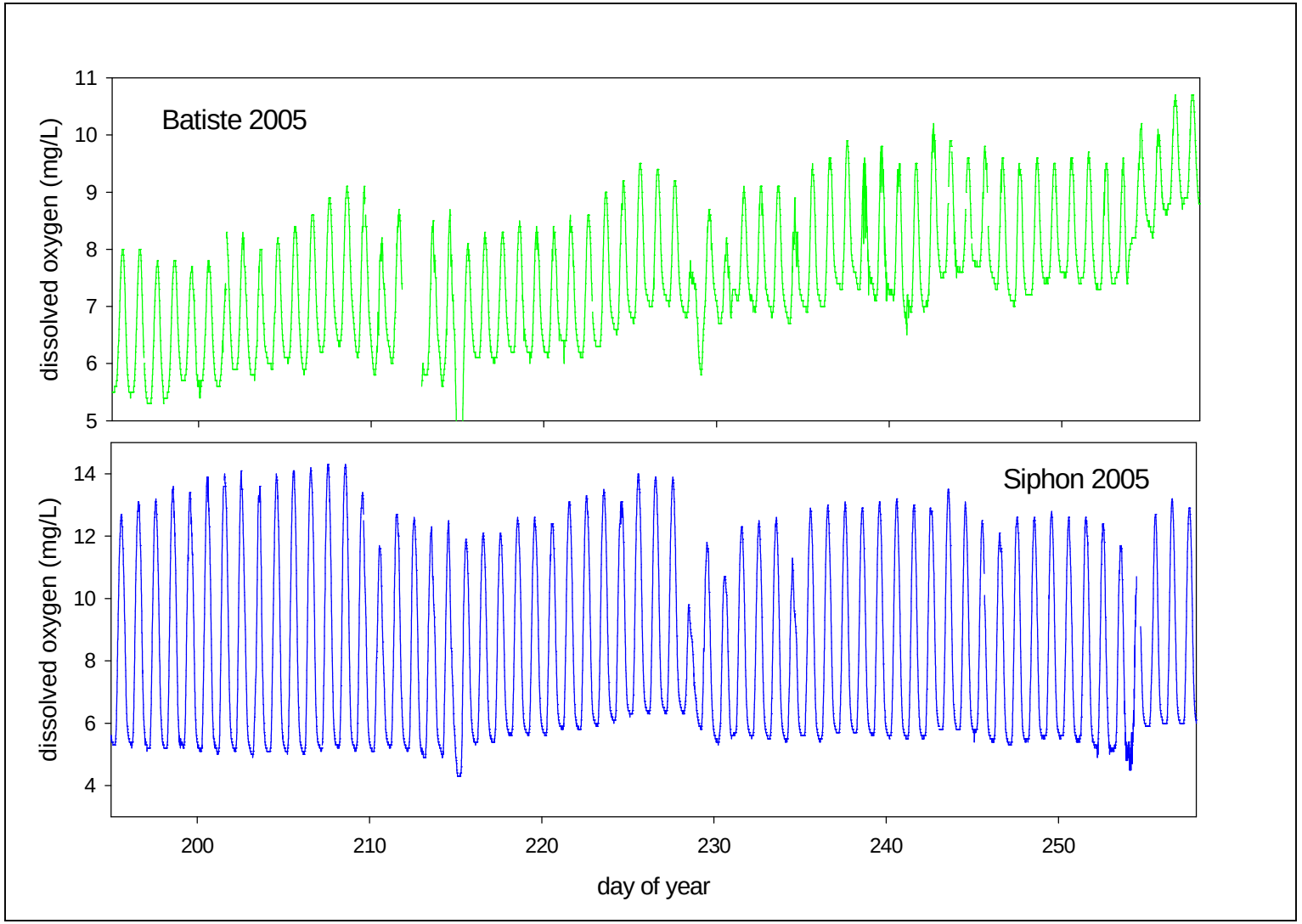


Figure 5a. Dissolved oxygen concentrations from 15 July (day of year 196) to 15 September 2005 (day of year 258) in the Portneuf River at Batiste and Siphon Roads. Data provided by DEQ PRO.

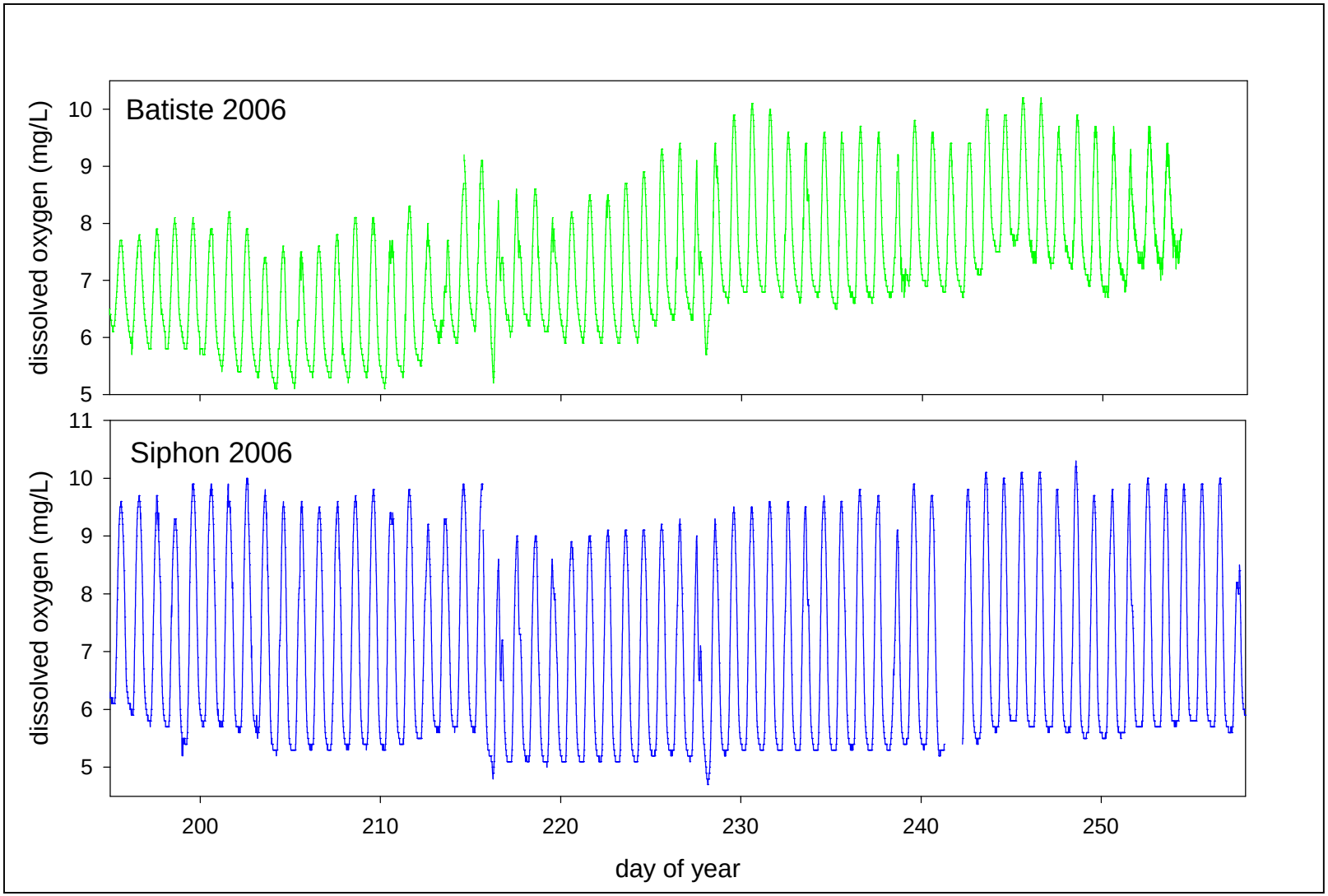


Figure 5b. Dissolved oxygen concentrations from 15 July (day of year 196) to 15 September 2006 (day of year 258) in the Portneuf River at Batiste and Siphon Roads. Data provided by DEQ PRO.

2.4 Macroinvertebrates

Their diversity of forms and habits combined with their relatively immediate response to environmental stresses make benthic macroinvertebrates model organisms to bioassess aquatic ecosystem health (Rosenberg and Resh 1993). Not surprisingly, a recent review of the biomonitoring literature determined that benthic macroinvertebrates were the most commonly cited (64% of sources) group of organisms for bioassessment of aquatic ecosystem health (Resh 2008). Macroinvertebrates were collected as part of two relatively extensive recent assessments of the mainstem Portneuf River. The first assessment repeated a classic assessment of ecological condition of the Portneuf River conducted from 1967 to 1972 (Minshall and Andrews 1973). This assessment was carried out over multiple seasons and provides a characterization of macroinvertebrates that includes seasonal trends. The second assessment was carried out in 2005 by DEQ and represents a characterization of macroinvertebrates in mainstem Portneuf River from a single visit. Additionally, two mainstem sites were included in the U.S. EPA's Environmental Monitoring and Assessment Program-Western pilot project (EMAP – West; Stoddard et al. 2005).

2.4.a Hopkins' Assessment

A 2004 survey of macroinvertebrate assemblages of ten reaches in the mainstem Portneuf River was designed to resample the same reaches assessed nearly four decades earlier (Minshall and Andrews 1973, Hopkins 2007). The original and contemporary investigations used multiple artificial substrate baskets within each reach (Hilsenhoff 1969) to standardize the collection of macroinvertebrate taxa present. What follows is a summary of the 2004 survey. A detailed comparison of the 1969 and 2004 assemblages is provided in Hopkins (2007).

In 2004, 167 macroinvertebrate taxa, represented largely by Chironomidae (59 taxa), Annelida (25 taxa), and Acari (12 taxa), were identified in the mainstem Portneuf River (Table 4). The most abundant taxon in 2004 was the exotic *Potamopyrgus antipodarum* (New Zealand mudsnail - NZMS, Mollusca) and was present at all locations and abundant in reaches with large spring influences. Several taxa of Chironomidae and *Coenagrion/Enallagma* (Odonata) were also present at each site but most abundant in the upper reaches. Several taxa showed restricted distributions in the Portneuf River; thirteen taxa were restricted to the upper reaches, twenty-six to the middle reaches, and nine to the lower reaches. Other taxa, such as *Simulium* (Diptera), Ostracoda, Tubificidae, and *Physa ampullacea* (Mollusca) were also widely distributed but not present at each location (Hopkins 2007). Macroinvertebrates exclusive to the upper reaches consisted of lentic taxa (e.g. *Gammarus lacustris*) likely influenced by the proximity of this site to the Chesterfield Reservoir and the annual, seasonal, and daily flow alterations associated with reservoir management. Two taxa (*Caecidotea* and *Quistradrilus multisetosus*) were only present at the most downstream site (Portneuf River at Siphon Road). These taxa have been reported elsewhere as indicators of eutrophication and substantial organic loading (e.g. *Q. multisetosus* in Carter et al. 2006).

The sites with the lowest richness (fewest taxa) were the major gaining reaches in the river (Upper Portneuf River near Pebble Creek and Portneuf River at Siphon Road). Although these sites were separated by 46 river miles (74 km) their macroinvertebrate assemblages were comprised of similar taxa and their richness was identical (19 taxa each). The assemblages at these two sites were best explained (in ordination space) by high nitrate concentrations, high macrophyte biomass, and high specific conductivity (Hopkins 2007). The reach that supported the highest richness (32 taxa) was located just below the confluence of Rapid Creek. This reach was also the most diverse of all reaches monitored and supported the greatest number of taxa from the orders Ephemeroptera, Plecoptera, and Trichoptera (EPT) across all seasons. Other sites showed seasonally high EPT richness and included the Portneuf River at Pebble Creek during the winter and the Portneuf River near Edson Fichter and Kraft Road sites during the summer and fall (Hopkins 2007). The latter sites may have recruited EPT taxa from the upstream site below Rapid Creek that consistently supported a higher abundance of EPT taxa.

A common macroinvertebrate metric used to assess water quality and degree of organic pollution is the Hilsenhoff Biotic Index (HBI); HBI assigns each species a numeric value which is multiplied by the abundance in the sample. Higher values are assigned to taxa with higher tolerance to organic pollution. The resulting HBI for a sample ranges from 1-10 with values close to 1 demonstrating clean water and high values near 10 for heavily polluted water. In 2004 HBI scores ranged from 4 to 10 and were lowest for the Portneuf River below Rapid Creek and at Kraft Road. Sites with the highest HBI score included the following mainstem Portneuf River sites: below Lava Hot Springs, below McCammon, at Batiste Road, and at Siphon Road. Most metrics, including the HBI, were strongly influenced by the abundance of the NZMS and reaches with a greater abundance of NZMS overall had decreased diversity and poorer biotic index scores (Hopkins 2007). The biotic index values were markedly different when analyzed without NZMS and ranged from 0.15 to 6.6. HBI also showed some seasonal variation, but overall resident macroinvertebrate assemblages including NZMS throughout the mainstem Portneuf River reflected water quality conditions spanning a continuum of good to very poor. Only three sites ranked in the HBI as having fair to good water quality and these sites were located in the lower watershed below Rapid Creek or within the City of Pocatello municipal boundary (see notes under Table 5).

Using non-metric multidimensional scaling, Hopkins (2007) showed that the benthic macroinvertebrate communities in the Portneuf River were partitioned such that those with > 50% NZMS abundance clustered in ordination space separately from those with that fell below the 50% threshold. Communities with < 50 NZMS abundance showed additional separation based on the abundance of *Simulium* (e.g. Fall samples from Portneuf River below Fish Creek confluence and above Lava Hot Springs and Portneuf River at Kraft Road) or Tubificidae (e.g. Portneuf River below Chesterfield Reservoir; see Figure 6).

NZMS were positively correlated with macrophyte abundance and negatively correlated with flow velocity and the abundance of rocky substrate. When present, NZMS was disproportionately represented relative to other taxa in the macroinvertebrate assemblage.

Thus biological (e.g. macrophytes) and physicochemical (e.g. flow velocity and specific conductivity) factors that influence the presence and absence of NZMS, explained most of the variation in the macroinvertebrate assemblages across reaches. When NZMS was removed from the analysis, the macroinvertebrate community structure was more strongly associated with the concentration of nitrate and total phosphorus (Hopkins 2007).

Hopkins recent biological assessment was able to describe longitudinal and seasonal changes in macroinvertebrate assemblages in the Portneuf River and identify biological and physical factors that influence the structure of macroinvertebrates throughout the mainstem Portneuf River. The technique used was also standardized among sites and years (1969 and 2004), however the substrate in the baskets used to collect samples was not reflective of the substrate present at all sites. In fact, in some reaches the basalt baskets used may have represented the only cobble-sized substrate in the reach. Consequently, organisms collected from this effort do not represent the expected benthic assemblage, but rather the potential assemblage, given a substrate composed of cobble-sized (5 to 8 cm) basalt.

Several key findings about the ecological condition of the Portneuf River emerged from Hopkins' work and are summarized here. Present day land use did not explain longitudinal variations in the macroinvertebrate assemblages in the Portneuf River. Instead, site specific habitat measures were better predictors of the macroinvertebrate assemblage and these measures may be useful in predicting macroinvertebrate assemblages elsewhere in the Portneuf River. Several macroinvertebrate community (e.g. diversity) and foodweb (number of predatory invertebrates) metrics indicate the Portneuf River below Rapid Creek supports an assemblage characteristic of good ecological condition. In contrast, degradation of ecological condition is most pronounced in the Portneuf River at Siphon Road; the invertebrate assemblage at Siphon Road was composed largely of taxa tolerant to low dissolved oxygen, mud and/or fine substrates, and high organic loading. At some sites, including the Portneuf River below Rapid Creek and below the Edson Fichter Nature Area, abundance, diversity, and richness measures were greater in 2004 than in 1969, suggesting that the ecological condition in select reaches of the Portneuf River have improved since the original study (Hopkins 2007).

Table 4. Mean (n=3) number of macroinvertebrates per substrate basket collected in the Portneuf River during 2004. Taxa are listed in order of decreasing abundance. Values are based on Fall collections unless otherwise noted: W = Winter, P = Spring, S = Summer. From Hopkins (2007). Used with author's permission.

		Site Number									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
(a) Present at most sites											
Mollusca	*Potamopyrgus antipodarum*	2	3712	78	8586	9270	40	170	6	5095	5318
Diptera	Chironomidae	1831	15	1472	8	351	529	178	40	16	12
Odonata	*Coenagrion/Enallagma*	195	231 w	83 s	4	2 w	2	9 p	9 p	11 s	2
Diptera	*Simulium*	12	8	6434	3	1033	462	290	359	47	-
Amphipoda	Ostracoda	3 w	-	1236 s	308 p	16	-	-	8 p	1	1 p
Mollusca	*Fluminicola*	-	9 w	-	-	39	4	346	3	1089	5 s
Oligocheata	Tubificidae	366 p	-	686 s	596 s	87	227	88	16	64	202
Mollusca	*Physa ampullacea*	573	6	88 w	-	5 w	12	24	3 s	12	5
Annelida	*Limnodrilus hoffmeisteri*	-	-	372 s	5	3 s	3	1	39 p	4	186 p
Ephemeroptera	*Tricorythodes minutus*	72	-	-	-	1	358	20	6	1	1
Mollusca	Sphaeriidae	12 w	-	4	355 p	10 w	7	12 p	1	21	2
Diptera	Ceratopogonidae	344	5 p	15 w	-	-	<1 s	26 p	22 s	9 p	-
Amphipoda	*Hyalella azteca*	335	107	269 w	-	66	37	-	-	5 s	48
Annelida	*Nais variabilis*	-	-	7	13 p	190 p	26	9	280 p	1 w	-
Aracnida	Acari	5 s	34 w	42 p	41 p	3	205	3	3	4	-
Ephemeroptera	*Baetis tricaudatus*	-	8 w	201	5	109	145	22	8	1	-
Annelida	Turbellaria	1	7 w	8	136	183	-	1	1	33	5
Coleoptera	*Microcylloepus*	2	-	13 w	8 w	3	30 p	124 s	148 s	62 p	-
Trichoptera	*Hydroptila*	-	34	21 p	136 p	12 s	55	-	-	-	-
Annelida	*Ophidonais serpentina*	-	-	-	13 p	29	1	6	85 p	9	11
	Nematoda	2	-	18	13 p	85 w	3	13	13 w	9 w	-
Coleoptera	*Dubiraphia*	-	-	31 w	-	1 w	40	5	28 p	74 p	1 p
Diptera	*Bezzia/Palpomyia*	52	-	17	2	-	5 p	7 p	5 p	-	-
Trichoptera	*Nectopsyche*	1 s	-	-	40 p	-	16	10	5 s	1	-
Coleoptera	*Optioservus quadrimaculatus*	-	10 w	-	5	13 p	39 s	20 s	-	13 s	3 p
Odonata	*Argia*	-	-	-	21 p	9 s	2 s	27 s	1 p	11 s	-
Coleoptera	*Haliplus (adult & larva)*	4	-	2 p	-	21 s	<1 s	-	-	1 p	1 p
(b) Widely distributed but present at 4 or fewer sites											
Trichoptera	*Helicopsyche borealis*	-	896	-	47	5 p	-	18	-	-	-
Trichoptera	*Lepidostoma*	-	89	-	-	2 w	-	-	-	-	2
Diptera	*Tipula*	4 w	-	17 w	-	72	5	-	-	-	-
Ephemeroptera	*Ephemerella inermis*	-	43 w	-	-	-	-	7 p	5 w	-	-
Annelida	*Nais barbata*	-	-	-	-	20 p	37	-	-	-	4 p
Annelida	*Enchytraeidae*	-	-	-	-	32	-	-	18 w	2 w	-
Diptera	*Dasyhelea*	31 w	-	-	-	-	1	-	-	-	-
Mollusca	*Pisidium*	4 p	-	-	-	-	-	30	-	48	4 p
Mollusca	*Planorbella*	5 p	-	16 w	-	-	-	28	-	-	-
Mollusca	*Gyraulus vermicularis*	24 p	33 w	-	-	11	1	-	-	-	-
Trichoptera	*Brachycentrus*	-	19 p	-	-	-	4	-	1 p	-	-
Annelida	Lumbriculidae	-	-	7 s	2	-	5	-	-	-	-
Ephemeroptera	*Baetis*	2	5	-	-	-	3 p	-	1 p	-	-

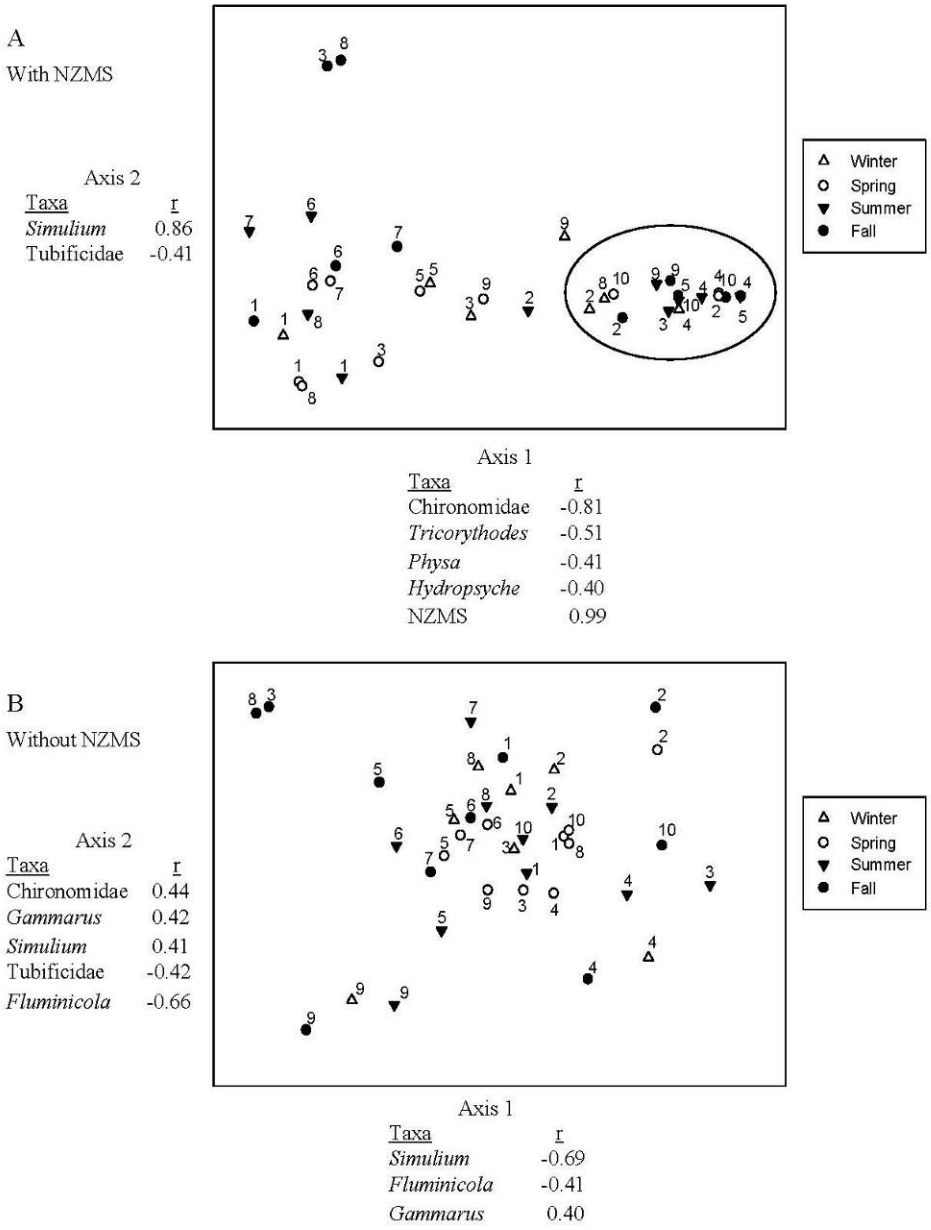
Table 4 continued. Mean (n=3) number of macroinvertebrates per substrate basket collected in the Portneuf River during 2004. Taxa are listed in order of decreasing abundance. Values are based on Fall collections unless otherwise noted: W = Winter, P = Spring, S = Summer. From Hopkins (2007). Used with author's permission.

		Site Number									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
(c) Restricted to upper reaches											
Amphipoda	*Gammarus lacustris*	257	935	-	-	-	-	-	-	-	-
Trichoptera	*Hesperophylax*	-	165	-	-	-	-	-	-	-	-
Branchiopoda	Cladocera	121 p	-	-	-	-	-	-	-	-	-
Ephemeroptera	*Caenis simulans*	25	-	-	-	-	-	-	-	-	-
Trichoptera	*Limnephilus*	1 w	-	-	-	-	-	-	-	-	-
Coleoptera	*Peltodytes*	4 w	-	-	-	-	-	-	-	-	-
Diptera	*Trichoclinocera*	5 w	-	-	-	-	-	-	-	-	-
Diptera	*Culicoides*	1 w	-	-	-	-	-	-	-	-	-
Mollusca	*Lymnaea palustris*	11 w	-	-	-	-	-	-	-	-	-
Mollusca	*Musculium*	2 p	-	-	-	-	-	-	-	-	-
Ephemeroptera	*Diphetor hageni*	-	1 w	-	-	-	-	-	-	-	-
Coleoptera	*Nebrioporus*	-	-	<1 w	-	-	-	-	-	-	-
Diptera	*Caloparyphus*	-	-	-	-	1	-	-	-	-	-
(d) Restricted to mid-reaches											
Trichoptera	*Hydropsyche*	-	-	12	-	8	108	36	5	-	-
Trichoptera	*Cheumatopsyche*	-	-	-	-	-	76	9 s	-	-	-
Diptera	*Hemerodromia*	-	-	<1 w	-	-	8	1	38 s	-	-
Annelida	*Nais elinguis*	-	-	-	-	16 w	-	-	-	-	-
Annelida	*Aulodrilus pluriseta*	-	-	-	-	-	-	5 s	47 p	1	-
Ephemeroptera	*Plauditus*	-	-	-	-	-	-	40 s	-	-	-
Mollusca	*Ferrissia*	-	-	-	-	-	30	-	48	-	-
Trichoptera	*Oecetis avara*	-	-	-	-	-	25	5 s	-	-	-
Trichoptera	*Protoptila*	-	-	-	-	-	8	<1	1	-	-
Annelida	*Nais pardalis*	-	-	-	-	-	12	-	5 w	-	-
Lepidoptera	*Petrophila*	-	-	-	-	-	3 s	10 s	-	-	-
Trichoptera	*Ochrotrichia*	-	-	-	-	4 p	1 s	-	-	-	-
Coleoptera	*Brychius*	-	-	-	-	4	-	<1	-	1 w	-
Plecoptera	Perlodidae	-	-	-	-	-	3 p	-	-	-	-
Trichoptera	*Oxyethira*	-	-	-	2 w	1 w	-	-	-	-	-
Odonata	*Ophiogomphus*	-	-	-	-	-	-	2 s	1 s	-	-
Ephemeroptera	*Drunella grandis*	-	-	-	-	-	-	2 s	-	-	-
Ephemeroptera	*Stenonema terminatum*	-	-	-	-	-	-	2 s	-	-	-
Trichoptera	Leptoceridae	-	-	-	-	2 p	-	-	-	-	-
Annelida	*Eclipidrilus*	-	-	-	-	2 p	-	-	-	-	-
Annelida	*Nais behningi*	-	-	-	-	-	-	-	1	-	-
Coleoptera	*Helichus*	-	-	-	-	-	-	1 p	-	-	-
Diptera	*Chelifera*	-	-	-	-	-	1	-	-	-	-
Diptera	*Neoplasta*	-	-	-	-	-	-	-	1 w	-	-
Annelida	*Dero*	-	-	-	-	-	-	-	<1	-	-
Plecoptera	*Hesperoperla pacifica*	-	-	-	-	-	1	-	-	-	-

Table 4 continued. Mean (n=3) number of macroinvertebrates per substrate basket collected in the Portneuf River during 2004. Taxa are listed in order of decreasing abundance. Values are based on Fall collections unless otherwise noted: W = Winter, P = Spring, S = Summer. From Hopkins (2007). Used with author's permission.

		Site Number									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
(e) Restricted to lower reaches											
Isopoda	*Caecidotea*	-	-	-	-	-	-	-	-	-	50
Annelida	*Quistradrilus multisetosus*	-	-	-	-	-	-	-	-	-	37 p
Annelida	*Rhyacodrilus*	-	-	-	-	-	-	-	13 p	-	-
Annelida	*Theromyzon*	-	-	-	-	-	-	-	-	-	1 p
Annelida	*Vejdovskyella*	-	-	-	-	-	-	-	1 p	-	-
Trichoptera	*Amiocentrus aspilus*	-	-	-	-	-	-	-	1 w	-	13
Coleoptera	*Agabus*	-	-	-	-	-	-	-	-	-	1 p
Diptera	*Pericoma/Telmatoscopus*	-	-	-	-	-	-	-	-	1 w	-
Hemiptera	*Hesperocorixa*	-	-	-	-	-	-	-	-	1 p	-
(f) Absent from mid-reaches, but present in upper and lower reaches											
Annelida	*Helobdella*	-	12	111 w	5 s	-	-	-	-	1 p	21
Amphipoda	Copepoda	102	-	-	4	-	-	-	-	-	4
Annelida	*Glossiphonia*	-	13 w	-	-	-	-	-	-	-	2
Odonata	*Aeshna*	8 s	-	-	-	-	-	-	1 p	3 p	-
Annelida	*Erpobdella*	-	2	-	-	-	-	-	1 p	4 s	9 p
Diptera	*Probezzia*	-	-	1 p	-	-	-	-	14 p	3 p	-
Coleoptera	*Stictotarsus*	<1 s	-	-	-	-	-	-	-	< 1 p	-

Figure 6. NMDS ordination of 2004 sampling sites partitioned in ordination space by the relative abundance of macroinvertebrate taxa from each site. Portneuf River site locations and codes (used in NMDS ordination) are downstream of Chesterfield Reservoir (1), upstream of the confluence with Pebble Creek (2), downstream of confluence with Fish Creek (3), above confluence with Dempsey Creek (4), downstream of McCammon (5), below Rapid Creek confluence (6), near EFNA (7), at Kraft Road (8), above Batiste Road (9), at Siphon Road (10). From Hopkins 2007. Used with author's permission.



2.4.b Idaho Department of Environmental Quality Assessment

In 2005, the DEQ sampled macroinvertebrates at nine locations in the mainstem Portneuf River (Table 5). These sites spanned approximately 44 river miles from Mike's Place Sportsman's Access above Lava Hot Springs to a reach just below the City of Pocatello's Wastewater Treatment Plant. The River Macroinvertebrate Index (RMI), a multimetric index designed for the bioassessment of rivers in Idaho, was used to summarize the biological condition of macroinvertebrate communities from each study reach (Royer and Mebane 2002). RMI scores represent a combination of the following metrics: taxa richness, EPT, percent Elimidae, percent predators and percent dominant taxa. Statewide, macroinvertebrate sampling protocols for the RMI require that macroinvertebrate collection for RMI analysis take place in riffle habitats.

Raw RMI scores ranged from 9 to 21 (39 to 91% of maximum possible RMI points). The highest scores for the Portneuf River included reaches near the Lower Sportsman's Access above Lava H. S. (19), Crane Creek Sportsman's Access (19), downstream of Marsh Creek (21), and at Cheyenne Crossing (19) just upstream of the City of Pocatello. Sites with the lowest RMI scores included the Portneuf River in McCammon and downstream of the City of Pocatello wastewater treatment plant. Taxa richness was greatest at the Portneuf River downstream of Marsh Creek and Cheyenne Crossing. EPT taxa at all sites did not exceed the 25th percentile value for the large rivers in Idaho used to develop the RMI (Royer and Mebane 2002). The percentage of macroinvertebrate predators was greatest from the McCammon reach to Cheyenne Crossing. The percentage of Elmidae were high at all but two sites (downstream of Lava H. S. and McCammon).

Although not included in the RMI, the HBI (described in section 2.5a) was used in the watershed-scale survey of the mainstem completed by Hopkins (2007) and therefore represents an approach to compare both studies. In the 2005 survey completed by the DEQ, HBI scores ranged from 6.75 at the Lower Portneuf Sportsman's Access to 8.71 downstream of the Lava Hot Springs wastewater treatment facility; this range of scores indicates conditions of fairly poor to poor water quality (Table 5). The HBI classified macroinvertebrate assemblages from four reaches (Mike's Place Sportsman's Access, Crane Creek Sportsman's Access, Cheyenne Crossing, and Kraft Road) as reflective of relatively poor water quality. Of the remaining reaches, HBI scores reflected poor water quality and these condition ratings are consistent with condition ratings generated from the 2004 sampling by Hopkins (2007). The HBI scores for the reach of the Portneuf River below Lava Hot Springs wastewater treatment plant were indicative of very poor water quality and severe organic pollution.

This standardized DEQ collection from riffles/runs allows for the direct comparison of reaches, segments, and rivers in Idaho, but it also introduces a possible source of error into the interpretation of ecological condition using macroinvertebrate assemblage information. In some river reaches, including the vast majority of the Portneuf River, riffles represent a very small fraction of the total available habitat. In these reaches, sampling from riffles may not represent the true condition of the greater river segment and instead indicate a refuge for riffle specialists (e.g. Elmidae) that are included in the RMI score.

The macroinvertebrate surveys completed in 2004 and 2005 provide useful measures of the biotic condition of Portneuf River reaches that extend from below Chesterfield Reservoir to the Portneuf River at Siphon Road. The approach used for the collection of benthic macroinvertebrates differed by year and these differences should be considered in the interpretation of the findings. In particular, the 2004 survey may represent the potential macroinvertebrate community at each site because cobble-sized substrates were introduced as a method of collecting benthic macroinvertebrates, regardless of the dominant substrate present at each site. Alternatively, the 2005 survey sampled assemblages in riffle/run habitats following DEQ's protocols for large river sampling (Royer and Mebane 2002). HBI scores used to characterized conditions in 2004 and 2005 are relatively good predictors of biotic condition. Although, the index was originally developed to examine the inputs of organic loading and its subsequent effects on dissolved oxygen, the HBI is now recognized for its ability to categorize effects from a suite of pollutants (Hilsenhoff 1998). The 2004 survey indicates that independent of season, biotic conditions are relatively good in the mainstem Portneuf River below Rapid Creek, and poor downstream of the City of Lava's wastewater treatment plant, above Batiste Road and downstream of Siphon Road. HBI scores at other sites varied seasonally but on average suggested fair to poor water quality. The RMI is used by the DEQ to discriminate reference and impaired streams in Idaho (Royer et al. 2001; Royer and Mebane 2002). In the Portneuf River, reaches alternated between macroinvertebrate scores reflecting good or poor water quality. River sites with higher RMI scores and categorized as good biotic condition included the Portneuf River at Lower Sportsman's Access, Crane Creek Sportsman's Access, downstream of the Marsh Creek confluence, and near Edson Fichter Nature Area. Sites with RMI scores indicating a poor biotic condition included the Portneuf River at Mike's Place Sportsman's Access, downstream of Lava Hot Springs wastewater treatment plant, near McCammon, at Kraft Road and downstream of the City of Pocatello's wastewater treatment plant.

Although RMI scores provide some indication of cold water aquatic life use, the DEQ does not base decisions on the support status of water body or assessment unit with only a single metric. At least two different metrics (e.g. RMI and RFI) are necessary to fully assess support status. That said, the evaluation criteria also states that any index that indicates conditions below the minimum threshold also shows that the cold water aquatic life use is not supported. The purpose of the minimum threshold is to identify significant impairment from one or more index that may not be apparent after the integration of multiple indices. Additional habitat or biological monitoring is recommended to fully evaluate the support status of all Portneuf River sites, but especially those (i.e. downstream of the Lava Hot Springs wastewater treatment plant, near McCammon, and below the Pocatello wastewater treatment plant) with RMI scores suggesting cold water aquatic life conditions are below the minimum evaluation threshold (Table 5).

Table 5. Macroinvertebrate metrics and index scores for nine sites in the Portneuf River. Samples were collected in 2005 by DEQ Pocatello Regional Office staff.

Site	RMI	Raw RMI score	Taxa Richness Score	EPT Score	Percent Elmidae Score	Percent Dominant Taxa Score	Predator Score		HBI Score
Mike's Place Sportsman's Access	1	13	3	1	3	5	1		6.75
Lower Sportsman's Access	3	19	5	3	5	5	1		7.86
Downstream of Lava H. S. WWTP	min thresh	5	1	1	1	1	1		8.71
McCammon	min thresh	9	1	1	3	1	3		8.09
Crane Creek Sportsman's Access	3	19	3	3	5	5	3		7.04
Downstream of Marsh Creek confluence	3	21	5	3	5	5	3		7.51
Cheyenne Crossing (above Pocatello)	3	19	3	3	5	5	3		7.41
Kraft Road (below Pocatello)	1	13	1	1	5	5	1		7.32
Downstream of Pocatello WWTP	min thresh	9	1	1	5	1	1		8.19

RMI scores receive categorical condition scores of 3, 2, 1, or minimum threshold (Min. Thresh). A condition score of 3 (Raw RMI > 16) indicates a good biotic condition. A condition score of 2 (Raw RMI 14 to 16) indicate intermediate biotic conditions, 1 (Raw RMI 11 to 13) indicates poor biotic condition, and the minimum of reference condition is identified as a minimum threshold. The purpose of a minimum threshold is to identify significant impairment that may not be apparent after data index integration (Grafe et al. 2002). The HBI scale ranges from 0 to 10 and provides an index of water quality and the extent of organic pollution. HBIs from 0 to 3.5 indicate excellent water quality with no apparent organic pollution, 3.5 to 4.5 reflect good water quality and possible slight organic pollution, 4.5 to 5.5 reflect good water quality and some organic pollution, 5.5 to 6.5 reflect fair water quality and fairly significant organic pollution, 6.5 to 7.5 reflect fairly poor water quality and significant organic pollution, 7.5 to 8.5 reflect poor water quality and very significant organic pollution, and 8.5 to 10 reflect very poor water quality and severe organic pollution (Hilsenhoff 1987).

2.4.c Environmental Monitoring and Assessment Program-West

The Portneuf River was one of 1,340 wadeable perennial waters included in a U.S. EPA's EMAP –West pilot project. This ecological assessment program was the largest monitoring and assessment effort conducted to date and was designed to evaluate the ecological condition of wadeable Western perennial lotic systems. The results from the state-wide assessment of Idaho waters included macroinvertebrate summaries from two sites on the mainstem Portneuf River (Kosterman et al. 2008). The EMAP-West project summarized macroinvertebrates in Idaho using several common metrics, as well as, the DEQ's RMI and a project specific metric (Macroinvertebrate Multi-metric Index; Stoddard et al. 2005).

In Idaho, DEQ's RMI was generally good at predicting impairment status for sites used in the development of the index; however, predictions were less useful for explanatory purposes when sites outside that dataset were included (Kosterman et al. 2008). In fact, of all of sites sampled in Idaho, 75% had RMI scores that rated the macroinvertebrate assemblages as having good biotic conditions. As a result, EPT taxa richness along with the percentage of Plecoptera and non-insect individuals were used for development of the Macroinvertebrate Multi-metric Index (MMI) used for EMAP; this index was found to be better at differentiating between high, moderate and least impacted sites. Using the MMI, the biotic condition ratings for waters in Idaho resulted in 37% (1,479 miles) of surveyed waters receiving Good condition ranking, 52% (2,092 miles) receiving Fair condition rankings, and 11% (463 miles) receiving Poor condition ratings (Kosterman et al. 2008).

The two mainstem Portneuf River sites included in the EMAP monitoring effort were upstream of the City of Pocatello (IDW02353-070; USGS Pocatello South Quadrangle) and downstream of the City of Lava Hot Springs (IDW02353-130; USGS Lava Hot Springs Quadrangle).

Macroinvertebrates downstream of Lava Hot Springs, had a total RMI score of 19 indicating a good biotic condition under DEQ's biotic condition criteria (Grafe et al. 2002). Elements of this score included total and EPT richness (43 and 6), percentage of sample represented by individuals of the dominant taxon (28.5%), predators, (3.1%), and riffle beetles (Family Elmidae; 7.7%). In contrast to the RMI, MMI indicated the Portneuf River below Lava Hot Springs as being in Fair biotic condition (MMI = 9). Despite the lack of agreement between the RMI and MMI, when the macroinvertebrate summary was integrated with other physicochemical habitat measures (pH, conductance, TN, TP, riparian disturbance and total number of pools), the overall EMAP impairment status was High (Kosterman et al. 2008).

In the reach sampled above the City of Pocatello, total macroinvertebrate richness was 40 and EPT richness was nine. The percentage of the sample represented by the dominant taxon, predators, and the Family Elmidae was 14.4%, 4.7%, and 4.1%, respectively. Combined, the components described along with others used to produce the RMI revealed a good condition rating (RMI=19; See Table 5). Despite this score, the MMI and EMAP status for this site were listed as Fair biotic condition and High impairment.

The RMI score for below Lava Hot Springs generated during the EMAP sampling contrasts with RMI scores from below the Lava Hot Springs wastewater treatment plant collected by DEQ in 2005 (RMI = 9). Above the City of Pocatello, the RMI sample score was consistent with an RMI score (19) for a reach located above Cheyenne Crossing that was collected by DEQ in 2005. Taken together, results from these independent sampling efforts indicates that the macroinvertebrate assemblage above the City of Pocatello is in relatively good biotic condition (e.g. RMI=19), but that local inputs from the Lava Hot Springs wastewater treatment plant and/or natural geothermal discharges that enter the river through Lava Hot Springs may influence macroinvertebrate assemblages downstream of the wastewater lagoon outlet. Since discharge from this municipality is intermittent, influences on downstream biota may likely influenced both by the timing and proximity of sampling to the recent discharge from the outfall.

2.5 Fish

Fish are considered good bioindicators because their study offers a unique perspective on the suite of abiotic and biotic variables representing different spatial and temporal scales that are directly linked to the habitat requirements of particular species (e.g. salmonids) and their ontogenetic stages (Jungwirth et al. 2000). Further, fish assemblages are widely used to evaluate the ecological integrity of waters because they are a required part of water body assessments under the CWA (Zaroban et al. 1999). The CWA requires that states adopt water quality standards which protect the fishability and swimmability of waters and ensure their use for public, municipal, and industrial water supplies[5]. The specific designated uses for the Portneuf River that relate to its fishery include cold water aquatic life and salmonid spawning (DEQ 2001).

The discussion of the Portneuf River fishery follows and is separated in two sections. The first section generally characterizes the fishery in the context of other subbasins in the Upper Snake River Basin, using annual Idaho Department of Fish and Game (IDFG) assessments. The second section uses available reach specific summaries collected as part of focused monitoring efforts in the mainstem Portneuf River and Marsh Creek. DEQ has monitoring protocols and an Index of Biological Integrity which was developed to assess large rivers of Idaho using fish survey data (Mebane et al. 2003). This index is composed of ten metrics which include the number of native cold water taxa, number of sculpin (*Cottus* spp.) age-classes, percentage of sensitive native individuals, percentage of cold water individuals, percentage of tolerant individuals, number of alien species, percentage of common carp (*Cyprinus carpio*) individuals, number of selected salmonid age-classes, catch per unit effort of cold water individuals, and percentage of individuals with selected anomalies. Although some of the component metrics of the IBI can be generated from the available fish datasets and from the species attributes provided in Zaroban et al.'s (1999) classification of Northwest fish species, several of the component metrics (e.g. percentage of individuals with anomalies) can not. Therefore only specific metrics (i.e.

[5]USC Title 33 Ch. 26, Subchapter III, § 1313(c)(2)(a) "*standards shall be established taking into consideration their use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes, and also taking into consideration their use and value for navigation"*.

number of native cold water species, number of sculpins, the number of alien species, and percentage of common carp; see Table 9) are included in the summary that follows.

2.5.a Annual assessments of native salmonids in the Upper Snake River Basin

In 2002, the IDFG sampled 63 sites in the Portneuf River Subbasin. Forty-six sites (73% of sampled reaches) contained salmonids and 41 contained Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*;YCT). Other major tributaries to the Upper Snake River Basin supported lower (e.g. Sinks Drainage and Henry's Fork of the Snake River) or similar (Teton River, Willow Creek, Blackfoot River, Raft River, and Goose Creek) percentages of streams with salmonids compared to the Portneuf River Subbasin (Table 6). Habitat assessments conducted concurrently with fish sampling in the Portneuf River Subbasin determined that YCT inhabit wider, higher-order reaches at lower elevations with a predominance of cobble/boulder substrate and vertical vegetative structures. Combined, these habitat features explained 63% of the variation observed in the presence or absence of YCT. A suite of habitat variables were also correlated with the variation in YCT biomass observed in the Portneuf River Subbasin, however, increases in fine substrate and stream gradient alone explained most of the variation in biomass (57%). Meyer and Lamansky (2003) noted that several streams in the Portneuf River Subbasin (e.g. Goodenough, Bell Marsh, Walker, Robbers Roost, and Harness creeks) are isolated from the mainstem river but contain populations of YCT, while connected streams like Rapid, Pebble, and Toponce creeks (and some of their tributaries) contain nonnative salmonids. The authors suggest that measures to conserve YCT should consider how tributary and mainstem connectedness relates to the presence or absence of nonnative salmonids.

Table 6. Percentage of Upper Snake River Subbasin sites with salmonids and native Yellowstone Cutthroat Trout in 2002

Subbasin	**% sites with salmonids**	**% sites with YCT**
Sinks Drainage	20%[1]	20%
Henry's Fork of the Snake R	23%	17%
Teton River	NR[2]	41%[2]
S. Fork of Snake River	NR	91%
Willow Creek	69%	63%
Blackfoot River	71%	64%
Portneuf River	**73%**	**65%**
Raft River	88%	61%
Goose Creek	77%	47%

NR = Not Reported
1 Fourteen of the 50 sites sampled were reported to be fishless.
2 In the Teton River only 59% (38 sites) had perennial streamflow. Salmonid and YCT presence in perennial sites was 75% and 68%.

Estimates from 2003 sampling conducted by the IDFG indicate a total of approximately 4.2 million trout occupy waters of the Upper Snake River Basin (Table 7). Approximately one half of all trout sampled were ≥ 100 mm in total length. In addition, half of estimated trout in the Upper Snake River Basin are YCT (2.2 million) indicating that YCT are the most abundant and widely distributed trout species (Meyer and

Lamansky 2004). The Portneuf River supports an estimated 322,322 trout and approximately 7.6% of the trout in the Upper Snake River Basin; nearly two thirds of the trout in the Portneuf River Subbasin are ≥ 100 mm in total length and this cohort represented 9% of the total Upper Snake River Basin cohort.

Table 7. Percentage of Upper Snake River Basin sites with salmonids and native Yellowstone Cutthroat Trout in 2003

Subbasin (No. of sample sites per subbasin)	**% sites with salmonids**	**% sites with YCT**	**total trout abundance estimate < 100 mm**	**total trout abundance estimate > 100 mm**
Sinks Drainage (69)	51%	15%	159,076	77,698
Henry's Fork of the Snake River (119)	73%	29%	NA	NA
Teton River (95)	62%	47%	302,495	426,286
Palisades/Salt River (163)	92%	91%	365,004	225,179
S. Fork of Snake River (78)	60%	59%	425,561	145,142
Willow Creek (58)	40%	36%	65,069	55,389
Blackfoot River (82)	60%	55%	133,383	432,002
Portneuf River (83)	**61%**	**57%**	**201,830**	**120,492**
Bannock Creek (7)	43%	43%	NA	NA
Rock Creek (15)	0%	0%	NA	NA
Raft River (95)	56%	37%	320,184	364,319
Goose Creek (80)	46%	25%	154,702	166,629
Dry Creek (7)	43%	43%	8,770	3,425
Marsh Creek (10)	80%	0%	30,412	31,284

Data from Meyer and Lamansky 2004. NA = Not Available

From sampling conducted in 2006, the IDFG estimated there were approximately 6 million mountain whitefish (*Prosopium williamsoni*) in the Upper Snake River Basin. Despite the abundance of this native salmonid, the distribution of mountain whitefish was restricted to 5% of Basin and, more notably, the species was absent in 9 of the 20 major river drainages, including the Portneuf River (Meyer et al. 2007) where it was once present (Mende 1989). In 1997, mountain whitefish were documented in Marsh Creek (Mende et al. 2000); however, the species was not seen in a 2007 sampling of lower

Marsh Creek reach. It is noteworthy that in 2007 this species was represented along with other native salmonids in the lower Portneuf River near Batiste Road (Keeley 2007).

2.5.b Focused assessments in the Portneuf River Subbasin

2.5.b.1 Portneuf River above Lava Hot Springs

The segment of the mainstem Portneuf River upstream of Lava Hot Springs was historically considered a blue ribbon fishery by the IDFG (Mende 1989); the 'blue ribbon' designation indicates that a water body supports high populations of relatively large trout and is a river of national importance (Annear et al. 2002). Results from fish surveys conducted by Mende (1987) are used to provide a more historical view of the fishery in the Portneuf River above Lava Hot Springs. In the spring of 1987, a 10.5-mile segment of the mainstem Portneuf River above Lava Hot Springs was electrofished in eight study segments primarily to characterize reproduction in rainbow trout and YCT (Mende 1989). A total of 2,153 fish were collected and 67% were described as wild rainbow trout. Yellowstone cutthroat trout were the second most abundant trout and represented 24% of the catch while hatchery rainbow trout and rainbow cutthroat hybrids represented 6% and 3% of the catch, respectively (Mende 1989).

In 2000 and 2007, IDFG electrofished the Portneuf River above Lava Hot Springs from the Mike's Place Sportsman's Access to the Cronie Road Sportsman's Access. Hatchery rainbow trout were the most abundant fish identified and represented 37% and 45% of the catch in 2000 and 2007. In, 2000 wild rainbow trout were the second most abundant fish, however, in 2007 YCT had a higher relative abundance. Total trout enumerated as part of these sampling efforts was greater in 2000 than 2007. A summary of the catch during electrofishing efforts in both years is found in Table 8.

Table 8. Idaho Department of Fish and Game summary of salmonids identified in the Portneuf River above Lava Hot Springs (from Mike's Place Sportsman's Access to Cronie Road Sportsman's Access) during 2000 and 2007 electrofishing efforts.

	Year	
Trout Species	**2000**	**2007**
Brown Trout	0	3
Hatchery Rainbow Trout	114	77
Wild Rainbow Trout	75	37
Yellowstone Cutthroat Trout	60	49
Hybrid (YCT and RBT)	61	7
Total	**310**	**173**

Data provided by D. Teuscher.

2.5.b.2 Portneuf River above Marsh Creek

A total of 493 fish were identified in two mainstem Portneuf River reaches above Marsh Creek on 18 September 2007. Approximately 1% of the fish species collected were trout and only brown trout (*Salmo trutta*) were detected in this reach. Average fish biomass (10.7 ± 13.8 g/m^2; mean ± 1 SD) and density (0.7 ± 0.6 fish/m^2; Fig. 7) were strongly influenced by the large abundance of three nongame species: longnose dace (*Rhinichthys cataractae*), speckled dace (*Rhinichthys osculus*), and redside shiner (*Richardsonius*

balteatus). Biomass values were also affected by the presence of Utah suckers (*Catostomus ardens*; mean mass 595 g). Native cold water taxa included Paiute sculpin (*Cottus beldingi*). Sculpins represented nearly 4% of the catch and two species of sculpin were detected: mottled sculpin and Paiute sculpin (*Cottus beldingi*). Cold water individuals represented 4.7% and tolerant individuals represented 6.3% of the catch (Table 9; Keeley 2007).

2.5.b.3 Marsh Creek

The IDFG electrofished three sections of Marsh Creek in September 1997. Of the 527 fish caught as part of this effort, approximately two thirds were Utah suckers. The other species in order of abundance included: redside shiners (17%), Utah chubs (10%) and common carp (*Cyprinus carpio;* 6%). Salmonids represented only 2.5 % of the total catch and included: six brown trout, four YCT, two mountain whitefish and one rainbow trout distributed throughout the sample reaches and isolated near small spring inflows (Mende et al. 2000).

A total of 103 fish were identified in two reaches of Lower Marsh Creek on 25 September 2007. No trout were detected during the sampling effort and the two most abundant species were speckled dace and redside shiner. Only a single sculpin was recovered and common carp were also present but represented only 1.9% of the catch. No native cold water species and no sensitive taxa were documented. Tolerant individuals represented 7.8% of the catch (Table 9). The average fish biomass (1.9 ± 0.9 g/m^2) and density (0.1 ± 0.05 fish/m^2) in this lower Marsh Creek stream segment were lower than observed in the Portneuf River above Marsh Creek (Figure 7; Keeley 2007).

2.5.b.4 Portneuf River at Edson Fichter Nature Area

On 11 September 2007, seventy fish were identified in two reaches of mainstem Portneuf River located within Edson Fichter Nature Area. Two salmonids (rainbow trout and brown trout) were collected along with speckled dace, longnose dace, and redside shiners (combined 87% of catch), Utah suckers, mottled sculpin, and Paiute sculpin. The two most abundant species were speckled dace and redside shiner. Paiute sculpin was the only native cold water species documented. Two alien species were present, but both were trout (brown trout and rainbow trout). The percentage of tolerant taxa was 2.8% of the catch (Table 9). Average fish biomass (2.7 ± 3.6 g/m^2) and density (0.07 ± 0.03 fish/m^2) in the mainstem Portneuf River at the Edson Fichter Nature Area were intermediate among other Portneuf River reaches (Keeley 2007).

2.5.b.5 Portneuf River at Batiste Road

A total of 70 fish were identified during an October 2007 survey of two mainstem lower Portneuf River reaches located near Batiste Road. Approximately 75% of the fish species collected were salmonids, including YCT (19% of total catch), rainbow trout (34%), rainbow/cutthroat hybrids (6%), and mountain white fish (17%). Other fish present included redside shiner, common carp, and Utah chub. Carp represented only 1.4% of the total catch but contrasted with a predominance of cold water taxa (75%; Table 9). Two native cold water species and 18.6% native sensitive species were documented. Average fish biomass (7.1 ± 0.3 g/m^2) and fish density (0.3 ± 0.01 fish/m^2) at Batiste Road was

intermediate among other Portneuf River sites sampled in the Fall of 2007 (Fig. 7; Keeley 2007).

Table 9. Fish metrics for Portneuf River (above Marsh Creek, at Edson Fichter Nature Area, and at Batiste Road) and Marsh Creek sites from 2007. Metrics shown, except for the number of sculpin species, are components of the Index of Biological Integrity (Mebane et al. 2003). Values presented are counts or percentages.

Site	No. of native cold water species	No. of sculpin species	% of sensitive native individuals	% of cold water individuals	% of tolerant individuals	No. of alien species	% carp
Above Marsh Creek	2	2	0	4.7	6.3	1	0
Marsh Cr.	0	1	0	0	7.8	1	1.9
Edson Fichter NA	1	1	0	0	2.8	2	0
Batiste Rd.	2	0	18.6	75.7	2.9	3	1.4

Data provided by E. Keeley.

From a recent estimate of subbasins in the Upper Snake River Basin, 61% of the sites sampled in the Portneuf River Subbasin supported salmonids and 57% of the sites sampled supported YCT. The latter estimate ranked the subbasin among the top subbasins for YCT. The overall salmonid fishery in the Portneuf River supports fewer numbers of total salmonids than subbasins of similar size (Meyer and Lamansky 2004).

Once touted as a blue-ribbon fishery, the Portneuf River above Lava Hot Springs continues to support wild populations of YCT, rainbow, and brown trout. Below the Portneuf Marsh Valley Canal, salmonids represent a smaller component of the fishery, although cool-water fish species predominate. In mainstem reaches sampled upstream of Marsh Creek and above Pocatello, the most abundant fish included Utah suckers, redside shiners, speckled dace, and longnose dace. Salmonids and sculpins were also identified in these reaches but their abundance was low relative to the dominant taxa. From 2007 sampling, the Portneuf River above Marsh Creek had higher fish biomass and fish densities than other mainstem Portneuf River and Marsh Creek reaches. In Marsh Creek, salmonids represented 2.5% of the total catch in a reach sampled in 1997. A lower Marsh Creek reach sampled in 2007 produced no salmonids or cold water taxa and only a single sculpin. Common carp were present in both Marsh Creek reaches sampled in 1997 and 2007 and were among the tolerant species documented at this site. Salmonids represented approximately 75% of the total catch in the lower Portneuf River downstream of Batiste Road. Collectively, these recent surveys indicate that the Portneuf River fishery is dominated by cold and cool water omnivores and invertivores. Salmonids are abundant in some main stem Portneuf River reaches, particularly above Lava Hot Springs and below Batiste Road.

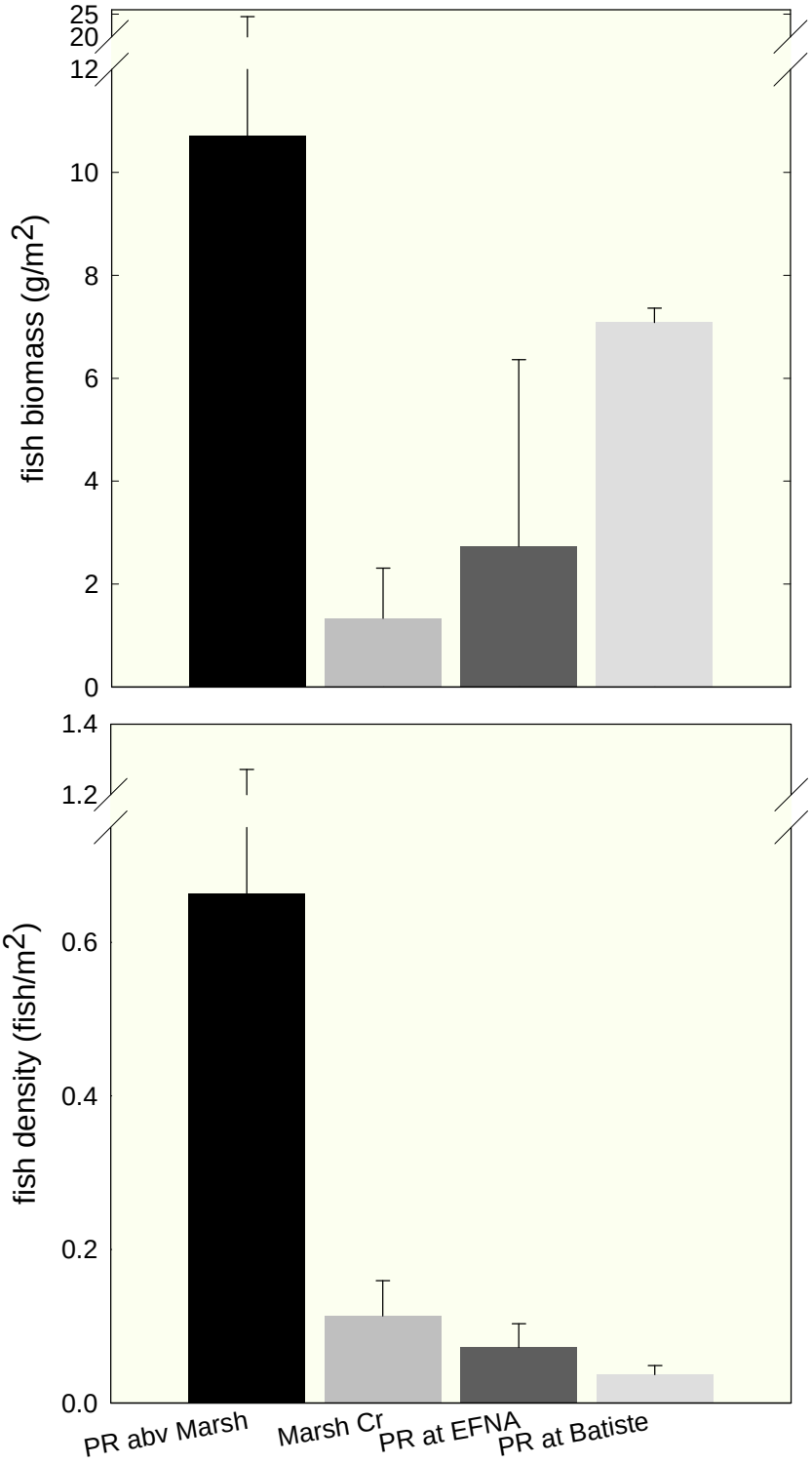


Figure 7. Fish biomass and density from three mainstem Portneuf River and one Marsh Creek reach in 2007. Histogram bars indicate a mean of three samples and error bars represent 1 S.E. Data provided by E. Keeley.

2.6 Biological Processes

While many bioassessment approaches focus on biological organization using community or assemblage measures, indicator species detection, or foodweb structure, several critical assumptions about biological communities are used. First, there is the assumption that temporal and spatial patterns of lotic organisms are relatively static. Secondly, it is assumed that the structure of assemblages reflect the physical and chemical condition of the habitat. The latter assumption overlooks the fact that community assemblages are also structured by ecological interactions such as competition, recruitment, and predation. Finally, these organizational measures neglect examination of features of ecosystem health including measures of ecosystem productivity, as well as, measures of ecosystem resilience to perturbations (Rapport et al. 1998). Bioassessments should therefore include multiple measures of ecosystem health including measures of ecosystem productivity, key processes that select for organisms present, and the response of assemblages to perturbations; combined these measures will better explain the variations in the structure of aquatic assemblages (Bunn and Davies 2000; Fellows et al. 2006). A number of assessments of biological processes are underway in the Portneuf River and these will help characterize the ecological condition of focal reaches. Two of the assessments are summarized here and include: 1). an examination of biofilm metabolism and biomass at seven locations in the Portneuf River and 2). a controlled bioassay used to examine how nutrient variation affects macrophyte and epiphyte production under controlled conditions.

2.6.a Insitu Biofilm Metabolism and Biomass

Marcarelli et al. (2009) recently examined biofilm metabolism and biomass using *insitu* nutrient diffusing substrate bioassays at eleven locations in the Upper Snake River Basin including seven locations in the Portneuf River and its largest tributary Marsh Creek. Portneuf River sites included the Lower Sportsman's Access above Lava Hot Springs (River Mile 59), above Marsh Creek (RM 32), Edson Fichter Nature Area (RM 22), Batiste Road (RM13), and Siphon Road (RM 11). Sampling locations were established to generally represent a gradient of impairment. Together several parameters were used as an index for impairment and included river discharge and extent of water withdrawals, temperature, turbidity, dissolved inorganic nitrogen (DIN) concentration, and ortho-phosphate (ortho-P) concentration.

The bioassay employed nutrient diffusing substrates (NDS) that enrich waters with nitrogen (N), phosphorus (P), or N and P and capture the response of biofilms on an artificial substrate. The responses measured by biofilm biomass (ash free dry mass; AFDM) or photosynthetic pigments (chlorophyll *a* [chl *a*]) provide a method of assessing which nutrient is limiting biofilms at a particular site. Differences in the nutrient limitation of biofilms attached to NDS were detected seasonally in the Portneuf River. In July, chl *a* at Batiste Road and AFDM at Lower Sportsman's Access, above Marsh Creek, Edson Fichter Nature Area, and Batiste Road were stimulated by N or by a combination of N and P. Chlorophyll *a* suppression was also documented and occurred as a consequence of P enrichment; P suppression was documented at Batiste Road in

November, Siphon Road in both July and August and Marsh Creek in July and November.

Generally, Portneuf River sites with a higher index of impairment had greater chl *a* biomass and more autotrophic biofilms (lower autotrophic index [AI]) than less impacted sites; AI is the ratio of AFDM to chl *a* biomass. Across all seasons, Marsh Creek had higher chl *a* biomass than all other Portneuf River sites. It should be noted that the concentrations of chl *a* documented in Marsh Creek were also higher than two sites in the mainstem Snake River and two sites in the Blackfoot River (Fig. 8). In August, the Portneuf River at Siphon Road had similar concentrations of chl *a* to Marsh Creek and more than 2X the concentrations detected at all other Portneuf River sites. Autotrophic indexes were near reciprocals of the chl *a* values; sites with high chl *a* concentrations had the lowest AI (Fig. 8). In addition, Marsh Creek and the Portneuf River at Batiste and Siphon roads had lower Gross Primary Production (GPP) when scaled per unit of chl *a*. This implies that relative to the upper four Portneuf River sites, Marsh Creek and Batiste and Siphon roads sites had lower rates of organic matter production when GPP was corrected for the amount of photosynthetic materials (chl *a*) present. The authors note that both GPP and community respiration in the Portneuf River were mediated by increases in biofilm biomass and not changes in metabolism (i.e. production or respiration; Marcarelli et al. 2009).

The lack of a metabolism response to experimental nutrient enrichment in the Portneuf River is consistent with the hypothesis that in eutrophic stream ecosystems metabolism may become saturated with response to nutrient enrichment (Earl et al. 2006). The lack of response in metabolism may also reflect differences in the algal communities among sites. Recall, Bechtold (*unpublished*) identified different diatom assemblages in the Portneuf River at Upper Sportsman's Access and Siphon Road sites. Others have shown that for similar concentrations of chl *a*, algae and aquatic macrophytes exhibit different photosynthetic rates (Krause-Jensen and Sand-Jensen 1998). Alternatively, these measures of metabolism which were carried out over a series of hours on artificial substrates do not necessarily reflect metabolism of resident biofilms in the stream that take weeks to months to establish (Fellows et al. 2006). Regardless of the potential limitations of surrogates used to estimate metabolism, it is apparent that the characteristics of biofilms grown on NDS in the Portneuf River differ by site. Marsh Creek consistently and Siphon Road in August had higher concentrations of chl *a* indicating a greater autotrophic community per unit area of biofilm. However, this greater potential for photosynthesis was not translated into higher levels of production. Marcarelli et al. (2009) postulated that at high nutrient sites (e.g. Marsh Creek and Portneuf River at Siphon Road), limitation of biofilms by N and P is relaxed and heterotrophs become limited by carbon (C). At this point, autotrophs capable of fixing C out-compete biofilm heterotrophs. To further strengthen their hypothesis, AI tended to increase at less nutrient-impacted sites suggesting that biofilm communities were comparatively more heterotrophic possibly because of nutrient competition amid algae and bacteria or fungi. This hypothesis provides an explanation for the differences documented at nutrient impacted and less-impacted sites and illustrates one manifestation of eutrophication in the Portneuf River.

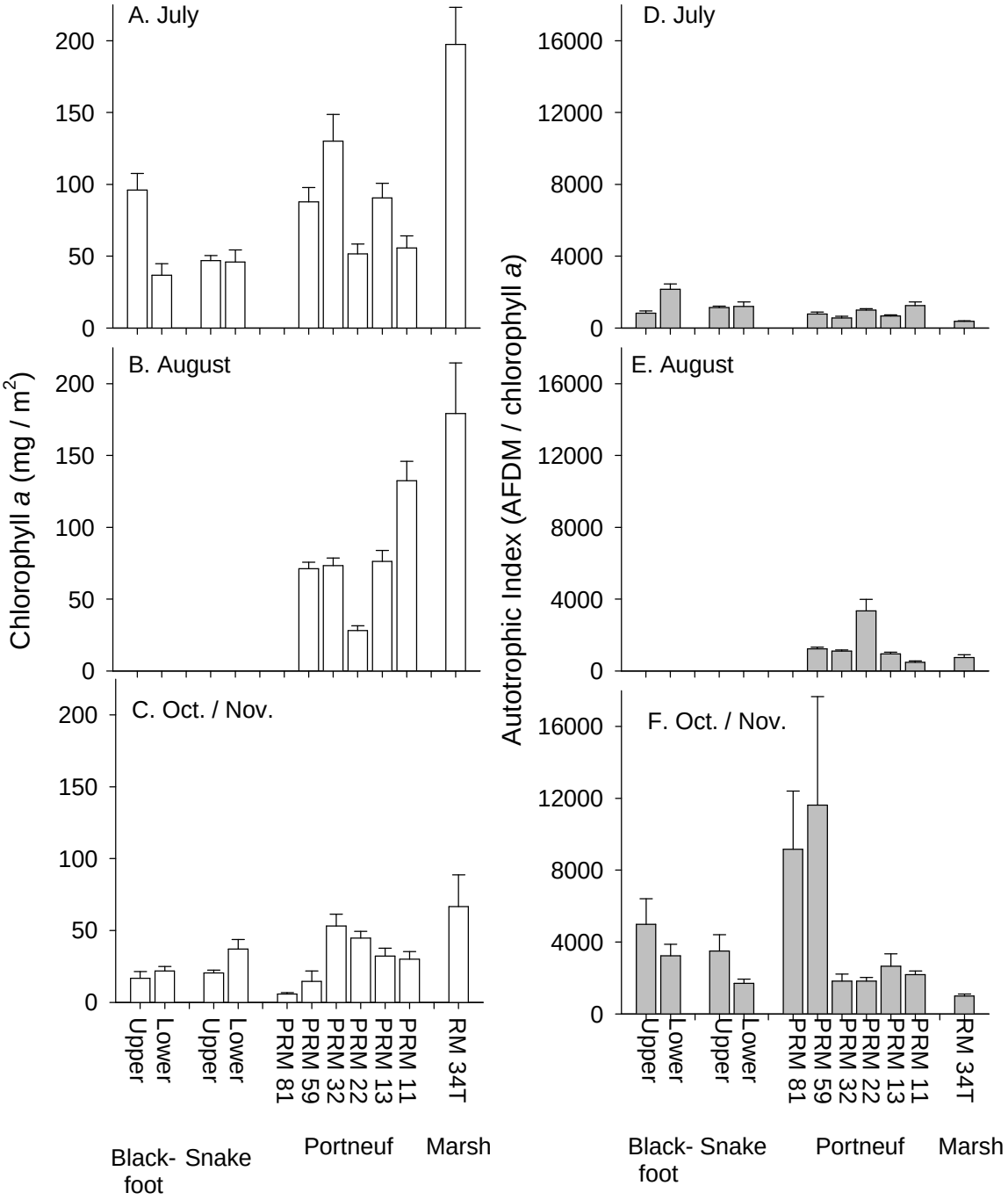


Figure 8. Chlorophyll *a* and autotrophic index summaries for the Blackfoot, Snake, and Portneuf Rivers. Marsh Creek is separated from mainstem Portneuf River sites. From Marcarelli et al. (2009). Used with author's permission.

2.6.b Effects of nutrient enrichment under controlled conditions

A combined macrophyte and epiphyte bioassay was used in 2007 to characterize the effects of a range of bioavailable nutrient concentrations present in different reaches of the mainstem Portneuf River and Marsh Creek. Differences in the suspended sediment concentrations and bacterial loads in each reach were controlled by passing all experimental waters through 0.45-µm filters. After filtering, DIN concentrations ranged from 0.009 mg/L in the control waters to 2.303 mg/L in the Portneuf River at Siphon Road. All ambient waters collected had DIN at or above 0.950 mg/L. Orthophosphate concentrations ranged from 0.002 mg/L in the control water to 0.775 mg/L at Siphon Road. Ambient waters from all other reaches differed little in ortho-P and concentrations; all other reaches were less than 0.022 mg/L. To examine the effects of nutrient conditions on Portneuf River macrophyte and epiphyte production, biomass and total plant counts of wild-harvested *Lemna minor* and biomass and chl *a* concentrations of associated epiphytes were measured after twelve days in a growth chamber.

Waters from Marsh Creek supported more than 1.3 times the dry mass of *L. minor* than all other mainstem Portneuf River sites except Lower Sportsman's access (Fig. 9a). And, although all tanks were originally seeded with 100 *L. minor* plants, waters from Marsh Creek and the Portneuf River at Batiste and Siphon Roads contained more *L. minor* plants than nutrient-poor control waters (Fig. 9b). Regardless of this finding, the total number of plants produced in waters from five locations in the mainstem Portneuf River and Marsh Creek did not differ statistically ($P>0.05$). Combining plant counts and plant biomass, it was determined that waters from Marsh Creek and the Portneuf River Lower Sportsman's access supported *L. minor* plants that had greater individual mass than waters from the Portneuf River at Batiste and Siphon Roads.

Surface waters from the Portneuf River at Siphon Road and Marsh Creek sites produced concentrations of chl *a* that were 2 orders of magnitude greater than all other sites (Fig. 10a). Nutrient rich water from the Portneuf River at Siphon Road supported a biofilm biomass that was 4 to 6 times higher than waters from the Portneuf River at Lower Sportsman's Access, above Marsh Creek, and Batiste Roads and 135 times higher than control waters (Fig. 10b). Similarly, waters from Marsh Creek supported a biofilm biomass that was 2 to 4 times higher than other mainstem Portneuf River sites. Although the response of epiphytes to bioavailable nutrients in waters from the Portneuf River at Siphon Road was not unexpected from the nutrient concentrations measured at the beginning of the experiment, the response to waters from Marsh Creek produced a similar chl *a* and biomass response. Moreover, the biofilms in waters from the Portneuf River Siphon Road and Marsh Creek sites had AI that was 10 to 30 times lower than all other Portneuf River reaches. The lower AI at these sites indicates that biofilms were more autotrophic in Marsh Creek and Siphon Road treatments than biofilms growing in waters from other Portneuf River reaches. This finding is consistent with the *insitu* bioassays conducted by Marcarelli et al. (2009).

It is interesting to note that the DIN concentrations at Marsh Creek are elevated relative to reference conditions in the watershed, but still lower than the Portneuf River at the Lower Sportsman's Access. Despite higher concentrations of DIN, the epiphyte response

to waters from the Lower Sportsman's Access were not statistically different from the biofilms in control waters (Fig. 10a and b). The epiphyte response might therefore be attributed to the concentration of ortho-P at Marsh Creek (0.022 mg/L) which ranked second highest behind Siphon Road but only 5 µg/L higher than waters from other reaches. A similar assay conducted with ambient and enriched waters from Stalker Creek, a tributary to Silver Creek in Central Idaho, showed that chl *a* and AFDM increased approximately 26X and 4X, respectively, when ambient waters were enriched from 15 to 40 µg/L P; subsequent enrichments induced additional but minor increases in both epiphyte measures (Mebane *unpublished*). Correll (1998) stated that concentrations of 20 µg/L P can create productivity problems in lakes, streams, and reservoirs. Whether the response at Marsh Creek was related to the absolute concentration of P, the ratio of N to P, or some other factor, is not known, but does suggest that nutrient concentrations at Marsh Creek and the Portneuf River at Siphon Road stimulate epiphyte production under controlled settings.

The *insitu* and controlled bioassays discussed here suggest that biofilm biomass in the Portneuf River watershed are greatest at Marsh Creek and the Portneuf River at Siphon Road. In addition, biofilms in these waters have lower AIs indicating there is a greater percentage of autotrophs in water from Marsh Creek and the Portneuf River at Siphon Road reaches. This dataset generated under controlled conditions supports the hypothesis by Marcarelli et al. (2009) which follows that at eutrophic sites (e.g. Marsh Creek and Portneuf River at Siphon Road), limitation of biofilms by N and P is relaxed and heterotrophs become limited by carbon (C) and autotrophs successfully out-compete biofilm heterotrophs in benthic or epiphytic communities. Controlled bioassays showed that *L. minor* measures did not provide clear separation among sites but did indicate that dry mass was greatest in Marsh Creek and the Portneuf River at the Lower Sportsman's Access. *L. minor* abundance was greater in experimental chambers filled with waters from the two lower Portneuf River sites and Marsh Creek relative to the nutrient scant experimental controls. Although not measured in the controlled bioassay, concentrations of epiphytic chl *a* and biomass observed in this bioassay were associated with larger diel fluctuations in dissolved oxygen in manipulative experiments of nutrient enrichment in the Portneuf River (Ray *unpublished*) and Stalker Creek (Mebane *unpublished*). These trends are consistent with comparative observations of the daily fluctuations monitored in the mainstem Portneuf River (see Fig. 5) and indicate that greater autotroph biomass in the Portneuf River is correlated with larger and potentially stressful fluctuations in dissolved oxygen and pH.

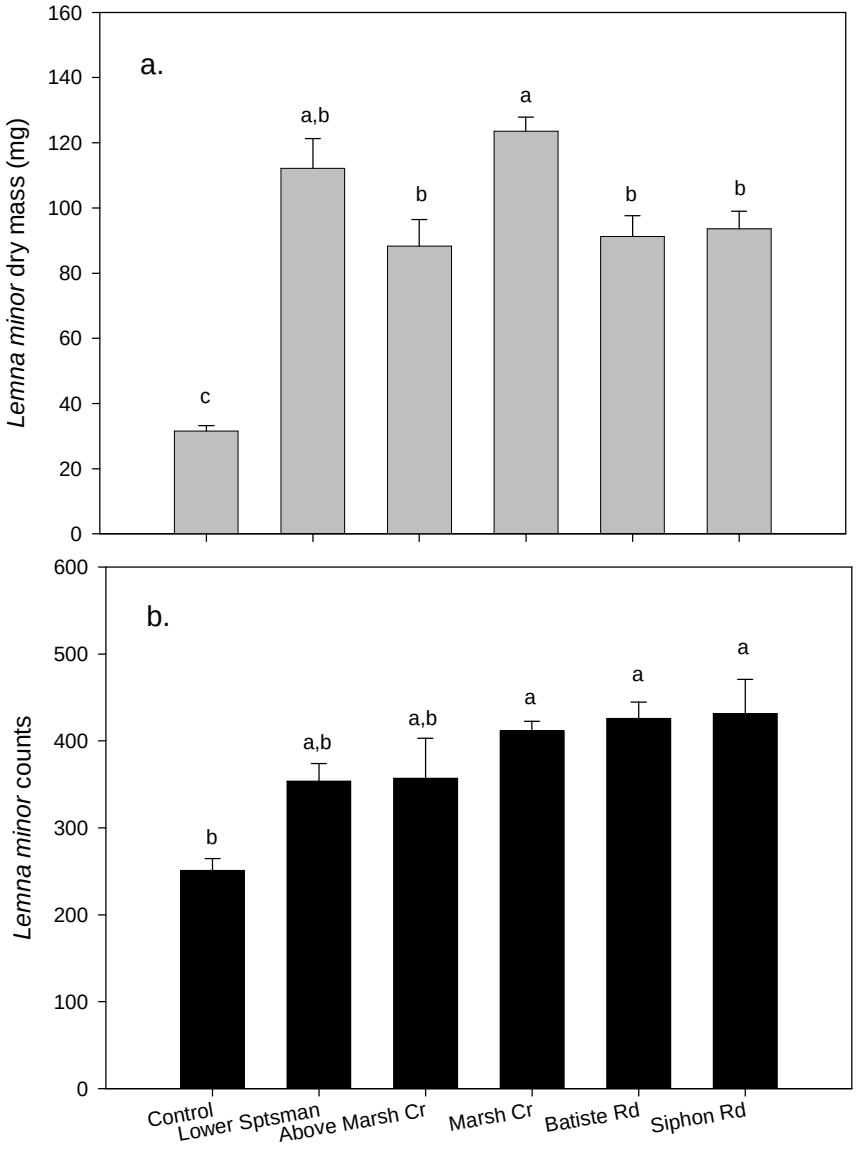


Fig 9. *Lemna minor* dry mass (a) and abundance (b) from experimental bioassays using ambient waters from five locations in the Portneuf River Subbasin and nutrient scant controls. Common letters indicate post-hoc groupings. Differences were assigned at *P*<0.05.

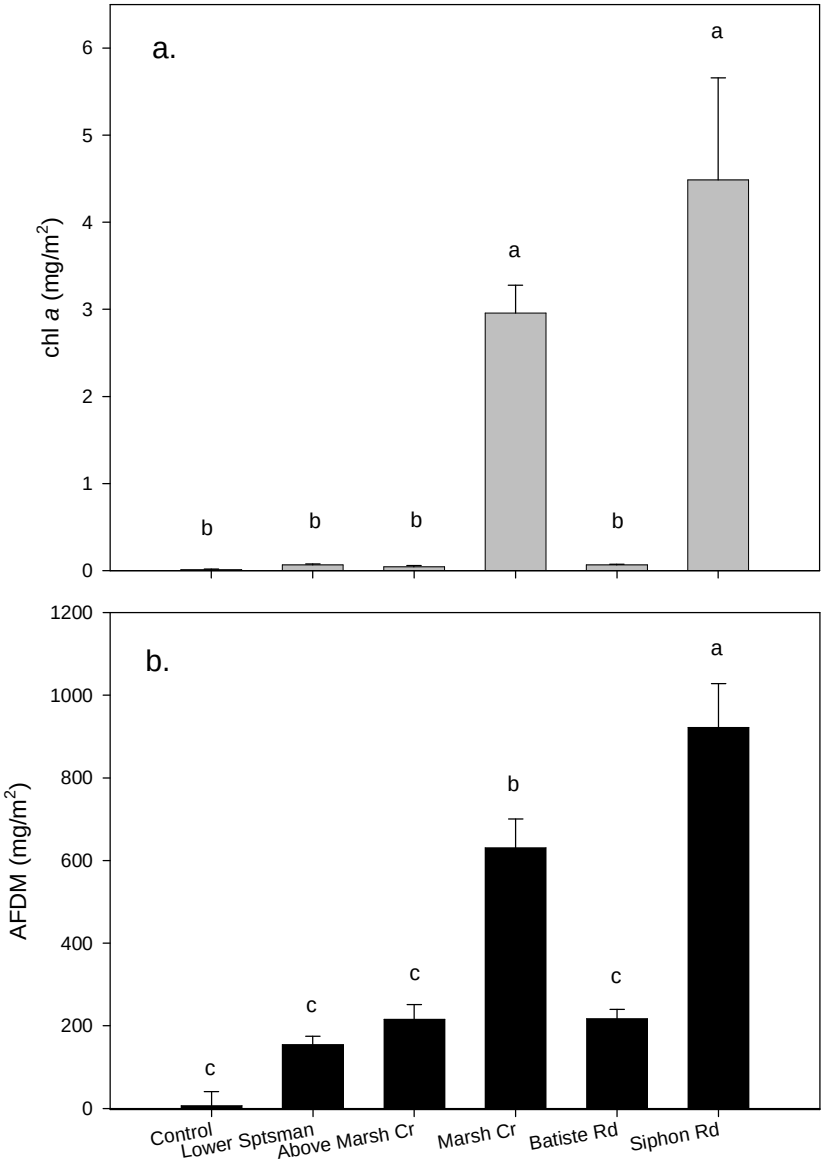


Fig. 10. Concentrations of (a) chlorophyll *a* and (b) AFDM in epiphytic communities associated with *L. minor* in experimental bioassays using ambient waters from five locations in the Portneuf River Subbasin and nutrient scant controls. Common letters indicate post-hoc groupings. Differences were assigned at *P*<0.05.

3.0 Portneuf River Tributaries

Major tributaries in the Portneuf River Subbasin include Mink Creek, Rapid Creek, Marsh Creek (treated with mainstem Portneuf River in this document), Dempsey Creek, Pebble Creek, and Toponce Creek. Tributaries also represent 23 of the 26 water body units described in Table 1. Segments of these tributaries and other subordinate tributaries are further described by assessment units (AUs). Assessment unit identifiers are assigned to individual streams, reaches of streams separated by land use, or for combinations of 1st and 2nd order tributaries. As a result, there are far more assessment units assigned to tributaries in the Portneuf River Subbasin (209 listed on DEQ's 2008 map-based integrated report) than there are named tributaries. Of the total 210 AU's, some form of biological assessment was conducted on 51 AUs between 2001 and 2007.

3.1 Bacteria

A small number of AUs were sampled only for microbiological indicators between 2002 and 2007 and those are discussed along with sites that underwent more thorough bioassessments below. Microbiological sampling was conducted by the DEQ BURP crew, DEQ surface water staff, or water quality scientists with the IASCD. IASCD conducted targeted sampling of four tributaries in 2006 and 2007. Included in this focused sampling effort was the sampling of multiple locations in Marsh Creek. The Marsh Creek summary is provided in Section ***2.1.b.3.a*** of this document.

3.1.a Idaho Department of Environmental Quality Recreational Use Support Assessments

The DEQ BURP crews collect macrobiological (e.g. fish) and microbiological samples from Idaho's surface waters annually. The information collected is summarized and used along with other available information to determine whether beneficial uses are being supported. Waters designated for recreational use are assessed by examining concentrations of *E. coli* from surface water samples. Waters designated for either primary and secondary contact recreation shall not contain concentrations of *E. coli* that ≥126 organisms/100 mL of stream water following a 30-day, 5 sample geometric mean sampling strategy.

From 2002 to 2007, 32 AUs were sampled for *E. coli* to determine whether recreation use status was supported. Fourteen AUs had a 5-sample geometric mean concentration of *E. coli* that exceeded Idaho's water quality criteria for primary and secondary contact recreation and therefore were determined to not support their designated contact recreation use (Table 10). During this time, an additional eighteen AUs were determined to fully support their recreational contact use (Table 11).

Documented contact recreation use criteria exceedances were detected across years indicating that weather or hydrologic conditions in a given annum was not responsible for the exceedances documented. Several tributaries had geometric means that were over an order of magnitude greater than Idaho's single sample instantaneous contact recreation criteria (e.g. Cherry Creek, Moonlight Creek, North Fork Pocatello Creek, and Yellow

Dog Creek) and additional sampling in these tributaries should be prioritized to evaluate the spatial extent and duration of the exceedance.

Table 10. List of Portneuf River tributaries and corresponding assessment units that failed to support the contact recreation use. Documented 30-day geometric mean exceedances for *E. coli* or shown by year (2002 to 2007) in organisms/100 mL of sample water.

Tributary Name	Assessment Unit	2002	2003	2004	2005	2006	2007
Birch Creek	ID17040208SK015_03			490			
Cherry Creek	ID17040208SK014_02b						2,183
Dempsey Creek	ID17040208SK017_03				1,005		
East Bob Smith Creek	ID17040208SK016_02b	2,115					
Garden Creek (upper)	ID17040208SK010_02a	558					
Indian Creek	ID17040208SK005_02						984
Moonlight Creek	ID17040208SK023_02f	1,381					
Mink Creek	ID17040208SK004_03a						381
North Fork Pebble Creek	ID17040208SK022_02d			854			
North Fork Pocatello Creek	ID17040208SK026_02a						1,257
Papoose Creek	ID17040208SK001_02c						505
South Fork Mink Creek	ID17040208SK004_03a		721				
West Bob Smith Creek	ID17040208SK016_02c	370					
Yellow Dog Creek	ID17040208SK013_02b						2,235

3.1.b IASCD Targeted Sampling Summaries

The IASCD sampled select tributaries for a suite of physical, chemical, and microbiological constituents. Summaries from work completed in 2006 and 2007 provide results from targeted sampling efforts established to bracket best management practices and other implementation work in the tributaries and proximal reaches described separately below.

Table 11. List of Portneuf River tributaries and corresponding assessment units assessed for contact recreation use between 2002 and 2007.

Tributary Name	Assessment Unit	Support	Not Supporting
Arkansas Creek	ID17040208SK006_02a	X	
Bell Marsh Creek (upper)	ID17040208SK008_02a	X	
Birch Creek	ID17040208SK015_03		X
Cherry Creek	ID17040208SK014_02b		X
City Creek	ID17040208SK002_02	X	
Clear Creek	ID17040208SK022_02b	X	
Cusick Creek	ID17040208SK001_02a	X	
Dempsey Creek	ID17040208SK017_03		X
East Bob Smith Creek	ID17040208SK016_02b		X
East Fork Mink Creek	ID17040208SK004_02d	X	
Garden Creek (upper)	ID17040208SK010_02a		X
Gibson Jack Creek (upper)	ID17040208SK003_02a	X	
Goodenough Creek (lower)	ID17040208SK009_02b	X	
Indian Creek	ID17040208SK005_02		X
Inman Creek	ID17040208SK023_03a	X	
Left Hand Fork Marsh Creek	ID17040208SK006_02e	X	
Middle Fork of Cherry Creek	ID17040208SK014_02a	X	
Mill Creek	ID17040208SK015_02a	X	
Mink Creek	ID17040208SK004_03a		X
Moonlight Creek	ID17040208SK023_02f		X
North Fork Pebble Creek	ID17040208SK022_02d		X
North Fork Pocatello Creek	ID17040208SK026_02a		X
Papoose Creek	ID17040208SK001_02c		X
Pebble Creek	ID17040208SK022_03	X	
Rapid Creek	ID17040208SK023_03	X	
Robber's Roost Creek	ID17040208SK016_02e	X	
South Fork Mink Creek	ID17040208SK004_03a		X
South Fork of Toponce Creek	ID17040208SK021_02d	X	
Toponce Creek	ID17040208SK021_03a	X	
West Bob Smith Creek	ID17040208SK016_02c		X
West Fork Mink Creek	ID17040208SK004_02b	X	
Yellow Dog Creek	ID17040208SK013_02b		X

3.1.b.1 North Fork Rapid Creek

Microbiological sampling of two locations in the North Fork of Rapid Creek (ID17040208SK023_02i) was initiated on 27 March 2006 upstream of McNabb Creek (but below Buckskin Road) and above Hoot Owl Road. Sampling was carried out bimonthly through October 2007. The upstream site (above McNabb Creek) had a median *E. coli* concentration of 579 organisms/100 mL. Seventeen of the 33 samples (52%) exceeded the single sample maxima criteria for secondary contact recreation. Exceedances primarily occurred from May to September, however, a concentration of >2,419 was detected in March of 2006. Downstream near Hoot Owl Road, *E. coli* concentrations were lower than those measured upstream; the median *E. coli* concentration was 153 organisms/100 mL of stream water. The range of concentrations was from 2 to 1,300 organisms/100 mL and exceedances of the single sample maxima for secondary contact were documented on nine occasions.

3.1.b.2 Twenty-four Mile Creek

Four locations were sampled between April 2006 and October 2007 in Twenty-four Mile Creek (ID17040208SK018_03a). Sampling locations included a site below the confluence with Pole Canyon Creek, upstream of Chesterfield Road, upstream of the North-South Hansen Road (5.6 miles below Twenty-four Mile Reservoir) and upstream of East-West Hansen Road. At the upstream-most site (below the confluence with Pole Canyon Creek) the median *E. coli* concentration was 179 organisms/100 mL, but ranged from 4 in March and April to > 2,419 organisms/100 mL in June 2007. Four samples collected from this site contained concentrations of *E. coli* above Idaho's single sample maxima criteria for secondary contact recreation. The site located just upstream of Chesterfield Road and downstream of the previous site supported a similar median concentration of *E. coli* (178 organisms/100 mL), but seven samples exceeded the single sample criteria. The site located approximately 5.6 miles below Twenty-four Mile Reservoir had a slightly lower median *E. coli* concentration (144 organisms/100 mL), but a similar range to the other sites (< 1 to > 2,419 organisms/100 mL). Concentrations were highest from May to October with exceedances of the single sample maxima criteria for secondary contact recreation documented in June, July, and October. The downstream-most site located upstream of the East-West Hansen Road had considerably lower median concentrations of *E. coli* (37 organisms/100 mL) than the three upstream sites but ranged from < 1 to 1,553 organisms/100 mL. Three exceedances of the single sample maxima criteria for secondary contact recreation were documented in June and August of different years.

3.1.b.3 West Fork Rapid Creek

Concentrations of *E. coli* were documented in the West Fork of Rapid Creek (ID17040208SK023_02g) at locations located approximately 0.5 mile and 1.5 mile upstream of the confluence with the North Fork of Rapid Creek. Median concentrations at the upstream and downstream sites were 57 and 103 organisms/100 mL, respectively. Higher concentrations of *E. coli* were documented in July and August at both sites. No exceedances of the instantaneous single sample maxima for secondary contact recreation were documented at the upstream location. Three exceedances of the single sample

maxima for secondary contact recreation criteria were detected over a period from April 2006 to October 2007 in the downstream location.

In the lower Portneuf River, *E. coli* concentrations are generally inversely correlated with discharge and positively correlated with water temperatures, however in some reaches, elevated concentrations were also detected in October and November after water temperatures dropped considerably. In Marsh Creek elevated concentrations of *E. coli* were documented between May and October indicating that factors other than low discharge and high stream temperatures control *E. coli* concentrations. Like Marsh Creek, protracted periods of with high concentrations of *E. coli* were documented in North Fork of Rapid Creek and Twentyfour Mile Creek. Land use is believed to play a significant role in *E. coli* concentrations in these and other surface waters in the Portneuf River Subbasin. Results from the DEQ BURP sampling shown in Table 10 reflect conditions of tributaries from July to September and do not provide information on *E. coli* concentrations in other seasons. IASCD results shown here demonstrate that exceedances of the single sample maxima for secondary contact recreation criteria are common in months from May to October and suggest that the risk of illness related to *E. coli* or other forms of fecal contamination from contact recreation is high for as many as six months of the year.

3.2 Macroinvertebrates

The importance of macroinvertebrates in assessing small streams is demonstrated by the fact that they are the most commonly cited organismal group for the bioassessment of aquatic ecosystems (Resh 2008). Not surprisingly, macroinvertebrates are the most commonly sampled organismal group in Idaho's streams. In the BURP bioassessment work conducted in the Portneuf River Subbasin between 2001 and 2006, 73 of 75 bioassessed sites sampled included the collection of macroinvertebrates. The DEQ stream assessment approaches employ multi-metric indices of macroinvertebrates (Stream Macroinvertebrate Index; SMI) along with, indices of habitat (Stream Habitat Index; SHI) and fish (Stream Fish Index; SFI). Collectively, the indices are used to characterize the ecological condition and determine aquatic life use support of small (wadeable) streams in Idaho (Grafe 2002). What follows is a summary of the indices from BURP sampling conducted in tributary streams between 2001 and 2006 in the Portneuf River Subbasin. Involved in this effort and consistent with DEQ sampling protocols, is the use of reference streams (Bell Marsh Creek, Webb Creek, and West Fork of Mink Creek) which helps quantify the interannual variation in stream indices.

3.2.a Beneficial Use Reconnaissance Program Sampling Results

The SMI is a multi-metric macroinvertebrate index that incorporates nine assemblage measures including: total taxa, Ephemeroptera taxa, Plecoptera taxa, Trichoptera taxa, percent Plecoptera, HBI, percent 5 dominant taxa, Scraper taxa, and Clinger taxa (Jessup and Gerritsen 2000). The SMI value for a given stream reach is a summation of these nine metric scores with a maxima of 100. The range of SMI scores is divided into condition rating ranges that vary from 3 (above the 25th percentile of reference condition) to a minimum threshold (below minimum of reference condition; see Table 12).

The SHI, is an index of habitat condition that is the sum of ten individual components that represent physical measures or indicators of landuse. The measures include instream cover, large organic debris, percent fines < 2mm in the wetted channel width, embeddedness, Wolman size class, channel shape, percent bank vegetative cover, percent canopy cover, disruptive pressures, and zone of influence. Generally, the habitat measures included are good predictors of stream biological condition (Fore and Bollman 2000) and therefore results of this index are reported here to provide some additional information to understand tributary condition.

From 2001 to 2006, the DEQ's Pocatello Region Office BURP crews bioassessed forty-three assessment units in the Portneuf River Subbasin. Some assessment units were sampled in multiple years or multiple times within a given year resulting in a total of seventy-five assessments conducted during this six-year period. The reference sites Upper Bell Marsh Creek and the West Fork of Mink Creek, were sampled annually over this period and Webb Creek was sampled every year except 2004. Across all sites and focal years, the average SMI score for reference streams was 77.98. On average, Upper Bell Marsh Creek had the highest annual SMI score (83.30) and the West Fork Mink Creek had the lowest average annual SMI (73.68). Across reference sites, the lowest average SMI scores occurred in 2005 (SMI=72.02) and the highest annual SMI scores occurred in 2001 (SMI=80.51)[6]. The coefficient of variation of the SMI for all reference sites was relatively small and ranged from 0.052 (upper Webb Creek) to 0.077 (upper Bell Marsh Creek). The highest SMI measured during the study period was not from a reference site but from Inman Creek in 2002 (90.49). The lowest SMI was associated with macroinvertebrates sampled in 2003 from lower Marsh Creek (SMI=18.79); a second bioassessment of lower Marsh Creek in 2005 yielded a considerably higher SMI score (50.47). All bioassessed reference sites met the cold water aquatic life use support criteria each year. Nine assessment units sampled did not support the cold water aquatic life use (Table 13). An additional unit (lower Marsh Creek) sampled in 2003 and 2006 resulted in bioassessment scores that were split between not fully and fully supporting, however, the cold water aquatic life use was supported in the most recent sampling.

3.3 Fish

The discussion of fish in Portneuf River tributaries follows and is separated in three sections. The first section characterizes the fishery of select tributaries sampled as part of annual IDFG assessments of subbasins in the Upper Snake River Basin. The second section describes fish surveys designed to document the distribution of native salmonids in the Westside Ranger District. Lastly, BURP SFI summaries are reported for select tributaries (Table 12).

[6]Only two reference sites were sampled in 2004 so results from these samplings were not included in the reference reach comparison used here.

Table 12. Index Scoring Criteria for Beneficial Use Reconnaissance Program Surveys from Grafe et al. 2002.

Condition Category (SMI)	SMI (Basins)	SHI (Northern Basin and Range)	Condition Category (SFI)	SFI (Rangeland)	Condition Rating
Above 25th percentile of reference condition	**≥51**	≥63	Above the median of reference condition	**>82**	**3**
10th to 25th percentile of reference condition	**43-50**	50-62	25th percentile to median of reference condition	**62-81**	**2**
Minimum to 10th percentile of reference condition	**33-42**	<50	5th to 25th percentile of reference condition	**39-61**	**1**
Below minimum of reference condition	**<33**	N/A	Below 5th percentile of reference condition	**<39**	**Minimum Threshold**

Note: N/A – Not available. SHI does not have a minimum threshold condition rating. Below the minimum of reference condition is identified as a minimum threshold. The purpose of a minimum threshold is to identify significant impairment that may not be apparent after data index integration. DEQ uses this as a signal from individual indexes to ensure protection of cold water aquatic life. DEQ concludes not fully supporting if a water body has even one index result below a minimum threshold.

3.3.a Annual assessments of native salmonids in the Upper Snake River Basin

In 1999, four sites (Big Springs, North Fork of Pebble Creek, and Upper and Lower Pebble Creek) within the Portneuf River Subbasin were sampled as part of the annual Upper Snake River Basin assessment of native salmonids. From this effort rainbow trout (*Oncorhynchus mykiss*), rainbow/cutthroat trout hybrid, YCT, and sculpin were identified and metrics were summarized for the subbasin. Salmonid densities for fish <100 mm was 0.41/m^2 and were greater than the seven other subbasins (range 0.02 to 0.41/m^2; median 0.085/m^2) included in the investigation. In contrast, densities of fish > 100 mm were 0.12/m^2 and were intermediate (range 0.5 to 0.16/m^2; median 0.10/m^2) between other subbasins sampled. Salmonid biomass in the Portneuf River subbasin was 5.6 g/m^2 (range 1.4 to 8.5 g/m^2; median 4.8 g/m^2) and average salmonid richness was 2.5 (range 1.1 to 3.4; median 2.2; Meyer 2000).

In 2000, 79 sites from 42 tributaries representing public (56%) and private (44%) lands in the Portneuf River Subbasin were sampled by the IDFG as part of the annual assessment of native salmonids in the Upper Snake River Basin. Fifteen sites were waterless or contained too little water to effectively sample. Of the remaining 64 sites, 70% contained salmonids. Of the sites with salmonids, YCT was the most common salmonid species

identified and was present at 90% of the sites. Mottled sculpin was the most common non-game fish present in the drainage and sculpin occurred in 29 fish-bearing streams. Salmonid densities in the Portneuf River Subbasin averaged 0.13 and 0.15/m² for fish <100 and > 100 mm total length, respectively. The average < 100 mm salmonid densities for the 64 fish-bearing tributaries sampled in 2000 and reported here is lower than densities in Big Springs and Pebble Creeks sampled in 1999 (Meyer et al. 2001).

3.3.b USDA Forest Service Caribou-Targhee National Forest Survey Results

In 2001, fish were surveyed in 25 streams throughout the Caribou-Targhee National Forest. The primary goal of this effort was to document the distribution of native salmonids in the Westside Ranger District; however, documenting the distribution of Yellowstone cutthroat trout (YCT) and non-native rainbow, brown, and brook trout (*Salvelinus fontinalis*) was also desirable. This dataset provides a relatively recent snapshot of salmonids in a 25 subbasin tributaries.

Multiple reaches of each stream were surveyed as part of the tributary survey effort starting with the first reach being furthest downstream. Reaches were further divided into five units of equal length. Units were surveyed by electro-shocking a 130 foot section using three passes. Captured trout were identified to species and measured to the nearest 0.2 inches fork length (length). Summaries that follow are separated by tributary (Capurso *unpublished*).

3.3.b.1 Bell Marsh Creek

Yellowstone cutthroat trout were present in Bell Marsh Creek. The first reach yielded 122 cutthroat trout and a second produced an additional 37 YCT. Yellowstone cutthroat trout ranged from 1.6 to 6.9 inches fork length; the average size was 3.1 inches. Habitat quality was considered good and the uniform distribution of fish confirmed these good habitat conditions throughout the entire sampling area (Capurso *unpublished*).

3.3.b.2 Cherry Creek

Brook trout were most abundant fish detected (1,138 fish) in Cherry Creek. Sculpin (37 fish) and rainbow trout (5) were also detected in Cherry Creek. Sculpin were detected in the most downstream portions of the first focal reach. In contrast, rainbow trout were caught in the upper units of the first reach. The brook trout collected ranged from 1.6 to 8.1 inches in fork length. Rainbow trout fork lengths ranged from 9.1 to 10.6 inches.

3.3.b.3 City Creek

No fish were detected in sampled reaches of City Creek. USFS noted that stream conditions (e.g. riparian and bank conditions) were indicative of high quality fish habitat, but that there was insufficient water to hold fish during the 2001 sampling visit (average depth was 0.1 ft; *Capurso unpublished*).

3.3.b.4 Clear Creek

Yellowstone cutthroat trout were present (36 fish) but not abundant in Clear Creek. Still, only one of the sampled units failed to produce fish. No non-native salmonids were identified during this sampling bout. Captured fish ranged from 3.0 to 8.1 inches fork length. Low water levels were suspected as having an effect on YCT abundance in Clear Creek (Capurso *unpublished*).

3.3.b.5 East Fork Mink Creek

Yellowstone cutthroat trout were present (33 fish) and uniformly distributed, but occurred in relatively low densities in East Fork Mink Creek. YCT varied in size from 2.2 to 5.9 inches fork length. Brook trout (9 fish) and sculpin (8 fish) were also present in East Fork Mink Creek. All fish were captured in the first and downstream-most reach and fish habitat was strongly influenced by the presence of dense aquatic vegetation (Capurso *unpublished*).

3.3.b.6 Gibson Jack Creek

Yellowstone cutthroat trout were present but detected in relatively low abundance (84 total) levels when compared with other Westside Ranger District streams sampled during the 2001 USFS sampling effort. The first reach sampled contained only 28 YCT and these fish ranged in size from 2.4 to 9.4 inches. Reach 2 contained 43 YCT that ranged in size from 3.1 to 8.7 inches. Reach 3 contained only 13 YCT ranging from 3.7 to 7.9 inches fork length. Sculpin were also detected and were present in two of three sample reaches.

3.3.b.7 Inman Creek

Yellowstone cutthroat trout were distributed throughout all of the sampling reaches and present at moderate densities in Inman Creek; 134 fish were found in the first two reaches. Fish size varied between 3.0 and 9.6 inches. Lower numbers of fish were present in Reach 2; this reach was partially impounded at time of sampling by a complex of beaver habitats. No other fish species were found in Inman Creek.

3.3.b.8 Left Fork of Cherry Creek

Eighty-one brook trout were counted in the Left Fork of Cherry Creek. Brook trout ranged from 1.8 to 5.7 inches in fork length. No other species of fish were detected in this tributary during the sampling bout.

3.3.b.9 Middle Fork of Cherry Creek

Five hundred two brook trout ranging in size from 1.8 to 6.9 inches were collected in the Middle Fork of Cherry Creek. No other species of fish were documented in the tributary at the time of sampling.

3.3.b.10 Middle Toponce Creek

A total of 79 YCT were detected in Middle Fork Toponce Creek. The size of YCT varied from 1.0 to 6.9 inches in fork length. Additionally, there were 65 sculpin caught in the survey of two reaches. Young of year trout were noted indicating that successful spawning has occurred in recent years in this tributary (Capurso *unpublished*).

3.3.b.11 Mink Creek

Yellowstone cutthroat trout (47 fish), brown trout (177 fish), and sculpin (278 fish) were detected in three reaches of Mink Creek. Brown trout in Mink Creek varied in size from 1.6 and 16.5 inches fork length. In contrast, YCT ranged in size from 3.5 to 11.6 inches fork length.

3.3.b.12 North Fork Pebble Creek

Physical stream conditions varied considerably between sampling reaches in North Fork Pebble Creek and YCT densities did as well. A total of 222 YCT were captured, however, more than two thirds of YCT caught were present in a single reach. Fish length varied from 2.0 to 9.4 inches. No other fish taxa were present in the sampled reaches.

3.3.b.13 North Fork of Toponce Creek

Yellowstone cutthroat trout were present in relatively low densities (19 fish) in North Fork Toponce Creek; YCT ranged in size from 1.6 to 5.5 inches fork length. Rainbow/cutthroat hybrids were found at similar densities (19 fish), along with 26 sculpin. Hybrids were slightly larger than YCT and ranged from 3.5 to 6.7 inches.

3.3.b.14 Pebble Creek

In 2001, a total of 264 YCT were detected in three reaches of Pebble Creek; YCT ranged in size from 2.6 to 11 inches fork length. Sculpin (71 fish) were also present in the three reaches of Pebble Creek. Rainbow trout (184 fish) that were recently stocked by the Idaho Department of Fish and Game were detected in the second sample reach. Rainbow trout ranged from 7.9 and 11.8 inches long. A single dead post spawn adult YCT (>11.8 inches) was in Pebble Creek during the time of sampling (Capurso *unpublished*).

3.3.b.15 Right Fork Cherry Creek

Insufficient water was present to support fish during the 2001sampling visit.

3.3.b.16 Robber's Roost Creek

Yellowstone cutthroat trout were present in low densities in Robber's Roost Creek. In total, 20 YCT were detected and YCT sizes ranged from 2.8 to 6.7 inches in length. No other species were found in this stream.

3.3.b.17 South Fork Hawkins Creek

No fish were found in South Fork Hawkins Creek and this was attributed to the relatively small size and shallow water (width ≤3 ft and average depth of sampled reach = 0.25 ft) (Capurso *unpublished*).

3.3.b.18 South Fork Inman Creek

Yellowstone cutthroat trout were the only fish encountered during the survey of South Fork Inman Creek. Fish present varied in between 2.6 and 7.3 inches.

3.3.b.19 South Fork Mink Creek

Yellowstone cutthroat trout (29 fish) were present at relatively low densities in South Fork Mink Creek. It is noteworthy that fish were absent from sample Reach 3 and Box Canyon. YCT documented varied in size between 3.1 to 9.8 inches. The average size of fish varied little as the sampling team moved upstream. Sculpin were also captured in all units of the first two reaches. In contrast to YCT, sculpin were present in high abundance (1,239 documented) in two survey reaches.

3.3.b.20 South Fork Pebble Creek

Three sample reaches were planned for South Fork of Pebble Creek. The first two yielded no fish and the third was completely dry.

3.3.b.21 South Fork Toponce Creek

The abundance of YCT in South Fork Toponce Creek, was intermediate among tributaries in 2001. A total of 176 YCT were documented along with rainbow trout (10), sculpin (557), suckers (7) and one dace. Cutthroat trout ranged from 2.2 to 11.0 inches and rainbow trout ranged from 8.3 to 11.6 inches in fork length. Rainbow trout captured appeared to be hatchery fish (Capurso *unpublished*).

3.3.b.22 South Fork Walker Creek

No fish were documented during the survey of this tributary.

3.3.b.23 Toponce Creek

Relatively low numbers of YCT (77 fish) were detected in Toponce Creek. The size of YCT varied from 3.1 to 11.8 inches. Rainbow trout (125 fish), brown trout (59 fish), made up the remainder of the salmonids caught. Additionally, 1,006 sculpin, 13 shiners, 122 suckers, and 10 speckled dace were also detected in Toponce Creek.

3.3.b.24 Walker Creek

While present, YCT abundance was low (27 fish) in Walker Creek. Yellowstone cutthroat trout varied in size from 3.1 to 6.5 inches. No other taxa were detected in Walker Creek. USFS noted that high water temperatures throughout the stream may have influenced trout abundance. Moreover, high temperatures were not correlated with estimates of shade which was characterized as abundant in all but one sampling unit (Capurso *unpublished*).

3.3.b.25 West Fork Mink Creek

A total of 78 YCT ranging in size from 3.1 to 8.5 inches were catalogued in West Fork Mink Creek; 71 fish were collected in one sample reach and a third reach had no fish. A single brown trout (5.7 inches fork length) was also present. Low densities from the second reach were attributed to difficulties in sampling and not to actual fish abundance. The surveyors noted that habitat conditions were similar to the first reach and speculated that YCT densities should have been higher. Five YCT collected had a clipped adipose fin. The USFS speculated that these fish were most likely from fin samples collected by IDFG in 2000 (Capurso *unpublished*).

Taken together, this work shows that salmonids are widely represented in streams throughout the Caribou-Targhee National Forest's Westside Ranger District. Twenty streams supported salmonids and YCT was the most common salmonid throughout the district. No fish were detected in sampling reaches of the following five tributaries: City Creek, Right Fork Cherry Creek, South Fork Hawkins Creek, South Fork Pebble Creek, and South Fork Walker Creek. In all cases where fish were absent, low or no water was suspected as the cause of impairment (Capurso 2001).

Brook trout were most common in Cherry Creek and tributaries to Cherry Creek, brown trout were most common in Mink Creek, and rainbow trout were most abundant in Toponce Creek and also common in Pebble Creek. Regardless, this effort clearly demonstrated that salmonids, as well as, cottids (sculpins) occur throughout the subbasin. These taxa are considered cold (and cool in the case of mottled sculpin) water taxa

(Zaroban et al. 1999) that are used along with other metrics (see below) in the SFI and evaluation of cold water aquatic life criteria (Mebane 2002).

3.3.c Beneficial Use Reconnaissance Program Survey Results

The Stream Fish Index (SFI) is a multi-metric fish index separated by ecoregion and dominant landuse as forested (Montane-forested) or rangeland (Desert-Basin/Rangeland) and is specific to streams of Idaho (Mebane 2002). Metrics used in SFI for rangeland streams common to the Portneuf River Subbasin include percent cold water individuals, percent long-nose dace, percent omnivores and herbivores, percent DELT anomalies, Jaccard community similarity coefficient, and the number of cold water individuals collected per minute of fishing. The sum of the unitless measures was adjusted to total a possible score of 100 when combined.

Only five of the 75 bioassessments conducted between 2001 and 2006 included fish sampling (Table 13). Two reference sites were sampled for fish and SFI scores for these sites were 72.38 and 50.38 for upper Bell Marsh Creek (2003) and West Fork of Mink Creek (2004), respectively. The highest SFI score was recorded in lower Garden Creek (94.37) in 2001 and the lowest SFI score was recorded in lower Marsh Creek (44.53) in 2003. Only lower Garden Creek produced an SFI score that ranked above the median reference scores used in the development of the rangeland SFI index developed by Mebane (2002). None of the SFI scores shown in Table 13 indicated conditions below the minimum evaluation threshold.

Table 13. List of Portneuf River tributaries assessed in the DEQ Beneficial Use Reconnaissance Program from 2001 to 2006. Cold water aquatic life use support (ALUS) is determined based on the integration of two or more stream indices (SMI, SHI, and SFI). ALUS support status is described as either not supporting or fully supporting. In some instances, less than two indices were available to establish support (NA = not available).

Tributary Name and **Assessment Unit**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Support Status**
Arkansas Creek ID17040208SK006_02a	31.04 - SMI 37.0 - SHI						*Not Supporting*
Beaverdam Creek ID17040208SK017_02c			26.75 - SMI 45.0 - SHI				*Not Supporting*
Bell Marsh Creek (upper) ID17040208SK008_02a	83.01*- SMI 71.0*- SHI	89.08*- SMI 72.0*- SHI	87.85 - SMI 72.0 - SHI 72.38 - SFI	88.34 - SMI 67.0 - SHI	73.55 - SMI 78.0 - SHI	77.95 - SMI 60.0 - SHI	**Fully Supporting**
Birch Creek ID17040208SK015_03		64.53[a]- SMI 65.0 - SHI		47.26 - SMI 57.0 - SHI			**Fully Supporting**
Cherry Creek ID17040208SK014_02a		62.29 - SMI 67.0 - SHI					**Fully Supporting**
City Creek ID17040208SK002_02		74.79 - SMI 76.0 - SHI					**Fully Supporting**
Dempsey Creek ID17040208SK017_03					28.47 -SMI 35.0 - SHI		*Not Supporting*
East Bob Smith Creek ID17040208SK016_02b				82.39 - SMI 57.0 – SHI			**Fully Supporting**
Garden Creek (lower) ID17040208SK010_02b	36.91 - SMI 47.0 - SHI 94.37 - SFI						*Not Supporting*
Garden Creek (upper) ID17040208SK010_02a		55.80*- SMI 54.0*- SHI					**Fully Supporting**
Gibson Jack Creek (upper) ID17040208SK003_02a		82.98 - SMI 84.0 - SHI					**Fully Supporting**

Goodenough Creek ID17040208SK009_02b		59.38 - SMI 70.0 - SHI					**Fully Supporting**
Hawkins Creek ID17040208SK013_02a	59.05 - SMI 49.0 - SHI						**Fully Supporting**
Indian Creek ID17040208SK005_02		49.29*- SMI 53.5*- SHI					**Fully Supporting** †
Inman Creek (upper) ID17040208SK023_03b		90.49 - SMI 72.0 - SHI					**Fully Supporting**
Inman Creek (lower) ID17040208SK023_03a						69.46*- SMI 58.5*- SHI	**Fully Supporting** †
Marsh Creek (upper) ID17040208SK006_03a			48.67 - SMI 57.0 - SHI				**Fully Supporting**
Marsh Creek (lower middle) ID17040208SK006_04a						33.14 - SMI 53.0 - SHI	*Not Supporting*
Marsh Creek (lower) ID17040208SK006_04			18.79 - SMI 33.0 - SHI 44.53 - SFI			50.47 - SMI 54.0 - SHI	*Not Supporting ('03);* **Fully Supporting ('06)**
Middle Fork Cherry Creek ID17040208SK014_02a					78.57 - SMI 79.0 - SHI		**Fully Supporting**
Middle Fork Toponce Creek ID17040208SK021_02c				57.54 - SMI 71.0 - SHI			**Fully Supporting**
Mill Creek ID17040208SK015_02a		53.73 - SMI 70.0 - SHI			67.30 - SMI 68.0 - SHI		**Fully Supporting**
North Fork Pebble Creek ID17040208SK022_02d				60.25 - SMI 60.0 - SHI			**Fully Supporting**
North Fork Pocatello Creek		57.96 - SMI 54.0 - SHI					**Fully Supporting**

ID17040208SK026_02a							
North Fork Rapid Creek ID17040208SK023_03c						39.91 - SMI 49.0 - SHI	*Not Supporting*
North Fork Toponce Creek ID17040208SK021_03a		50.41 - SMI 68.0 - SHI		64.21 - SMI 60.0 - SHI 58.51 - SFI			**Fully Supporting**
Papoose Creek ID17040208SK001_02c		48.21 - SMI 60.0 – SHI					**Fully Supporting**
Pebble Creek ID17040208SK022_03		73.68 - SMI 77.0 - SHI					**Fully Supporting**
Pilot Springs Creek ID17040208SK011_02					10.0 - SHI		***NA*** (<2 indexes)
Pocatello Creek (middle) ID17040208SK024_03a		29.94 - SMI 45.0 - SHI					*Not Supporting*
Pocatello Creek (lower) ID17040208SK024_03					10.0 - SHI		***NA*** (<2 indexes)
Potter Creek ID17040208SK006_02f		53.78 - SMI 37.0 - SHI					*Not Supporting*
Rapid Creek (middle) ID17040208SK023_03	54.92 - SMI 56.0 - SHI						**Fully Supporting**
Rapid Creek (lower) ID17040208SK023_03	72.53 - SMI 79.0 - SHI						**Fully Supporting**
Robbers Roost Creek ID17040208SK016_02e		76.57 - SMI 70.0 - SHI					**Fully Supporting**
South Fork Pebble Creek ID17040208SK022_02c				59.48 - SMI 83.0 - SHI			**Fully Supporting**
South Fork Toponce Creek ID17040208SK021_02d				62.79 - SMI 54.0 - SHI			**Fully Supporting**
Toponce Creek (middle)		50.41 - SMI 68.0 - SHI		64.21 - SMI 60.0 - SHI			**Fully Supporting**

ID17040208SK021_03a							
Twentyfour Mile Creek ID17040208SK018_02a	47.08 - SMI 48.0 - SHI					40.93 - SMI 40.0 - SHI	*Not Supporting*
Webb Creek (upper) ID17040208SK023_02c	80.51*- SMI 82.5*- SHI	75.69*- SMI 82.0*- SHI	71.62 - SMI 72.0 - SHI		74.87 - SMI 80.0 - SHI	81.12 - SMI 73.0 - SHI	**Fully Supporting**
Webb Creek (lower) ID17040208SK023_02c	64.69 - SMI 86.0 - SHI						**Fully Supporting**
West Bob Smith Creek ID17040208SK016_02c				68.61 - SMI 70.0 - SHI			**Fully Supporting**
West Fork Mink Creek ID17040208SK004_02b	78.02*- SMI 70.5*- SHI	75.04*- SMI 76.0*- SHI	76.74 - SMI 74.0 - SHI	75.74*- SMI 68.0*- SHI 50.38 - SFI	67.63 - SMI 68.0 - SHI	68.90 - SMI 60.0 - SHI	**Fully Supporting**
Yago Creek ID17040208SK006_02c			44.89 - SMI 56.0 - SHI				**Fully Supporting**
Yellow Dog Creek ID17040208SK013_02b		58.90 - SMI 36.0 - SHI					**Fully Supporting**

*indicate the average of multiple samplings (see Bell Marsh Creek 2001 and 2002). †indicates that one of the two samplings indicated the aquatic life use support was below criteria necessary for full support rating, but the average of two samplings suggested full support. A superscript letter indicates a subsection of the assessment unit (e.g. Birch Creek ID17040208SK015_03a in 2002).

4.0 Summary

4.1 Assemblage Summaries

4.1.a Bacteria

Microbiological sampling suggests that *E. coli* concentrations in the mainstem Portneuf River varied by site and year. However, concentrations exceeding the primary and secondary recreation contact triggers are not widespread. *E. coli* concentrations tended to be highest in late summer and again in October. Elevated concentrations of *E. coli* in the mainstem in July and August were correlated with increases in river temperatures and decreases in discharge. Elevated concentrations in October are not likely tied to temperatures, but instead abrupt flow regulation changes and the end of the irrigation season. In the channelized and hardened segment of the lower Portneuf River specifically, exceedances of contact recreation criteria have been documented. In this segment, *E. coli* concentrations increase predictably from upstream to downstream with concentrations at the downstream monitoring location regularly exceeding the single sample instantaneous criteria for contact recreation.

In Marsh Creek, typically during the months of May to October, consistently higher concentrations of *E. coli* are documented. Sites located in the upper middle (ID17040208SK006_03) and lower middle (_04a) Marsh Creek AUs had repeated exceedances of the single sample instantaneous secondary contact recreation criteria. Additional sampling is recommended to determine whether beneficial uses are supported. Fourteen AUs from smaller tributaries had documented 5-day geometric mean concentrations of *E. coli* that exceeded Idaho's water quality criteria for contact recreation; primary and secondary contact recreation in these AUs were not supported (Table 10).

4.1.b Algae

Diatom assemblages from two mainstem locations and Gibson Jack Creek included flora common to nutrient enriched and alkaline rivers. One third of the flora are characterized as motile and therefore capable of readily colonizing introduced substrates. Diatom richness and diversity were highest for the Portneuf River at Siphon Road. These measures of diatom assemblages are commonly found in rivers with higher levels of disturbance.

4.1.c Macrophytes

Macrophyte species distributed throughout the Portneuf River and Marsh Creek have been described as indicators of eutrophic waters elsewhere. Abundance of macrophytes was highest in gaining reaches and particularly in the lower Portneuf River where groundwater is rich in both N and P. Elevated nutrients in the lower Portneuf River are translated into additional plant biomass and promote luxury uptake of N and P by macrophytes. Increase in tissue nutrients, however, were not proportional to increases in available surface water nutrients present at the most nutrient-rich sites. High macrophyte abundance in the lower Portneuf River was associated with higher daily fluctuations in

dissolved oxygen. In the Portneuf River at Siphon Road, dissolved oxygen concentrations are reportedly affected by macrophytes and exceedances of cold water aquatic life dissolved oxygen criterion (6 mg/L; WQS § 250.02) are common from mid July to mid September.

4.1.d Macroinvertebrates

In the Portneuf River, site specific habitat measures were better predictors of the macroinvertebrate assemblage than coarse scale land use patterns. In 2004, common measures of the benthic macroinvertabrate assemblages of the Portneuf River showed that the Portneuf River below Rapid Creek is in good ecological condition. From this same dataset, locations categorized as having poor water quality and tolerant invertebrate assemblages included sites downstream of the City of Lava's wastewater treatment plant, above Batiste Road, and at Siphon Road. In 2004, the Portneuf River at Siphon Road had the most compromised assemblage which consisted of taxa tolerant to low dissolved oxygen, fine sediment, and high organic loading. In 2005, DEQ's river macroinvertebrate index (RMI) was applied to samples from nine mainstem sites and RMI discriminated the sites based on their assemblages. Sites with higher RMI scores and categorized as having good biotic condition included the Portneuf River at Lower Sportsman's Access, Crane Creek Sportsman's Access, downstream of the Marsh Creek confluence, and near Edson Fichter Nature Area. Sites with RMI scores below the minimum reference threshold and reflective of poor biotic condition included the Portneuf River at Mike's Place Sportsman's Access, downstream of Lava Hot Springs wastewater treatment plant, near McCammon, at Kraft Road, and downstream of the City of Pocatello's wastewater treatment plant. At least two mainstem sites (below Rapid Creek and near Edson Fichter Nature Area) sampled in 1969 and 2004 had higher abundance, diversity, and richness measures in 2004.

From 2001 to 2006, BURP crews assessed the macroinvertebrate assemblages of forty-three AUs in the Portneuf River Subbasin. Reference AUs were sampled in multiple years or multiple times within a given year resulting in a total of seventy-five assessments. The reference sites Upper Bell Marsh Creek, West Fork of Mink Creek, and Webb Creek were sampled annually (except Webb Creek in 2004). All bioassessed reference sites met the cold water aquatic life use support criteria each year. Nine assessment units did not support the cold water aquatic life use; these included Arkansas, Beaverdam, Dempsey, lower Garden, lower middle Marsh, North Fork of Rapid, middle Pocatello, Potter and Twentyfour mile creeks (Table 12). Lower Marsh Creek had bioassessment scores that were split between not fully (2003) and fully supporting (2006), however, the cold water aquatic life use was supported in the most recent sampling.

4.1.e Fish

In the Portneuf River above and below Lava Hot Springs wild populations of YCT, rainbow, and brown trout exist. Despite the presence of these cold water fish species, two locations within the upper river had macroinvertebrate indices reflective of poor biotic conditions. Below the Portneuf Marsh Valley Canal, salmonids represent a smaller component of the fishery, although cool-water fish species still predominate. In Marsh

Creek, salmonids were detected in low abundance in 1997, but were not present in two reaches sampled in 2007. Also absent in 2007 were other native cold water or sensitive taxa. Common carp were present in Marsh Creek reaches sampled in 1997 and 2007. In the lower Portneuf River downstream of Batiste Road, salmonids represented approximately 75% of the total catch. Collectively, fish surveys suggest that the Portneuf River above the Portneuf Marsh Valley Canal supports an abundance of wild salmonids. Below this diversion, the fishery is predominantly nongame cold and cool water omnivores and invertivores. In the lower Portneuf River where the complex of 27 springs contributes approximately 225 cfs year round, salmonids again predominate. Salmonids in the Portneuf River are found in the river above major flow diversions or reaches supplemented by groundwater flows. For example, in flow regulated reaches of Marsh Creek, IDFG identified salmonids distributed throughout their sample reaches and isolated near small spring inflows. In 2001, the USFS demonstrated that 80% of the Portneuf River tributary streams within the Caribou-Targhee National Forest contained salmonids and YCT predominated in these streams. The remaining streams lacked fish and were characterized by very low water conditions. Collectively, these findings suggest that the distribution and abundance of fish in the Portneuf River Subbasin may be more closely linked to hydrologic rather than water quality conditions.

Only five of the 75 bioassessments conducted by BURP crews between 2001 and 2006 included surveys of fish and all surveys documented fish assemblages that were above the minimum condition threshold. Two reference sites were sampled for fish and SFI scores for these sites were indicative of intermediate to poor biotic conditions. The highest SFI score was recorded in lower Garden Creek which is sometimes isolated from Marsh Creek. IDFG surveys reported that streams permanently or seasonally isolated from the mainstem Portneuf River (e.g. Goodenough, Bell Marsh, Walker, Robbers Roost, and Harness creeks) contained YCT, while connected streams like Rapid, Pebble, and Toponce creeks (and some of their tributaries) contained nonnative salmonids. Mainstem connectivity may be important for explaining attributes of fish assemblages in the tributaries streams in the Portneuf River Subbasin.

4.2 Process Summary

4.2.a Biological Processes

From instream and controlled bioassays, waters from Marsh Creek and the Portneuf River at Siphon Road consistently produced biofilms with greater biomass and more chlorophyll *a* relative to waters from other mainstem Portneuf River sites. Differences in biofilm biomass were attributed to differences in the nutrients available to biotic communities present in Marsh Creek and the Portneuf River. Portneuf River reaches with elevated nutrients may offer a competitive advantage to photosynthetic algae and bacteria thereby altering the autotrophic index of benthic and epiphytic biofilms. In addition, Marsh Creek and lower Portneuf River sites at Batiste and Siphon roads had lower GPP than other mainstem sites when GPP was controlled for concentrations of chl *a*. This work provides evidence that metabolism in the lower Portneuf River and Marsh Creek is controlled by an abundance of biofilm biomass and not by changes in community production or respiration.

4.3 Conclusions

The Portneuf River biological monitoring has revealed secondary contact recreational impairment in the lower Portneuf River near the City of Pocatello and in fourteen assessment units associated with tributary streams (Tables 10 and 11). DEQ BURP monitoring results also indicates that nine assessment units from tributary streams did not support the cold water aquatic life use (Table 13). Other recent, DEQ and non-DEQ sponsored monitoring efforts show that cold water fish species are absent or poorly represented in lower Marsh Creek and that macrophyte abundance is greatest in the lower Portneuf River. Dissolved oxygen concentrations in the lower Portneuf River where macrophyte abundance is greatest, regularly exceeds the dissolved oxygen threshold for cold water aquatic life criteria.

The multi-assemblage approach used in assessing the ecological integrity of the Portneuf River offers advantages over the use of a single biological assemblage (e.g. macroinvetrebrates). For example, the recent invasion of the New Zealand mud snail in the Portneuf River illustrated how some methods of interpretation of macroinvertebrate data can be confounded by the disproportionate abundance of a single invasive taxon (Hopkins 2007). The multi-assemblage approach includes organisms representing different trophic positions and very different generation times; inclusion of organisms with long (e.g. fish) and short (e.g. algae) generation times assists in determining whether measured conditions in the Portneuf River are more chronic or acute, localized or widespread. Moreover, the structure of fish assemblages (representing mobile, relatively long-lived organisms), including the presence or absence of individual species, provides a first overall indication of the biological situation in a water body (Schimer 2000). Finally, comparisons between contemporary and historic biomonitoring efforts (Minshall and Andrews 1973 or Mende 1989) offer additional insight on the direction of change in the Portneuf River over several decades.

Acknowledgements

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Appendix G. Data Sources

Information and data used for the Portneuf River Subbasin TMDL and Biological Assessment were provided from the following sources:

- City of Inkom
- City of Lava
- City of Pocatello
- Idaho Association of Soil Conservation Districts
- Idaho Department of Environmental Quality
- Idaho Department of Fish and Game
- Idaho State University (faculty and students)
- Three Rivers RC & D
- U.S. Environmental Protection Agency
- U.S. Geological Survey
- U.S.D.A. Forest Service
- Dr. Rob Van Kirk, Humboldt State University

Information other than that collected by the DEQ is followed by a citation and the complete reference is included at the end of the TMDL or Biological Assessment (see Appendix F).

Appendix H. Distribution List

Brad Higginson	U.S. Forest Service
Bud Smalley	Caribou Conservancy
Candice Hurt	City of Pocatello
Candon Tanaka	Shoshone-Bannock Tribes
Cary Myler	U. S. Fish and Wildlife Service
Chris Banks	Idaho Association of Soil Conservation District
Clarice Villa	Shoshone-Bannock Tribes
Damien Miller	U. S. Fish and Wildlife Service
Doug Andersen	Hoku Scientific
Dub Hatch	Caribou Soil Conservation District
Hannah Sanger	City of Pocatello
Janet Pacioretty	Portneuf Soil and Water Conservation District
Jim Mende	Idaho Fish and Game
John Sigler	City of Pocatello
Jon Herrick	City of Pocatello
Karl Taft	Hoku Scientific
Keene Hueftle	Southeast Environmental Network
Ken Shimada	Hoku Scientific
Kevin Koester	Portneuf Soil and Water Conservation District
Kim Gower	J.R. Simplot Company
Leigh Woodruff	U.S. Environmental Protection Agency
Lin Whitworth	Bannock County
Louis wasniewski	U.S. Forest Service
Marti Bridges	Idaho Department of Environmental Quality
Monty Johnson	J.R. Simplot Company
Roger Thompson	Southeast Idaho Flyfishers
Roger Turner	Shoshone-Bannock Tribes
S. Galloway	Shoshone-Bannock Tribes
Stewart William	U.S. Environmental Protection Agency
Sue Skinner	U.S. Environmental Protection Agency
Tracy Chellis	U.S. Environmental Protection Agency

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Appendix I. Public Comments

The following comments were received during the Public Comment period and are presente din the order in which they were received. They include responses from the US EPA, City of Pocatello, Shoshone Bannock Tribes and J.R. Simplot Company. Comments are in plain text and responses follow in italics.

EPA Comments

Loading Capacity:

During our review of the TMDL we noted that DEQ did not specifically define a loading capacity for any of the parameters. Furthermore, the loading capacity needs to be broken out between point and non-point sources as well as a margin of safety and take into account natural background conditions. While wasteload allocations (WLA) are defined for point sources, it is never clearly stated how the loads are broken out or what non-point sources (Simplot, agriculture, etc) were given allocations. There is no readily observed information to add the TMDL allocations (WLA, LA) and compare against the total loading capacity.

> *This is duly noted. Tables 5.5 through 5.14 have been updated to reflect these changes. Load capacity is clearly defined along with point and non-point sources, while the margin of safety is implicit in the pollutant target concentration and thus carries through in the load and wasteload allocations. Additional information has been included to allocate loads to non-point sources and groundwater in appropriate reaches.*

There should be a load allocation assigned to Simplot/FMC groundwater or at least to non-point sources in the Batiste to Siphon road reach.

> *Non-point load allocations have been separated out in Table 5.14. Furthermore, both non-point source load allocations and contributions from groundwater have been separated out in this table.*

Reasonable Assurance and the City of Pocatello WLA:

While DEQ did not specifically outline reasonable assurance, it seems likely that the wasteload allocation given to the City of Pocatello was impacted by reductions DEQ believes will be achieved through the VCO with Simplot. If this is the case, then DEQ needs to outline the specific reductions expected through the VCO and how this reduction impacted the WLA given to the City of Pocatello and define it appropriately as reasonable assurance.

> *See section 5.2c in the TMDL for additional language defining reasonable assurance.*

The basis for City of Pocatello allocation is not clear. The key element is the assigned concentration (250 ug/l), and this is buried in a footnote with no policy or technical basis. Also on page 123, DEQ states that "[i]t is anticipated the City of Pocatello will meet this wasteload allocation in a time frame commensurate with the large-scale reductions required through Simplot's remedial actions (i.e., by the year 2020)." However, as EPA has noted on several occasions, the City's National Pollutant Discharge Elimination System (NPDES) permit compliance schedule will be based on 40 CFR §122.47 (a)(1) which states " [a]ny schedule of compliance under this section shall require compliance as soon as possible, but no later than the applicable statutory deadline under the CWA."

The key element for the City of Pocatello's phosphorus wasteload allocation is the final load of 25.1 lbs/day. As is understood, the concentration in the effluent times the flow determines that final load number. For design purposes a concentration of 250 ug/l with the City's design flow capacity achieves a wasteload allocation that based on the total allocation of phosphorus in the river at Siphon Road meets the loading capacity based on our analysis presented in Table 5.14. The City of Pocatello has committed to finance, design, construct and optimize their wastewater treatment facility in a time frame commensurate with J. R. Simplot Company's large-scale remediation project that anticipates meeting the Portneuf River's loading capacity for total phosphorus by the year 2021. In fact, the City has committed to meeting this wasteload allocation 2 years (2019) ahead of the time frame dictated in the Voluntary Consent Order/Compliance Agreement signed by DEQ with J.R. Simplot Company.

Basis for Phosphorus Targets for Mainstem:

Phosphorus targets for the mainstem are based on the TSS targets and TSS/TP relationship, but there is no discussion of whether the values derived from the TSS/TP regression are likely to control nuisance algae growth. DEQ needs to cite literature, Eco-regional criteria, other TMDLs, or use a model to support the selected target values. Otherwise, they are just surrogates for TSS. The reservoir targets are supported by review of literature values and EPA ambient criteria. Need to do the same with riverine phosphorus.

The TP low flow target of 0.070 mg/L is based on the existing 0.075 mg/L target in the Portneuf River TMDL approved by EPA in April 2001, comparisons of site-specific data (TP and dissolved oxygen), and also is consistent with other Snake River watersheds' TMDL TP targets (see the Snake River/Hells Canyon, Mid Snake – Succor, Mid Snake – CJ Strike, Mid Snake – Rock, and American Falls Subbasin TMDLs). Based on extensive data collected in the Portneuf River, a strong, highly significant correlation exists among TSS and TP at all sites except Siphon Road. This relationship was used to predict high flow sediment-derived TP that will unavoidably increase TP concentrations over those found at low flow and arrive at a realistic high flow TP target. Only the high flow TP target was selected based on an empirical relationship with the high flow TSS target. The WAG decided on dual targets (high and low flow) for TP along with TSS, as TP is

highly correlated with TSS and a TP target independent of additional TSS present during runoff would be unreasonable and unattainable. In addition the 0.07 mg/l low flow target presented here incorporates a 9% margin of safety over and above the 2001 Portneuf River TMDL target of 0.075 mg/l.

Miscellaneous:

Table A should be expanded to two tables (high flow, low flow) corresponding to the split targets in the TMDL.

Table A has been updated to correspond to include low flow and high flow targets representing the split targets for the TMDL.

"Wasteload" and "Wasteload Allocation" should be used only in reference to point sources. Need to use "Load allocation" in the TMDL for non-point sources.

This oversight has been noted and changes throughout the document have been made where applicable.

City of Pocatello Comments

1. This document has grown over 200 pages since the last internal review opportunity with changes in chapter numbering, page numbering and wholesale changes or deletions of entire sections.

As a result of internal editing the document has indeed been modified, including changes in page and chapter numbering and section headings.

2. The Portneuf River TMDL Revision and Addendum, Draft Final Version, October 26, 2009 and attachments, "DEQ Pocatello Regional Office Response to: POCATELLO WAG MEMBER COMMENTS", dated 29 May 2009 and Memorandum, dated 19 June 2009 to the Pocatello Watershed Advisory Group, from the DEQ Pocatello Regional Office, regarding "Revisions to the Revised Portneuf River Subbasin TMDL (date 29 May 2009)", were received (all three documents) November 2, 2009.

As a result of the extensive internal editing process, the distributions of these materials were delayed several months.

3. An entirely new methodology for calculating storm water loads has been inserted since the last draft TMDL, January 9, 2009. The methodology and assumptions of calculating the storm water loads appear to be unique to the State of Idaho and possibly the EPA region.

*In DEQ's Responses to City of Pocatello Comments (6-19-09), this method was proposed and defined, based on the inadequacy of monthly sampling data to sufficiently characterize short term discrete events. Continuous monitoring up and downstream of the Pocatello Urbanized Area (PUA) is required in Part IV.5. of the MS4 Stormwater Permit. Initial stormwater load estimates were based on monthly sampling data; however, a much more complete data set was available using continuous turbidity monitoring records. Many discrete, short term events are included in the continuous record that are missed during monthly monitoring. For estimates of daily sediment load we converted turbidity data to total suspended solids (TSS) concentrations with an empirical relationship based on samples taken at six long-term sampling locations along the Portneuf River. This relationship was linear and statistically significant (TSS (mg/l) = 2.3597*NTU + 9.609, R^2 = 0.95, P<0.001, N = 217). A similar process was used to convert turbidity to TP estimates, using the linear and statistically significant relationship among turbidity and TP (TP (mg/L) = 0.003*NTU + 0.0264, R^2 = 0.90, P<0.001, N = 192).*

Data collected at the Fichter and Batiste sites bracket the PUA contributions to the Portneuf River. These data were used to estimate suspended sediment and phosphorus inputs, as they are the best available data to use for these purposes. DEQ acknowledges there may be some gaps in this data set. City Creek and Pocatello Creek (return flows from the Highline Canal) may influence loads to the river. The City's future data set regarding stormwater outfall loads will help refine these load estimates.

DEQ agrees that the methodology and assumptions used for calculating stormwater loads may be somewhat unique to Idaho and EPA Region 10. The Portneuf River, the PUA's stormwater inputs to it, and the design of the water quality monitoring system is unique in and of itself and has allowed us to objectively quantify pollutant loads in this complex river reach.

4. Comments were formally made through the WAG process and especially the last review dated February 25, 2009 on the 9 January 2009 DRAFT Portneuf River TMDL Revision. Although all of the comments were addressed in a response dated 29 May 2009, only a few of the comments and responses affected language in the TMDL or showed up in the October 26, 2009 Portneuf River TMDL Revision and Addendum reflecting changes.

DEQ made numerous changes to the TMDL based on these comments and attempted to address additions or deletions in the document where warranted. We also attempted to address each comment with a response in the document of 19 June 2009 regardless of whether or not the comment elicited a change in the document.

5. Title: The title is now "Portneuf River TMDL Revision and Addendum". What is the Addendum and where is it described in the document?

The addendum includes the appendices and the biological assessment.

6. Page xxx; Table A; The TP load/wasteload allocation (lbs/day) for the City of Pocatello WWTP is 25.1. The footnote refers to Tables 5.5 to 5.14 for seasonal and interannual estimates, yet Table 5.14 (page 128) lists 25.1 for every month for the City of Pocatello WWTP TP wasteload allocation. Why isn't there a seasonal TP wasteload for the WWTP?

Unlike the Portneuf River and its tributaries, flows discharged from WWTPs are relatively steady throughout the year. Also, TSS is fairly consistent, and is not a large component of the WWTP discharge. Loads for the river incorporate changes in monthly flows and runoff and non-runoff TSS/TP target concentrations. Assigning even monthly waste load allocations for the WWTP is consistent with waste loads allocated to other WWTPs in this region.

7. When and how will the process for the "Implementation Plans" be addressed?

Implementation is the responsibility of individual agencies, cities and groups. It is anticipated that the Portneuf River TMDL Implementation Plan completed by Portneuf River stakeholders and assembled under one cover by DEQ in July 2003 will be reviewed and updated by the those entities that originally contributed to its development. It is DEQ's intent to continue to provide an opportunity for the WAG to meet and move the implementation process forward.

J. R. Simplot Company Comments

This document provides J.R. Simplot Company (Simplot) comments on the draft final October 2009 Portneuf River Total Maximum Daily Load (TMDL) Revision and Addendum. As a stakeholder in the TMDL process for many years, Simplot recognizes the amount of work that the Idaho Department of Environmental Quality (DEQ) and others have invested in evaluation and assessment of the river, and also recognizes DEQ's considerable efforts in producing this document. Simplot believes that this version of the TMDL represents a reasonable path forward to improve water quality in the river given our current state of understanding of the complex relationships involved.

Our comments are focused on the following primary areas:

1) Development of the Nutrient Target

2) Uncertainties and Data Gaps

3) Future Monitoring Goals

4) Phased Implementation

Development of the Nutrient Target:

One of the primary revisions to the TMDL relative to previous versions in this phased TMDL process was to establish empirically-based targets for nutrients. This empirical approach is warranted at this time given that nutrient loading and cycling is a complex connection of physical, biological, and chemical processes that differ depending on each river's unique characteristics. As recently concluded by the Ecological Processes and Effects Committee of U.S. Environmental Protection Agency's Science Advisory Board ("SAB Review of Empirical Approaches for Nutrient Criteria Derivation," pre-draft of report to be issued on December 9, 2009), empirical approaches alone generally are not sufficient for establishing clear "cause-and-effect" relationships between nutrients and response variables, but can serve as an important line of evidence in a weight of evidence approach.

> *DEQ understands this and appreciates Simplot's view*.

In the case of the Portneuf River, the empirical approach used by DEQ for this TMDL revision is based on a reasonably strong dataset that has been collected cooperatively by the agency and other stakeholders, including Simplot. DEQ also conducted a much more extensive biological assessment for this TMDL revision than had previously been available (Appendix F of the revised TMDL). Thus, DEQ has been diligent to explore multiple lines of evidence and stressor responses, and although we don't yet have all the answers (see *Uncertainties and Data Gaps* section), we are making progress.

> *DEQ agrees that there is yet to be more known and/or discovered and appreciates Simplot's view.*

A unique aspect of this revised TMDL is that the total phosphorus (TP) target was developed for the mainstem river, in part, by the empirical relationship between total suspended sediments (TSS) and TP. This approach relies on existing data that are specific to the Portneuf River. Flow-tiered TSS targets were based on the 2001 TMDL for high-flows (14-day average concentration not to exceed 80 mg/L), and a revised target for low-flows (28-day average concentration not to exceed 35 mg/L). The flow-tiered target was developed recognizing that spring and high-flow periods represent a higher loading regime than low-flow periods. The revised low-flow target of 35 mg/L is lower than the 2001 TMDL target based on literature values and Marsh Creek fish sampling data.

> *See response to the Shoshone-Bannock Tribes first comment for further clarification of this statement.*

Consistent with the TSS target, a flow-tiered TP target was also developed. Both targets are summarized in Exhibit 1.

EXHBIT 1.
SUMMARY OF TSS AND TP TARGETS FOR MAINSTEM PORTNEUF RIVER IN REVISED TMDL

Constituent	High-Flow Target (March – June)	Low-Flow Target (July – February)
TSS	80 mg/L	35 mg/L
TP	125 ug/L	70 ug/L

Monitoring data used to develop the relationship between TSS and TP were collected over 3 years and represent nearly 200 sample pairs. These samples represent a reasonably wide range of TSS and TP concentrations (4.1 mg/L to 341 mg/L TSS and 5 ug/L to 420 ug/L TP), which helps lend credibility to the approach.

Based on these sample pairs, a low-flow TP concentration of 72.5 ug/L corresponds to the low-flow TSS target concentration of 35 mg/L. DEQ adjusted the target down to 70 ug/L via an implicit margin of safety (MOS). A high-flow TP concentration of 125 ug/L corresponds to the high-flow TSS target concentration of 80 mg/L. No additional MOS was applied to the high-flow target because DEQ determined that the high-flow design discharge was conservative.

To rely on such an approach, the two constituents (TSS and TP) need to be well correlated. The available dataset relied primarily on optical turbidity measurements, which were then converted to TSS and TP. Above the Eastern Michaud Flats (EMF) Superfund Site (i.e., Batiste Road and upstream locations), the relationships were linear and statistically significant (TSS $R2 = 0.95$, $P < 0.001$, $N = 217$ and TP $R2 = 0.90$, $P < 0.001$, $N = 192$). At Siphon Road (downstream of the EMF Site), relationships based only on Siphon Road-

specific samples were also statistically significant but had a lower correlation coefficient (TSS R2 = 0.84, P < 0.001 and TP R2 = 0.66, P < 0.001).

The correlation is better upstream of Batiste Road primarily because upstream TP sources are largely non-point source loads that are variable depending on flow regime. In contrast, downstream of Batiste Road the river is more influenced by groundwater inputs and is less dependent on instream turbidity conditions. In addition, the data show that the form of phosphorus is different at Batiste Road as compared to Siphon Road. At Batiste Road, dissolved phosphorus is approximately 34 percent of TP, which means that there is more particulate phosphorus associated with sediments. In contrast, the Siphon Road site has a greater percentage of dissolved phosphorus (92 percent of TP), which reflects the larger influence from groundwater. Both of these influences help explain why the correlation between TSS and TP is stronger at, and upstream from, Batiste Road.

DEQ agrees.

DEQ also evaluated whether these empirically-based targets would support beneficial uses. Upstream from the EMF Site at Batiste Road, median TP concentrations of 75 ug/L were observed. These TP concentrations were observed with average dissolved oxygen (DO) values of ~6.5 mg/L and 29 percent of DO measurements falling below the minimum criterion of 6.0 mg/L. Thus, DO values are below water quality standards even when the TP target is met at this location. This is presumably because a number of water quality processes influence DO concentrations, including elevated temperatures, low water levels, flow regulation, oxygen-demanding materials, groundwater, or some combination of all these factors.

DEQ recognizes this and appreciates Simplot's view.

The compounding effects of these same issues at Siphon Road make interpretation of DO data difficult, where median TP concentrations are much higher than 75 ug/L and low DO values are also observed (average DO values of ~5.6 mg/L and 76+ percent of DO measurements falling below the minimum criterion of 6.0 mg/L). This issue is discussed in more detail in the *Uncertainties and Data Gaps* section.

The revised TP target of 70 ug/L (from 75 ug/L) is consistent with other regional targets developed specific to the Snake River and its tributaries (Exhibit 2).

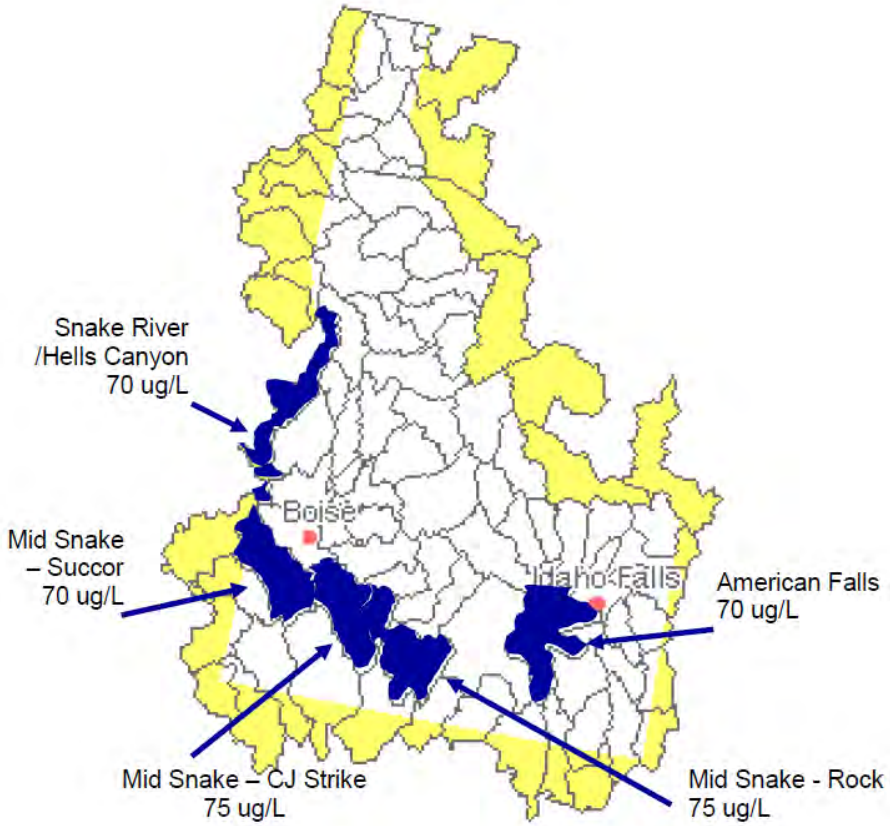


EXHIBIT 2.
REGIONAL TP TMDL TARGETS

The revised TP target is consistent relative to these other TMDL targets. More importantly, the approach used in this revised TMDL is based on a more complete empirical dataset than most other regional TMDLs, which is due to the partnership approach used to collect data in this watershed.

DEQ agrees.

Uncertainties and Data Gaps:

DEQ has expanded on the previous TMDL by including additional chemical and biological data collected through 2009. The summaries of available information add credibility to the TMDL.

Nonetheless, there continue to be uncertainties related to the question of how much of the observed impairment is due to excess nutrients and how much of the observed impairment is due to other factors such as elevated temperatures, low water levels, flow regulation, groundwater influences, oxygen-demanding materials, land uses, or some combination of all these factors.

DEQ recognizes these additional variables and is committed to additional work in the future. It is likely that TMDLs will need be written for temperature coupled with dissolved oxygen in the future.

The purpose of this section is to identify the primary uncertainties given the available dataset so that data gaps can be identified. Future monitoring can then be targeted to potentially address these gaps and refine our collective understanding of nutrient impairment in the Portneuf River.

Batiste Road Compared to Siphon Road

The Portneuf River changes in the reach between the Batiste Road (immediately upstream from the EMF Site) and Siphon Road (farthest downstream) monitoring stations. This change and the data collected from each reach are helpful in identifying uncertainties.

For example, if nutrients were the primary cause of impairment, there should be a stronger relationship between TP and DO. Exhibit 3 shows a plot of average daily minimum DO and average summer TP levels for 2003 through 2008, and the lack of strong relationship between those two parameters at both Batiste Road and Siphon Road.

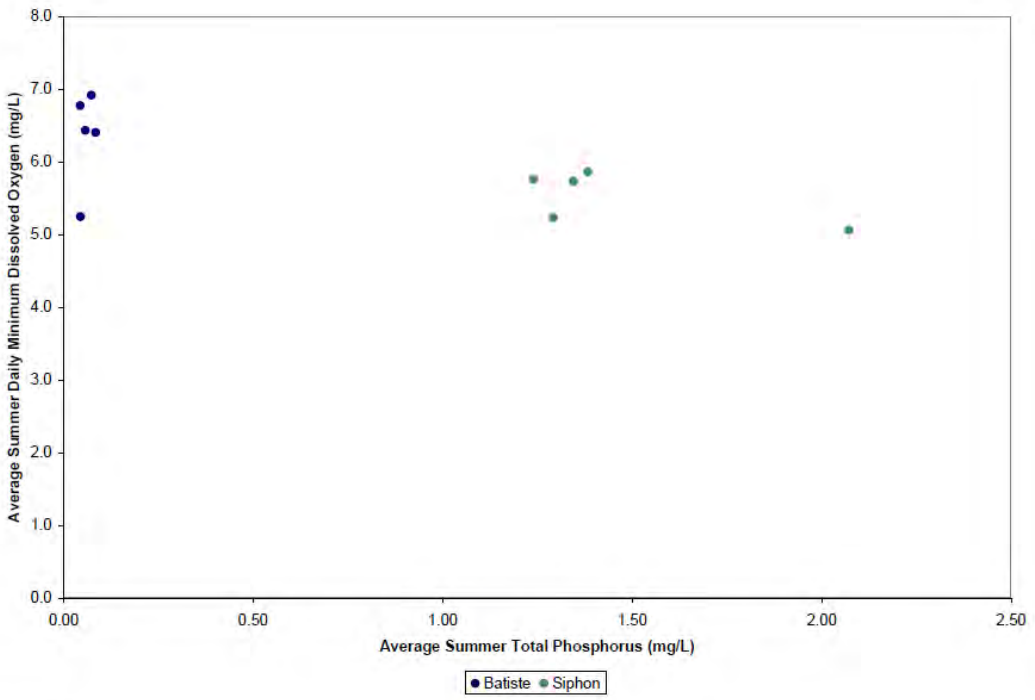


EXHIBIT 3.
AVERAGE SUMMER DAILY MINIMUM DO COMPARED TO AVERAGE SUMMER TP (2003 TO 2008)

Exhibit 3 would present better with the x-axis transformed lognormal.

The differences in phosphorus concentrations between Batiste Road and Siphon Road are substantial, but the minimum DO values do not seem to be strongly related to this nutrient gradient (the coefficient of determination [R2] for data in Exhibit 3 is only 0.49).

The available data show that the minimum DO values at the downstream site are within the range of the minimum DO values at the upstream sites even though the nutrient concentration ranges are substantially different. Thus, a clear causative linkage to nitrogen and/or phosphorus is difficult to establish from these data. Exhibits 4 and 5 show data collected in 2008 as an example.

> *DEQ does not disagree with this statement but asserts that hydrology and water temperature play a significant role in dissolved oxygen dynamics and potential differences from Batiste Road to Siphon and may mask nutrient impacts.*

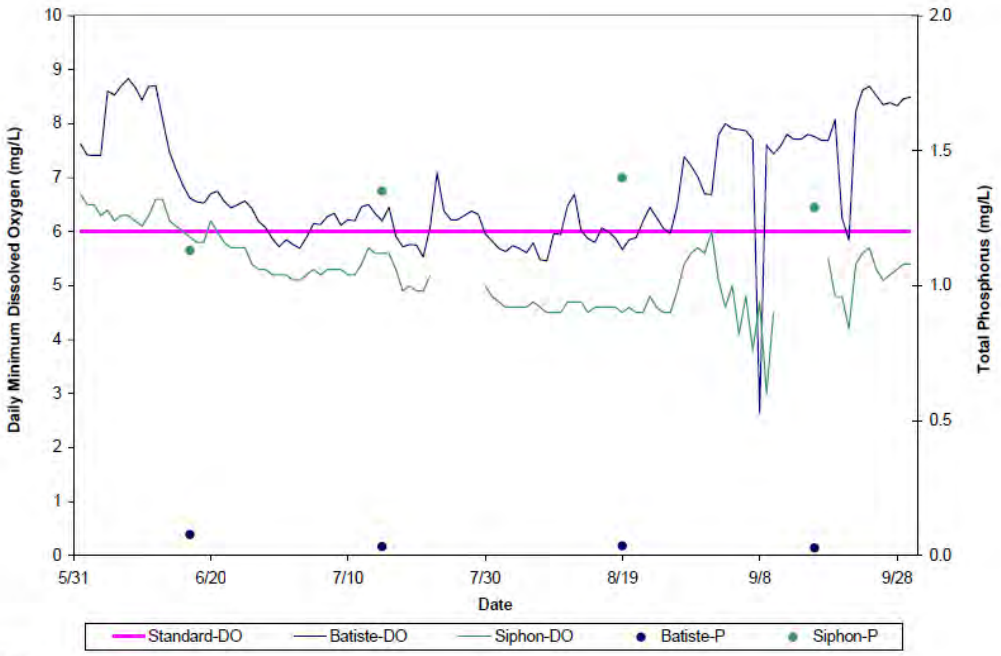


EXHIBIT 4.
SUMMARY OF DO AND TP MONITORING AT BATISTE ROAD V. SIPHON ROAD (2008)

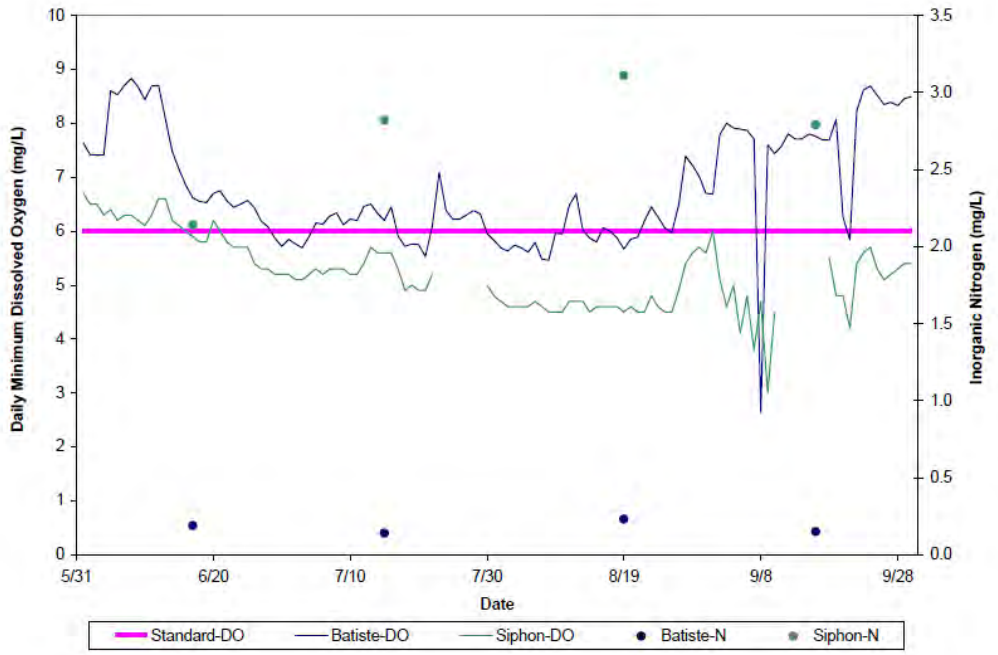


EXHIBIT 5.
SUMMARY OF DO AND NITROGEN MONITORING AT BATISTE ROAD V. SIPHON ROAD (2008)

A summary of average observed data at both sites is presented in Exhibit 6.

		Batiste	Siphon
2000	Avg Daily Min DO	-	-
	Avg Daily Min pH	-	-
	Avg Daily Max pH	-	-
	Avg P	0.08	1.33
	Avg N	0.17	2.62
	Veg (%)	42.90	72.00
2001	Avg Daily Min DO	-	-
	Avg Daily Min pH	-	-
	Avg Daily Max pH	-	-
	Avg P	0.06	1.30
	Avg N	0.30	2.77
	Veg (%)	33.30	85.20
2003	Avg Daily Min DO	5.25	5.76
	Avg Daily Min pH	7.86	7.13
	Avg Daily Max pH	8.52	7.62
	Avg P	0.05	1.24
	Avg N	0.24	2.91
	Veg (%)	-	-
2005	Avg Daily Min DO	6.92	5.73
	Avg Daily Min pH	9.39	7.47
	Avg Daily Max pH	9.53	7.77
	Avg P	0.07	1.35
	Avg N	0.18	2.42
	Veg (%)	70.00	96.30
2006	Avg Daily Min DO	6.41	5.97
	Avg Daily Min pH	9.34	7.46
	Avg Daily Max pH	9.47	7.62
	Avg P	0.09	1.36
	Avg N	0.39	2.53
	Veg (%)	14.30	74.10
2007	Avg Daily Min DO	6.44	5.06
	Avg Daily Min pH	8.22	7.33
	Avg Daily Max pH	8.41	7.63
	Avg P	0.06	2.07
	Avg N	0.23	2.86
	Veg (%)	-	-
2008	Avg Daily Min DO	6.78	5.24
	Avg Daily Min pH	8.31	7.44
	Avg Daily Max pH	8.49	7.76
	Avg P	0.04	1.29
	Avg N	0.18	2.72
	Veg (%)	-	-
2009	Avg Daily Min DO	-	-
	Avg Daily Min pH	-	-
	Avg Daily Max pH	-	-
	Avg P	0.10	0.72
	Avg N	0.22	2.02
	Veg (%)	-	-
Combined	Avg Daily Min DO	6.36	5.53
	Avg Daily Min pH	9.26	7.37
	Avg Daily Max pH	8.48	7.65
	Avg P	0.07	1.34
	Avg N	0.24	2.61
	Veg (%)	40.13	81.90

Note: DO and pH averages come from continuous datasets. P and N averages come from discrete datasets where samples were collected approximately once per month. DO, pH, P, and N measurements were averaged over the summer season (June-September). Vegetative cover percentages come from a single summer measurement.

EXHIBIT 6.
SUMMARY OF AVERAGE DATA AT BATISTE ROAD V. SIPHON ROAD (2000 TO 2009)

One important data point to note is that the average TP concentration at Siphon Road for 2009 was 0.72 mg/L as compared to values ranging from 1.24 to 2.07 mg/L for previous years. This represents a 41 percent to 65 percent reduction from those previous years. This is a direct result primarily of the groundwater remediation project currently being implemented

by Simplot at the Don Plant site. For example, phosphorus load at Siphon Road has reduced from approximately 3,000 pounds per day in 2007 to 1,600 pounds per day in 2009. Currently, the groundwater extraction system at the Simplot Don Plant removes approximately 2,000 pounds of phosphorus per day in groundwater before it can discharge to the Portneuf River. The full effect of the current extraction system has yet to manifest in the river due to groundwater travel times. Further, the extraction system will be expanded in 2010 and extensive source controls will begin implementation.

> *At this juncture DEQ does not wholly agree with the groundwater extraction system being responsible for the downward trending concentrations evidenced in the river at Siphon Road. It is likely that other remedial actions taken by Simplot in the Don Plant area through 2008-09 may have shown successes. Regardless, DEQ is encouraged by the apparent decreasing phosphorus concentrations and is hopeful this trend continues.*

For water temperature and maximum pH (which is related to increased algal activity), the general trend is substantial improvement in quality at Siphon Road compared to Batiste Road. The substantially cooler water temperatures at Siphon Road are presumably related to groundwater that enters the river downstream of Batiste Road. This groundwater inflow is relatively constant at approximately 225 cubic feet per second (cfs), compared to an average annual instream flow of approximately 200 cfs (but highly variable) at Batiste Road (DEQ data from June 2003 to August 2009). Regional groundwater in the valley just north of the EMF facilities has a relatively constant temperature year-round, typically between 12 and 13 degrees C and relative constant pH, typically 7.4 to 7.6 su (EMF wells 524 and 524, data record from 2000 to present). Approximately 30 cfs of this groundwater originates from the EMF Site and has a pH ranging from 6.5 to 7.5 (Batiste Spring and the Spring at Batiste, quarterly data since 2000) and is not elevated in temperature. Thus, regional groundwater tends to reduce the pH and cool the river down- stream of Batiste Road and is believed to have a significant influence on river conditions at Siphon Road.

> *DEQ agrees.*

Comparison of the data with Idaho water quality standards for pH and temperature is summarized below:

- pH: The water quality standard for pH is to be in the range of 6.5 to 9.0 units. pH upstream of the EMF Site at Batiste Road is substantially higher (approaching the maximum end of the allowable range) than at Siphon Road. High pH is often attributable to eutrophic conditions (i.e., algal activity). When average summer daily maximum pH is compared to TP and inorganic nitrogen concentrations, eutrophication due to high pH is not occurring at Siphon Road because of substantial neutralization from groundwater inputs.
- Temperature: The corresponding temperature standard for the Portneuf River on a daily average basis is 19 degrees C for protection of cold water biota (note: 22 degrees C is the instantaneous standard). Average daily temperature values frequently

exceed the temperature standard at Batiste Road, while the standard is always met at Siphon Road, due to the large influx of regional groundwater with temperature typically in the range of 12 to 13 degrees C. An example for 2008 is shown in Exhibit 7.

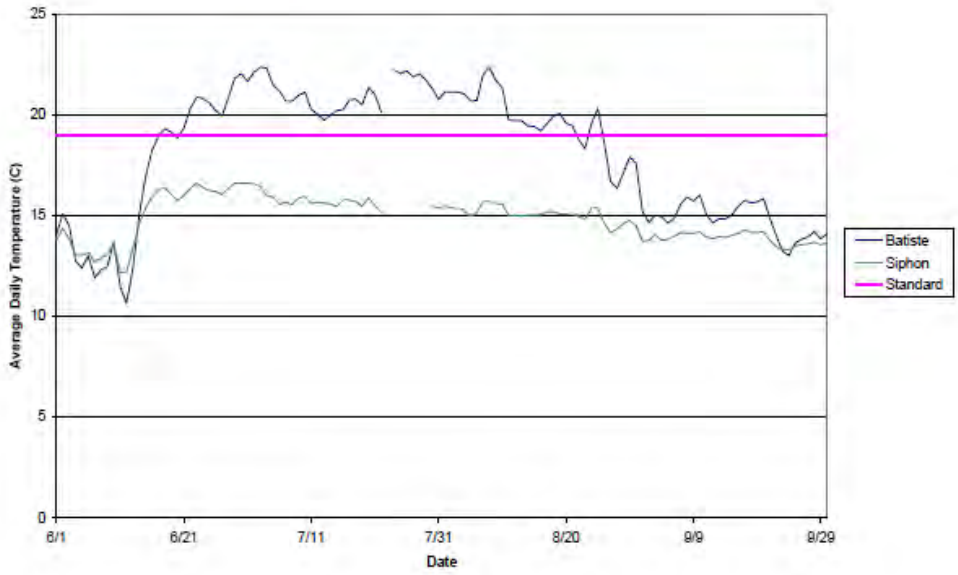


EXHIBIT 7.
DAILY TEMPERATURE COMPARISON BATISTE ROAD V. SIPHON ROAD (2008)

Finally, there are some key data gaps that prevent further assessment. There are other sources of pollutants and other activities that occur between Batiste Road and Siphon Road that could explain, at least in part, some of the differences observed between these sites. These include, regional groundwater inflow, discharge from the Pocatello Wastewater Treatment Plant, septic tanks, fish hatchery operations, runoff from agricultural and urban areas, and removal of water via the Michaud Canal. DO concentrations are affected by multiple processes, including sediment oxygen demand, reaeration, and oxygen-demanding materials; in addition to nutrient-related eutrophication effects. The relative importance of these various processes on the DO regime requires further analysis.

DEQ agrees and intends to continue working with interested stakeholders to describe these processes as time and resources permit

Biological Data

Appendix F of the revised TMDL presents a detailed Biological Assessment. Uncertainties and data gaps related to these data are summarized below.

Periphyton and Macrophytes

Based on a recent study by Hopkins[1], DEQ notes that both *Cladophora glomerata* and *Spirogyra communis* were observed at sites along the mainstem and suggested that "the near dominance of *C. glomerata* in the Portneuf River (present at 8 of 10 sites), is likely

1 Hopkins. J.M. 2007. Spatial and temporal evaluation of macroinvertebrate communities in the Portneuf River, Idaho. PhD dissertation, Idaho State University.

characteristic of nutrient enrichment and a subsequent loss of algal diversity" (p. 258 in Appendix F).Relative abundance of these two species (both of which are common, widely distributed, native filamentous green algae) in the Portneuf watershed was not presented on a mass or areal extent basis, but *C. glomerata* was observed at both Batiste Road and Siphon Road, while *S. communis* was observed at Siphon Road but not at Batiste Road (Hopkins, 2007). In addition, the Batiste Road site had only one taxon present (*C. glomerata*), the Siphon Road site had a total of 9 taxa present. The observation of multiple taxa at Siphon Road (below the Simplot Don Plant) may suggest that nutrient enrichment has not caused as much depletion of algal diversity as suggested in Appendix F.

With respect to diatoms, the available data also appear to be somewhat contradictory. For example, diatom richness and diversity was lowest at the minimally-impaired stations Upper Portneuf Sportsman's Access (47 species) and Gibson Jack Creek (54 species). In contrast to these upper river sites, a total of 87 species were identified at Siphon Road. Similarly, Shannon's diversity index was 2.9, 3.1, and 3.5 for the Upper Portneuf Sportsman's Access, Gibson Jack Creek, and Siphon Road, respectively. Although higher community richness can be generally associated with a better ecological condition, Idaho-specific research conducted to develop waterbody assessment guidance showed the total number of diatom taxa increased with increasing measures of human disturbance (except mining disturbance). Given this relationship, the rich diatom assemblage at Siphon Road may or may not reflect greater disturbances. The diatom study results may also be an artifact of collection method limitations.

> *Hopkins (2007) used a line intercept method to document the composition of the macrophyte assemblages and estimate the wet weight of total macrophyte aboveground standing stock biomass along three transects at each study reach. Macrophyte biomass may provide a better indicator of the trophic status of a river reach (i.e. an expression of ecological condition) than other community metrics (i.e. diversity or richness). Macrophyte biomass is directly correlated with dissolved oxygen concentrations (Kaenel et al. 2000; Miranda et al. 2000) and respiration by large stands of macrophytes (regardless of floristic composition) at night can created dissolved oxygen levels that are toxic or lethal to fish (Miranda et al. 2000). Moreover, diversity and richness macrophytes indices reported without an understanding of biomass of the community are of limited value because nutrient status is one of only a number of selective pressures (i.e. water depth, velocity, substrate, light penetration) shaping the macrophyte assemblages (Kelly and Whitton 1998). A comparison of factors contributing to the richness of macrophyte assemblages among reaches is not possible from information provided; however, from*

the sampling conducted by Hopkins, macrophyte richness is a good predictor of macrophyte biomass (R^2=0.88, P<0.001, N=10; natural log biomass [expressed as wet weight] = 0.506 [macrophyte transect richness] + 0.735). In 2005, Hopkins (2007) reported that Portneuf River macrophyte biomass was greatest just upstream of the confluence of Pebble Creek (1,187 g/m^2) and at Siphon Road (980 g/m^2). That year, macrophyte biomass was 196X greater at Siphon Road than for the Portneuf River Batiste Road. Figure 5a from the biological assessment contrasts dissolved oxygen concentrations in the Portneuf River at Batiste and Siphon Road in 2005 (the year of Hopkins study). Dissolved oxygen in the Portneuf River at Siphon Road dropped below the DEQ's aquatic life criteria on 82% of the days within the critical biological period (15 July and 15 September). Taken together, the statistically significant positive relationship between macrophyte richness and biomass indicates that these two measures are related and not contradictory and show that both macrophyte richness and biomass are positively correlated with nutrient enrichment in the Portneuf River.

Diatom assemblage summaries from three locations of the Portneuf River are reported from work completed by Bechtold (unpublished). This work shows that diatom richness was greatest for samples taken from the Portneuf River at Siphon Road. More specifically, 78% of the taxa found on the control treatments from the Portneuf River at Siphon Road are tolerant of elevated N, 41% are tolerant of moderate dissolved oxygen concentrations, 74% are tolerant of moderate pollution, and 69% of identified taxa were indicative of a eutrophic status. Gibson Jack Creek and the Portneuf River at Upper Sportsman's Access were also represented predominantly by diatoms common to eutrophic rivers (75 and 74 %, respectively). It should be noted that this analysis was restricted in both space (3 sites) and time (one sampling) and therefore a cautious interpretation of these findings is encouraged. However, like macrophytes, diatom composition and abundance is a result of range of selection pressures (e.g. temperature, light, nutrient status, substrate availability) and habitat heterogeneity. The Portneuf River at Siphon Road presents lentic-like (or slow-water) conditions below a segment dominated by riverine habitats; increased optical clarity and additional substrates from a rich and abundant collection of macrophytes are also available below Siphon Road. When the combined influence of increased habitat complexity, reduced velocities, and an abundance of dissolved nutrients are considered collectively, it is not altogether surprising that additional diatom species were supported in the Portneuf River below Siphon Road.

Hopkins, J. M. 2007. Spatial and temporal evaluation of macroinvertebrate communities in the Portneuf River, Idaho & an inquiry-based field and laboratory exercise on in-stream leaf litter decay. Doctor of Arts Dissertation, Idaho State University, 185 p.
Kaenel, B. R., H. Buehrer, and U. Uehlinger. 2000. Effects of aquatic plant management on stream metabolism and oxygen balance in streams. Freshwater Biology 45:85-

95.

Kelly, M.G. and B.A. Whitton. 1998. Biological monitoring of eutrophication in rivers. Hydrobiologia 384:55-67.

Miranda, L. E., M. P. Driscoll, and M. S. Allen. 2000. Transient physicochemical microhabitats facilitate fish survival in inhospitable aquatic plant stands. Freshwater Biology 44:617-628.

In recent years, DEQ has been collecting data relating to vegetative cover of substrate at various sites within the Portneuf River. There are no promulgated water quality standards for percent cover by aquatic vegetation. The percent cover by aquatic vegetation data exhibit extensive variability from year to year, with the upstream stations ranging from 5 percent to 75 percent. Information from the DEQ survey from all years combined is summarized in Exhibit 8 (percent cover includes macrophytes, filamentous algae, and epilithic algae)

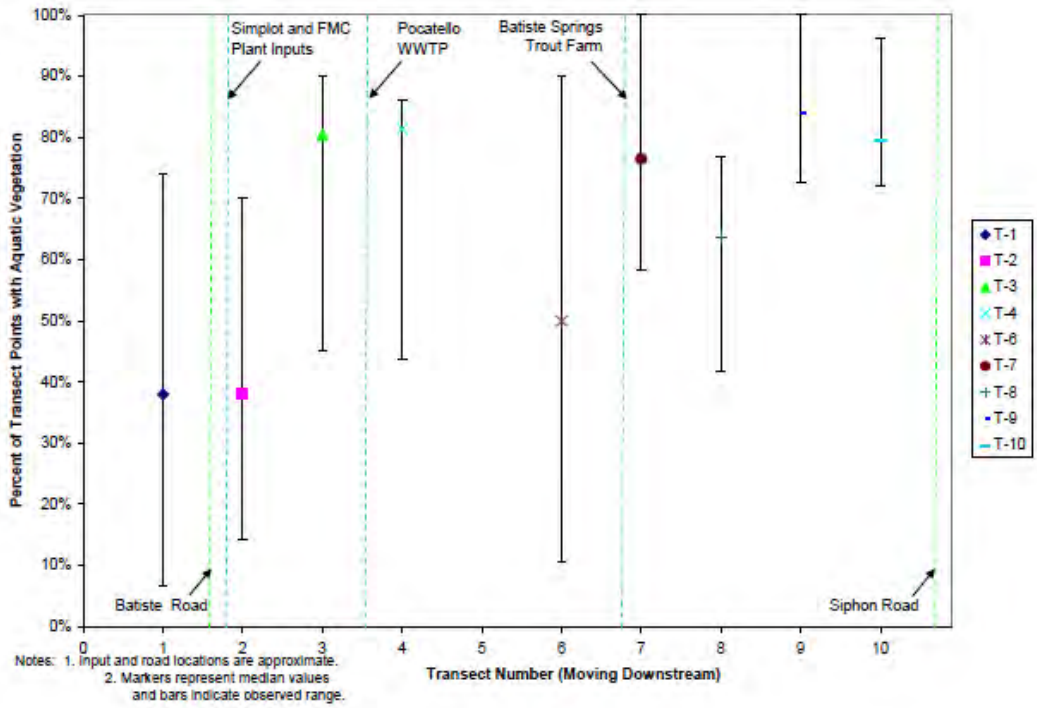


EXHIBIT 8.
SUMMARY OF DEQ AQUATIC VEGETATION COVER SURVEYS (CHART PREPARED BY CH2M HILL FROM DEQ DATA)

The percent cover and macrophyte data are difficult to interpret because there is no information available on key factors affecting these biological communities; in particular the nature of the bottom substrate, riparian cover, and river hydraulic conditions. Any of these factors, alone or in combination, can have a more determinative role than water chemistry, including nutrients.

Also, these percent cover data include both macrophytes and periphyton, without characterization of how much of the cover is represented by each of these aquatic vegetation types. This is an important consideration because rooted aquatic plants obtain their nutrients from the sediment, while periphytic algae obtain nutrients from the water column. Exhibit 9 (copied from Table 3 of DEQ's Appendix F) also includes the "percent occluded" data, which is the percent of emergent vegetation (i.e., plants with roots in the sediment but which rise out of the water for much of the year). It is apparent that the percent emergent vegetation cover does not exhibit a uniform increase in the downstream direction between Batiste Road and Siphon Road, and indicate that the portion of the total vegetation cover represented by emergent vegetation is fairly low and about the same at Batiste Road and Siphon Road (10% and 2%, respectively).

EXHIBIT 9.
PERMANENT TRANSECT LOCATIONS FOR AQUATIC VEGETATION MONITORING IN THE LOWER PORTNEUF RIVER

Transect	Reach Description	Transect length (ft)	Percent occluded*	Percent transect with aquatic vegetation**
1	Above Interstate (FMC & Swanson springs complex)	44.3	0.9	39.1
2	Below FMC & Swanson springs complex	60.5	11.8	40.1
3	Above Pocatello WPC	81.1	4.5	74.0
4	Below Pocatello WPC	92.8	21.8	73.2
6	Above Batiste Springs Trout Farm discharge	61.1	14.7	50.1
7	Below Batiste Springs Trout Farm discharge	96.5	16.2	77.8
8	Between Batiste Road and Papoose Springs	97.5	5.6	61.5
9	Above Papoose Springs	88.4	1.6	85.2
10	Below Papoose Springs	111.2	8.1	81.9

Source: Originally produced as Table 3 in Appendix F of the *Portneuf River TMDL Revision and Addendum* (DEQ, 2009)

Notes:
Values represent averages of years 2000, 2001, 2005, and 2006. Data provided by DEQ PRO.
*Percent occluded indicates the percentage of emergent vegetation.
**Percent transect with aquatic vegetation includes emergent and submerged macrophytes, filamentous algae, and epilithic algae (the latter are periphyton that attach to bottom gravels and cobbles).

Lastly, with respect to periphyton and macrophyte data, two additional recent studies were described in DEQ's Appendix F (Section 2.6). The first was a study published in 2009 assessing Portneuf River biomass using *in-situ* nutrient diffusing substrate bioassays. The second was conducted in 2007 and used controlled conditions bioassays with macrophytes and epiphytes (the latter is a kind of periphyton that attaches to aquatic plants). Both studies included sites on Marsh Creek and the mainstem river, including at Batiste Road and Siphon

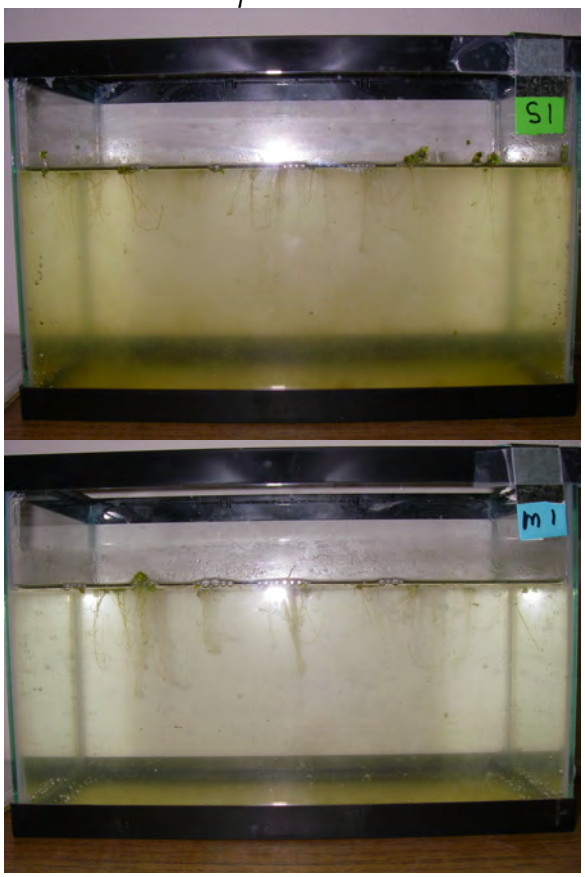
Road. DEQ concludes from these two studies combined that: "…biomass in the Portneuf River watershed are greatest at Marsh Creek and the Portneuf River at Siphon Road," which are sites DEQ characterizes as eutrophic. This general conclusion, however, does not appear to be consistent with some of the more specific results. For example, the

Marsh Creek bioassay testing had an orthophosphorus (OP) concentration of only 22 ug/L compared to a Siphon Road concentration of 775 ug/L, yet the plant biomass concentration at Marsh Creek was higher than at Siphon Road. In addition, the plant biomass at Batiste Road for the bioassay testing was about the same as at Siphon Road.

On the other hand, the epiphyte biomass in the bioassays was substantially greater at Siphon Road and Marsh Creek than at Batiste Road (which may be reflective of the concept that rooted macrophytes obtain nutrients via sediment while the epiphytes uptake nutrients from the water column), but the biomass values do not appear to be well-predicted by the relative OP concentrations at these sites (e.g., the biomass at Marsh Creek is substantially higher than Batiste Road even though the OP concentrations are similar).

> *The bioassays discussed in Section 2.9 provide evidence to how aquatic organisms, specifically macrophytes, epiphytic algae, and epiphytic bacteria, may respond to variations in available nutrients. It should be noted that these simplified, short-term (10 to 14 days) experiments provide some indication on the relative potential, but not the absolute magnitude of the plant, algal, or bacterial growth under various nutrient scenarios. The nutrient diffusing substrates (NDS) used by Marcarelli et al. were located on the river bed and are subject to shearing forces of flowing water or grazing by snails and other macroinvertebrate grazers. For this reason, the absolute amount of chlorophyll a or dry mass (AFDM) should not be interpreted as the absolute difference in gross primary production among sites that vary in nutrients only; these sites co-vary in terms of the site-specific clarity and water velocity. Additionally, aquatic macrophytes and algae can vary considerably in their ability to incorporate nutrients, either based on the availability of nutrients or the velocity of water at a given site (see Baldy et al. 2007 or Wilhelm 2006 for a local example). Work completed recently in the Portneuf River showed that a single plant species can vary considerably in its tissue nutrient contents. Potamogeton pectinatus was surveyed across its occurrence in the Portneuf River to demonstrate this point. Variation in the mass of nitrogen (N) and phosphorus (P) in Potamogeton pectinatus aboveground tissues was high among sites; P. pectinatus tissue N ranged from 1.2 to 3.4% nitrogen (by mass) and tissue P varied from 0.14 to 0.72% across 10 river locations. From this work, it is apparent that nutrient rich sites can support plants or algae with tissue concentrations that are 3X (N) to 5X (P) higher than nutrient poor sites and these differences are not revealed from biomass estimates alone.*
>
> *The unpublished assay using duckweed and it native epiphytes was carried out over a 10-day period and under controlled conditions. While plant biomass was similar between waters collected from lower Marsh Creek and the Portneuf River at Siphon Road, epiphyte AFDM was significantly greater in waters from the Portneuf River at*

Siphon Road (see attached photos for visual illustration: S=Siphon Road and M=Marsh Creek). Epiphytes are positioned atop macrophyte tissues and therefore absorb/intercept a large fraction of the incident light reaching macrophyte surfaces (Drake et al., 2003); epiphytes also have carbon fixation and P uptake rates that can exceed those of vascular aquatic plants (Cattaneo and Kalff, 1980; Pelton et al., 1998), and can cycle N at rates that exceed those in benthic sediments (Eriksson and Weisner, 1999). Accordingly, epiphyte biomass may be a better indication of the biological response to nutrient enrichment than that of macrophytes. As noted above, the nutrient content of the test macrophytes and epiphytes would provide another useful measure of the biological response to nutrient enrichment. Although tissue nutrients were not documented in this assay, beginning and ending water nutrients provide a better understanding of how biological community responded to nutrient enrichment. In waters from the PR at Siphon treatments N and P decreased by 66 and 63%, respectively over the 10-day incubation period. In contrast, changes in water column N and P concentrations in the Marsh Creek treatments were a 42% (0.57 mg/L) reduction in N and a slight increase in P by 0.01 mg/L. These results indicate that macrophytes and epiphyte algae and bacteria were readily incorporating or transforming available N, but contributing some of their initial tissue nutrients to the water column. Taken together, these pieces of evidence indicate that plants and epiphytes show disparate responses to waters from Marsh Creek and the Portneuf River at Siphon Road.



Photographs of tanks from the Lemna minor bioassay described in Section 2.9. Treatments shown are S1 (Siphon Road replicate 1) and M1 (March Creek replicate 1). Photos qualitatively illustrate the differences in the epiphyte response to nutrient enrichment. Epiphyte biomass in each aquarium is shown adhering to the plants and tank surfaces after 10 days of incubation.

Baldy, V., Tremolieres, M., Andrieu, M., and Belliard, J. 2007. Changes in phosphorus content of two aquatic macrophytes according to water velocity, trophic status, and time period in hardwater streams. Hydrobiologia 575, 343-351.

Cattaneo, A. and Kalff, J. 1980. The relative contribution of aquatic macrophytes and their epiphytes to the production of macrophyte beds. Limnol. Oceanogr. 25, 280-289.

Drake, L.A., Dobbs, F.C., Zimmerman, R.C., 2003. Effects of epiphyte load on optical properties and photosynthetic potential of the seagrasses Thalassia testudinum Banks ex König and Zostera marina L. Limnol. Oceanogr. 48, 456-463.

Eriksson, P.G., Weisner, S.E.B., 1999. An experimental study on the effects of submerged macrophytes on nitrification and denitrification in ammonium-rich aquatic ecosystems. Limnol. Oceanogr. 44, 1993-1999.

Marcarelli, A.M., Rugenski, A.T., Bechtold, H.A., Inouye, R.S., 2009. Nutrient limitation of biofilm biomass and metabolism in the Upper Snake River basin, southeast Idaho, USA. Hydrobiologia 620, 63-76.

Pelton, D.K., Levine, S.N., Braner, M., 1998. Measurements of phosphorus uptake by macrophytes and epiphytes from the LaPlatte River (VT) using ^{32}P in stream microcosms. Fresh. Bio. 39, 285-299.

Macroinvertebrates

Several macroinvertebrate surveys have been conducted within the Portneuf River, with somewhat contradictory observations. Although there also are no promulgated water quality standards for macroinvertebrates, DEQ has developed guidance for evaluation of these data via the River Macroinvertebrate Index (RMI). The lowest RMI scores in 2005 were seen between Batiste Road and Siphon Road (raw score of 9). As compared to sites located upstream from Pocatello where raw RMI scores were between 19 and 21, the final RMI scores near Siphon Road are lower (indicative of lower water quality). However, a raw RMI score of 13 (a poor biotic condition) was observed at the uppermost reference site (Mike's Place Sportsman Access).

Another common macroinvertebrate metric used to assess water quality and degree of organic pollution is known as the Hilsenhoff Biotic Index (HBI). Surveys have found that the lowest HBI scores (in this case indicative of better water quality) are found in gaining reaches, which include the minimally-impaired Pebble Creek and Siphon Road sites. So, in

this system, the HBI index may be highly influenced by hydraulic regime in addition to nutrient loading.

Finally, the macroinvertebrate data are also difficult to interpret because of the substantial New Zealand mudsnail infestation that has occurred in the Portneuf River. This non-native invasive species dramatically alters macroinvertebrate communities, not only in nutrient enriched rivers but many other rivers throughout the West, including Greater Yellowstone rivers such as the Madison River and others.

DEQ agrees.

Fish

A number of fish surveys have also been collected to assess biological condition. Compared to other rivers in the Upper Snake that the Idaho Department of Fish and Game (IDFG) sampled in 2002, the Portneuf River (63 sites) has one of the highest percentages of sites with salmonids and sites with Yellowstone cutthroat. This suggests that protecting the cold water habitat for these species is certainly important. In addition, from IDFG ***(these data where collected by Idaho State University not Idaho Dept. of Fish and Game)*** fish sampling in 2007, compared to upper river sites, fish collected downstream of Batiste Road had a high percentage of sensitive native fish and cold water individuals. However, overall fish biomass and densities are lower in this reach of the Portneuf River compared to those upstream of Marsh Creek (fish data at Siphon Road were not collected during this event).

In Section 4.1.e of the biological assessment (Appendix F), DEQ concludes: "In the lower Portneuf River where the complex of 27 springs contributes approximately 225 cfs year round, salmonids again predominate. Salmonids in the Portneuf River are found in the river above major flow diversions or reaches supplemented by groundwater flows…Collectively, these findings suggest that the distribution and abundance of fish in the Portneuf River Subbasin may be more closely linked to hydrologic rather than water quality conditions." The cooler water provided by these springs also likely provides benefits for cold and cool water fish downstream of Batiste Road (see Exhibit 5).

DEQ agrees with this statement.

Future Monitoring Goals

Section 5.3 of the Addendum includes a brief and general description of the monitoring approach DEQ intends to use as part of TMDL implementation. This description is focused primarily on evaluating progress toward meeting the numeric targets identified in the Addendum, but not on further investigation associated with resolving the uncertainties and data gaps identified in Simplot's comments above, in particular those related to how this river ecosystem responds to nutrient loads and concentrations.

Given that Simplot and other stakeholders are already implementing measures to reduce nutrients to the Portneuf River, the TP concentrations are expected to decline substantially in the coming years, allowing further insights in attendant biological responses. For example, recent monitoring data shows that improvements are already occurring (see Exhibit 10 for TP concentration trends at Siphon Road).

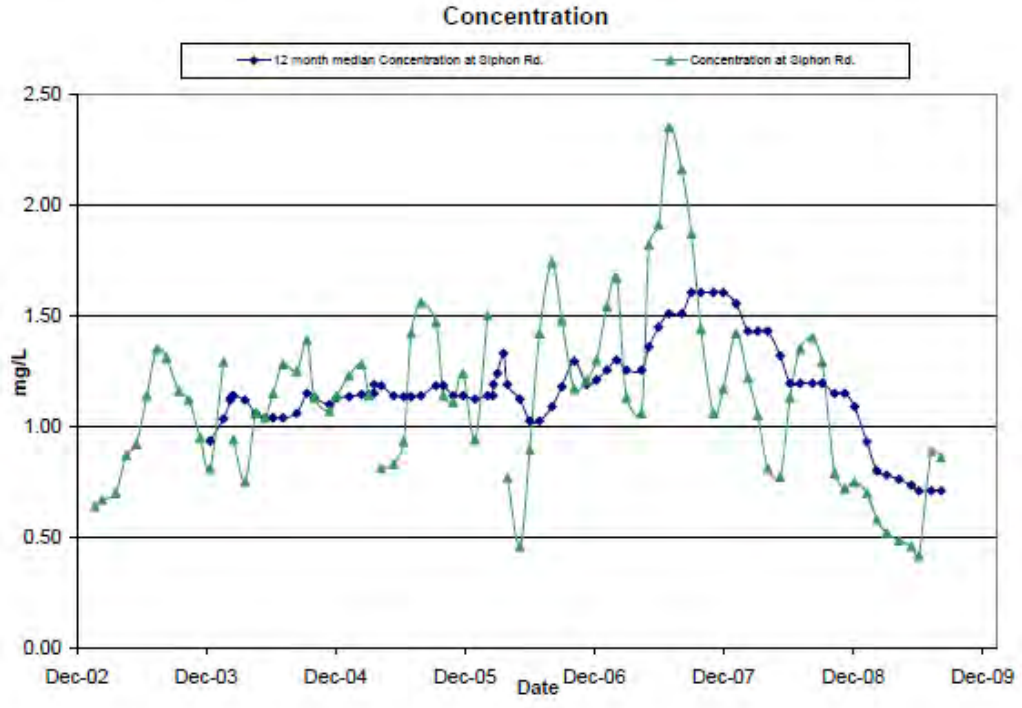


EXHIBIT 10.
TOTAL PHOSPHORUS MONITORING TRENDS AT SIPHON ROAD (2002 TO 2009)

In addition, due to additional control measures that are expected to be implemented in 2010 (the groundwater extraction system at EMF will be expanded), additional future improvements are anticipated (see Exhibit 11 for predicted TP concentration trends).

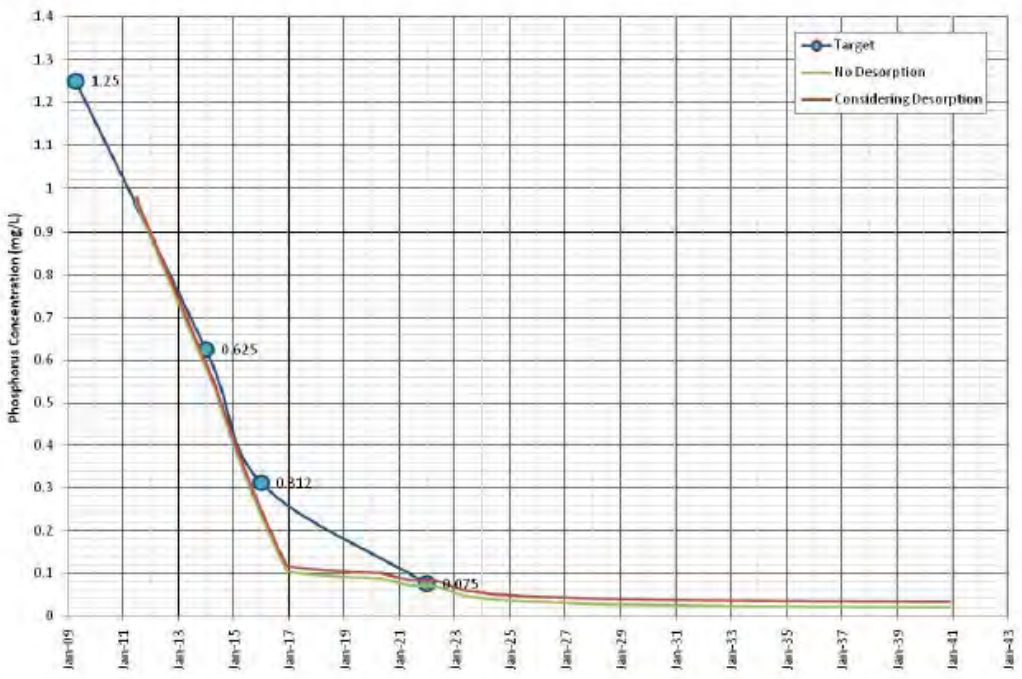


EXHIBIT 11.
PREDICTED TOTAL PHOSPHORUS MONITORING TRENDS AT SIPHON ROAD (2010 AND BEYOND))

As part of adaptive management in a phased TMDL process, if TMDL implementation is not resulting in corresponding improvements in water quality, including biological responses, then additional monitoring data can help the agency and stakeholders to re-assess what implementation activities need to be modified.

In summary, Simplot believes that future water quality monitoring should continue to include the basic program that has been occurring for the last decade or so, including hydrologic monitoring, discrete sampling for chemical analyses and use of the continuous data sondes for DO, temperature, turbidity and pH. In addition, periodic monitoring of the key aquatic biological communities described above (periphyton, macrophytes, macroinvertebrates, and fish) should be planned and conducted. These could be done coincident with DEQ's legislatively mandated 5-year TMDL reviews, and/or in relation to planned and observed nutrient reductions. For example, Exhibit 11 shows that Simplot anticipates very substantial TP reductions at Siphon Road over the next 5 and 10 year periods.

> *DEQ agrees and will continue to keep these activities as a regional priority in the coming years and looks forward to a continued collaborative stakeholder effort.*

Phased Implementation

This addendum to the TMDL does not include substantive discussion or affirmation that DEQ still intends to adaptively manage the implementation process, nor does it explicitly acknowledge that DEQ is still committed (by legislation) to having a continuous five year review of the TMDL. Even though there are uncertainties, as noted in Simplot's comments above, changes will be noted within 5 year periods and adjustments, if needed, can be made. With the TMDL goals in place, work has begun with the implementation of projects to reduce nutrients and time is needed to see if there is an effect from further nutrient reductions. Simplot believes that DEQ should add explicit language to Section 5.3 of this Addendum relating to phased implementation. To reinforce this point, language from the American Falls TMDL settlement with DEQ pertaining to the Portneuf River TMDL is cited below:

"The Portneuf TMDL is designed to be implemented in phases. According to the February 2001 Supplement to Final TMDL Plan for the Portneuf River, phase I of implementation consists of the collection and analysis of additional water quality data and the implementation of short term control measures. Based on the additional water quality data and the evaluation of control measures and progress towards water quality goals, new load and waste load allocations are intended to be submitted to EPA. Final Supplement at page 4. The allocation of pollutant loads for the Portneuf will be refined taking into account several principles: 1. Future growth; 2. Seasonal or climatic variations; 3 Temporal aspects; 4. Antibacksliding requirements; 5. Antidegradation requirements; 6. Margin of safety; 7. Allocation refinement; and 8. Principles of fairness.

With the cooperation of Portneuf River stakeholders, DEQ has collected additional data regarding Portneuf River water quality. DEQ has begun to meet with the Portneuf River WAG to refine allocations and appropriate pollution control strategies. DEQ intends to evaluate the Portneuf TMDL as a Phased TMDL and will continue to follow the staged approach for implementation of the Portneuf TMDL. Implementation of the Portneuf TMDL will function as the means of implementing the AF TMDL for the sources on the Portneuf River. The AF TMDL will not set load or waste load allocations for sources on the Portneuf River. Those load and waste load allocations will be set in the Portneuf TMDL."

This is duly noted and DEQ agrees, language has been added on page 156.

Conclusions

Simplot believes that the draft final October 2009 version of the TMDL represents a reasonable path forward to improve water quality in the Portneuf River given our current state of understanding of the complex relationships involved. Reasons include:

The empirical approach used for TP target selection by DEQ for this TMDL revision is based on a reasonably strong dataset that has been collected cooperatively by the agency and other stakeholders. The data show a strong relationship between target TP concentrations and TSS concentrations.

- DEQ also conducted a much more extensive biological assessment for this TMDL revision than had previously been available. Thus, DEQ has been diligent to explore multiple lines of evidence and stressor responses.

- The revised TP target of 70 ug/L (from 75 ug/L) is consistent with other regional targets developed specific to the Snake River and its tributaries.

There continues to be uncertainties related to the question of how much of the observed impairment is due to excess nutrients and how much of the observed impairment is due to other factor such as elevated temperatures, low water levels/flow regulation, groundwater influences, oxygen-demanding materials, land uses, or some combination. Additional monitoring of key parameters may result in information that helps reduce these uncertainties. However, as the TP loads decrease through more stringent point source and non-point source controls, future monitoring should focus on whether the river is responding to these improvements. Monitoring should evolve from defining the problem (that is, assessing the current chemical and biological status of the river) to measuring improvements related to TMDL implementation.

Simplot and other stakeholders are implementing measures to reduce nutrients to the Portneuf River. Recent monitoring data shows that improvements are occurring and additional improvements are predicted. As part of adaptive management in a phased TMDL process, if TMDL implementation is not resulting in corresponding improvements in water quality, then additional monitoring data can help the agency and stakeholders to re-assess what implementation activities need to be modified.

DEQ looks forward to continuing to assess water quality and its relationship to supporting beneficial uses in the Portneuf River.

SHOSHONE-BANNOCK TRIBES

Sediment

1) Based on the logic used for selecting TSS targets section 5.1 page 97, "In the Portneuf River subbasin, a lower Marsh Creek reach sampled in 2007 produced no salmonids or fish from coldwater taxa (Keeley 2007) and only a single sculpin. Averaged across the years 2004 through 2006, the mean low-flow TSS concentration in Marsh Creek was 36 mg/L, and concentrations regularly exceed this value during low-flow periods. Therefore, the absence of fish from cold water taxa in Marsh Creek was used to support the establishment of a low-flow TSS target of 35 mg/L to support the cold water aquatic life beneficial use.", How does IDEQ justify a target of 35 mg/L (a reduction of less than 2.7%) to restore and protect beneficial uses specifically cold water biota?

> *DEQ agrees this statement regarding TSS concentrations in Marsh Creek is somewhat difficult to interpret. The point is that while TSS concentrations in Marsh Creek may be meeting the old target (50 mg/L), further reductions are necessary, given that TSS (along with water temperature, dissolved oxygen levels, and flow modification) can negatively impact Cold Water Aquatic Life (CWAL). Reductions in Marsh Creek TSS loads are necessary because even though the average TSS concentration (2004-2006) was 36 mg/L, there are many excursions above the target, especially in 2006 (Figure 2.7, page 49 of the TMDL). The TSS target was discussed by the Watershed Advisory Group (WAG) in reference to evidence presented in Rowe et al. 2003, and the WAG voted to lower the existing target of 50 mg/L to 35 mg/L. It was evident during WAG discussions of this (and other) target(s), that stakeholders desired to promote water quality improvement on a phased basis, rather than pursuing very conservative targets that, while likely being protective of beneficial uses, might be extremely difficult (and possibly unnecessary) to meet in the future. WAG stakeholders also made it clear that targets could (and should) be further lowered if their attainment does not facilitate restoration of beneficial uses.*

2) If there were no cold water taxa fish found at a mean of 36mg/L at low-flow. This statement is troubling because the 35 mg/L low-flow TSS target was used as the foundation to develop phosphorus targets through an empirical relationship that does not apply to the entire mainstem of the Portneuf River particularly the lower Portneuf River as it flows onto the Fort Hall Reservation.

> *As stated above, there were numerous factors and discussions developing the foundation for reducing the existing TSS target from 50 to 35 mg/L. DEQ agrees that the TSS-total phosphorus relationship does not hold in the Portneuf River at Siphon Road, as that system is groundwater dominated and phosphorus associated with groundwater needs to be reduced. An analysis of dissolved oxygen at Batiste Road versus Siphon Road indicated that at a median TP concentration of 0.075 mg/L, the*

dissolved oxygen standard for cold water aquatic life of 6 mg/L was not met all of the time. However, DO standards were not met at Siphon Road during 85% of the days in the same time period. This piece of evidence supports reducing TP concentrations at Siphon Road. Other factors, such as water temperature, oxygen-demanding materials, ground water infusion, and flow regulation also affect dissolved oxygen levels at Siphon Road and elsewhere on the Portneuf River and its tributaries. After extensive discussion, the WAG decided to adopt TSS and TP targets that will move waterbodies in the Portneuf watershed towards attainment of beneficial uses, while noting targets may need to be changed in the future if beneficial uses are not met.

3) Why wasn't a target selected at or below 25 mg/L TSS if this is the threshold of negative impacts to cold water biota such as salmonids?

As stated previously, the WAG undertook a lengthy discussion of TSS targets. Although 25 mg/L was identified as a threshold where negative impacts to CWAL such as salmonids may occur, attainment of beneficial uses is the goal of TMDLs. Targets are typically set based on attaining or maintaining beneficial uses – not attainment of background water quality conditions. The WAG agreed that reducing the TSS target to 35 mg/L would move the Portneuf River towards attainment of beneficial uses including CWAL. In some cases where water quality TSS is less than either low or high flow targets, existing loads become the actual target. During certain months, when Portneuf River at Siphon Road TSS loads are less than target loads, existing loads are the actual target (page 73 of the TMDL; Portneuf River at Siphon Road).

From WAG minutes 15 January 2008. Brad Higginson reiterated a concern he had expressed in the past about creating the potential for allowing additional pollution in tributaries that are already well below the targets. Greg Mladenka clarified that measured concentrations at any site would continue to serve as de-facto targets where measured values are already less than approved target concentrations. In other words, new point sources would not be permitted if they would add pollutants to the system even if current concentrations are below the targets

Phosphorus

1) Why was the target for phosphorus selected through an empirical relationship with total suspended solids if the correlation was not consistent through out the river system, specifically in the lower river where the most significant phosphorus impact occurs and the effects of eutrophication evident?

The lower Portneuf River between Batiste and Siphon Roads is an exception to the flow-dependent TSS-TP relationship present in the rest of the Portneuf River. Only the high flow TP target was selected based on an empirical relationship with the high flow TSS target. The WAG decided on dual targets (high and low flow) for TP along with TSS, as

TP is highly correlated with TSS and a TP target not related to additional TSS present during runoff would be unreasonable and unattainable. While we agree that Portneuf River hydrology at Siphon Road is different than at Batiste Road, the general opinion of the WAG was that the TP target of 0.070 mg/L is realistically attainable, and has the potential to facilitate attainment of beneficial uses in all reaches of the Portneuf River. This TP target is an order of magnitude less than current median TP concentrations (approximately 1 mg/L) at Siphon Road. WAG stakeholders also made it clear that targets could (and should) be lowered further if their attainment does not result in beneficial use restoration where other impacts (such as high temperature or excess sediment) are not responsible for impairments.

2) If the river below Batiste Bridge is relatively unaffected by sediment during critical low-flow periods, but regularly exceeds numeric cold water biota criteria (suppressed dissolved oxygen below numeric criteria of 6.0 mg/L), why was a phosphorus target selected according to its relationship with TSS and not by the scientific merits of the negative impacts of excess phosphorus itself? The only mention of the effects of phosphorus references the EPA's (1986) recommending that streams that discharge to lakes and reservoirs should be managed below 0.05 mg/L to avoid eutrophic effects. This is especially disconcerting if the target for sediment is as flawed as it is presented.

There likely is much sediment deposited in the reach of the Portneuf River between Batiste Road and Siphon Road, even though suspended sediment concentrations may decline during low flow periods. TSS low and high flow targets, and TP low flow targets were derived independently. Each was discussed during WAG meetings and targets also were agreed upon independently. The TP low flow target is based on comparisons of site-specific data (TP and dissolved oxygen), EPA gold book recommendations (0.1 mg/L for streams and rivers; the target compliance point at Siphon Road is approximately 6-11 miles from American Falls Reservoir, depending on reservoir level), and the existing 0.075 mg/L target in the Portneuf River. Based on extensive data collected in the Portneuf River, a strong, highly significant correlation exists among TSS and TP at all sites except Siphon Road. This relationship was used to predict high flow sediment-derived TP that will unavoidably increase TP concentrations over those found at low flow and arrive at a realistic high flow TP target.

Nitrogen

1) It is difficult to glean from section 5.1 why nitrogen is not being addressed in mainstem, where the majority of the nitrogen is found, is it because it is primarily originates from ground water? If this is the case should this be dealt with in the implementation phase and not the TMDL which is supposed to establish the bench marks or restoration goals regardless of source?

The Total Nitrogen target set for Portneuf River tributaries is 1.0 mg/L. For comparison purposes, the median TN load at Batiste during 2004-2006 (using

available discharge data) was 962 pounds/day with a median TN concentration of 1.11 mg/L. TN concentrations associated with groundwater inputs to the lower Portneuf River are on the order of 3.10 mg/L, which approximates the median TN concentration at Siphon Road. The median TN concentration at Siphon (2004-2009) was 2.94 mg/L and the load was 6318 lbs/day. Nitrogen in the mainstem Portneuf River is being addressed by other measures, including the State of Idaho Groundwater Rule and conversion of septic to centrally-treated sewerage systems. The goal for all waters in the Portneuf watershed is attainment of beneficial uses. In the future, if other mainstem Portneuf River targets set in the TMDL are met and beneficial uses are still not attained, a mainstem TN target may be considered.

2) What were the contributions of nitrogen from the city of Pocatello's POTW?

The median TN concentration from the City of Pocatello's POTW (using data after ammonia reduction infrastructure was in use in June 2004-2009) was 18.6 mg/L, resulting in a load of 1058 pounds/day.

3) It would seem more appropriate to analyze all nutrients on the mainstem especially because this is where the effects of eutrophication are most pronounced.

4) According to a recent study on N and P limitation there is a synergistic response to primary production from combined nitrogen and phosphorus enrichment (Elser et al 2007). If this is the case wouldn't there be a more significant response in deterring the effects of eutrophication if nitrogen was also reduced?

The goal of the nutrient TMDL is restore beneficial uses. In Idaho and EPA Region X generally, this is being done via TP TMDLs. TP is the nutrient of concern that can be reduced most-readily in the Portneuf River. These reductions will be the focus of this TMDL, while mainstem TN reductions may be considered in the future if necessary to attain beneficial uses.

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Appendix J. Voluntary Consent Order(VCO)/ Compliance Agreement with the J. R. Simplot Company, April 11, 2008

IDAHO DEPARTMENT OF ENVIRONMENTAL QUALITY

IN THE MATTER OF:	VOLUNTARY CONSENT ORDER/COMPLIANCE AGREEMENT
The J.R. Simplot Company PO Box 27 Boise, ID 83807	Idaho Code 39-108 and § 39-116A

1) Pursuant to the Idaho Environmental Protection and Health Act, Idaho Code § 39-1 01, 39-108 and Idaho Code §39-116A, the J.R. Simplot Company ("Simplot") enters into this Voluntary Consent Order/Compliance Agreement ("VCO/CA") with the Idaho Department of Environmental Quality ("Department"). The Department and Simplot may be hereinafter collectively referred to as the "Parties" and, may be singularly referred to as "Party."

2) Definitions. The following definitions apply in this Compliance Agreement Schedule:

   a) "Simplot" means the J.R. Simplot Company;

   b) "Department" means the Idaho Department of Environmental Quality;

   c) "Don Plant" means Simplot's phosphate and fertilizer processing plant and related facilities located near Pocatello, Idaho;

   d) "Blackrock Land Exchange" means the proposed land exchange of Bureau of Land Management property south of the Don Plant for Simplot-owned land in Blackrock Canyon near the Portneuf Gap; and

   e) "VCO/CA" means this Voluntary Consent Order/Compliance Agreement Schedule entered into by Simplot and the Department.

3) Introduction.

   a) IDAPA 58.01.02.001 et. seq., The Idaho Water Quality Standards, required under the Federal Clean Water Act (CWA), are designed to preserve water quality in Idaho. See IDAPA 58.01.01.001 et. seq., Idaho Code § 39-3609 requires the Department to prepare a list of Idaho waters not meeting State Water Quality Standards. The Portneuf River was included on the list in 1994.

   b) In April 1999, the Department submitted to the Environmental Protection Agency ("EPA") a Total Maximum Daily Load ("TMDL") for the Portneuf River. The TMDL is in accordance with the State of Idaho Guidance for Development of Total

Maximum Daily Loads (June 1999). The TMDL lists nutrients among pollutants that need to be addressed in the Lower Portneuf River. Based upon the narrative water quality criteria for nutrients, the Department has established a water quality target for total phosphorous for this segment of river as set forth in the approved TMDL. The target for total phosphorus in the Lower Portneuf River is 75 micrograms per liter at Siphon Road. The Portneuf TMDL has been formally described as a phased TMDL in the Department's February 23, 2001 "Supplement to Final TMDL for the Portneuf River, 4.0 Management Actions and Implementation." This VCO/CA is intended to be consistent with the phased approach to TMDL implementation reflected in the "Supplement to Final TMDL for the Portneuf River."

c) The Don Plant is a site listed on the National Priority List ("NPL") pursuant to 40 CFR 300 et. seq. and is subject to a Remedial Design/Remedial Action Consent Decree (Civil Action No. 99-296-E-BLW) with the EPA under the Comprehensive Response Compensation and Liability Act CERCLA (hereinafter "CERCLA Consent Decree"). In accordance with the CERCLA Consent Decree, Simplot currently operates a ground water extraction system at the site to contain the migration of contaminants of concern (primarily arsenic) from the phosphogypsum stack and reduce the areal extent of shallow ground water contamination resulting there from. Orthophosphate contamination in the ground water was not specifically addressed in the remedy described in the CERCLA Consent Decree. Phase I of this system focused on a field investigation which evaluated hydraulic and geologic conditions and well design/construction options in the upper ground water extraction zone. Approximately 250-300 gallons per minute (gpm) of ground water is extracted under Phase I. Phase I of the ground water extraction system currently is being expanded with Phase II. Phase II consists of a more extensive field program to obtain chemistry and hydrogeologic information needed to fill major data gaps to support further design of the extraction system. Approximately 600 gpm of ground water will be extracted under Phase II. A subsequent Phase III also is planned and will include the system design and start up. Approximately 1000-1100 gpm of ground water is expected to be extracted under Phase III. Phase I, II and III of the ground water extraction system may complement the goals of the TMDL by removing ground water containing phosphorus compounds.

d) In January, 2004, the Department completed a study entitled, "Evaluation of Water Quality Impacts Associated with FMC and Simplot Phosphate Ore Processing Facilities, Pocatello, Idaho." The study concluded ground water underlying the facilities is contaminated with nitrate, ammonia, and orthophosphate. Sources contributing to the contaminated ground water include the gypsum stack and the phosphoric acid/liquid plant area. The ground water discharges from beneath the Don Plant into springs and the Portneuf River. Sampling has shown that the Lower Portneuf River exceeds the TMDL water quality target for total phosphorus generally by an order of magnitude. The average measured annual median value for total phosphorus at Siphon Road from 2004 through 2007 was approximately 1,250 micrograms per liter. Discharges of total phosphorus in excess of the

Lower Portneuf River established TMDL may be causing or contributing to violations of the State water quality standard for dissolved oxygen.

4) Purpose.

a) This VCO/CA between Simplot and the Department is intended to implement Simplot's responsibilities under the approved TMDL for the Lower Portneuf River for nutrients.

b) In entering into this VCO/CA, it is the objective of the parties that Simplot takes reasonable affirmative measures to reduce the loading of total phosphorus to the Portneuf River. The reduction of total phosphorus in the Portneuf River will be achieved through source control, and groundwater extraction/reuse or treatment.

c) The Parties enter into this VCO/CA to establish and implement a process under which the Parties will work cooperatively with respect to environmental improvements to be made by Simplot in furtherance of the objectives of this VCO/CA.

d) This agreement is furthermore intended to work in conjunction with and to complement the existing CERCLA Consent Decree. Since the sources of orthophosphate and arsenic are identical and the ground water plumes for these contaminants are co-mingled, it will be beneficial to coordinate with the CERCLA action to maximize efficiencies and facilitate mutual attainment of remediation goals. Therefore, it is anticipated that information gathered pursuant to this VCO/CA and information gathered pursuant to the CERCLA remedial action will be shared between the two clean up actions. Although work plans and/or reports will be shared and comments considered between EPA and Department staffs, each document will be maintained, reviewed, and approved by the individual Agencies implementing the parent agreement requiring the report or plan. Furthermore, it is recognized that work plans and/or reports required under this agreement may derive from, or include portions of documents that were developed for the CERCLA remedial action. Notwithstanding the foregoing, however, this VCO/CA is a separately enforceable agreement between the Department and Simplot. If CERCLA requirements initiated under the Consent Decree are also utilized to support actions in this VCO/CA, modification of the remedial action objectives and specific performance standards (as specified in the Remedial Design/Remedial Action Consent Decree Statement of Work) may require additional negotiation under this VCO/CA to ensure the needs of this agreement are met.

5) Agreement.

a) To address total phosphorus releases to the Portneuf River from the Don Plant site, Simplot will: (1) institute a surface and ground water monitoring program, and (2) develop and implement short-term and long-term solutions to remove and/or treat total phosphorus in groundwater entering the Portneuf River to meet the following concentration-based requirements in the Portneuf River as measured at Siphon Road to:

i) Achieve a 50% reduction (625 micrograms/L) in the concentration of total phosphorus in the Portneuf River as measured by the annual median of monthly samples collected at Siphon Road by December 31, 2013.

ii) Achieve a 75% reduction (938 micrograms/L) in the concentration of total phosphorus in the Portneuf River as measured by the annual median of monthly samples collected at Siphon Road by December 31, 2015.

iii) Achieve a 94% reduction (1,175 micrograms/L) in the concentration of total phosphorus in the Portneuf River as measured by the annual median of monthly samples collected at Siphon Road by December 31, 2021. This level equates to the water quality target of 75 micrograms/L established for total phosphorous for this segment of river as set forth in the approved TMDL.

b) Measuring Compliance and Performance:

In measuring compliance with the reduction requirements set forth in paragraph 5(a), the Department will collect samples at the point of compliance (Siphon Road) to determine the concentration of total phosphorus in the Portneuf River on a monthly basis. The calculation basis for compliance shall be the annual median of monthly values.

For purposes of measuring progress toward meeting the requirements of paragraph 5(a), Simplot will conduct monthly sampling at the following two locations:

i) Batiste Road;

ii) A location approximately 300-400 meters north of Batiste Road at site T-2B (As defined by the Department's study entitled, *Evaluation Of Water Quality Impacts Associated With FMC And Simplot Phosphate Ore Processing Facilities, Pocatello, Idaho*, Ground Water Quality Technical Report No. 21, January, 2004.)

Simplot will analyze these samples to determine the concentrations of total phosphorus and orthophosphate in the Portneuf River using a depth/spatial composite sampling protocol consistent with current sampling methodology

employed by the Department as described in the DEQ Quality Assurance Project Plan (QAPP) for the Portneuf River Monitoring Project.

c) Within twelve (12) months of approval of this VCO/CA, Simplot will submit a report (Technical Report No. 1) that specifies a:

i) Ground Water and Surface Water Monitoring Program Plan

(1) A monitoring plan specific to the objectives of this VCO/CA, including description of sampling locations and methodologies for ground water; interim monitoring points that shall be used to evaluate the effectiveness of the selected remedies; and sample locations and methodologies for surface water which may be included by reference from the QAPP for the Portneuf River Monitoring Project.
(2) For ground water monitoring, a description of sample collection and QA/QC procedures analytical methods and justification of sampling locations. Surface water monitoring, sample collection, and QA/QC procedures may be addressed by reference from the QAPP for the Portneuf River Monitoring Project. The Monitoring Plan shall ensure data quality and quantity is sufficient to verify that remedial actions successfully limit plant impacts to surface water in the Portneuf River per the concentration-based requirements in paragraph 5(a).
(3) A summary of the recent ground water and surface water total phosphorus and orthophosphate sampling data, including concentration trends.
(4) The statistical methods that will be used to evaluate trends in the ground water and surface water concentration data in order to show that the required concentration values have been attained or improvement is occurring.
(5) A schedule for implementation and completion of the ground water and surface water monitoring plan requirements.
(6) A description of the procedures Simplot will use to monitor the surface water to determine:
(a) Discharge rates of the stream transects and springs at the sampling locations specified in paragraph 5(c)(i)(1) above;
(b) Water quality parameters including, at a minimum, temperature, pH, specific conductance, total dissolved solids, and concentrations of total phosphorus and orthophosphate. Concentrations of nitrate, chloride, sulfate and dissolved oxygen, should also be measured.
(c) Calculations of total phosphorus loading to the stream from sampling points.

ii) Description of past two (2) years of past releases, tank inspection, and maintenance activities in the Phosphoric Acid Plant and "Liquid" Plant (Production Area).

iii) In cooperation with the Department, Simplot will compare well monitoring data with reported Production Area releases to develop a total phosphorus source term for the Area. The results of this investigation will be included in Technical Report No. 1.

(1) This source term shall be used to determine if monitoring well placements in and around the Production Area are adequate to monitor potential Plant impacts to ground water.
(2) Additional characterization in the Production Area may be required if the Department determines it is necessary to meet the requirements of paragraph 5(a).

iv) Calculation methodology for determining pounds of total phosphorus removed per day by extraction system and by source control (as defined in the RAP).

d) Remedial Action Plan (RAP)

i) Within 12 months of the effective date of this VCO/CA, Simplot shall submit a RAP which proposes action(s) to meet the required reductions of paragraph 5(a). Key aspects of the plan should include short-term and long-term actions to be taken by Simplot to prevent phosphorus releases to soil and ground water and/or reduce the amount of phosphorus contaminated ground water entering the Portneuf River, including a schedule for the implementation of such actions. It is anticipated that the remedial action taken under this VCO/CA may incorporate and build upon the CERCLA groundwater extraction system referenced in paragraph 3(c) above. To the extent that the RAP submitted pursuant to this paragraph relies on, or seeks to rely on, groundwater extraction, or may impact the groundwater extraction system, all submissions or deliverables to EPA pursuant to the CERCLA Consent Decree shall also be submitted to the Department. The proposal and schedule shall provide options for addressing releases of phosphorus to the soil and ground water, and may include any or all of the following:

(1) A full description and schedule for installation of a ground water extraction system for the removal of ground water containing phosphorus compounds and an evaluation of the system's ability to reduce phosphorus discharges to the Portneuf River,
(2) Description of plans for the completion of the Blackrock Land Exchange and the development of a new, lined gypsum storage facility,
(3) Plans to line and/or close the existing gypstack,
(4) Treatment of ground water at or near the Portneuf River,
(5) Any additional treatment options Simplot determines necessary or appropriate to meet the requirements listed in paragraph 5(a).
(6) A plan for construction of the selected remedial measure(s) including:
(a) A project schedule identifying timing for initiation and completion of tasks, major milestones, and dates for the completion of the project.

(b) Construction quality assurance objectives including responsibility and authority, personnel qualifications, inspection activities, sampling requirements and documentation.

(7) A schedule for providing the Department with progress reports of the remediation of contaminated ground water and surface water.

(8) A description and schedule of implementation for post-remediation monitoring procedures.

ii) The RAP will also include:

(1) A plan to prevent releases of phosphoric acid from the Don Plant "Liquid" and Phosphoric Acid plant areas. The plan will include an identification of actions to be taken and a schedule for implementation of these actions.

(2) The RAP may need to undertake mitigative measures to address past releases of phosphoric acid from the plant areas if deemed to be a significant source of total phosphorus in the Portneuf River.

(3) Appropriate remedial action objectives (such as mass load reductions from extraction system) and interim monitoring goals for any and all actions used to achieve the reductions outlined in paragraph 5(a).

iii) In the event that a significant release(s) of phosphoric acid from the plant areas is discovered during the interim 12 months of RAP development, Simplot will take immediate action to control the release and notify the Department. Simplot will investigate the release and provide to the Department within four (4) weeks of discovery, the constituents of the release, the cause of the release, estimated amount released and corrective actions taken.

iv) In the event the measures taken by Simplot pursuant to the approved Remedial Action Plan (RAP) fail to achieve the required levels of total phosphorous reduction in the Portneuf River as measured at Siphon Road by the dates specified in paragraph 5(a), Simplot shall either demonstrate to the Department's satisfaction by use of monitoring data in the river, groundwater data and/or other information that the failure to achieve the total phosphorus concentrations in the river at Siphon Road were not due to Simplot or Simplot shall revise the RAP to propose additional actions which will, if implemented, further reduce total phosphorous loading to the Portneuf River so as to achieve the required reduction within not less than two years or such other time as agreed to by the Department. This Revised RAP (RRAP) must be submitted to the Department with the annual report by March 31 of the year immediately following the failure to meet the specific requirement outlined in paragraph 5(a) and must include the following:

(1) A description of the additional remedial measures selected to remediate contaminated ground water to achieve the water quality requirements in the Portneuf River in paragraph 5(a) above, including methods for final disposition of any wastes generated as a result of remediation.

(2) A plan for construction of the selected remedial measure(s) including:
(a) A project schedule identifying timing for initiation and completion of tasks, major milestones, and dates for the completion of the project.
(b) Construction quality assurance objectives including responsibility and authority, personnel qualifications, inspection activities, sampling requirements and documentation.
(3) A schedule for providing the Department with progress reports of the remediation of contaminated ground water and surface water.
(4) A description and schedule of implementation for post-remediation monitoring procedures.

e) Upon the Department's approval pursuant to paragraph 7 below, the ground water and surface water monitoring plan in Technical Report No. 1, the RAP, and any RRAP's shall be incorporated by reference into this VCO/CA and shall become enforceable requirements hereof. Changes can be made in the ground water and surface water monitoring plan as agreed upon during the Annual Meeting described in paragraph 5(h) below.

f) By March 31 of each year, Simplot shall submit an Annual Report for the previous calendar year which discusses/forwards:

i) Monitoring results and trends

(1) gallons of ground water extracted,
(2) pounds of total phosphorus in the extracted ground water,
(3) pounds of total phosphorus not released due to RAP,
(4) ground water monitoring results and trends,
(5) Portneuf River water quality monitoring results and trends,

ii) Status of improvement/implementation plans as specified in the RAP/RRAP to meet the requirements outlined in paragraph 5(a) including:

(1) The effectiveness of the ground water extraction system to remove total phosphorus from the ground water plume that reaches the Portneuf River with a predicted trend towards compliance with TMDL established water quality requirements of paragraph 5(a).

g) Within sixty (60) days of the completion of the actions required in the RAP/RRAP, Simplot shall prepare and submit a Final Remediation Action Plan Report for the Department's review and approval in accordance with paragraph 7 of this VCO/CA. The Final Remediation Action Plan Report shall include the results of all analyses, a summary of all investigations and detailed maps of any/all identified sources of phosphorus on the Site.

h) Any new gypsum storage/stack built at the Don Plant, including any gypsum stack built on any new land to be acquired for this purpose, shall include a liner in its

design, a siting evaluation report, a background water quality investigation, a groundwater monitoring program, and a corrective action plan in the event of liner failure. The design and supporting documentation, operation and maintenance procedures, final reclamation plans and closure plans for any new gypsum stack shall be approved by the Department prior to the start of construction.

i) Annual Meeting. Throughout the effective life of this Compliance Agreement, on at least an annual basis between October 1 and December 31, the Department and Simplot will meet to discuss implementation and possible modification of this VCO/CA. The Parties recognize that modifications may be necessary to address necessary and/or material changes, including but not limited to, changes in federal or state environmental statutes and rules, the use of new technologies, the complexity of addressing multi-media pollutants, the coordination with CERCLA requirements and any additional environmental issues at the Don Plant. More frequent meetings may be necessary, as determined by the Department, to resolve specific issues that may arise in relation to this VCO/CA. The matters discussed at the annual meeting shall include, but not be limited to:

   i) The status of existing ground water and surface water monitoring plans.

   ii) Review of the RAP/RRAP identifying mutual priorities and progress towards meeting reduction requirements.

   iii) Review, discuss and recommend approaches to address current and predicted compliance activities under State authority, across all media, related to Don Plant.

   iv) Discuss any other items determined necessary by the parties to implement the agreement.

   v) Additional meetings may be conducted, at the Department's discretion, between applicable Agencies and Simplot to discuss information and progress on the respective CERCLA and orthophosphate clean-up efforts. These meetings would facilitate appropriate coordination between the Agencies and promote the sharing of information which is common between each program.

j) Simplot will support the Portneuf Watershed Partnership and will provide Funding:

   i) For the operation of one (1) monitoring station. Beginning in 2008 and payable by August 31 of each year, Simplot will provide $15,000 annually for a period of ten (10) years. If the Portneuf Watershed Partnership ceases to exist, then Simplot will submit to the Department within ninety (90) days of the cessation of the Watershed Group a monitoring plan for the segment of the Portneuf River near the Don Plant. This money may also be applied to the creation of an additional monitoring station on the Portneuf River at the Department's discretion.

ii) For water quality improvements on the Upper Portneuf River. Beginning in 2008 and payable by August 31 of each year, Simplot will provide $25,000 annually for a period of four (4) years. Simplot agrees to assess available projects through local agencies (e.g. NRCS, Three Rivers RC&D, DEQ, Portneuf Watershed Partnership), select the most beneficial and cost effective project to improve water quality in the Portneuf River with the Department's concurrence, and monitor the local agency's completion of the project. Also, with the Department's concurrence, the annual contribution can be placed into a trust for the purpose of improving water quality in the Portneuf Watershed.

6) Deliverables submitted pursuant to this VCO/CA shall be shared with EPA and the Shoshone-Bannock Tribes. Comments by EPA on such deliverables with regard to phosphorus will be considered in the Department's review and approval process pursuant to this VCO/CA and incorporated in such approvals where appropriate. The State also recognizes that the EPA may share information with and take comments from the Shoshone-Bannock Tribes in formulating its comments on the deliverables subject to this VCO/CA. The State will consider comments submitted on behalf of the Shoshone-Bannock Tribes by EPA and incorporate such comments in approvals where appropriate.

7) Department Submittal Review and Approval Process. Unless otherwise set forth specifically herein, the following document submittal and review process (Submittal Review Process) shall be followed regarding submittals required by this VCO/CA for which Department approval is required. This process shall be followed until the document is approved by the Department or the document review time frame has expired.

   a) Within thirty (30) calendar days of receipt of Simplot's submittal, the Department shall: (1) notify Simplot in writing the document is approved; (2) notify Simplot in writing of any deficiencies in the document; or, (3) notify Simplot of the Department's extension of the Department's review and comment period for an additional thirty (30) days. If the Department notifies Simplot of deficiencies in the document, Simplot shall submit a revised document to resolve those deficiencies within thirty (30) calendar days of receipt of the Department's notice. The approved document shall be incorporated by reference into and enforceable as part of this VCO/CA.

   b) The Submittal Review Process shall be repeated until the Department notifies Simplot the document is approved. However, Simplot documents must meet the requirements of this VCO/CA, as determined by the Department, within one hundred twenty days (120) days from the due date for the first submittal of the document. Simplot's failure to develop a Department-approved document within such time frames may be considered a breach of this VCO/CA.

8) Compliance with State and Federal Environmental Authorities. This VCO/CA provides a basis for the Parties to systematically work toward achieving the above stated objectives and goals over the term of this VCO/CA. This VCO/CA does not relieve Simplot from any obligation to comply with federal and state environmental laws, rules and regulatory standards or any permit issued to Simplot and such laws, rules, permits and regulatory standards shall remain enforceable independent of any of the provisions contained herein.

9) Communications. The Department agrees to conduct all communications related to this VCO/CA with Director, Environmental and Regulatory Affairs, J.R. Simplot Company, PO Box 27, Boise, ID 83707; and with General Counsel, J.R. Simplot Company, PO Box 27, Boise, ID 83707. Simplot agrees to conduct all communications related to this VCO/CA, to Director at 1410 North Hilton, Boise, Idaho 83706. Either Party may, in their discretion, and upon written notice to the other Party, re-designate other individuals to serve as their respective contact persons in any given matter related to this VCO/CA.

10) Termination. This VCO/CA shall terminate upon completion of the required activities established by this VCO/CA and demonstration to the Department's satisfaction that the concentration based requirements set forth in paragraph 5(a)(i-iii) have been and will continue to be met as a result of the completed activities.

11) Modification of VCO/CA. The Parties may modify the terms and conditions of this VCO/CA by a writing signed by both Parties. Any such written modification shall be incorporated into this VCO/CA and be enforceable as if included herein.

12) Force Majeure. In the event delay, or anticipated delay, in performance of any action addressed by this VCO/CA or any report, plan or other document developed and approved by Simplot and the Department arises from causes beyond the control of the Parties (a "force majeure event"), the time for performance of the action that is affected by the force majeure event will be extended by the Parties for such time as is necessary to complete that requirement.

13) Enforcement. Simplot expressly recognizes that failure to comply with the terms of this VCO/CA may result in a district court action for specific performance of the VCO/CA, civil penalties, assessment of costs, restraining orders, injunctions and other relief available under Idaho Code §§ 39-108.

14) Stipulated Penalties. Simplot hereby stipulates and agrees that, if Simplot fails to submit any of the documents required by paragraphs 5(c through e) or to commence, conduct or complete any activity required by this VCO/CA, within the time periods specified in any deliverable submitted and approved pursuant to this VCO/CA, Simplot shall be subject to a stipulated penalty of one thousand ($1,000.00) for each day that Simplot fails to achieve compliance with the requirement. Notwithstanding the foregoing, it is expressly understood and agreed that stipulated penalties shall not accrue for any failure to meet the reduction requirements of paragraphs 5(a).

a) The Department shall give Simplot written notice of the alleged violation for which the Department seeks a penalty. The notice shall describe the alleged violation and demand payment of the penalty.

b) Upon receipt of such notice from the Department, Simplot shall reply in writing within seven (7) days. The reply shall: (1) explain the reason for the alleged violation and the proposed means and time required to remedy the same; or (2) state if Simplot believes the Department's claim is invalid.

c) The Department shall thereafter respond to Simplot's reply by notifying Simplot whether Simplot must pay the stipulated penalty.

d) Any stipulated penalty shall be paid by Simplot to the Department within thirty (30) days of Simplot's receipt of the Department's final response, except as otherwise provided for or limited by law.

e) All stipulated penalties shall begin to accrue upon the day a violation occurs and shall continue to accrue through the day:

   i) the violation is corrected or the VCO/CA requirement is met, or

   ii) Simplot receives written notice from the Department that the relevant activity is withdrawn from the scope of this VCO/CA.

f) Nothing shall prevent the simultaneous accrual of separate stipulated penalties for separate violations of this VCO/CA.

g) The payment of stipulated penalties shall not alter in any way Simplot's obligation to complete the performance of this VCO/CA.

h) If required, payment shall be made by electronic transfer of funds or by check payable to the Idaho Department of Environmental Quality and sent to the following address:

   Accounts Receivable
   Fiscal Office
   Idaho Department of Environmental Quality 1410 N. Hilton
   Boise, Idaho 83706-1255

15) Simplot enters this VCO/CA voluntarily without issuance of a Notice of Violation. By entering this VCO/CA, Simplot does not admit any violation of law or regulation and this VCO/CA does not constitute, nor shall it be used as evidence of any admission of law or fact or the waiver of any right or defense of any party. Nothing in this paragraph shall limit the Department's authority to enforce, pursuant to the Environmental Protection and Health Act, the provisions of this VCO/CA.

16) Waiver. A waiver by the Parties of any provision, term, condition or requirement of this VCO/CA shall not constitute a waiver of any other provision, term, condition or requirement of this VCO/CA.

17) Entire Agreement. This VCO/CA contains the entire agreement between the Parties. This VCO/CA may not be enlarged, modified or altered, except in writing signed by the Parties. Nothing in this VCO/CA creates legal rights or obligations other than those entered into between Simplot and the Department.

18) Third Party Rights. This VCO/CA does not give any member of the public or individual the right to sue either Simplot or the Department for any alleged failure to implement its terms, to compel its implementation, or to recover damages.

19) Authorization. Each Party represents and warrants it has the authority to enter into this VCO/CA and to take all actions provided for herein and no further action or authorizations required.

20) Reimbursement of State Costs. Reasonable Costs incurred by IDEQ with respect to the Site under this VCO/CA will be reimbursed in the following manner:

a) As an initial deposit, Simplot will pay the sum of Ten Thousand Dollars ($10,000.00) to be deposited to an account established for this Agreement.

b) Thereafter, IDEQ shall provide a quarterly accounting and invoice to Simplot of Costs incurred by IDEQ in relation to this VCO/CA. "Costs" subject to reimbursement under this paragraph shall mean all direct or indirect costs incurred by IDEQ after the effective date of the VCO/CA in connection with IDEQ's support of Work performed by or on behalf of IDEQ under this VCO/CA including but not limited to: reasonable time and travel costs associated with oversight of the Work performed under the VCO/CA; IDEQ's contractor costs; compliance monitoring, including the collection and analysis of split samples; Site visits; review and approval or disapproval of document submittals; reasonable overhead charges and any other costs directly or indirectly incurred in overseeing this VCO/CA.

c) Within thirty (30) days of Simplot's receipt of IDEQ's quarterly accounting invoice, Simplot shall reimburse the State for all costs reflected in the accounting invoice.

d) The initial deposit will be returned to Simplot within sixty (60) days of the date IDEQ incurs final response costs.

e) All payments necessary to IDEQ shall he made to:

Administrative Services-Accounts Receivable
Idaho Department of Environmental Quality
1410 N. Hilton

21) Effective Date. The effective date of this VCO/CA shall be upon signature by the Department's Director.

Dated this 11th day of April, 2008.

By: _____
J.R. Simplot Company

By: _____
Director,
Idaho Department of Environmental Quality