American Falls Subbasin Total Maximum Daily Load Plan: Subbasin Assessment and Loading Analysis

Idaho Department of Environmental Quality
Shoshone-Bannock Tribes
U. S. Environmental Protection Agency
May 2012

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May 2012

Prepared by:
Pocatello Regional Office
Department of Environmental Quality
444 Hospital Way, #300
Pocatello, Idaho 83201

Shoshone-Bannock Tribes
P. O. Box 306
Fort Hall, Idaho 83203

Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, Washington 98101

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Abbreviations, Acronyms, and Symbols

303(d), §303(d) Refers to section 303 subsection (d) of the Clean Water Act, or a list of impaired water bodies required by this section

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

ac-ft acre foot (feet)

avg average

BLM United States Bureau of Land Management

BMP best management practice

BOR United States Bureau of Reclamation

BURP Beneficial Use Reconnaissance Program

C Celsius

CAFO confined animal feeding operation

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

cfs cubic foot (feet) per second

cm centimeter(s)

CWA Clean Water Act

DEQ Idaho Department of Environmental Quality

DMR Discharge Monitoring Reports

DO dissolved oxygen

EIFAC European Inland Fisheries Advisory Commission

EPA United States Environmental Protection Agency

EPTC s-ethyl dipropylthiocarbamate

F Fahrenheit

GIS Geographical Information Systems

GWLF Generalized Watershed Loading Functions

HUC Hydrologic Unit Code

IDAPA Refers to citations of Idaho administrative rules

in inch

INL Idaho National Laboratory

USLEP Universal Soil Loss Equation parameters

km kilometer

km^2 square kilometer

L liter

LA load allocation

LC load capacity

m meter

m^3 cubic meter

MCL maximum contaminant level

mg milligram

mg/L milligrams per liter

mi mile

mi^2 square miles

mm millimeter

MOS margin of safety

N nitrogen

NAE National Academy of Engineering

NAS National Academy of Sciences

NAWQA National Water Quality Assessment

NB natural background

nda no date available

NDEP Nevada Division of Environmental Protection

NDEQ Nebraska Department of Environmental Quality

NH_3 ammonium

NO_2 nitrite

NO_3 nitrate

NPDES National Pollutant Discharge Elimination System

nr near

NRCS Natural Resources Conservation Service

ODEQ Oregon Department of Environmental Quality

P	phosphorus
PO_4	phosphate
ppm	part(s) per million
QAPP	quality assurance project plan
STATSGO	State Soil Geographic Database
T&E	threatened and/or endangered species
TIN	total inorganic nitrogen
TKN	total Kjeldahl nitrogen
TMDL	total maximum daily load
TP	total phosphorus
TSS	total suspended solids
*u*g/L	micrograms per liter
UNEP	United Nations Environment Programme
U.S.	United States
U.S.C.	United States Code
USDA	United States Department of Agriculture
USFS	United States Forest Service
USGS	United States Geological Survey
WAG	Watershed Advisory Group
WLA	wasteload allocation
WWTP	wastewater treatment plant
WY	water year (October to September)

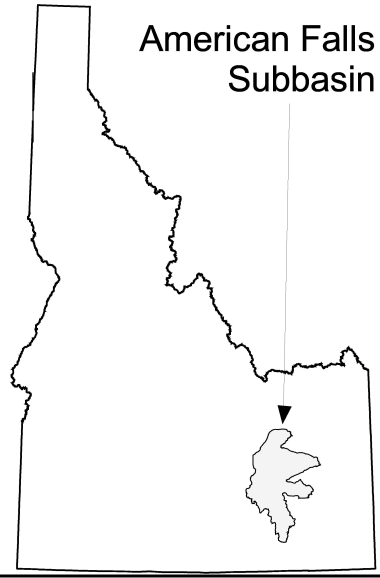
Cross Reference for Water Body Identification

NOTE: assessment units may include more than the specified water body.

Waterbody	Segment Upper	Segment Lower	Assessment unit
Snake River	HUC	American Falls Reservoir	SK022_02
American Falls Reservoir			SK001L_0L
McTucker Creek	Headwaters	Snake River	SK024_02, SK024_02a
Danielson Creek			SK000_02a
Hazard Creek/Little Hole Draw	Aberdeen		SK025_2a
Cedar spillway			SK026_03
Colburn wasteway			SK001_02, SK000_02
Crystal springs			SK001_02
Nash spill			SK026_02
R spill	None		
Spring Hollow	Headwaters	American Falls Reservoir	SK026_02
Sterling wasteway			SK001_02
Spring Creek			SK020_02
Clear Creek			SK019_02
Bannock Creek	Headwaters	Pauline	SK002_02, 03
Bannock Creek	Pauline	American Falls Reservoir	SK002_04, 05; SK001_05
Moonshine Creek	Headwaters	Reservation boundary	SK006_02
Rattlesnake Creek	Headwaters	Reservation boundary	SK010_02,02b,03,04
West Fork Bannock Creek	Headwaters	Reservation boundary	SK008_02
Knox Creek	Headwaters	Bannock Creek	SK009_02, 03
Seagull Bay tributary	None		
Sunbeam Creek			SK005_02

TMDL at a Glance

Subbasin:	*American Falls*
HUC:	*17040206*
Key Resources:	*Cold water Aquatic Life, Salmonid Spawning, Primary/Secondary Contact Recreation, Domestic & Agricultural Water Supply, Aesthetics, Wildlife Habitat*
Uses Affected:	*Cold water Aquatic Life, Salmonid Spawning, Primary/Secondary Contact Recreation, Domestic Water Supply, Aesthetics*
Pollutants:	*Sediment, Nutrients, Bacteria, Dissolved Oxygen, Flow Alteration, Unknown*
Sources Considered:	*Point Sources – wastewater treatment plants, fish hatcheries, stormwater* *Non-Point Sources - agriculture, grazing, roads, urban*



Executive Summary

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the CWA are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters whenever possible. Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list of impaired waters, currently every four years. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. This document addresses the water bodies in American Falls Subbasin that have been placed on what is known as the "303(d) list." This subbasin assessment and TMDL analysis has been developed to comply with Idaho's TMDL schedule. This assessment describes the physical, biological, and cultural setting; water quality status; pollutant sources; and recent pollution control actions in the American Falls Subbasin located in southeast Idaho. The first part of this document, the subbasin assessment, is an important first step in leading to the TMDL. The starting point for this assessment was Idaho's current 303(d) list of water quality limited water bodies. Nineteen assessment units in American Falls Subbasin were included on this list. The subbasin assessment portion of this document examines the current status of 303(d)-listed waters, and defines the extent of impairment and causes of water quality limitation throughout the subbasin. The loading analysis quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition of meeting water quality standards.

Subbasin At A Glance

American Falls Subbasin covers 2,869 square miles (1.8 million acres, 0.75 million hectares) in southeast Idaho. Urban areas within or adjacent to the subbasin are American Falls, Aberdeen, Blackfoot, Firth, and Shelley. Much of the subbasin lies within the Fort Hall Reservation. Major land uses include: dryland and irrigated agriculture, and livestock grazing. American Falls Reservoir is the predominant water body in the subbasin and provides both irrigation water and electricity. Major subbasin tributaries to the reservoir include Snake River from the reservoir to Bingham-Bonneville county line, Spring Creek, McTucker Creek, Danielson Creek, Bannock Creek, and Ross Fork.

Historically, American Falls Subbasin water bodies sustained several beneficial uses (Table ES-1). All streams supported cold water aquatic life, agriculture and industrial water supply, aesthetics, and wildlife habitat as well as secondary contact recreation, with the bigger streams also supporting primary contact recreation. Most streams also maintained spawning populations of salmonids. Domestic water supply has been officially declared a designated use in Snake River and American Falls Reservoir. Current information suggests that some beneficial uses, such as cold water aquatic life and salmonid spawning, are impaired and are not fully supported in several water bodies in the subbasins.

There are nineteen water quality assessment units included on the 2010 303(d) list. In addition to American Falls Reservoir, three streams that flow into the reservoir are on the list – Snake River, McTucker Creek, and Bannock Creek. The remaining listed water bodies are tributaries of

Bannock Creek and include Moonshine Creek, Rattlesnake Creek, West Fork Bannock Creek, and Knox Creek.

Public participation and public comments are included in Appendix I.

Key Findings

The current list of water quality limited water bodies includes streams from previous lists including 1996, 1998, 2002 and 2008. Most streams listed prior to 1998 had sediment, nutrients, or both listed as a pollutant of concern.

Dissolved oxygen was identified as a problem in both American Falls Reservoir and Snake River, with the river also listed for flow alteration. Bannock Creek was also on the list for bacteria concerns. For Knox Creek, which was added to the list in 1998, pollutants of concern were listed as unknown. Key beneficial uses affected by these pollutants are cold water aquatic life, salmonid spawning, and contact recreation.

Sources of Pollutants

Several sources of pollutants have been identified in American Falls Subbasin. Agriculture has been positively related to both nutrient and sediment loading. Stormwater runoff is also a source of both sediments and nutrients. Other likely contributors to sediment loading in subbasin streams are livestock practices, stream channels and banks, and roads. Windblown sediment and shoreline erosion add to sediment loading in American Falls Reservoir. In addition to agriculture and stormwater, wastewater treatment plants are a source of nutrients in the subbasin. Waterfowl add to nutrient loading, primarily in the reservoir. Another source of phosphorus in the reservoir is bottom sediments, which add to overall phosphorus loading through internal recycling. Other possible contributors of nutrients include livestock grazing, recreation, and failed septic systems. From a geographical perspective, a major contributor of both nutrients and sediment to American Falls Reservoir is an out-of-subbasin tributary, the Portneuf River.

There are thirteen National Pollutant Discharge Elimination System (NPDES) dischargers within American Falls Subbasin. Four are wastewater treatment plants at Aberdeen, Blackfoot, Firth, and Shelley. Four additional permits relate to fish hatcheries with Crystal Springs holding three permits and Indian Springs holding one permit. The other five NPDES permits relate to large confined animal feeding operations – Snake River Cattle Company, Tom Anderson Cattle Company, Bragg feedlot, Kerry Ward feedlot, and Alan Andersen dairy. Additional NPDES permits are required for the control of stormwater from construction activities that disturb greater than one acre.

Table ES-1. Water body quality limited assessment units in American Falls Subbasin on the 2010 303(d) list addressed by this TMDL including listed pollutants and beneficial uses.

			Beneficial uses[2]				
			Cold water aquatic life	Salmonid spawning	Contact recreation		Domestic water supply
Water body	**Assessment unit(s)**	**Listed pollutants[1]**			Primary	Secondary	
American Falls Reservoir	ID17040206SK001L_0L	DO, Nut, Chlorophyll-a, Sed	D		D	P	D
Snake River	ID17040206SK022_02	DO,Sed	D	D	D	P	D
McTucker Creek	ID17040206SK024_02, 024_02a	Sed	P			P	
American Falls - Bannock Creek	ID17040206SK001_05;	Cause unknown (suspected nutrients), Sed	D	E	E	D	
Bannock Creek	ID17040206SK002_02, ID17040206SK002_04, 002_05 ID17040206SK002_03	Cause unknown (suspected nutrients), Fecal coliform, Sed E-coli, Sed	D	E	E	D	
Moonshine Creek	ID17040206SK006_02,	Sed	P			P	
Rattlesnake Creek	ID17040206SK010_02, 010_02b, 010_03, 010_04	Sed	P			P	
West Fork Bannock Creek	ID17040206SK008_02	Sed	P			P	
Knox Creek	ID17040206SK009_02 ID17040206SK009_03	Sed Combined biota/habitat bioassessment	P			P	
Danielson Creek	ID17040204SK000_02a	Combined biota/habitat bioassessment	P			P	
Little Hole Draw	ID17040206SK025_02a	Combined biota/habitat bioassessment	P			P	

[1]DO=dissolved oxygen, , Nut=nutrients, Sed=sediment,

[2]D=designated in State Water Quality Standards, P=use not designated so presumed to support use, E=existing use; all water bodies are considered to support agriculture and industrial water supply, wildlife habitat, and aesthetics; beneficial use information from the Idaho Water Quality Standards and Wastewater Treatment Requirements and Beneficial Use Reconnaissance Program monitoring

Load Allocations

Load allocations (quantity of pollutants a stream can assimilate without impairing beneficial uses) were based on target concentrations chosen such that attainment of the target would result in meeting beneficial uses:

- Phosphorus is considered the most likely limiting nutrient in American Falls Reservoir. The target for total phosphorus is set at 0.05 mg/L for tributaries and point sources to the reservoir, with an interim total phosphorus target of 0.07 mg/L to be achieved in the short-term and until the 0.05 mg/L target is reevaluated.
- No phosphorus load allocations were placed on the reservoir, but a target average not to exceed chlorophyll *a* concentration for July 1 to August 30 of 0.015 mg/L is set.
- An average concentration not to exceed 60 mg/L of suspended sediment over a 14-day period was recommended for water bodies in American Falls Subbasin listed for sediment problems, except for Bannock Creek watershed. For Bannock Creek and tributaries, a surrogate sediment target of 80% streambank stability was used to develop load allocations and necessary reductions.

Load allocations were not established for dissolved oxygen or bacteria:

- Data did not indicate dissolved oxygen was a problem in the Snake River, and it was assumed that control of nutrients and subsequent reduction in algal densities will lead to attainment of water quality standards and beneficial uses in the reservoir.
- Data were insufficient to conclude contact recreation impairment by bacteria in Bannock Creek, so a plan was recommended to collect necessary data to determine beneficial use support.

Margins of Safety

TMDLs must also include a margin of safety (MOS) and consider seasonality in the analysis. In TMDLs for American Falls Subbasin, the choice of conservative targets result in an inherent margin of safety when estimating load and wasteload allocations. Seasonality was only considered in the establishment of the chlorophyll *a* target for the reservoir, which is based on a July and August average. It is during these months that recreational use is high as is the potential for growth of aquatic vegetation.

The amount and periodicity of data varied by water body, load allocations were thus based on available data. Most of the data used to calculate loads were collected since 2000 and generally reflect drought conditions in southeast Idaho. Discharge Monitoring Reports (DMRs) provided the basis for estimating wasteloads for NPDES permit holders.

Loading Analysis

A quick overview of both listed and unlisted water bodies, and point sources, for which load and wasteload allocations were recommended is as follows:

American Falls Reservoir (ID17040206SK001L_0L)– This water body is listed for DO, nutrients, Chlorophyll-a and sediment (Table ES-1). No data were reviewed to indicate sediment was impairing beneficial uses in the reservoir, so no TMDL was completed. The reservoir has a history of algae problems exacerbated by nutrient loading to the reservoir. The primary beneficial use affected is cold water aquatic life. Sources of nutrients into the reservoir include: tributaries, springs, drains, waterfowl; and internal recycling of phosphorus. The target for chlorophyll *a* is an average (July and August) concentration not to exceed 0.015 mg/L of chlorophyll *a* for the reservoir, with the assumption that attainment of this target will lead to observance of water quality standards for dissolved oxygen and support of cold water aquatic life beneficial use. A rudimentary model was employed to examine effects of suggested reductions in phosphorus loading to the reservoir. The model predicts that, with recommended phosphorus load reductions from tributaries and an average target concentration of chlorophyll *a* at 0.015 mg/L, the DO water quality standards will be supported except in the highest of water years. This reservoir should be scheduled for future lake monitoring to determine support of beneficial uses. Interim load allocations and reductions are detailed in Table ES-2b.

Snake River (ID17040206SK022_02) – River mile 791 to American Falls Res.— This water quality limited assessment unit is listed for sediment (Table ES-1).

No data were reviewed that suggest sediment is impairing beneficial uses in this reach; however, the effect of bedload and water column sediment in average to high water years is unknown. Until such data are collected, or BURP assessment indicates beneficial support, it is assumed that sediment is impairing beneficial uses in the reach. Beneficial uses possibly affected are cold water aquatic life and salmonid spawning. Eroding streambanks, stormwater runoff from the City of Blackfoot, and agriculture are sources of sediment. Other possible sediment sources are livestock grazing and instream channel. The load allocations for suspended sediment as measured at the U.S. Geological Survey (USGS) gages at Ferry Butte near Blackfoot (13069500) and near Shelley (13060000) are 164,471 tons/year and 118,286 tons/year, respectively (Table ES-2a).

Nutrients do not appear to be impairing beneficial uses in the Snake River, but as the river discharges to American Falls Reservoir, a load allocation was established for phosphorus. Nitrogen is also an important component of nutrient dynamics in lotic as well as lentic waters; although load allocations for nitrogen are not established, DEQ recommends maintaining current levels of nitrogen. Wastewater treatment plants (WWTP) in Blackfoot, Firth, and Shelley, as well as City of Blackfoot stormwater runoff, contribute nutrients to the Snake River in this reach. Other possible nutrient sources include agriculture and livestock. Annual load allocations at USGS gage sites at Ferry Butte, at Blackfoot (13062500), and near Shelley are 167, 146, and 171 tons of total phosphorus. This stream segment should be scheduled for future BURP monitoring to determine support of beneficial uses. Interim load allocations and reductions are detailed in Table ES-2b.

Table ES-2a. Load and wasteload allocations for phosphorus (TP targets of 0.05 mg/L) and sediment for American Falls Subbasin water bodies & point sources.

Water body		Site	Total phosphorus (tons/year)				Suspended sediment (tons/year)			
			Annual load		Annual wasteload		Annual load		Annual wasteload	
			Allo-cation	Reduc-tion	Allo-cation	Reduc-tion	Allo-cation	Reduc-tion	Allo-cation	Reduc-tion
303(d) listed water bodies										
Snake River		nr Blackfoot USGS gage[1]	167	0			164,471	0		
		at Blackfoot USGS gage	146	0						
		nr Shelley USGS gage	171	0			118,286	0		
Bannock Creek			2.6	3.9			948	99		
Danielson Creek			1.92	0.00			548	0		
Hazard Creek (Little Hole Draw)			0.82	3.26			164	0		
Moonshine Creek							168	218		
Rattlesnake Creek							307	327		
West Fork Bannock Creek							55	0		
McTucker Creek			6.5	0.0			1,439	0.0		
Portneuf River[2]		Tyhee USGS gage	22	365						
Non 303(d) listed water bodies										
Clear Creek			1.07	0.00						
Seagull Bay tributary			0.27	0.89						
Spring Creek			8.62	0.00						
Sunbeam Creek			0.22	0.85			261	153		
Cedar spillway			0.49	0.00						
Colburn wasteway			0.26	0.00						
Crystal springs			2.34	0.00						
Nash spill			0.009	0.00						
R spill			0.003	0.00						
Spring Hollow			0.26	0.48						
Sterling wasteway			0.27	0.17						
Point sources										
Aberdeen WWTP					0.16	0.66			7.3	0.0
Blackfoot WWTP					7.10	0.00			72.5	0.0
Firth WWTP					0.48	0.00			8.0	0.0
Shelley WWTP					1.26	0.00			21.0	0.0
IDFG Springfield Hatchery					1.63	0.00			347	0.0
Sho-Ban Tribes Crystal Spgs Hatchery					0.78	0.00			166	0.0
City of Blackfoot stormwater runoff					0.33	0.00			21.9	68.0

[1] This gage site is actually at Ferry Butte and Tilden Bridge

Table ES-2b. Interim Load and wasteload allocations for phosphorus (TP targets of 0.07 mg/L) and sediment for American Falls Subbasin water bodies & point sources.

		Total phosphorus (tons/year)				Suspended sediment (tons/year)			
		Annual load		Annual wasteload		Annual load		Annual wasteload	
Water body	Site	Allo-cation	Reduc-tion	Allo-cation	Reduc-tion	Allo-cation	Reduc-tion	Allo-cation	Reduc-tion
303 (d) listed water bodies									
Snake River	nr Blackfoot USGS gage[1]	167	0			164,471	0		
	at Blackfoot USGS gage	146	0						
	nr Shelley USGS gage	171	0			118,286	0		
Bannock Creek		3.6	3.0			948	99		
Danielson Creek		1.92	0.00			548	0		
Hazard Creek (Little Hole Draw)		1.13	2.95			164	0		
Moonshine Creek						168	218		
Rattlesnake Creek						307	327		
West Fork Bannock Creek						55	0		
McTucker Creek		6.5	0.0			1,439	0.0		
Portneuf River[2]	Tyhee USGS gage	30.5	356						
Non 303(d) listed water bodies									
Clear Creek		1.07	0.00						
Seagull Bay tributary		0.38	0.78						
Spring Creek		8.62	0.00						
Sunbeam Creek		0.31	0.77			261	153		
Cedar spillway		0.49	0.00						
Colburn wasteway		0.26	0.00						
Crystal springs		2.34	0.00						
Nash spill		0.009	0.00						
R spill		0.003	0.00						
Spring Hollow		0.37	0.38						
Sterling wasteway		0.38	0.06						
Point sources									
Aberdeen WWTP				0.16	0.66			7.3	0.0
Blackfoot WWTP				7.10	0.00			72.5	0.0
Firth WWTP				0.48	0.00			8.0	0.0
Shelley WWTP				1.26	0.00			21.0	0.0
IDFG Springfield Hatchery				1.63	0.00			347	0.0
Sho-Ban Tribes Crystal Spgs Hatchery				0.78	0.00			166	0.0
City of Blackfoot stormwater runoff				0.33	0.00			21.9	68.0

[1] This gage site is actually at Ferry Butte and Tilden Bridge

[2] Portneuf River is not on the 303(d) list under American Falls Subbasin, but is on the 303(d) list under its own subbasin

Bannock Creek –(ID17040206SK002_02, 002_03, 002_04, and 002_05 and ID17040206SK001_05Source to American Falls Reservoir– These water quality limited assessment units are variously listed for bacteria as *E. coli* or fecal coliform, sediment, and cause unknown (nutrients suspected) (Table ES-1). Data were incomplete to confirm violations of water quality standards for *E. coli*; therefore, no TMDL was written for bacteria. It was recommended that DEQ and Shoshone-Bannock Tribes cooperate in a sampling effort to confirm bacteria standards violations. No data were reviewed as to support of beneficial uses in this water quality limited assessment unit of Bannock Creek.

The beneficial use most likely affected is cold water aquatic life. Load allocations were established for both nutrients and sediment. Land management activities (e.g., agriculture and livestock grazing) are major sources of nutrients into mainstem Bannock Creek. Nutrient load allocation is 2.6 tons/year for total phosphorus. Possible sources of sediment include agriculture, livestock grazing, and roads. Additional sediment sources may include the instream channel and streambanks. The Generalized Watershed Loading Functions (GWLF) model was used to establish a sediment load for Bannock Creek in comparison to streambank stability and water column sediment data from West Fork Bannock Creek, which served as a reference for Bannock Creek watershed streams. The annual load allocation for sediment is 948 tons (Table ES-2a). This stream assessment unit should be scheduled for future BURP monitoring to determine support of beneficial uses. Interim load allocations and reductions are detailed in Table ES-2b.

Moonshine Creek – (ID17040206SK006_02. This tributary to Bannock Creek is listed on the 303(d) list for sediment (Table ES-1). No data were reviewed as to support of beneficial uses in Moonshine Creek. The beneficial use most likely affected is cold water aquatic life. Possible sources of sediment include agriculture, livestock grazing, and roads. Additional sediment sources may include the instream channel and streambanks. The GWLF model was used to establish a sediment load for Moonshine Creek in comparison to streambank stability and water column sediment data from West Fork Bannock Creek, which served as a reference for Bannock Creek watershed streams. The annual load allocation for sediment is 168 tons (Table ES-2a). This stream should be scheduled for future BURP monitoring to determine support of beneficial uses. Interim load allocations and reductions are detailed in Table ES-2b.

Rattlesnake Creek – (ID17040206SK010_02, 010_02b, 010_03, 010_04) This tributary to Bannock Creek is listed on the 303(d) list for sediment (Table ES-1). Assessment of BURP data indicates the stream is not supporting its beneficial uses. The primary beneficial use affected is cold water aquatic life. Possible sources of sediment include agriculture, livestock grazing, and roads. Additional sediment sources may include the instream channel and streambanks. The GWLF model was used to establish a sediment load for Rattlesnake Creek in comparison to streambank stability and water column sediment data from West Fork Bannock Creek, which served as a reference for Bannock Creek watershed streams. The annual load allocation for sediment is 307 tons (Table ES-2a). Interim load allocations and reductions are detailed in Table ES-2b.

West Fork Bannock Creek – This tributary to Bannock Creek was listed on previous 303(d) lists for sediment (Table ES-1). No data were reviewed as to support of beneficial uses in West Fork. This tributary presently displays significant water quality and habitat improvement. These improvements are directly related to the management measures (fencing of riparian corridor) that have been implemented in the subwatershed. This improvement in water and habitat quality is deemed significant enough to consider West Fork a viable target in the GWLF model for gaging the level of improvement necessary in other 303(d) listed water bodies within Bannock Creek watershed. The annual load allocation for sediment is 55 tons (Table ES-2a). This stream should be scheduled for future BURP monitoring to determine support of beneficial uses. Interim load allocations and reductions are detailed in Table ES-2b.

Knox Creek – (ID17040206SK009_02 and 009_03) This tributary to Bannock Creek is listed on the 303(d) list for sediment on the 2nd order reach and combined biota/habitat bioassessment on the third order reach. (Table ES-1). Assessment of BURP data indicates the stream is not supporting its beneficial uses. The primary beneficial use affected is cold water aquatic life. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the instream channel, streambanks, and roads. No data were available to indicate nutrients are affecting beneficial uses, although the overall nutrient load allocation for Bannock Creek would encompass Knox Creek. An individual load allocation for sediment was not made for Knox Creek, but is part of the overall sediment load allocation for Bannock Creek More data are needed to determine what is causing impairment of beneficial uses in Knox Creek. Interim load allocations and reductions are detailed in Table ES-2b.

McTucker Creek – (ID17040206SK024_02 and 024_02a). This stream is listed on the 303(d) list for sediment (Table ES-1). Assessment of BURP data indicates the stream is not supporting its beneficial uses. Beneficial uses affected are cold water aquatic life and salmonid spawning. Possible sources of sediment are historic activities, livestock grazing, instream channel, and streambanks. The annual load allocation for sediment is 1,439 tons (Table ES-2a). As this stream contributes to nutrients in American Falls Reservoir, a load allocation is recommended for total phosphorus at 6.5 tons/year. Interim load allocations and reductions are detailed in Table ES-2b.

Danielson Creek – (ID17040206SK000_02a). This stream is listed on the 303(d) list for combined biota/habitat bioassessment (Table ES-1). Assessment of BURP data indicates the stream is not supporting its beneficial uses. The primary beneficial uses affected are cold water aquatic life and salmonid spawning. It is unknown what is causing impairment of beneficial uses in Danielson Creek so load allocations are recommended for both nutrients and sediment. In addition, Danielson Creek is a source of nutrients into American Falls Reservoir. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the instream channel and streambanks. Total phosphorus load allocation is 1.92 tons/year (Table ES-2a). The annual load allocation for sediment is 548 tons. Interim load allocations and reductions are detailed in Table ES-2b.

Hazard Creek/Little Hole Draw – (ID17040206SK025_02a) This stream is on the 303(d) list for combined biota/habitat assessments, but assessment of BURP data indicates the stream is not supporting its beneficial uses. The primary beneficial use affected is cold water aquatic life.. It is unknown what is causing impairment of beneficial uses in Hazard Creek/Little Hole Draw so load allocations are recommended for both nutrients and sediment. In addition, Hazard Creek/Little Hole Draw is a source of nutrients into American Falls Reservoir. While Aberdeen WWTP contributes nutrients and some sediment to the creek, other possible pollutant sources are agriculture, livestock grazing, and urban activities. Additional sediment sources may include the instream channel and streambanks. Total phosphorus load allocation is 0.82 tons/year (Table ES-2a). The annual load allocation for sediment is 164 tons. Interim load allocations and reductions are detailed in Table ES-2b.

Sunbeam Creek – This stream is not on the 303(d) list, but assessment of BURP data indicates the stream is not supporting its beneficial uses. The primary beneficial use affected is cold water aquatic life. It is unknown what is causing impairment of beneficial uses in Sunbeam Creek so load allocations are recommended for both nutrients and sediment. In addition, Sunbeam Creek is a source of nutrients into American Falls Reservoir. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the instream channel and streambanks. Total phosphorus load allocation is 0.22 tons/year (Table ES-2a). The annual load allocation for sediment is 261 tons. Interim load allocations and reductions are detailed in Table ES-2b.

Clear Creek – This stream is not on the 303(d) list, but does contribute to nutrient loads in American Falls Reservoir. Total phosphorus load allocation is 1.07 tons/year (Table ES-2a). This stream should be scheduled for future BURP monitoring to determine support of beneficial uses. Interim load allocations and reductions are detailed in Table ES-2b.

Seagull Bay tributary – This stream is not on the 303(d) list, but does contribute to nutrient loads in American Falls Reservoir. Total phosphorus load allocation is 0.27 tons/year (Table ES-2a). This stream should be scheduled for future BURP monitoring to determine support of beneficial uses. Interim load allocations and reductions are detailed in Table ES-2b.

Spring Creek – This stream is not on the 303(d) list, but does contribute to nutrient loads in American Falls Reservoir. Total phosphorus load allocation is 8.62 tons/year (Table ES-2a). This stream should be scheduled for future BURP monitoring to determine support of beneficial uses. Interim load allocations and reductions are detailed in Table ES-2b.

Cedar spillway – This agricultural return drain is not on the 303(d) list, but does contribute to nutrient loads in American Falls Reservoir. Total phosphorus load allocation is 0.49 tons/year (Table ES-2a). Interim load allocations and reductions are detailed in Table ES-2b.

Colburn wasteway – This agricultural return drain is not on the 303(d) list, but does contribute to nutrient loads in American Falls Reservoir. Total phosphorus load allocation is 0.26 tons/year (Table ES-2a). Interim load allocations and reductions are detailed in Table ES-2b.

Crystal springs – This water body is not on the 303(d) list, but does contribute to nutrient loads in American Falls Reservoir. Total phosphorus load allocation is 2.38 tons/year (Table ES-2a). Interim load allocations and reductions are detailed in Table ES-2b.

Nash spill – This agricultural return drain is not on the 303(d) list, but does contribute to nutrient loads in American Falls Reservoir. Total phosphorus load allocation is 0.009 tons/year (Table ES-2a). Interim load allocations and reductions are detailed in Table ES-2b.

R spill – This agricultural return drain is not on the 303(d) list, but does contribute to nutrient loads in American Falls Reservoir. Total phosphorus load allocation is 0.003 tons/year (Table ES-2a). Interim load allocations and reductions are detailed in Table ES-2b.

Spring Hollow – This water body is not on the 303(d) list, but does contribute to nutrient loads in American Falls Reservoir. Total phosphorus load allocation is 0.26 tons/year (Table ES-2a). Interim load allocations and reductions are detailed in Table ES-2b.

Sterling wasteway – This agricultural return drain is not on the 303(d) list, but does contribute to nutrient loads in American Falls Reservoir. Total phosphorus load allocation is 0.27 tons/year (Table ES-2a). Interim load allocations and reductions are detailed in Table ES-2b.

Portneuf River – This stream is on the 303(d) list and a TMDL has already been approved for the Portneuf River Subbasin. The river contributes to nutrient loads in American Falls Reservoir. The total phosphorus load allocation is 22 tons/year (Table ES-2a). Interim load allocations and reductions are detailed in Table ES-2b.

Aberdeen wastewater treatment plant – This point source contributes nutrients and some sediment to Hazard Creek/Little Hole Draw, and ultimately to American Falls Reservoir. The total phosphorus load allocation is 0.160 tons/year (Table ES-2a). The annual wasteload allocation for sediment is 7.3 tons. The total phosphorus load allocation requires a reduction of current estimated wasteloads, while the sediment wasteload allocation does not. Interim wasteload allocations and reductions are detailed in Table ES-2b.

Blackfoot wastewater treatment plant – This point source contributes nutrients and some sediment to the Snake River, and ultimately to American Falls Reservoir. The total phosphorus load allocation is 7.103 tons/year (Table ES-2a). The annual wasteload allocation for sediment is 72.5 tons. Neither phosphorus nor sediment wasteload allocations require a reduction of current estimated wasteloads. Interim wasteload allocations and reductions are detailed in Table ES-2b.

Firth wastewater treatment plant – This point source contributes nutrients and some sediment to the Snake River, and ultimately to American Falls Reservoir. The total phosphorus load allocation is 0.487 tons/year (Table ES-2a). The annual wasteload allocation for sediment is 8.0 tons. Neither phosphorus nor sediment wasteload allocations require a reduction of current estimated wasteloads. Interim wasteload allocations and reductions are detailed in Table ES-2b.

Shelley wastewater treatment plant – This point source contributes nutrients and some sediment to the Snake River, and ultimately to American Falls Reservoir. The total phosphorus load allocation is 1.267 tons/year (Table ES-2a). The annual wasteload allocation for sediment is 21.0 tons. Neither phosphorus nor sediment wasteload allocations require a reduction of current estimated wasteloads. Interim wasteload allocations and reductions are detailed in Table ES-2b.

Crystal Springs conservation hatchery complex – This point source consists of IDFG Springfield Hatchery and the Sho-Ban Tribes Crystal Springs Hatchery and contributes nutrients and sediment that reach American Falls Reservoir. The total phosphorus load allocation is 1.63 tons/year for IDFG and 0.78 tons/year for the Sho-Ban Hatchery (Table ES-2a). The annual wasteload allocation for sediment is 347 tons/year for IDFG and 166 tons/year for the Sho-Ban hatchery. Neither phosphorus nor sediment wasteload allocations require a reduction of current estimated wasteloads. Interim wasteload allocations and reductions are detailed in Table ES-2b.

City of Blackfoot stormwater runoff – This point source contributes nutrients and sediment to the Snake River, and ultimately to American Falls Reservoir. The total phosphorus load allocation is 0.33 tons/year (Table ES-2a). The annual wasteload allocation for sediment is 21.9 tons. Phosphorus wasteload allocation does not require a reduction of current estimated wasteloads while the sediment wasteload allocation does. Interim wasteload allocations and reductions are detailed in Table ES-2b.

Water bodies Recommended for Delisting

Information used to prepare this document justifies the delisting of pollutants for several water bodies in the subbasin. None of the data reviewed suggested sediment was adversely affecting beneficial uses in American Falls Reservoir. Monitoring of dissolved oxygen in the Snake River showed no violations of water quality standards. Levels of nutrients observed in the Snake River were low compared to target concentrations used to establish load allocations. Thus, it is recommended that for future 303(d) lists, American Falls Reservoir be delisted for sediment, nutrients and dissolved oxygen as load reductions from tributaries and meeting chlorophyll – a targets is expected to achieve water quality standards and beneficial uses.

Possible Additions to 303(d) List

Data examined during preparation of the TMDL imply possible impairment of beneficial uses due to pollutants additional to those on the 303(d) list. Violations of water quality standards for temperature in the Snake River were documented. Continuous temperature sampling should be undertaken and analyzed to see if temperature exceedances are more that 10% of the time.

Data Gaps

Several aspects of the TMDL would be improved with additional data. These data would serve to better refine links between pollutants and beneficial uses, natural background levels, more appropriate targets, and better estimates of load allocations. The following is by no means an exhaustive list of all data needs in the American Falls Subbasin:

- natural background levels of nutrients and sediment
- nutrient and sediment data from average and above average water years
- refinement of nutrient levels necessary to support beneficial uses
- contribution of springs to reservoir nutrient loads
- bathymetric data from American Falls Reservoir
- better estimates of internal phosphorus loading in American Falls Reservoir
- increased sampling of the reservoir to include more sites over a longer period (e.g., April through September)
- sediment bedload data from average to above average water years in subbasin streams, especially the Snake River
- complete survey of streambank stability in Bannock Creek watershed streams
- additional water quality information from tributaries on the Fort Hall Reservation
- regular stream flow information throughout the year for tributaries
- bacteria sampling in Bannock Creek

- ambient monitoring above and below wastewater treatment plant effluent discharges identification of pollutant sources in the subbasin

Implementation Strategies

Any implementation plan will concentrate on reducing nutrients and sediment. For point sources such as wastewater treatment plants, it is expected that future NPDES permits will include recommended limitations on nutrients. Reduction in pollutant loadings for nonpoint sources will most likely require a mix of policy changes, program initiatives, and implementation of *Best Management Practices*.

Certain state agencies have been designated to work with particular industries that have the potential for contributing nonpoint source pollutants. For example, the *Idaho Soil Conservation Commission* has the responsibility to work with agriculture and the livestock industry on development of their implementation plan to meet recommendations set out in the American Falls Subbasin TMDL.

No timelines are presented as to when water quality will improve to the point of supporting beneficial uses. Such dates are dependent on a myriad of factors such as financial support, landowner cooperation, and geological processes (e.g., sufficient stream flows to mobilize sediment and move it out of the system). The hope would be so see some significant changes toward meeting the goals of the TMDL within ten years.

Interim Targets and Load Allocations in a Phased TMDL Approach

Phased TMDLs are appropriate for situations in which the state expects, because of data gaps, to revise the TMDL, including the loading capacity and allocation scheme, as additional information is collected. A prime example of when a phased TMDL is appropriate is a TMDL for phosphorous in a lake watershed where there are uncertain loadings from the major land uses and limited knowledge of the in-lake processes. Even where there is little data uncertainty, TMDLs may contain provisions for adaptive implementation using flexible load allocation/wasteload allocation schemes.

The Idaho Water Quality Act, Idaho Code § 39-3611(7), requires DEQ to review and reevaluate each TMDL, including the water quality criteria used, instream targets, pollution allocations, and the underlying assumptions and analysis, at intervals no greater than five years.

With respect to the AF TMDL, DEQ acknowledges uncertainties and data gaps regarding the model used in connection with setting tributary targets and load allocations. Uncertainty regarding loading and a limited knowledge of in-reservoir processes required the use of certain assumptions and estimates in the model, which in turn affect the certainty of the load reductions necessary to meet water quality standards. More data and more sophisticated or detailed analytical techniques may increase DEQ's ability to predict water quality conditions and set load allocations that will achieve water quality standards. Since the development of the original TMDL, DEQ has already begun the process of collecting additional data and information regarding water quality in the AF reservoir and the significant tributaries. Given these circumstances and the applicable Idaho law, DEQ intends to reevaluate, and as appropriate revise, the targets and load allocations set forth in this TMDL within 5 years of its issuance.

Within the next 5 years additional data will be gathered that measures AF Reservoir water quality conditions, tracks progress in attaining TMDL objectives, and fills data gaps. DEQ shall form a Technical Advisory Committee to develop a work plan for additional monitoring and analysis. The work plan will be reviewed/revised on an annual basis. The work plan may include more refined modeling and DEQ expects at a minimum the work plan will include the measurement of water column total phosphorus, chlorophyll a, and dissolved oxygen within each segment addressed by the TMDL during time frames that represent high, low and average flow conditions, if possible. The work plan will also establish a timetable for revision of the TMDL, as appropriate, within the 5 year time period required by Idaho Code 39-3611(7).

Until the TMDL is reevaluated, and while the additional data is being gathered, DEQ believes an interim water quality target of 0.07 mg/l total phosphorus for the tributaries is appropriate. Load allocations based on this target are set out below. DEQ has selected this interim water quality target of 0.07 mg/l total phosphorus based upon data comparing median chlorophyll a concentration with median total phosphorous concentration data for lakes and reservoirs in the Pacific Northwest. See Snake River - Hells Canyon TMDL, Figure 3.2.13.b. This data suggests that, for the water bodies evaluated, total phosphorous concentrations of 0.07 mg/l correlate with chlorophyll a concentrations of 13 ug/l or less. Please note that where current loads are lower than the target, the load allocations are set at the current loads.

Adaptive Implementation

As noted, TMDLs may use an iterative implementation approach that makes progress toward achieving water quality goals while using any new data and information to reduce uncertainty and adjust implementation activities. Clarification at page 3-4. Implementation can also be staged.

The Idaho Water Quality Act provides that TMDLs should be implemented through pollution control strategies, which are defined as cost-effective actions in TMDL implementation plans to control the discharge of pollutants that can reasonably be taken to improve the water quality within the physical, operational, economic and other constraints that affect individual enterprises and communities. Idaho Code § 39-3602 (5); 39-3611(4).

DEQ intends to facilitate development of an Implementation Plan for the AF TMDL within 18 months of the TMDL's approval by EPA. The Implementation Plan will take into account the fact that long-term targets and allocations will be reevaluated within five years, and that interim water quality goals have been set. In the case of sources on the Portneuf River, load allocations, wasteload allocations and implementation will be controlled by the Portneuf River TMDL and an implementation plan developed by DEQ and other designated agencies in consultation with the WAG for that tributary.

The Implementation Plan should consider the following principles:

1. Attainable water quality goals should reflect control strategies that are feasible on a broad, watershed basis. Highest cost management practices should not be the basis for water quality planning. For example, it is not reasonable to expect sources to achieve zero discharge, or to expect all of irrigated agriculture to convert to sprinkler irrigation, or to expect all point sources to retrofit with the most expensive pollution control technology available.

2. After completing an implementation plan, site-specific analyses must be performed to determine the most appropriate and effective control strategies for particular locations and land use actives. The time required for ground-level planning and project approval process varies widely depending upon then nature of the land and related hydrology, the land use, the parties involved, the type of treatment selected, and other factors.

3. Construction and implementation of management practices follows project approval. As with the planning and approval process, the time required to complete a project and realize water quality improvements varies from more immediate, as with introduction of rotational grazing as a management practice, to longer term, as with stream bank re-vegetation and created wetlands (6-7 years may be necessary to establish vegetation that will produce adequate results).

4. In addition to the time required to achieve effective reductions, the time required for the river and reservoirs to fully respond to the improvement in inflowing water quality and process the existing pollutant loads already in place within the system must also be recognized.

5. Data collection will continue throughout the implementation process to determine progress and improve understanding of the AF TMDL system. As this TMDL is a phased process, it is projected that the goals and objectives of this TMDL will be revisited periodically to evaluate new information and assure that the goals and milestones are consistent with the overall goal of meeting water quality standards in the AF TMDL reach.

6. The load allocation mechanism established and implemented through tributary TMDLs should allow attainment of water quality targets through (to the extent possible) fair and equitable distribution of the identified pollutant loads, and result in productive implementation without causing undue hardship on any single pollutant source.

7. The adaptive implementation process will address the use of water quality trading.

Implementation of the American Falls TMDL and the Portneuf TMDL

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.

Interim Target vs. Final Target

As stated the American Falls TMDL will institute an interim total phosphorus concentration of 0.07 mg/L, while preserving the final target of 0.05 mg/L. It is noted, however, that while the interim target is instituted the attainment of long-term water quality is the ultimate goal. During this time DEQ will conduct additional water quality monitoring along with more in-depth analyses to assess whether the interim target total phosphorus concentration is effective in meeting these goals. The goal of the American Falls TMDL is to improve water quality in the reservoir and impaired tributaries while maintaining water quality in the remaining water bodies in the subbasin; therefore the development of any implementation plans will be designed in consideration of the final target.

1. Subbasin Assessment – Watershed Characterization

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the CWA, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters whenever possible. Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies not meeting water quality standards). States and tribes must periodically publish a priority list of impaired waters, every four 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 American Falls Subbasin that have been placed on the 1998 "303(d) list", subsequent "303 (d) lists" and carried forward to the 2010 Integrated Report in Category 5 "303 (d) list."

The overall purpose of this subbasin assessment and TMDL is to characterize and document pollutant loads within American Falls Subbasin and develop load reductions to attain water quality standards and beneficial uses. The first portion of this document, the subbasin assessment, is partitioned into four major sections: watershed characterization, water quality concerns and status, pollutant source inventory, and a summary of past and present pollution control efforts (Chapters 1 – 4, respectively). This information is then used to develop a TMDL for each pollutant of concern for the American Falls Subbasin (Chapter 5).

1.1. Introduction

In 1972, Congress passed the Federal Water Pollution Control Act, more commonly called the Clean Water Act (CWA). The goal of this act was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Water Pollution Control Federation 1987). The act and the programs it has generated have changed over the years as experience and perceptions of water quality have changed. The CWA has been amended 15 times, most significantly in 1977, 1981, and 1987. One of the goals of the 1977 amendment was protecting and managing waters to ensure "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.

1.1.1. Background

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

Section 303 of the CWA requires DEQ to adopt, with EPA approval, water quality standards and to review those standards every three years. Additionally, DEQ must monitor waters to identify those not meeting water quality standards. For those waters not meeting standards, DEQ must establish TMDLs for each pollutant impairing the waters. Further, the agency must set appropriate controls to restore water quality and allow the water bodies to meet their designated uses. These requirements result in a list of impaired waters, called the 303(d) list. This list describes water bodies not meeting water quality standards. Waters identified on this list require further analysis. A subbasin assessment and TMDL provide a summary of the water quality status and allowable TMDL for water bodies on the 303(d) list. American Falls Subbasin Total Maximum Daily Load Plan: Subbasin Assessment and Loading Analysis provides this summary for the currently listed waters in American Falls Subbasin.

The subbasin assessment section of this report (Chapters 1 – 4) includes an evaluation and summary of current water quality status, pollutant sources, and control actions for impaired water bodies in American Falls Subbasin to date. While this assessment is not a requirement of the TMDL, DEQ performs the assessment to ensure impairment listings are timely 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 while still allowing that water body to meet water quality standards (Water quality planning and management, 40 CFR 130). Consequently, a TMDL is water body- and pollutant-specific. The TMDL also includes individual pollutant allocations among various sources discharging the pollutant. EPA considers certain unnatural conditions, such as flow alteration, lack of flow, or habitat alteration, as "pollution" as long as they are not the result of the discharge of a specific pollutant (e.g., sediment, nutrients). TMDLs are required for water bodies that are impaired by pollution, but not specific pollutants. In common usage, a TMDL also refers to the written document containing the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.

1.1.2. 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 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 habitat, aesthetics

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

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

- Determine the degree of designated beneficial use support of the water body (i.e., attaining or not attaining water quality standards).
- Determine the degree of achievement of biological integrity.
- Compile descriptive information about the water body, particularly the identity and location of pollutant sources.
- When water bodies are not attaining water quality standards, determine the causes and extent of the impairment.

While the Shoshone-Bannock Tribes can establish specific water quality standards for water bodies (e.g., portions of Bannock Creek and its tributaries) within the Fort Hall Reservation, they have not gone through the formal process to do so at this time. For the purposes of the American Falls Subbasin TMDLs, existing State of Idaho water quality standards will be used as the basis for water quality targets for Bannock Creek and its tributaries.

1.2. Physical and Biological Characteristics

Among the physical and biological characteristics of the subbasin are geography and climate, both of which are described in the following—along with other characteristics.

1.2.1. Geography

American Falls Subbasin covers 2,869 square miles (1.8 million acres, 0.75 million hectares) in southeast Idaho (Figure 1-1). The main feature is American Falls Reservoir, with American Falls Dam marking the downstream boundary of this subbasin. The subbasin also includes the Snake River from the reservoir to Bingham-Bonneville county line, the upstream boundary of the subbasin. Other significant tributaries within the subbasin include Spring Creek, McTucker Creek, Danielson Creek, Bannock Creek, and Ross Fork. While Blackfoot and Portneuf rivers are also tributaries to the Snake River and American Falls Reservoir, respectively, these water bodies lay within their own subbasins.

Although the Snake River Plain is the dominant geographic feature in the subbasin, higher elevations occur in Ross Fork and Bannock Creek watersheds. South Putnam Mountain rises to 8,950 ft above mean sea level (NOTE: all elevations will be above mean sea level) in Ross Fork watershed, and Deep Creek Peak in Bannock Creek watershed reaches an elevation of 8,747 ft. The lowest elevation in the subbasin is about 4,250 ft at the base of American Falls Dam.

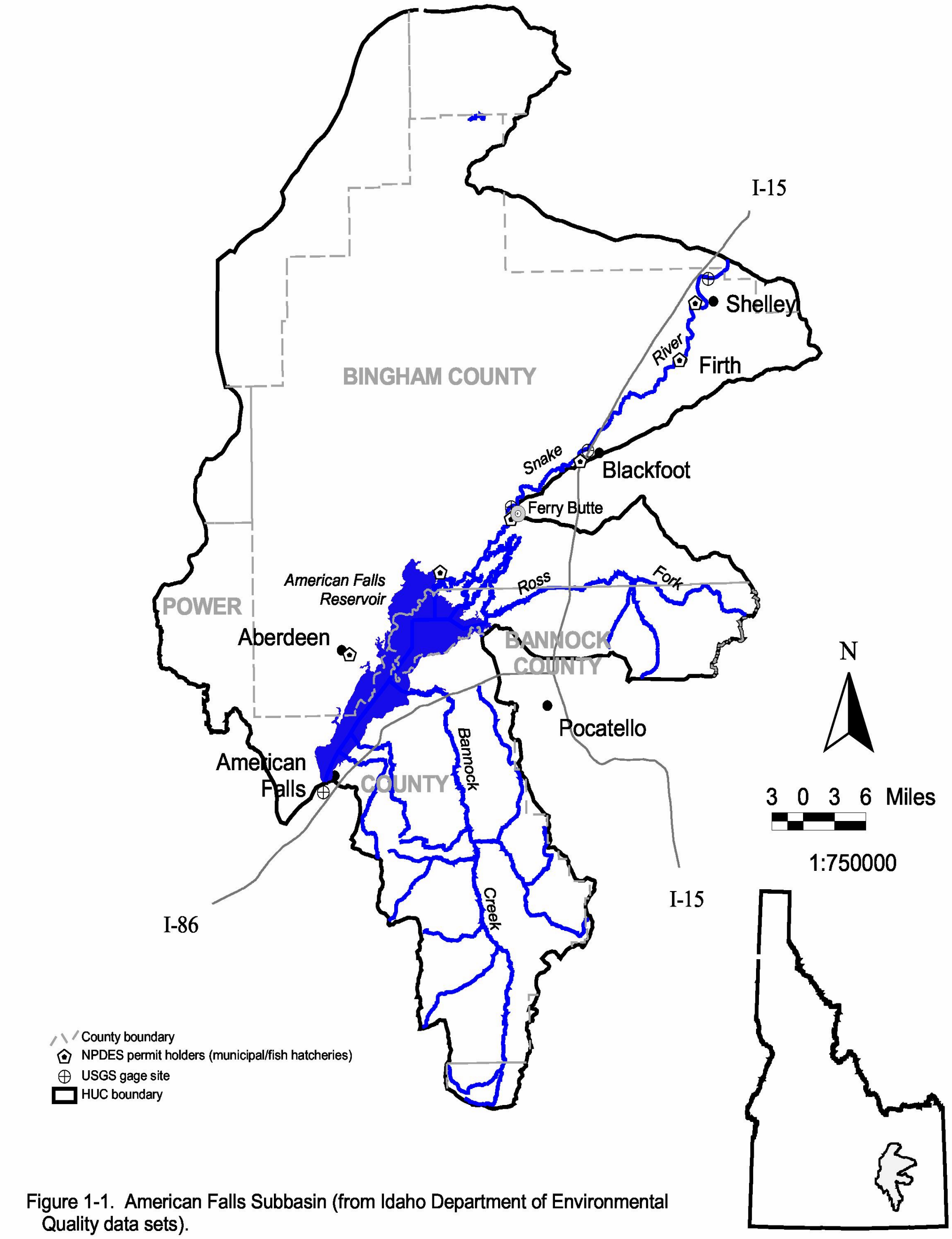


Figure 1-1. American Falls Subbasin (from Idaho Department of Environmental Quality data sets).

Figure 1-1. American Falls Subbasin (from Idaho Department of Quality Environmental Quality data sets).

1.2.2. Climate

Much of the subbasin's semi-arid climate is the result of the Cascade and Sierra mountains to the west and the Bitterroot and Rocky Mountains to the north, which effectively block Pacific moisture (Idaho Power Company Web site). The temperature moisture regimes are frigid and mesic/aridic (EPA et al. 2000). Data from four weather stations (near American Falls, Aberdeen, Arbon, and Blackfoot) indicate average annual temperature is about 7.7 ^{o}C (46 ^{o}F; Table 1-1). Highest temperatures occurred in July and August, and highest precipitation at these stations was in May, with lowest precipitation occurring during summer months. Annual precipitation ranged from 22.3 cm (8.8 in) at Aberdeen to 40.7 cm (16.0 in) at Arbon. On an annual basis, the percentage of sunshine at Pocatello averages 64%. Local agriculture is dependent on snowmelt in April and May, summer thunderstorms, and ground water irrigation for ensuring adequate moisture for raising crops.

1.2.3. Subbasin Characteristics

American Falls Subbasin straddles two ecoregions. More than three-fourths of the subbasin is in the Snake River Plain Ecoregion (Table 1-2), which is part of the xeric intermontane west (EPA et al. 2000). Most of the subbasin is unglaciated containing nearly level river terraces, floodplains, and lake plains (EPA et al. 2000). Geology consists of quarternary mixed alluvium, lake deposits (from the ancient Bonneville flood), and basalt bedrock, common to the eastern Snake River plain. Subbasin soils are mollisols, entisols, and aridisols. Potential natural vegetation is mostly sagebrush and saltbush-greasewood. In riparian areas, potential natural vegetation includes sedges, perennial grasses, willows, and cottonwood.

The southern part of the subbasin, including most of Bannock Creek watershed is in the Northern Basin and Range Ecoregion (Table 1-2). Plains and mountains typify this ecoregion, and livestock grazing occurs throughout the watershed. Potential natural vegetation includes sagebrush, saltbush, and greasewood. Aspen, lodgepole pine, and douglas-fir are supported in alluvial fans and along drainages.

Potential native vegetation along the Snake River above the reservoir is typical of wet or semi-wet meadow complexes consisting of sedges, rushes, shrubby cinquefoil, willows, dogwood, and black cottonwood (USDA 1986 cited in Sampson et al. 2001). Sampson et al. (2001) observed Reed's canary grass, cottonwood, willows, Russian olive, red osier dogwood, snowberry, golden currant, hawthorn, and skunkbrush sumac in their study of the Snake River above the reservoir.

The natural vegetation of Bannock Creek watershed typically consists of a shrub overstory with an understory of perennial grasses and forbs. Basin big sagebrush may be on sites having deep soils or accumulations of surface sand (Shumar and Anderson 1986). Other common shrubs include gray rabbitbrush, winterfat, spiny hopsage, prickly phlox, broom snakeweed, and horse-brush. Utah juniper, threetip sagebrush, and/or black sagebrush often dominate peripheral communities on slopes of buttes, alluvial fans, and foothills of adjacent mountains.

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Table 1-1. Climatological data from sites in and near American Falls Subbasin.

Site	Period of record	Month												Annual
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean monthly temperature (^oC)														
American Falls 1 SW	1948-2003	-4.0	-1.3	3.1	8.1	12.8	17.2	21.6	20.8	15.8	9.4	2.4	-2.7	8.6
Aberdeen Experiment Station	1914-2003	-6.1	-3.0	1.7	6.9	11.8	16.1	20.4	19.3	13.9	7.9	0.9	-4.4	7.1
Arbon 2 NW	1962-2002	-5.4	-3.0	1.5	6.3	11.1	15.5	19.9	19.4	14.2	8.1	0.9	-4.8	7.0
Blackfoot 2 SSW	1948-2003	-4.9	-2.1	2.6	7.7	12.6	16.9	20.9	20.0	15.1	8.7	1.5	-4.2	7.9
Average total precipitation (centimeters)														
American Falls 1 SW	1948-2003	2.7	2.1	2.7	2.8	3.7	2.4	1.3	1.5	1.8	2.1	2.7	2.5	28.2
Aberdeen Experiment Station	1914-2002	1.8	1.6	1.8	2.1	2.8	2.3	1.2	1.2	1.7	2.0	1.8	1.9	22.3
Arbon 2 NW	1962-2002	4.1	3.6	3.8	3.7	4.4	3.5	2.4	2.3	2.4	2.7	3.8	4.2	40.7
Blackfoot 2 SSW	1948-2002	2.3	2.0	2.3	2.4	3.2	2.6	1.2	1.2	1.7	1.8	2.3	2.3	25.3
Average total snowfall (centimeters)														
American Falls 1 SW	1948-2003	23.1	11.9	7.9	3.3	1.0	0.0	0.0	0.0	0.0	3.3	6.9	17.8	75.4
Aberdeen Experiment Station	1914-2002	16.3	9.4	5.1	3.6	0.3	0.0	0.0	0.0	0.0	1.3	4.1	12.2	52.1
Arbon 2 NW	1962-2002	34.3	25.4	13.0	4.3	0.8	0.0	0.0	0.0	0.3	1.8	16.5	32.8	128.8
Blackfoot 2 SSW	1948-2002	17.0	10.4	5.8	2.3	0.0	0.0	0.0	0.0	0.0	1.8	6.1	16.3	59.7
Mean percent of possible sunshine														
Pocatello	NA[1]	40	53	61	66	67	75	83	81	80	71	46	40	64

[1]NA=not available

Table 1-2. Characteristics of ecoregions in American Falls Subbasin (modified from Mart et al. 1997 and Omernik and Gallant 1986).

Ecoregion	Percentage of surface area	Land surface form	Potential natural vegetation	Land use	Soils
Snake River Basin/High Desert	76	Tableland with moderate to high relief; plains with hills or low mountains	Sagebrush steppe (sagebrush, wheatgrass, saltbush, and greasewood)	Desert shrubland grazed; some irrigated agriculture	Aridisols, aridic mollisols
Northern Basin & Range	24	Plains with low to high mountains; open high mountains	Great Basin sagebrush, saltbush, and greasewood	Desert shrubland, grazed	Aridisols

.

The most common native grasses in Bannock Creek watershed include thick-spiked wheatgrass, bottlebrush squirreltail, Indian ricegrass, needle-and-thread grass, and Nevada bluegrass. Patches of creeping wildrye and western wheatgrass are locally abundant. Bluebunch wheatgrass is rare at lower elevations, but common along the eastern side of the drainage. It is often the dominant grass on alluvial fans and slopes of buttes and foothills. There are no known threatened or endangered (T&E) aquatic plant species within Bannock Creek watershed (INL Environmental Surveillance, Education and Research Program Web site).

Soil slope is lowest along the Snake River and increases with distance from the river. Slope is less than about 4%, generally in areas adjacent to the reservoir and river (Figure 1-2). Areas of slope greater than 26% occur in the headwaters of Bannock Creek and Ross Fork, and in the northern part of the basin. The soil type and steep slopes cause soil erosion to be a significant problem in Bannock Creek watershed. The most highly erodible soils are found in Bannock Creek and Ross Fork watersheds and in a large part of the lava area in the northern part of the subbasin (Figure 1-3). Areas with lowest soil erodibility potential are located along the Snake River and western edge of the subbasin.

Snake River Plain Ecoregion streams generally have higher primary productivity than streams with forest canopy overstory (EPA et al. 2000). Natural fish assemblages include both mesothermal (intermediate [6-22^{o} C] temperature favoring) species such as minnows and suckers as well as stenothermal (tolerant of a narrow range of temperatures) salmonid and sculpin species.

The historic fish community in the subbasin consisted of suckers, chubs, daces, salmonids, and sculpins. Yellowstone cutthroat trout and mountain whitefish were the only native salmonids found in the subbasin. Introduced salmonids include rainbow trout, brook trout, and brown trout. Other introduced species are common carp, bullhead, smallmouth bass, black crappie, and yellow perch. Sampson et al. (2001) listed rainbow trout, cutthroat trout, rainbow x cutthroat trout hybrids, sculpins, suckers, yellow perch, and smallmouth bass as present in the Snake River above the reservoir. Other species, which have been reported in the reservoir, include kokanee, white crappie, black crappie, largemouth bass, black bullhead, brown bullhead, yellow perch, Utah chub, speckled dace, and fathead minnow (Johnson et al. 1977, Heimer 1989).

U. S. Geological Survey (USGS) characterized fish assemblages in the upper Snake River Basin as part of their National Water Quality Assessment (NAWQA) Program (Maret 1997). Two sites were within American Falls Subbasin – Snake River near Blackfoot and Spring Creek near Fort Hall. Species common to both sites included Utah sucker, mottled sculpin, mountain whitefish, and rainbow trout. Common carp, longnose dace, and redside shiner were found only in the Snake River. The only species collected in Spring Creek and not in the Snake River was cutthroat trout. Further work by USGS in 2002 captured bluehead sucker, Utah sucker, mottled sculpin, Paiute sculpin, common carp, fathead minnow, longnose dace, redside shiner, speckled dace, brown trout, cutthroat trout, mountain whitefish, and rainbow trout during electrofishing sessions on the Snake River at Shelley (Maret and Oat 2003).

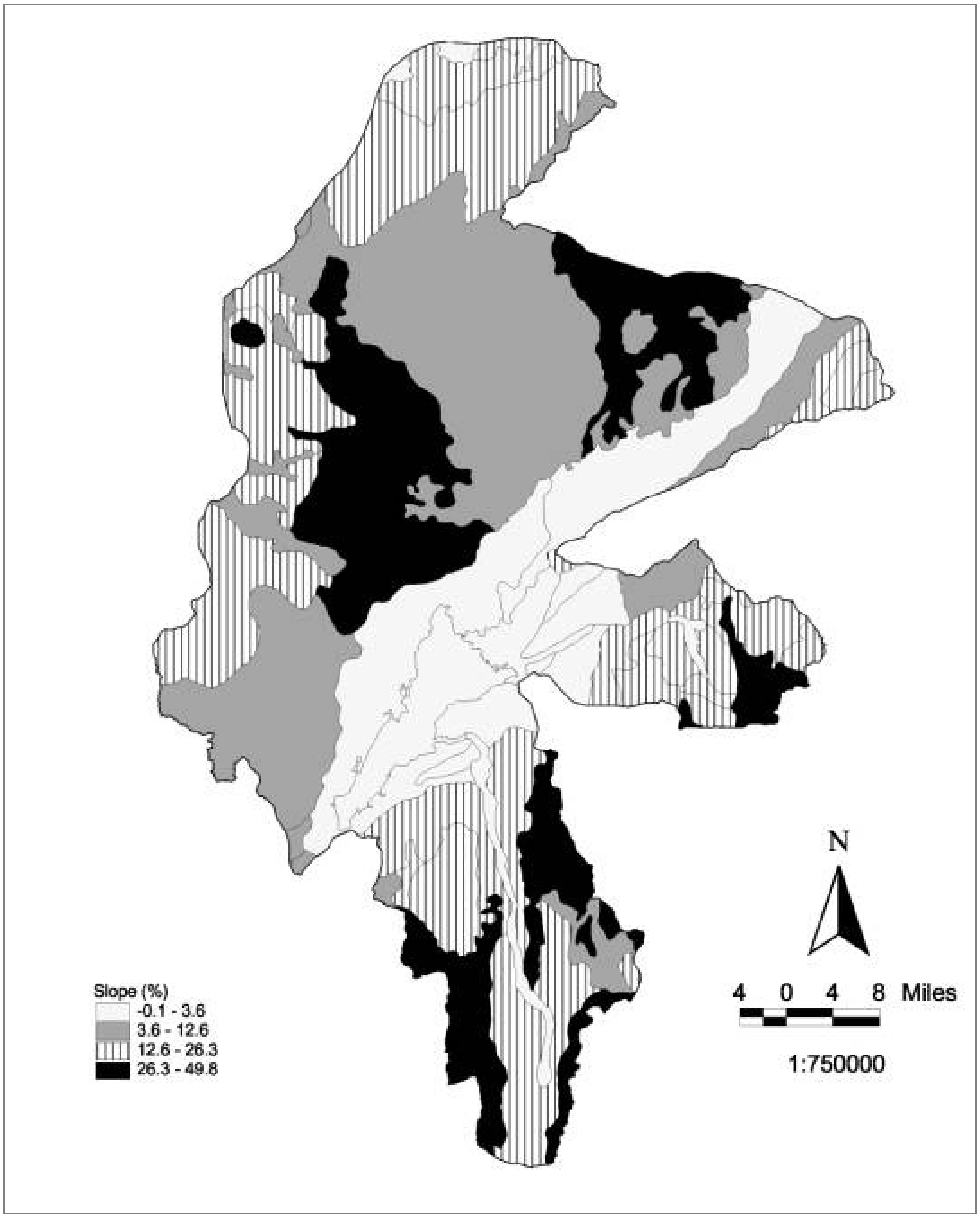

Figure 1-2. Soil slope in American Falls Subbasin (from Idaho Department of Environmental Quality GIS data sets).

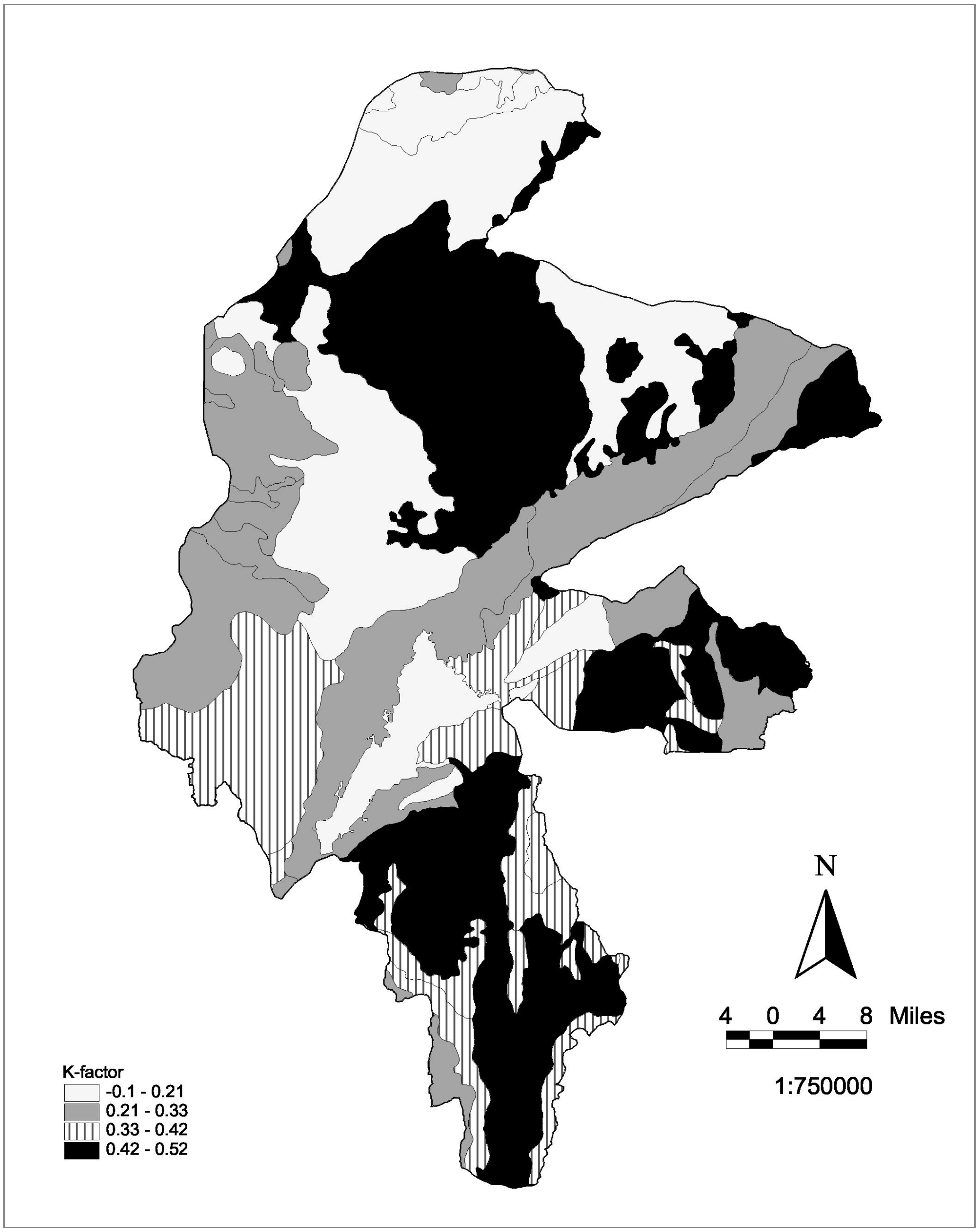

Figure 1-3. Soil erosion capability in American Falls Subbasin (from DEQ GIS data sets). Soil erosion capability increases as K-factor increases.

1.2.4. Subwatershed and Stream Characteristics

The subbasin can be divided into four regions. American Falls Reservoir, Snake River, and Bannock Creek are considered watersheds; all other tributaries (e.g., McTucker Creek) have been lumped together and can be considered subwatersheds. The characteristics of each of these watersheds and streams are described in the following sections.

1.2.4.1. American Falls Reservoir Watershed

American Falls Reservoir is the largest reservoir in Idaho with a surface area of 56,055 acres at a pool elevation of 4,354.5 ft (Bushnell 1969). Storage capacity at elevation 4,354.5 ft is 1.67 million acre-feet (Bureau of Reclamation Web site a). There is about 100 miles of shoreline around the reservoir. Total drainage area to the reservoir, which includes area outside American Falls Subbasin, is 13,580 square miles.

The primary purpose of American Falls Reservoir is irrigation. The Bureau of Reclamation (BOR) operates American Falls Reservoir as part of their Minidoka project, which includes Minidoka Dam, Jackson Lake Dam, Island Park Dam, and Grassy Lake Dam (Bureau of Reclamation Web site b). Refill typically starts in October and continues through winter and early spring (Heimer 1989). Final fill in average water years occurs during spring runoff. Irrigation season begins in June and the reservoir is drawn down as outflow exceeds inflow. This method of operation has changed the pre-dam hydrograph: spring flows are reduced while summer flows are increased for water delivery to downstream irrigators (Figure 1-4). Water fluctuations in the reservoir can vary widely depending on water year and irrigation demand as evidenced by reservoir storage in WY2003 compared to average storage from WY1970 to WY2000 (Figure 1-5).

In addition to the Snake River, which enters American Falls Reservoir to the northeast, Portneuf River, Spring Creek, McTucker Creek, Danielson Creek, and Bannock Creek are the main tributaries. Other water entering the reservoir comes from springs, irrigation return water, and smaller tributaries. The Snake River accounts for about 65% of the flow into the reservoir with Portneuf River and Spring Creek contributing about 6% and 5%, respectively (Table 1-3). Additionally, from Ferry Butte to Neeley (below the dam), ground water via springs or direct flow, accounts for about 2,500 cfs annually (Kjelstrom 1995).

Fort Hall Bottoms are located at the northeast end of the reservoir on Fort Hall Reservation, and this area is one of the largest reaches of intact, forested floodplain in the area (Sampson et al. 2001). Much of its rich diversity of animal and plant life is due to the proximity of the Snake River.

1.2.4.2. Snake River Watershed

The Snake River winds its way through the subbasin for about 55 miles (Table 1-4), widening in several areas as it flows around islands and through side channels. The meander belt width for the river below Ferry Butte is 2,000-3,000 feet (Sampson et al. 2001).

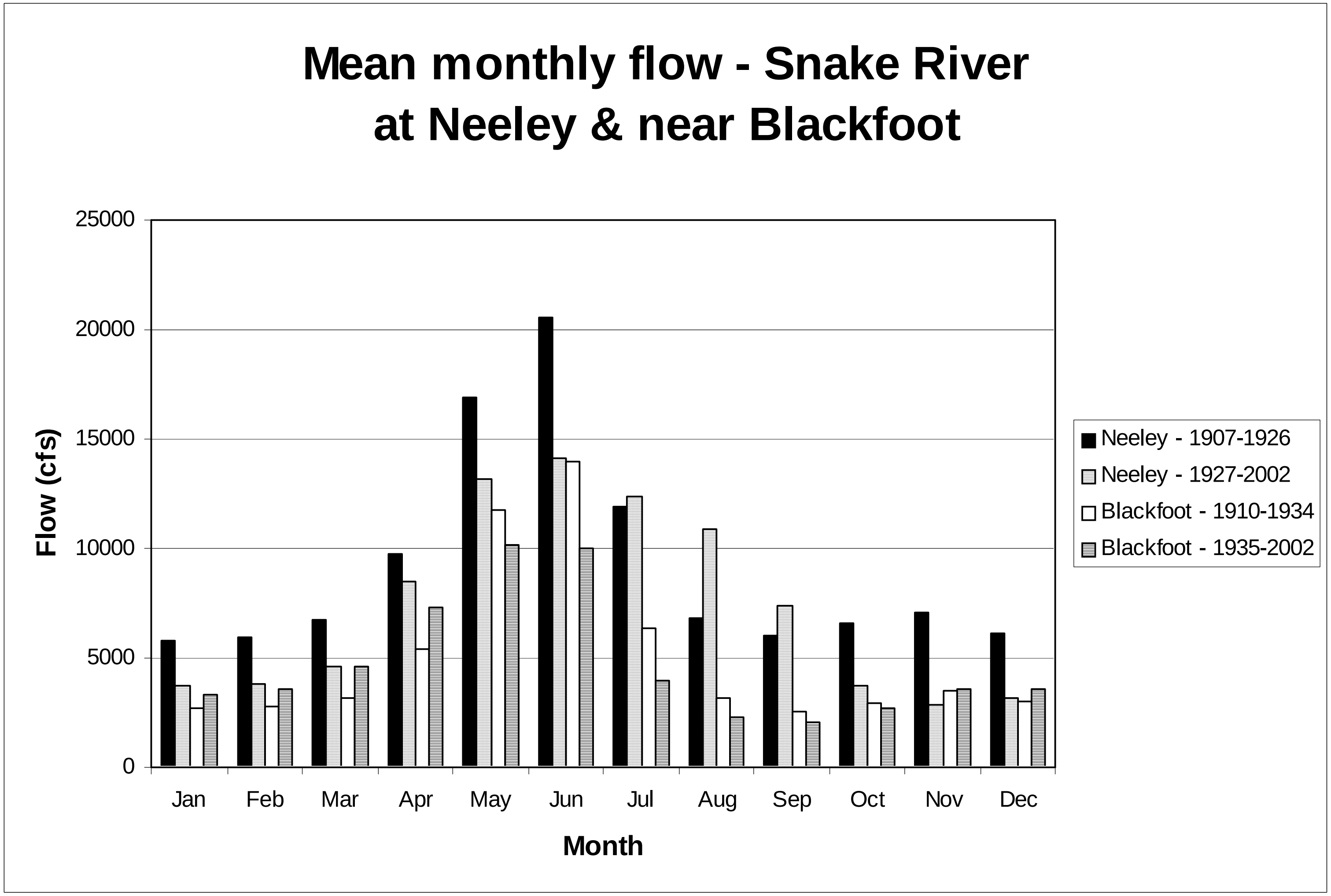

Figure 1-4. Mean monthly flows at USGS surface-water stations in the Snake River at Neeley (13077000) before and after construction of American Falls Dam and near Blackfoot (13069500) before and after construction of Island Park Dam.

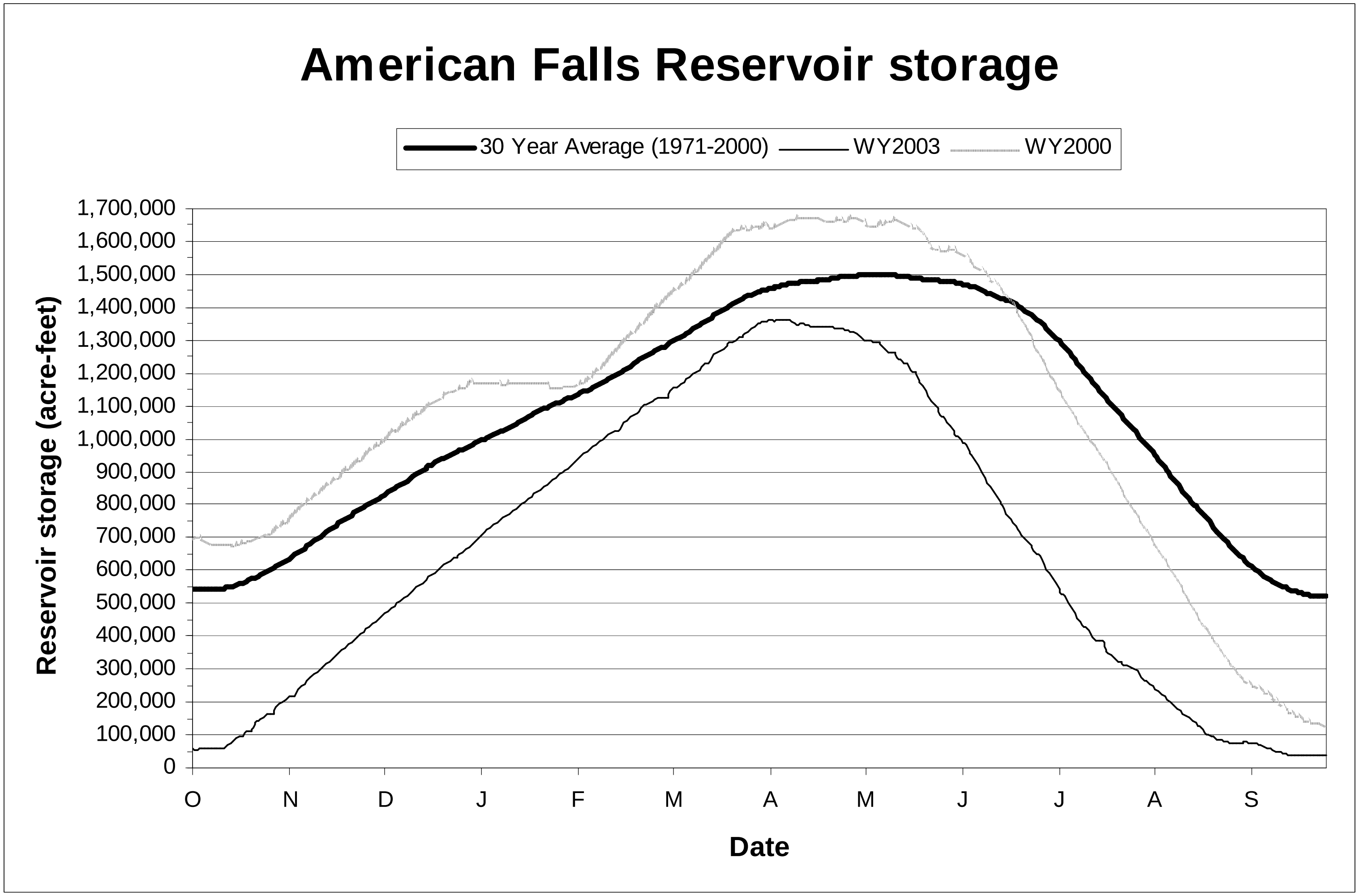

Figure 1-5. American Falls Reservoir storage (from Bureau of Reclamation Web site).

Table 1-3. Flow into American Falls Reservoir from various tributaries based on flow measured at USGS gage sites. Avg=average.

	Water body								
	Snake River at Neeley	Snake River at Ferry Butte	Portneuf River at Tyhee	Spring Creek at Sheepskin Rd	Danielson Creek at Edwards Rd	Bannock Creek at Interstate 86	Ross Fork at Rio Vista Rd	Crystal waste at Crystal Springs Rd	Aberdeen waste at 2600 W Rd
Gage number	13077000	13069500	13075910	13075983	13069540	13076200	13075960	13069532	13069565
Period of record	1927-2002	1910-2002	1985-2002	1980-2002	1980-1988	1985-1994	1985-1994	1985-1994	1985-1994
Avg total annual (WY) runoff (ac-ft)	5,346,614	3,506,451	321,231	258,347	43,686	28,780	39,846	29,534	16,560
Average annual (WY) flow (cfs)	7,380	4,840	443	357	60	40	55	41	23
Percentage of flow into reservoir[1]	100.0%	65.6%	6.0%	4.8%	0.8%	0.5%	0.7%	0.6%	0.3%

[1]percentage of flow based on average of annual comparison to flow at Snake River at Neeley gage, which was assumed to represent entire flow into reservoir

Table 1-4. Physical data, land use, and land ownership of water bodies in American Falls Subbasin.

Water body	**Length (miles)**	**Drainage area (acres)**	**Gradient (%)**	**Begin elevation (ft)**	**End elevation (ft)**	**Land use (acres)** Irrigated agriculture: gravity flow	sprinkler	Dryland agriculture	Rangeland	Forest	Riparian	Water	Urban	**Land ownership** Private	Shoshone Bannock Tribes	BLM	Forest Service	Open water	State of Idaho
American Falls Reservoir[1]		8,691,165																	
Snake River[2]	56.6	7,238,371	0.1	4,630	4,320														
McTucker Creek[3]	2.24		0.3	4,375	4,340														
Bannock Creek	53.1	264,869	0.4	5,520	4,350	3,963	9,481	95,823	105,694	48,420	393	231	866	152,057	63,211	40,751	7,030	19	1,801
Moonshine Creek	9.68	28,863	2.6	6,080	4,740			6,114	11,750	11,000				5,796	17,650	5,359			59
Rattlesnake Creek	18.7	52,515	1.9	6,530	4,700			23,740	19,032	9,744				33,608	3,492	8,715	5,733		967
West Fork Bannock Creek	7.09	9,640	5.6	7,040	4,930	362		330	1,676	7,273				3,418	480	5,743			
Knox Creek	7.824	14,920	1.6	5,700	5,020		264	4,939		9,717				6,479		7,799			642

[1]most of the drainage area of American Falls Reservoir is outside the subbasin

[2]most of the drainage area of Snake River is outside the subbasin, listed drainage area is at USGS surface-water station near Blackfoot (13069500)

[3]as McTucker Creek is a spring stream and relatively flat, it is difficult to establish a drainage area. Land use looks to be near 100% sprinkler irrigated land. Visual estimation of ownership is 67% private and 33% Bureau of Land Management

[4]from confluence of right and left forks of Knox Creek

Sampson et al. (2001) noted five large-scale changes that have affected the Snake River from Ferry Butte to American Falls Reservoir:

1. Construction of American Falls Dam created backwater areas of the reservoir that caused a flattening of the river.
2. Changes from flood to sprinkler irrigation have decreased sediment loads.
3. Additional dam construction and river management have introduced flow modifications.
4. The flow regime has become more variable.
5. The declining presence of young woody plants (e.g., cottonwood, willow, dogwood) has resulted in a change in vegetative composition.

These changes have resulted in the upper section of the reach becoming more sinuous due to decreased annual sediment load, increased low flow volumes, and decreased peak flows. In contrast, the downstream section is becoming straighter with more branching and less sinuosity due to a localized flattening of the energy grade line.

Numerous water diversions occur along this stretch of the Snake River (Table 1-5). A quick comparison of Snake River flow near Shelley and near Blackfoot shows losses of up to 3,151 cfs during the irrigation season of April to October (Table 1-6). The losses shown by Table 1-6 represent absolute change in flow between the Snake River near Shelley and near Blackfoot gages. This absolute change includes both losses from irrigation diversions, evapotranspiration, ground water infiltration (Kjelstrom 1995), as well as gains from the Blackfoot River, irrigation returns, and spring flow. One of the largest users of the Snake River water in the subbasins is the Aberdeen-Springfield Canal Company. The canal diverted an average of 590 cfs during the 1981 irrigation season from April to October (USGS Web site).

USGS maintains three gage sites along this reach of the Snake River (Figure 1-1). Gages are located, and named accordingly, near Shelley, at Blackfoot, and near Blackfoot (actually at Ferry Butte and Tilden Bridge). Data from these gages indicate that the Snake River from Shelley to Ferry Butte is a losing reach of stream despite input from springs in the lower end of the reach (Kjelstrom 1995). From Ferry Butte to Neeley, the Snake River gains about 2,500 cfs from ground water on an annual basis. Ground water discharge from the Portneuf River is about 1,650 cfs, accounting for 66% of the gain in flow from Ferry Butte to Neeley. In addition to Portneuf River, Blackfoot River (average total annual flow 1,867 cfs; Brennan et al. 2003) also enters the Snake River in this reach just upstream of Ferry Butte.

1.2.4.3. Bannock Creek Watershed

Bannock Creek watershed, in the southern portion of American Falls Subbasin, is predominately located in the Northern Basin and Range Ecoregion. The creek drains an area of approximately 265,000 acres. The watershed encompasses portions of Bannock, Oneida, and Power counties, with 112,500 acres of the watershed contained within Fort Hall Reservation. Sparsely populated Arbon Valley is situated within Bannock Creek watershed, with the city of Pocatello nearby to the northeast.

Table 1-5. Irrigation diversions in Snake River from Bingham-Bonneville county line to American Falls Reservoir.

Diversion name
Reservation
Blackfoot
New Lava Side
R. C. Adams #1
R. C. Adams #2
Peoples
Aberdeen
Swid
Corbett
Nielson-Hansen
R. Lambert
K. Christensen
Riverside
Danskin
Trego
Jensen Grove
Monroc Blackfoot
Wearyrick
Watson
Parsons
Fort Hall Michaud

Table 1-6. Mean monthly flows from April to October (general irrigation season) at USGS gage sites on Snake and Blackfoot rivers, Water Years 1964-2002.

Site	Gage number	Flow (cfs)						
		April	May	June	July	August	September	October
Snake River near Shelley	13060000	8,823	12,964	13,010	7,881	5,249	4,347	3,686
Blackfoot River near Blackfoot[1]	13068500	198	233	183	117	133	133	202
Snake River near Blackfoot	13069500	8,177	10,837	10,269	4,847	2,899	2,562	3,061
Flow lost[2]		844	2,361	2,924	3,151	2,483	1,919	826

[1]Blackfoot River enters Snake River just upstream of the Snake River near Blackfoot gage site

[2]flow lost=flow at Snake River near Shelley plus flow at Blackfoot near Blackfoot minus flow at Snake River near Blackfoot

.

Elevation change in the Bannock Creek watershed is almost 4,000 ft. The valley floor of the gently rolling terrain of the watershed has land-surface elevations ranging from 5,300 feet above sea level in the south to approximately 4,400 feet near Bannock Creek-American Falls Reservoir confluence. Mountain peaks and ranges border Bannock Creek to the west and east, physically delineating this watershed from adjacent watersheds. The Deep Creek Mountains flank the western edge and the Bannock Range the eastern edge of the watershed. The maximum elevation is Bannock Peak, which rises to 8,256 feet in the Deep Creek Mountains (Spinazola and Higgs 1998).

Bannock Creek flows almost due north approximately 50 miles to American Falls Reservoir, and is the major stream in the watershed (Figure 1-6, Table 1-4). Other important tributaries to Bannock Creek include Moonshine Creek, Rattlesnake Creek, West Fork, and Knox Creek (Figure 1-7). Rattlesnake Creek, the largest of the tributaries, has a drainage area of 52,500 acres and a stream length of 18.7 miles, draining much of the eastern section of the watershed (Spinazola and Higgs 1998). Moonshine Creek has a drainage area of 29,900 acres and Knox Creek has a drainage area of 14,900 acres. The West Fork Bannock Creek, tributary to Bannock Creek, originates from a group of springs on the western section of the watershed and has the smallest drainage area at 9,640 acres. The geology of Bannock Creek watershed has been significantly altered by tectonic activity and volcanism.

1.2.4.4. Physical characteristics and Beneficial Use Reconnaissance Program (BURP)

Beneficial Use Reconnaissance Program (BURP) monitoring was completed by DEQ in Bannock Creek watershed and along tributaries to Bannock Creek outside of the Fort Hall Reservation. Monitoring on Bannock Creek was limited to one site because of access constraints. BURP monitoring verified high levels of sediment loading in the streambed surface (Table 1-7) and no riffles or runs were found at the site. Stream bank cover of the site was ranked as good and bank stability at the site was rated as fair to good.

Additional BURP monitoring results are limited to portions of Rattlesnake Creek (including Rattlesnake Creek tributaries Midnight Creek and Crystal Creek) and Knox Creek subwatersheds outside of Fort Hall Reservation. The headwaters of Crystal Creek originate on U. S. Forest Service (USFS) property and travel through state, Bureau of Land Management (BLM), private, and Shoshone-Bannock tribal lands before flowing into Rattlesnake Creek (USFS 2001). The overall gradient found in Rattlesnake Creek was 1.9% (Table 1-4) and pool-to-riffle ratios were low at both upper and lower Rattlesnake Creek BURP sites. Both monitoring sites in Rattlesnake Creek showed high levels of sediment (Table 1-7). Bank stability in Rattlesnake Creek was determined to be poor during the first monitoring event, but improved with time, shown from data taken during later monitoring events. Stream bank vegetative cover varied by site and year, but generally was fair to good.

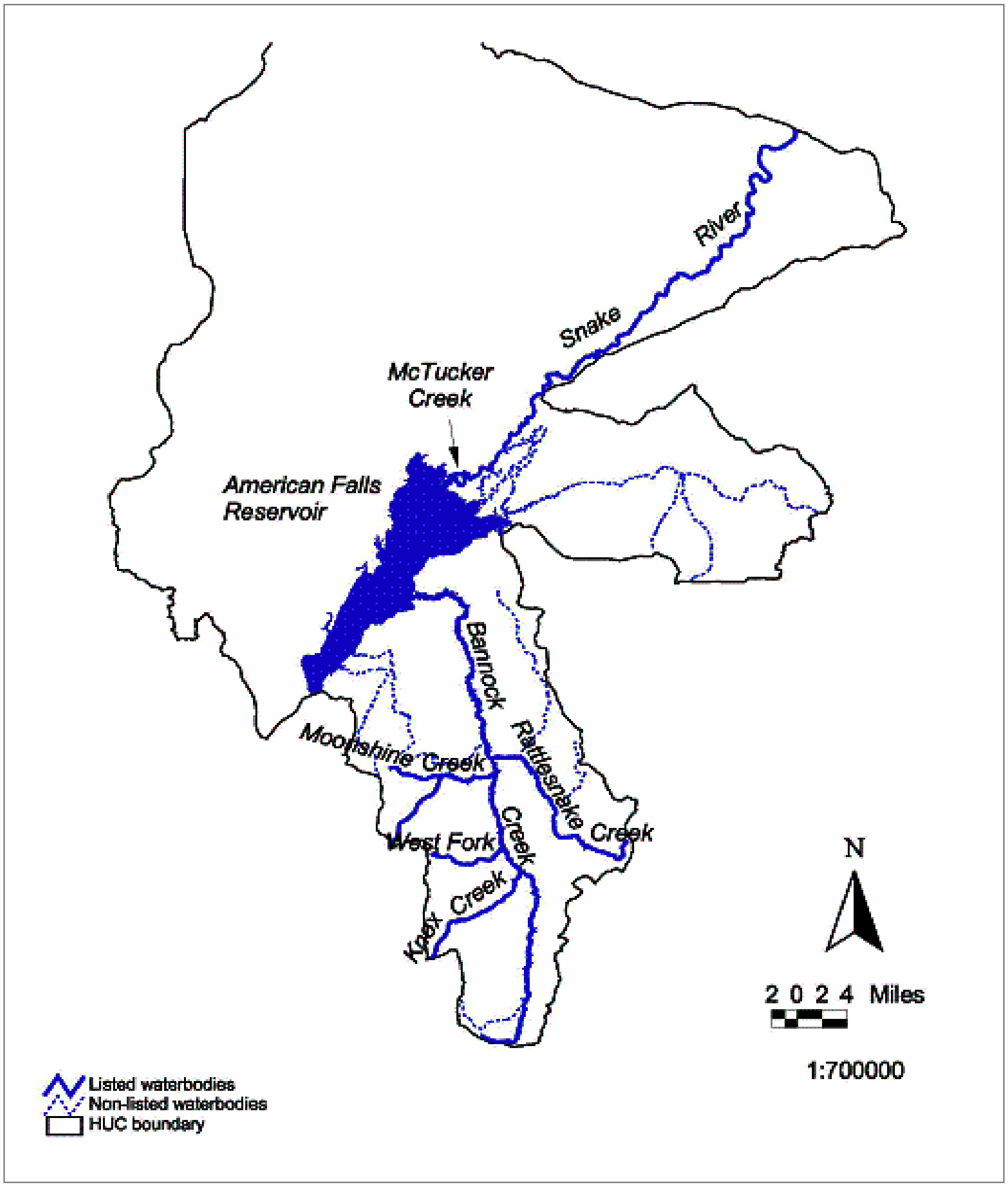

Figure 1-6. 303(d) listed water bodies in American Falls Subbasin (from Idaho Department of Environmental Quality data sets).

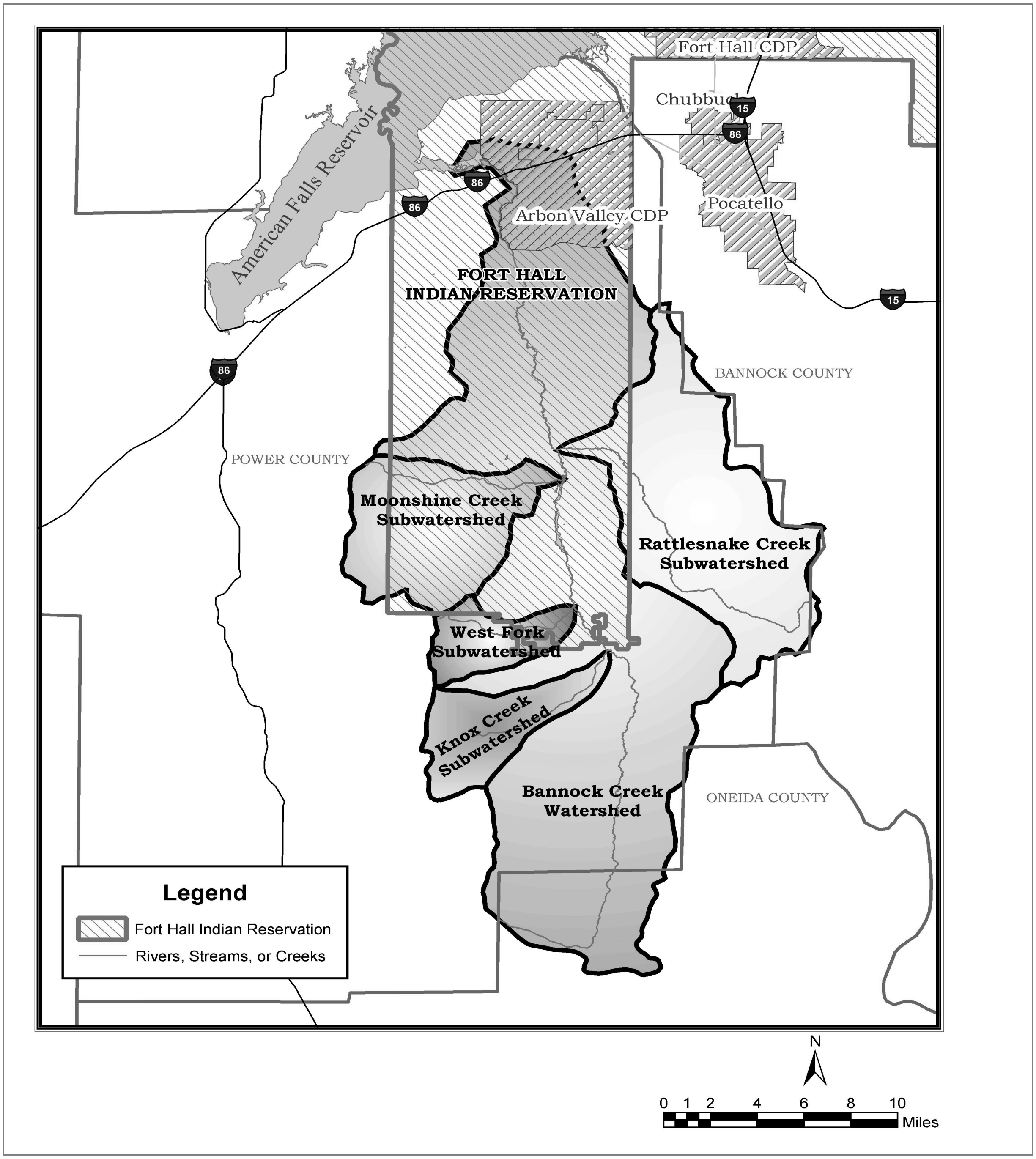

Figure 1-7. Bannock Creek Watershed.

Table 1-7. Watershed characteristics of tributaries in the American Falls Subbasin (from DEQ BURP data).

Waterbody	303(d) listed	Site	Date	Stream order	Site elevation (ft msl)	Valley type	Sinuosity	Gradient	Rosgen channel type	Percent fines < 2.5 mm (bankfull)	Pool: riffle ratio[1]	Width: depth ratio	Bank vegetation protection	Bank stability	Fish captured electrofishing
McTucker Creek	Y		31-Jul-96	1	4360	Trough-like	Moderate	1.25%	C	67.1%	0.6:1	33.6:1	87.0%	77.5%	rainbow trout, sculpin
			10-Jul-01	2	4330	Flat bottom	Moderate	1.0%	C	55.1%	1.2:1	23.1:1	98.5%	97.0%	
Bannock Creek	Y		11-Jun-96	1	5040	Trough-like	Moderate	0.5%	F	100.0%	AP[3]	5.1:1	100.0%	96.0%	
			10-Jul-01	4	5040	Flat bottom	Moderate	0.5%	E	100.0%	AP[3]	4:1	98.3%	65.5%	
Rattlesnake Creek	Y	Lower	17-Jun-96	2	4960	Trough-like	High	1.0%	F	100.0%	AP[3]	8:1	77.5%	0.0%	
		Upper	10-Jun-96	1	5085	Trough-like	Moderate	2.0%	G	68.4%	0.9:1	3.9:1	78.0%	17.0%	
		Lower	9-Jul-01	2	5040	Flat bottom	Moderate	1.0%	E	99.0%	0:1	3.7:1	43.8%	51.3%	
		Upper	9-Jul-01	2	5680	Trough-like	Moderate	0.5%	C	64.3%	AR[2]	2.9:1	97.0%	67.7%	
Knox Creek[4]	Y		11-Jun-96	1	5750	V-shape	Low	3.0%	B	41.3%	AR[2]	7.6:1	86.0%	0.0%	
			10-Jul-01	2	5750	Box canyon	Low								
Midnight Creek	N		17-Jun-96	1	5413	V-shape	Low	3.0%	B	28.0%	AR[2]	12:1	88.5%	88.5%	
Crystal Creek	N		16-Jun-98	1	5360	V-shape	Low	3.5%	B	25.7%	AR[2]	6.2:1	100.0%	100.0%	
Michaud Creek	N	Lower	30-Jun-97	2	4920	Trough-like	Low	2.0%	B	47.0%	AR[2]	5.6:1	85.0%	85.0%	
		Upper	30-Jun-97	2	5560	V-shape	Low	3.0%	B	34.4%	AR[2]	6.4:1	100.0%	100.0%	
Sunbeam Creek	N		16-Jun-98	1	4722	U-shape	Moderate	1.0%	F	43.6%	1.1:1	6.9:1	28.5%	23.5%	
			17-Jul-03	2	4780	NN[5]	Moderate	3.0%	B	51.7%	0:1	6.5:1	80.0%	60.5%	
Danielson Creek	N		15-Jul-98	1	4400	Trough-like	Moderate	2.0%	F	76.7%	1.7:1	17.2:1	99.0%	99.0%	rainbow trout, sculpin, minnow
Hazard Creek (Little Hole Draw)	N		15-Jul-98	1	4370	Trough-like	Moderate	1.0%	C	25.4%	2.5:1	12.9:1	100.0%	100.0%	sucker, minnow
			17-Jul-03	3	4350	NN[5]	Moderate	2.0%	G	36.1%	5.4:1	12.4:1	95.0%	89.5%	

[1]pool=pool or glide, run=riffle or run
[2]all riffle or run, no pool or glide
[3]all pool or glide, no riffle or run
[4]stream dry in 2001
[5]none noted

Tributaries to Rattlesnake Creek, Midnight Creek and Crystal Creek, were higher gradient B-channel streams (Rosgen 1996) with a lower sinuosity than Rattlesnake Creek and had lower percent streambed surface fines – surface materials less than 2.5 mm along the shortest axis. (NOTE: percent streambed surface fines represent the percentage of streambed surface fines at bankfull level). No pools were observed along Rattlesnake Creek tributary monitoring sites in the BURP assessment. Stream bank vegetative cover and bank stability of Midnight and Crystal creeks were assessed as good. In August 2001, USFS conducted a one-day fish distribution survey on Midnight and Crystal creeks and recorded no flowing water on that date at the Fort Hall Reservation boundary (USFS 2001). Canopy cover was recorded as moderate with aspen and birch providing shade and root mass along banks. Sub-dominant vegetation consisted mostly of various species of grass and sedge.

Knox Creek is a higher order stream than Rattlesnake Creek and enters Bannock Creek much higher in the system (Figure 1-6). Sinuosity was low and gradient was 3% in the section of B-channel at the BURP site (Table 1-7). Percent streambed surface fines were about 40% and no pools were found at the site. Vegetative stream bank cover was good, but overall bank stability was very poor.

1.2.4.4.1. Soils

Soils of Bannock Creek watershed vary (Table 1-8). Average soil slope provides a gage of potential soil erosion or erodibility risk. In the valley, slopes are high (12-26%) and gradually increase towards the two bordering mountain ranges. Slopes are fairly steep (up to 49%) in the Bannock and Deep Creek mountains.

The K-factor is the soil erodibility factor in the *Universal Soil Loss Equation*. This factor is composed of four soil properties: texture, organic matter content, soil structure, and permeability. K-factor values range from 1.0 (most erosive) to 0.01 (nearly non-erosive). Weighted average K-factors are fairly low to moderate (0.21 to 0.52) for this watershed. In comparing K-factors for the watershed, values are lowest along the mountain ridges where unweathered bedrock and fragmented material are found. Soil erodibility in the valley and surrounding hillsides is fairly low to moderate with a K-factor range of 0.21 to 0.42.

1.2.4.4.2. Geomorphic Description

Riparian vegetation has an important effect on stream morphology and stream bank stability of certain stream types. Stream morphology also influences presence, amount, and potential for establishment of riparian vegetation communities (Rosgen 1996). Stream systems like those in Bannock Creek watershed characterized by high slopes, erosive soils, and intermittent high flows are dependent on riparian vegetation for stream bank stability. This interrelationship is very important to existing and potential conditions observed in Bannock Creek and its tributaries. In some areas, unmanaged overgrazing has shifted riparian communities that previously had significant components of intermediate sized woody/shrub species to primarily grass/forb communities. Additionally, with loss of bank stability and resultant straightening, stream channels can incise, lowering the water table adjacent to the stream, removing the streams access to its flood plain, and changing how the channel functions. Changes in composition, vigor, and density of riparian vegetation produce corresponding changes in rooting depth, rooting density, shading, water temperature, physical protection from bank erosion processes, terrestrial insect habitat, and contribution of detritus to the channel (Rosgen 1996).

Table 1-8. Soil series in Bannock Creek watershed (from STATSGO soils database for Idaho).

Soil series name	Acres
Chedehap	160.9
Water	278.8
Broncho	2,416.50
Arbone	2,478.90
Camelback	6,564.90
Portino	11,907.20
Burgi	13,253.50
Declo	16,832.40
Highams	19,399.60
Rexburg	20,731.80
Pocatello	22,983.50
Hondoho	24,255.40
Lanoak	30,196.00
Neeley	92,934.10

1.2.4.4.3. Wildlife

Power County, in which Bannock Creek watershed lies, has over 80 different species of mammals, over 70 species of birds associated with water bodies throughout the county, and over 140 song bird species. Federally listed threatened or endangered species potentially occurring within the Bannock Creek watershed include peregrine falcon and bald eagle (Idaho Power Company Web site).

1.2.4.5. Other tributaries

McTucker Creek is a small (slightly greater than two miles in length), low gradient (about 0.3%) stream originating from springs located in the Snake River floodplain near where the river enters American Falls Reservoir (Table 1-4, Figure 1-6). DEQ has monitored the stream as part of its BURP effort (Table 1-7). BURP data indicated the C-channel stream was wide with a low number of pools. The percentage of fines on the surface of the streambed was high at over 67%. Bank stability and bank cover were generally good. Rainbow trout were present at this popular fishing site.

In addition to McTucker Creek, BURP monitoring occurred on Danielson Creek and Hazard Creek/Little Hole Draw, which empty into the reservoir on the north and west side, and Sunbeam Creek, located in the southern part of the subbasin west of Bannock Creek watershed. Danielson and Sunbeam creeks were higher order streams as compared to Hazard Creek/Little Hole Draw (Table 1-7). Sinuosity was moderate for all three streams. Percent streambed surface fines were highest in Danielson Creek at over 75% and lowest in Hazard Creek/Little Hole Draw at about 30%. Incidence of pools was lowest in Sunbeam Creek and highest in Hazard Creek/Little Hole Draw. Danielson Creek had the highest width to depth ratio. Stream bank vegetative cover and stability were good in Danielson Creek and Hazard Creek/Little Hole Draw, and had improved substantially between sampling events in Sunbeam Creek.

1.3. History and Social Characteristics

This area is rich in history beginning with American Indian habitation. Land use and socio-economic features are also discussed in this subsection.

1.3.1. History

Two American Indian tribes inhabited southeastern Idaho prior to 19th century immigration by Europeans. The Bannock and Shoshone Indians occupied and used the territory for their home and to support their livelihood by hunting, fishing and gathering from time immemorial. The Tribes preferred the country along the Snake River because it contained abundant natural resources (water, game, fisheries, timber, berries and roots) for their subsistence.

On July 3, 1868, the Eastern Shoshone and Bannock tribes concluded the Second Treaty of Fort Bridger. By Article 2 of the Treaty, the United States guaranteed the creation of separate reservations for the exclusive use and occupancy of the signatory tribes. Article 2 also provided for a separate reservation to be established for the Bannock Tribe (also known as the Mixed Bands of Shoshones and Bannock). Pursuant to this guarantee and the Executive Order of 1869, the Fort Hall Reservation was established as the “permanent home” for the Shoshone and Bannock tribes’ exclusive use and benefit. The present day Shoshone-Bannock Tribes are successors in interest to the signatories of the Fort Bridger Treaty.

Although the Fort Bridger Treaty called for the Reservation to be approximately 1.8 million acres, various surveying calls or errors in 1873 reduced its actual size to approximately 1.2 million acres (see Swim v. Bergland, 696 F.2d 712, 714 (9th Cir. 1983)). Subsequent cession agreements with the United States reduced the Fort Hall Reservation to the present day size of approximately 544,000 acres or 870 square miles.

In 1911, Congress enacted legislation to provide allotments to the Lemhi Band of Shoshone, which were removed from north central Idaho to the Fort Hall Reservation. The Reservation was surveyed and apportioned to provide allotments to all Tribal members of the Reservation. However, at the time of allotment the Reservation did not yet have a reliable water supply for its irrigable lands. Irrigation development initially began on the Reservation in the 1890s. This was followed by the development of the Fort Hall Irrigation Project, which was planned, surveyed, and built between 1906 and 1912.

Hatzenbuehler (2002) describes the arrival of the first European-American settlers:

> *The first permanent European-American settlements began in the 1860s, when members of the Church of Jesus Christ of Latter-Day Saints moved northward from Cache Valley, Utah, into Idaho Territory . . . followed . . . in subsequent years by settlements along the Bear River Valley, the Malad River, and Goose, Warm and Rock creeks and Raft River. Large-scale settlement of Idaho and other western states came with introduction of the railroad. The Railroad Act of 1862 set the stage for the entry of railroad development in the West, and in 1869 the transcontinental railroad was completed . . . In 1881, Union Pacific Rail Road announced plans to build a main line across Idaho, from east to west, to eventually reach the Pacific coast.*

The railroad brought both people and an expansion of economic activity to Idaho; in addition to the railroad, large-scale irrigation projects helped settle the Snake River Plain, as described by Link and Phoenix (1996):

> *The American Falls Project of the Bureau of Reclamation, successor to the Reclamation Service, built in the 1910s and 1920s, assured late-season water for small cooperatives on the upper Snake, the thousands of farmers in the Twin Falls and North Side projects and the Minidoka Project. In later years, expansion of the American Falls Project required the removal of the town of American Falls to higher ground because a new dam would flood the old town. This large concrete structure created a reservoir of 1.7 million acre-feet, to bring into cultivation an additional 115,000 acres in the vicinity of Gooding and provided supplemental water for over one million acres above and below the facility. Construction began in 1925, and the gates were closed upon completion in October, 1926. The reservoir first reached its maximum storage size on July 1, 1927.*

The American Falls Dam was authorized and built to satisfy irrigation needs of the local communities. The reservoir flooded some lands of Fort Hall Reservation (Bureau of Reclamation 1921 cited in Stene 1997). Approximately 14,500 acres of tribal lands were inundated. BOR negotiated with the Indian Service, later the Bureau of Indian Affairs, to appraise the reservation lands for purchase. In addition to flooding the lands, some people feared the reservoir would engulf Fort Hall itself. Fort Hall escaped flooding, but in 1993 BOR preservation officers debated the erosion threat to the fort, and it was listed as an endangered site. In 1954, the Tribes waived its claim to certain water rights in order to receive storage rights in the American Falls and Palisades reservoirs.

By the early 1970s, American Falls Dam began showing increasing signs of deterioration (Bureau of Reclamation 1974 and 1980 and John Dooley, personal communication, all cited in Stene 1997). BOR and the American Falls Reservoir District No. 2 reached an agreement in 1973 to replace the dam through private funds. Construction preparations began in 1974, and in 1977 BOR breached the old American Falls Dam, and began storing water behind the new dam. Workers finished most of the new American Falls Dam in 1978.

Today American Falls Dam, along with the other parts of the Minidoka Project, plays an important role in the agriculture base of southern Idaho (Idaho Public Television Web site). The main crops in this area are alfalfa and potatoes and, to a lesser extent, apples, barley, beans, sugar beets, corn, hay, onions, pears, peas, prunes, and rye are also grown. In 1992 1,062,093 acres were irrigated, producing $462,684,605 worth of crops. In addition to irrigation responsibilities, power generation is also an authorized purpose of American Falls Dam (Bureau of Reclamation Web site b). Ancillary benefits include: recreation use; fish and wildlife benefits, including water for flow augmentation in lower Snake and Columbia rivers to aid endangered and threatened anadromous fish; and flood control.

1.3.2. Land Use and Ownership

Land use includes cropland, pastureland, cities, suburbs, and industries (EPA et al. 2000). Agriculture, both irrigated and dryland, accounts for almost 40% of the land use in the subbasin (Table 1-9, Figure 1-8). Farmers grow small grains, sugarbeets, potatoes, and alfalfa mostly on irrigated land. Almost 50% of the area is rangeland, presently supporting primarily cattle. No other specific use accounts for more than 5% of the subbasin area.

Private landowners and BLM own over 60% of American Falls Subbasin (Table 1-10). Fort Hall Reservation comprises 18.1% and Department of Energy (Idaho National Laboratory) covers just over 11% of subbasin land (Figure 1-9). The remaining 8% is open water or State of Idaho and U. S. Forest Service lands.

1.3.3. Demographics and Economics

Most of the land area encompassed by American Falls Subbasin comprises three counties (Figure 1-1). Bannock County is the most populous, followed by Bingham and Power counties (Table 1-11). The largest city in the area is Pocatello with over 50,000 residents. Within the subbasin, major municipalities are Blackfoot, American Falls, Shelley, Aberdeen, and Firth. The population of the Shoshone-Bannock Tribes on Fort Hall Reservation is 4,824. The three counties differ in their employment patterns. Manufacturing is responsible for almost half of the employment in Power County while jobs in Bingham and Bannock counties are more diverse (Table 1-12). The agriculture sector employs almost 20% of Power County, almost 9% of Bingham County, and about 1.5% of Bannock County workers. Government accounts for 20-30% of employees in all three counties. Food processing associated with the potato industry is also prominent in the area with plants in American Falls, Blackfoot, Firth, and Shelley. Per capita income in all three counties is below both state and national averages.

Table 1-9. Land use in American Falls Subbasin and Bannock Creek Watershed.

	American Falls Subbasin		Bannock Creek watershed	
Land use	Area (ac)	Percentage	Area (ac)	Percentage
Dryland agriculture	181,279	9.9%	95,823	36.2%
Forest	57,775	3.1%	48,420	18.3%
Irrigated - gravity flow	106,015	5.8%	3,963	1.5%
Irrigated - sprinkler	429,762	23.4%	9,481	3.6%
Rangeland	909,769	49.6%	105,694	39.9%
Riparian	21,710	1.2%	393	0.1%
Rock	74,485	4.1%	0	0.0%
Urban	4,404	0.2%	866	0.3%
Water	50,769	2.8%	231	0.1%

Table 1-10. Land ownership in American Falls Subbasin.

Land ownership	Area (ac)	Percentage
Bureau of Land Management	463,681	25.5%
Bureau of Indian Affairs	329,768	18.1%
Department of Energy	213,217	11.7%
Open water	58,625	3.2%
Private	660,865	36.4%
State of Idaho	83,184	4.6%
U. S. Forest Service	8,628	0.5%

Table 1-11. Population data for counties and cities in or near American Falls Subbasin (from Idaho Department of Commerce Web site).

	Population		
County/city	1990	2000	**Percent change**
Counties			
Bingham	37,583	41,735	11.0%
Power	7,086	7,538	6.4%
Bannock	66,026	75,565	14.4%
Municipalities			
Aberdeen	1,406	1,840	30.9%
American Falls	3,757	4,111	9.4%
Blackfoot	9,646	10,419	8.0%
Firth	429	408	-4.9%
Pocatello	46,117	51,466	11.6%
Shelley	3,536	3,813	7.8%

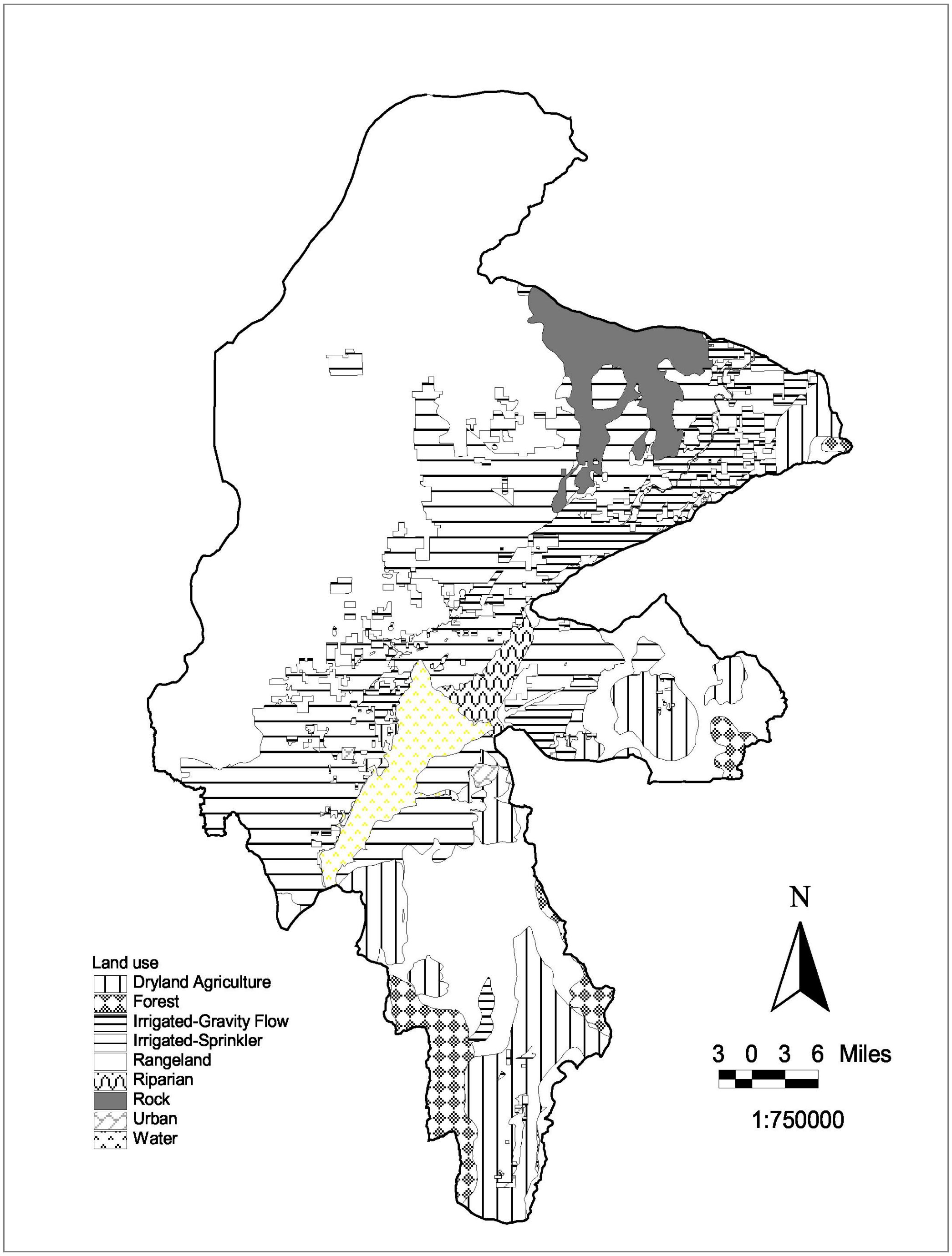

Figure 1-8. Land use in American Falls Subbasin (from Idaho Department of Water Resources GIS data sets).

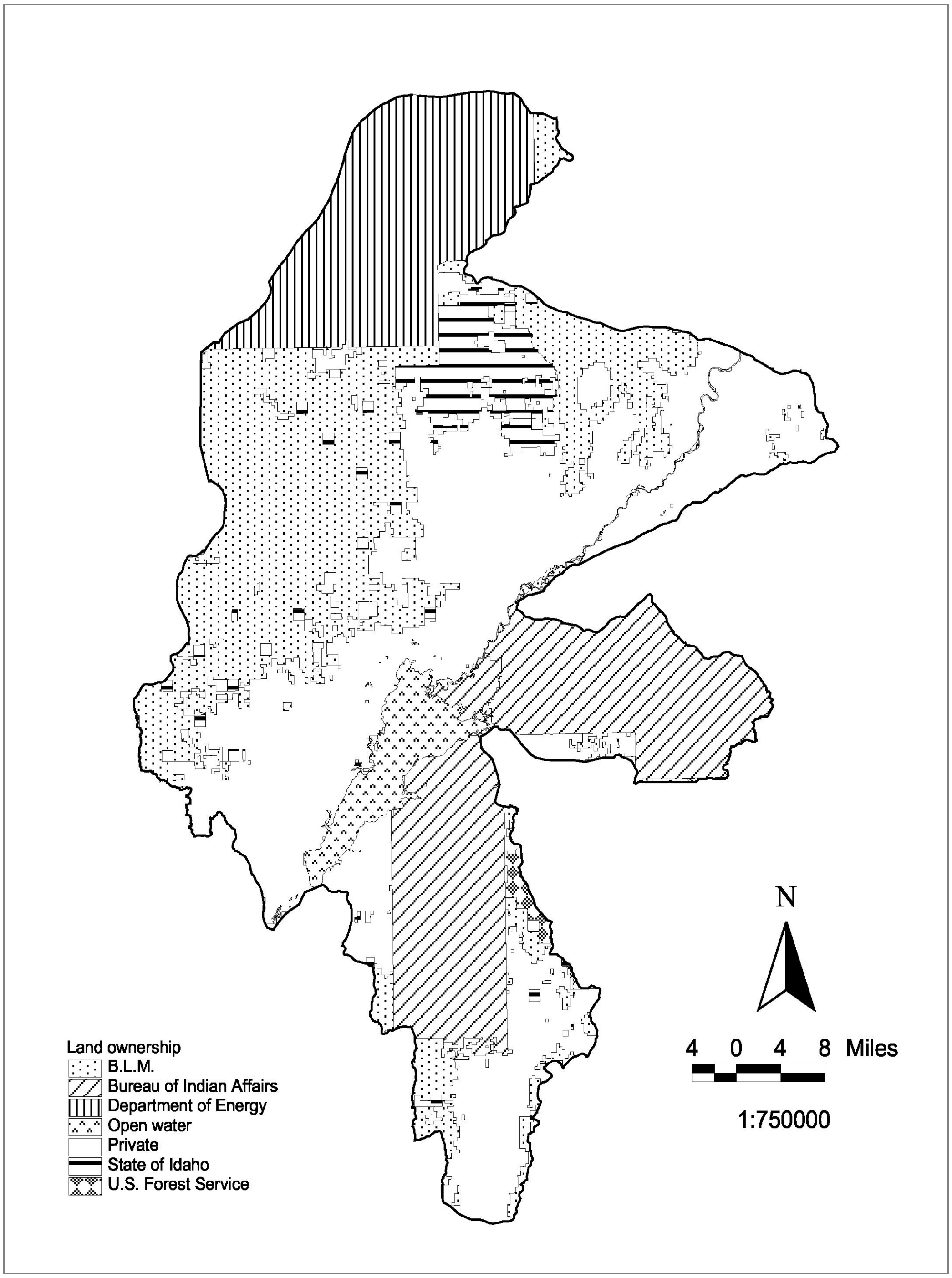

Figure 1-9. Land ownership in American Falls Subbasin (from DEQ data sets).

Table 1-12. Employment data for Bingham, Power, and Bannock Counties, 2001 (from Idaho Department of Labor Web site).

County	Agriculture	Percentage of nonfarm payroll jobs[1]							Per capita income		
		Mining & construction	Manufacturing	T, C, & U[2]	Trade	F, I, & RE[3]	Services	Government	County	State of Idaho	United States
Bingham	8.7%	6%	18%	3%	28%	3%	11%	31%	$19,340	$24,506	$30,413
Power	18.4%	7%	44%	8%	13%	2%	6%	20%	$19,905	$24,506	$30,413
Bannock	1.4%	5%	8%	5%	25%	5%	25%	27%	$21,780	$24,506	$30,413

[1]because this section is based on a percentage of all nonfarm employment, summing these percentages with agriculture employment will result in a value greater than 100%

[2]transportation, communication, & utilities

[3]finance, insurance, & real estate

There are thirteen (four municipal, four aquaculture, four *confined animal feeding operations* (CAFOs) , one dairy) active or pending National Pollution Discharge Elimination System (NPDES) permitted dischargers in American Falls Subbasin (Figure 1-1, Table 1-13). The cities of Shelley, Firth, and Blackfoot release their effluent directly into the Snake River and Aberdeen discharges to Hazard Creek/Little Hole Draw, which empties into American Falls Reservoir. Crystal Springs fish hatchery and Indian Springs fish hatchery each hold one permit, but neither facility is presently operating. American Falls Reservoir is the final disposition of Crystal Springs discharge while the Snake River is the receiving water for Indian Springs. Large CAFOs (1000 animals or more) are required to have an NPDES permit, which dictates that they control their animal waste discharge. In American Falls Subbasin these include: Snake River Cattle Company, Tom Anderson Cattle Company, Bragg feedlot, and Kerry Ward feedlot. The only dairy with an NPDES permit in the subbasin is the Alan Andersen dairy.

Table 1-13. National Pollution Discharge Elimination System permit holders or applicants in American Falls Subbasin (from EPA Web site and David Domingo, EPA/Seattle, personal communication).

Entity	Permit number	Permit issued date	Permit expired date	Description	Receiving water body
City of Aberdeen	ID0020176	Sep-01	Sep-06	Sewerage	Wasteway canal
City of Blackfoot	ID0020044	Oct-02	Nov-05	Sewerage	Snake River
City of Firth	ID0024988	Sep-87	Sep-92	Sewerage	Snake River
City of Shelley	ID0020133	Jun-88	Jun-93	Sewerage	Snake River
Indian Springs Hatchery	IDG130023 ID0022420	Aug-99	Sep-04	Fish hatchery	Snake River
Crystal Springs Trout Farm	IDG130038 ID0022420	Feb-00	Sep-04	Fish hatchery	Boom Creek/ Am. Falls Reservoir
Snake River Cattle Company	IDG010069			CAFO[1]	none
Tom Anderson Cattle Company				CAFO[1]	none
Bragg feedlot				CAFO[1]	none
Kerry Ward feedlot				CAFO[1]	none
Alan Anderson dairy				dairy	none

[1]CAFO=confined animal feeding operation

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2. Subbasin Assessment – Water Quality Concerns and Status

Water quality in American Falls Subbasin has been affected by land use (EPA et al. 2000). Aquatic resources in the upper Snake River Plain, which includes American Falls Reservoir, Snake River, and adjacent areas, have been degraded by irrigation diversions, channelization, grazing, dams, sewage treatment, nonpoint pollution, food processing, and phosphate processing.

2.1. Water Quality Limited Assessment Units Occurring in the Subbasin

There are nineteen water quality limited assessment units in American Falls Subbasin on the 2010 303(d) list . Sediment and nutrients are the predominant pollutant concerns in the subbasin (Table 2-1). Only Knox Creek was added in 1998; other water bodies were carryovers from previous 303(d) lists.

The 2010 303(d) list shows dissolved oxygen, nutrients, and sediment affecting beneficial uses in American Falls Reservoir. Beneficial uses in the reservoir designated in Idaho Water Quality Standards (see Section 2.2) are cold water aquatic life, primary contact recreation, and domestic water supply . Secondary contact recreation is an existing beneficial use (see Section 2.2). All water bodies are considered to have agriculture and industrial water supply, wildlife habitat, and aesthetics as beneficial uses.

The Snake River is listed for sediment (Table 2-1). Designated beneficial uses as recognized in Idaho Water Quality Standards for this reach of the Snake River are cold water aquatic life, salmonid spawning, primary contact recreation, and domestic water supply. The Snake River also supports secondary contact recreation.

McTucker Creek is listed for sediment as a pollutant of concern. There are no designated beneficial uses in the water quality standards for McTucker Creek, but presumed beneficial uses include cold water aquatic life and secondary contact recreation.

Bannock Creek was originally listed on the 1998 303(d) list, along with four tributaries: Knox Creek, Moonshine Creek, Rattlesnake Creek, and West Fork Bannock Creek. The tributaries are listed from their headwaters to the Fort Hall Reservation boundary. Designated beneficial uses for Bannock Creek are cold water aquatic life and secondary contact recreation. Salmonid spawning and primary contact recreation are considered existing uses. Bannock Creek water quality limited assessment units were originally grouped into two sections – American Falls Reservoir to Knox Creek confluence and Knox Creek confluence to headwaters. Both sections were listed as being impaired for bacteria, nutrients, and sediment. The four tributaries of Bannock Creek have existing beneficial uses of cold water aquatic life and secondary contact recreation. Moonshine Creek (headwaters including Squaw Creek fork to Bannock Creek), Rattlesnake Creek (headwaters and unnamed tributaries to Bannock Creek), and West Fork Bannock Creek (headwaters to Bannock Creek) were listed as having sediment impairments.

Knox Creek (headwaters and unnamed tributaries, including forks to Bannock Creek) was added to the 1998 list as not supporting the cold water aquatic life beneficial use for an unknown pollutant based upon the assessment completed through the BURP monitoring project.

Table 2-1. Water quality limited assessment units in American Falls Subbasin on the 2010 303(d) list including listed pollutants and beneficial uses.

Water body	Tributary of	Water quality limited assessment unit(s)	Listed pollutants[1]	Beneficial uses[2]: Cold water aquatic life	Salmonid spawning	Contact recreation: Primary	Contact recreation: Secondary	Domestic water supply
American Falls Reservoir		ID17040206SK001L_0L	DO, Nut, Chlorphyll-a, Sed	Yes		Yes	Yes	Yes
Snake River		ID17040206SK022_02	Sed	Yes	Yes	Yes	Yes	Yes
McTucker Creek	Snake River	ID17040206SK024_02, 024_02a	Sed	Yes			Yes	
American Falls Res – Bannock Creek Bannock Creek	American Falls Reservoir	ID17040206SK001_05; ID17040206SK002_02,002_04, 002_05	Fecal coliform, cause unknown (nutrients suspected), Sed	Yes	Yes	Yes	Yes	
		ID17040206SK002_03	E. coli, Sed	Yes	Yes	Yes	Yes	
Moonshine Creek	Bannock Creek	ID17040206SK006_02	Sed	Yes			Yes	
Rattlesnake Creek	Bannock Creek	ID17040206SK010_02,010_02 b, 010_03, 010_04	Sed	Yes			Yes	
West Fork Bannock Creek	Bannock Creek	ID17040206SK008_02	Sed	Yes			Yes	
Knox Creek	Bannock Creek	ID17040206SK009_02 ID17040206SK009_03	Sed Combined biota/ habitat bioassessment	Yes			Yes	
Danielson Creek		ID17040206SK000_02a	Combined biota/habitat bioassessment	Yes			Yes	
Little Hole Draw		ID17040206SK025_02a	Combined biota/habitat bioassessment	Yes			Yes	

[1]DO=dissolved oxygen, Nut=nutrients, Sed=sediment, Bact=bacteria

[2]beneficial use information from the Idaho Water Quality Standards and Wastewater Treatment Requirements and Beneficial Use Reconnaissance Program monitoring. All water bodies are considered to support agriculture and industrial water supply, wildlife habitat, and aesthetics.

2.2. Applicable Water Quality Standards

Several water quality standards apply to water bodies in the American Falls Reservoir Subbasin, such that, when met, beneficial uses are supported. These standards take two forms – numeric and narrative. Numeric standards have a specific value (e.g., concentration, temperature, turbidity units) below or above which beneficial use support is impaired. Narrative standards do not have specific thresholds and may vary based on site-specificity. Such standards typically state that quantities of the pollutant should not exceed the point where beneficial uses are being impaired. Ultimately, the goal of water quality standards and a TMDL plan is to support beneficial uses in Idaho lakes and streams.

Some water quality numeric standards are more directly applicable to conditions in American Falls Subbasin. These include standards for dissolved oxygen, temperature, turbidity, and bacteria (Table 2-2). Standards also exist for other pollutants that are generally not a problem in American Falls Subbasin such as pH, toxic substances, and ammonia (Appendix A).

2.2.1. Beneficial Uses

Idaho water quality standards require that surface waters of the state be protected for beneficial uses wherever attainable (IDAPA 58.01.02.050.02). These beneficial uses are interpreted as existing uses, designated uses, and “presumed” uses as briefly described in the following paragraphs. The *Water Body Assessment Guidance, second edition*, (Grafe et al. 2002) details beneficial use identification for use assessment purposes.

2.2.2. 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 those uses shall be maintained and protected (IDAPA 58.01.02.003.35, .050.02, and 051.01 and .053). Existing uses include those actually occurring, whether or not the level of quality to fully support the uses exists. Practical application of this concept would be when a water body could support salmonid spawning, but salmonid spawning is not yet occurring.

2.2.3. 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, examples include aquatic life support, recreation in and on the water, domestic water supply, and agricultural use.

Table 2-2. State of Idaho water quality numeric standards (from DEQ water quality standards and wastewater requirements). Max = maximum, avg = average, and min = minimum.

	Criteria			
Beneficial use	Dissolved oxygen[1]	Temperature	Turbidity[2]	*E. coli*
Cold Water Biota	>= 6.0 mg/l, instantaneous	<= 22°C, instantaneous; and, <= 19°C, max daily avg	<= 50 NTU, instantaneous; or, <= 25 NTU, for > 10 consecutive days	
Salmonid Spawning	1-day min >= the greater of 6.0 mg/l or 90% saturation	<= 13°C, instantaneous; and, <= 9°C, max daily avg		
Primary Contact Recreation				<= 406 organisms/100 ml, single sample; or, <= geometric mean of 126 organisms/100 ml in min of 5 samples taken every 3-5 days over 30-day period
Secondary Contact Recreation				<= 576 organisms/100 ml, single sample; or, <= geometric mean of 126 organisms/100 ml in min of 5 samples taken every 3-5 days over 30-day period
Domestic Water Supply			increase of <= 5 NTU, when background < 50 NTU; or increase of <= 10%, not to exceed 25 NTU when background > 50 NTU	

[1]criteria for streams only, criteria for lakes and reservoirs differ

[2]above background

Water quality must be sufficiently maintained to meet the most sensitive use. Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life or salmonid spawning. Designated uses are specifically listed for water bodies in Idaho in tables in the Idaho water quality standards (see IDAPA 58.01.02.003.22 and .100, and IDAPA 58.01.02.109-160 in addition to citations for existing uses.)

2.2.4. Presumed Uses

In Idaho, most water bodies listed in the designated use tables in the water quality standards, along with all unlisted water bodies, do not yet have specific use designations. These undesignated uses are to be designated. In the interim, and absent information on existing uses, DEQ presumes that most waters in the state will support cold water aquatic life and either primary or secondary contact recreation (IDAPA 58.01.02.101.01). To protect these “presumed uses,” DEQ will apply the numeric criteria for cold water aquatic life and primary or secondary contact recreation to undesignated waters. If, in addition to these presumed uses, there is an existing use, salmonid spawning for example, because of the requirement to protect levels of water quality for existing uses, numeric criteria for salmonid spawning would apply (e.g., intergravel dissolved oxygen, temperature). Conversely, if cold water is not found to be an existing use, an appropriate use designation 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).

2.3. Summary and Analysis of Existing Water Quality Data

The quantity of data varies by water body. More data exist for the Snake River and American Falls Reservoir than for smaller water bodies. Major monitoring on the river and reservoir has been done by BOR, DEQ, and USGS. Neil and Marita Poulson, working under contract for various entities, and BOR have gathered information on smaller water bodies.

2.3.1. Flow Characteristics, Water Column and Biological Data, Other Data, Status of Beneficial Uses, Conclusions

2.3.1.1. American Falls Reservoir

Low and Mullins (1990) estimated total reservoir inflow at about 5.8 million ac-ft. Of this amount, 63% is from surface water runoff, 33% from ground water discharge, and 4% from ungaged tributaries, canals, ditches, sloughs, and precipitation.

American Falls Reservoir can undergo substantial changes in storage volume on an annual basis. These fluctuations depend on water year and irrigation demands. For example, in WY2003, storage was at a high in the beginning of April at almost 1.4 million ac-ft (Figure 1-5). The average high occurs in late April at about 1.55 million ac-ft. In October of 2003, storage volume was down below 36,000 ac-ft compared to an average of about 520,000 ac-ft. Heimer (1989) noted that annual water level fluctuations and poor water quality make for stressful conditions for game fish populations.

American Falls Reservoir has a history of heavy algal blooms associated with increased levels of nutrients. Based on phosphorus levels, the reservoir falls in the range of eutrophic (nutrient rich) water bodies (Bushnell 1969). Bushnell (1969) noted in his review of the 1967 irrigation season that the Idaho Public Health Department reported “. . . a very heavy algal bloom occurred resulting in septic conditions in the reservoir and for some distance downstream causing offensive odors and extensive fish kills.” Problems at the time with low dissolved oxygen levels were a result, in part, from chemical oxygen demand linked to municipal and industrial loadings. Input from such sources has been greatly diminished through the Clean Water Act and the NPDES program. Recreationists still, however, complain about the abundance of algae in late summer (Appendix G).

In addition to nutrient concerns, the reservoir has had considerable shoreline erosion problems (John Dooley, former Minidoka Project manager, personal communication, cited in Stene 1997). Bureau of Reclamation and land holders in American Falls have lain miles of riprap, using basalt from the surrounding area, to control the erosion problem. BOR also worked with the Natural Resources Conservation Service (NRCS) Plant Materials Center at Aberdeen on vegetation to control shoreline erosion. Of the approximately 100 miles of shoreline around the reservoir, 85 miles have been identified as being in highly erodible soils (Alicia Lane Boyd, Bureau of Reclamation/Burley, personal communication). BOR has placed 15 miles of rock or other nonerodible material, and performed erosion control work on approximately 20 miles of shoreline. Another 18 miles of shoreline is scheduled to have erosion work done. The remaining 47 miles of shoreline would be considered highly erosive sediment, but not highly erodible sections, because the shoreline is flat rather than characterized by steep cliffs.

Sediment into the reservoir has decreased overall capacity (Alicia Lane Boyd, Bureau of Reclamation/Burley, personal communication). When originally built in 1926, reservoir volume was estimated at 1.7 million acre-feet. During reconstruction of the dam in 1976, volume was estimated at 1.67 million acre-feet representing a decrease in volume of 30,000 acre-feet over 50 years, although the margin of error of the estimate probably exceeds the 30,000 acre-feet difference.

This loss of volume is probably of little concern from both water storage and beneficial use perspectives. The 1.8% reduction in storage volume in American Falls Reservoir over 50 years equates to an annual loss of 0.04% or a 3.5% decrease over 100 years, well below BOR’s goal of less than 5% loss before a portion of storage volume is allocated to sediment. Idaho does not have criteria pertaining to reservoir volume loss and subsequent effects on beneficial uses. An internet review identified Nebraska as having guidelines regarding sedimentation of lakes and reservoirs. Nebraska (NDEQ 2001) considers any lake or reservoir with less than 25% volume loss due to sedimentation in full support of aesthetics beneficial use. An annual long-term sedimentation rate greater than or equal to 0.75% is used by Nebraska to place reservoirs on the state’s Water Quality Concerns list for sedimentation (NDEQ 2003). Thus, based on thresholds used by BOR and Nebraska, loss of storage volume in American Falls Reservoir has had little impact.

Recent data for American Falls Reservoir have been collected by BOR and DEQ (Appendix B). BOR has sampled water quality and field parameters for five sampling events since 1995. DEQ began its sampling in 2001 and sampled up to four sites in the summer, depending on accessibility, the number of sampling events varied by year depending on boat access to the reservoir. The number of sites sampled during each sampling event also changed based on weather conditions

Unfortunately, the three years of DEQ sampling have been low water years. Based on the Palmer Drought Index, the Pocatello area has been in drought conditions since early fall of

1999. Generally, conditions in the area have been rated as severe to extreme (Tom Edwards, Air Quality Analyst, DEQ/Pocatello, personal communication).

Data from the two agencies were summarized based on agency, site, year, and parameter. Parameters of greatest interest are phosphorus, nitrogen, and chlorophyll *a*. All three parameters provide an estimate of nutrients in the system: phosphorus and nitrogen directly, and chlorophyll *a* indirectly as an indicator of algal growth.

Concentrations of total phosphorus and orthophosphorus exhibited different trends in American Falls Reservoir in 2001 to 2003. Orthophosphorus did not vary substantially between bottom and column samples (Table 2-3), but there was a general trend of decreasing levels from down-reservoir (i.e., dam) to up-reservoir (i.e., county boundary). The trend of decreasing orthophosphorus concentrations moving up-reservoir did not hold true for total phosphorus. The mid-reservoir sites, Fenstermaker and Little Hole Draw (Figure 2-1), were just as likely to show higher concentrations of total phosphorus. With one exception, overall differences between column and bottom total phosphorus was minimal (Table 2-3). The exception during 2001 at the dam site was caused by a high concentration of 2.14 mg/L total phosphorus in a bottom sample taken in July of 2001. This concentration was not consistent with data from other sites and dates during 2001, as it was almost ten times the next highest concentration of 0.22 mg/L measured the following week. BOR data showed a difference between column and bottom samples in three of their five years of sampling, with the greatest difference being 0.13 mg/L in 1997. Based on visual examination of the data, no discernable differences for either phosphorus parameter appear between these years.

The level of internal phosphorus recycling is unknown, but it appears to be occurring. Phosphorus is released from the sediment at zero to low dissolved oxygen conditions (Alaoui Mhamdi et al. 2003, Cusimano et al. 2002), which often occurs during stratification. The level of low DO at which point phosphorus releases is unclear, but Lock et al. (2003) found increased stability (less tendency to move from sediment to water column) of phosphate at concentrations of 1-2 mg/L of DO. DEQ sampling in the reservoir near the dam showed low DO concentrations corresponded with the highest concentrations of dissolved orthophosphorus in bottom samples from 2001 to 2003 (Appendix B). On the five days (12 and 19 July 01, 2 and 15 July 02, 23 July 03) where DO was less than 3 mg/L, orthophosphorus ranged from 0.107-0.208 mg/L (Table 2-4). For the other fifteen sampling events, orthophosphorus levels never exceeded 0.097 mg/L. The only other site with DO less than 3 mg/L was the county boundary site on 3 July 01. Low DO at this site on this date corresponded to a generally elevated level of orthophosphorus, but not out of line with sampling events on other dates (23 May 01, 28 May 03) with higher levels of DO. The reason for either the lower than expected concentration of orthophosphorus at this site in July or the higher than expected concentrations of orthophosphorus on the two dates in May is unknown.

Table 2-3. Phosphorus, chlorophyll *a*, and nitrogen data (from BOR and DEQ sampling in American Falls Reservoir.

Year	Sampling agency	Number of samples[1]	Sample site	Sample location	Orthophosphorus (mg/L)			Total phosphorus (mg/L)			Chlorophyll *a* (mg/L)			NO_3/NO_2 (mg/L)			NH_3 (mg/L)			TKN (mg/L)			TN (mg/L)[2]
					Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	
1995	BOR	1		Column	0.06			0.08			0.007			0.02			0.12			0.41			0.43
		1		Bottom	0.06			0.07						0.02			0.12			0.25			0.27
1997	BOR	1		Column	0.00			0.03			0.052			0.02			0.07			0.86			0.88
		1		Bottom	0.13			0.16						0.03			0.09			0.18			0.21
1998	BOR	1		Column	0.01			0.01			0.003			0.04			0.04			0.29			0.33
		1		Bottom	0.07			0.09						0.15			0.12			0.25			0.40
2000	BOR	1		Column	0.05			0.07			0.006			0.09			0.06			0.28			0.37
		1		Bottom	0.06			0.06						0.10			0.08			0.30			0.40
2001	DEQ	10, 8	Dam	Column	0.08	0.00	0.05	0.10	0.01	0.07	0.041	0.001	0.008	0.14	0.02	0.08	0.15	0.01	0.08	0.72	0.27	0.47	0.54
		10		Bottom	0.21	0.00	0.08	2.14	0.02	0.29				0.16	0.03	0.08	0.40	0.03	0.15	0.62	0.29	0.44	0.51
		1	Fenster-	Column	0.04			0.06			0.014			0.16	0.16	0.16	0.07	0.07	0.07	0.42	0.42	0.42	0.58
		1	maker	Bottom	0.05			0.06						0.14	0.14	0.14	0.08	0.08	0.08	0.35	0.35	0.35	0.49
		8, 6	Little Hole	Column	0.05	0.00	0.04	0.16	0.03	0.09	0.057	0.006	0.019	0.35	0.01	0.16	0.19	0.01	0.09	0.73	0.40	0.54	0.70
		8	Draw	Bottom	0.06	0.00	0.04	0.14	0.03	0.08				0.32	0.01	0.15	0.19	0.01	0.11	0.93	0.32	0.56	0.71
		8, 6	County	Column	0.03	0.01	0.02	0.11	0.03	0.07	0.033	0.006	0.016	0.41	0.01	0.17	0.21	0.01	0.09	0.76	0.32	0.52	0.68
		7	Boundary	Bottom	0.04	0.01	0.02	0.10	0.03	0.08				0.35	0.01	0.20	0.24	0.01	0.11	0.68	0.36	0.50	0.70
		4	All sites	Column			0.04			0.07			0.014			0.14			0.08			0.49	0.63
2002	DEQ	5	Dam	Column	0.12	0.01	0.05	0.16	0.03	0.10	0.027	0.006	0.011	0.06	0.01	0.03	0.39	0.01	0.16	0.78	0.26	0.55	0.59
		5		Bottom	0.15	0.01	0.08	0.19	0.04	0.10				0.20	0.02	0.06	0.43	0.01	0.14	0.63	0.34	0.47	0.53
		3	Fenster-	Column	0.05	0.00	0.03	0.08	0.03	0.06	0.018	0.005	0.010	0.06	0.01	0.03	0.07	0.01	0.04	0.48	0.30	0.39	0.41
		3	maker	Bottom	0.05	0.03	0.04	0.14	0.05	0.09				0.20	0.02	0.08	0.37	0.01	0.21	0.72	0.27	0.46	0.54
		4	Little Hole	Column	0.09	0.02	0.05	0.15	0.04	0.08	0.018	0.003	0.013	0.36	0.03	0.13	0.17	0.01	0.08	0.76	0.40	0.52	0.65
		4	Draw	Bottom	0.09	0.03	0.05	0.14	0.05	0.09				0.33	0.01	0.10	0.18	0.01	0.09	0.82	0.42	0.54	0.64
		4	County	Column	0.05	0.01	0.02	0.12	0.04	0.08	0.042	0.011	0.023	0.37	0.01	0.13	0.08	0.01	0.04	0.70	0.41	0.62	0.75
		3	Boundary	Bottom	0.02	0.01	0.02	0.11	0.05	0.07				0.11	0.03	0.06	0.06	0.01	0.03	0.92	0.42	0.64	0.70
		4	All sites	Column			0.04			0.08			0.014			0.08			0.08			0.52	0.60
2003	BOR	1		Column	0.05			0.08			0.006			0.07			0.05			0.43			0.50
		1		Bottom	0.09			0.11						0.10			0.19			0.51			0.61
	DEQ	6	Dam	Column	0.10	0.01	0.05	0.17	0.03	0.09	0.031	0.004	0.011	0.06	0.01	0.04	0.13	0.01	0.07	0.83	0.26	0.49	0.52
		6		Bottom	0.13	0.01	0.06	0.16	0.03	0.09				0.07	0.01	0.05	0.21	0.01	0.11	0.71	0.28	0.47	0.52
		3	Fenster-	Column	0.06	0.05	0.05	0.15	0.10	0.12	0.069	0.004	0.032	0.07	0.01	0.03	0.17	0.02	0.07	1.27	0.65	0.87	0.91
		3	maker	Bottom	0.08	0.05	0.06	0.16	0.10	0.13				0.07	0.03	0.05	0.18	0.03	0.09	1.04	0.44	0.70	0.74
		5	Little Hole	Column	0.05	0.00	0.03	0.10	0.04	0.08	0.033	0.002	0.010	0.13	0.03	0.07	0.15	0.02	0.10	0.58	0.45	0.50	0.58
		4	Draw	Bottom	0.05	0.04	0.04	0.09	0.06	0.07				0.14	0.03	0.07	0.19	0.07	0.14	0.70	0.47	0.56	0.63
		4	County	Column	0.02	0.00	0.01	0.07	0.04	0.06	0.023	0.006	0.014	0.13	0.04	0.09	0.07	0.02	0.04	0.49	0.32	0.43	0.51
		3	Boundary	Bottom	0.04	0.01	0.02	0.08	0.05	0.07				0.08	0.06	0.07	0.10	0.02	0.06	0.53	0.44	0.49	0.57
		4	All sites	Column			0.04			0.08			0.017			0.06			0.07			0.57	0.63

[1]lower number represents number of chlorophyll *a* samples

[2]calculated by adding nitrate+nitrite concentration to total Kjeldahl nitrogen concentration (maximum values for BOR data, mean values for DEQ data)

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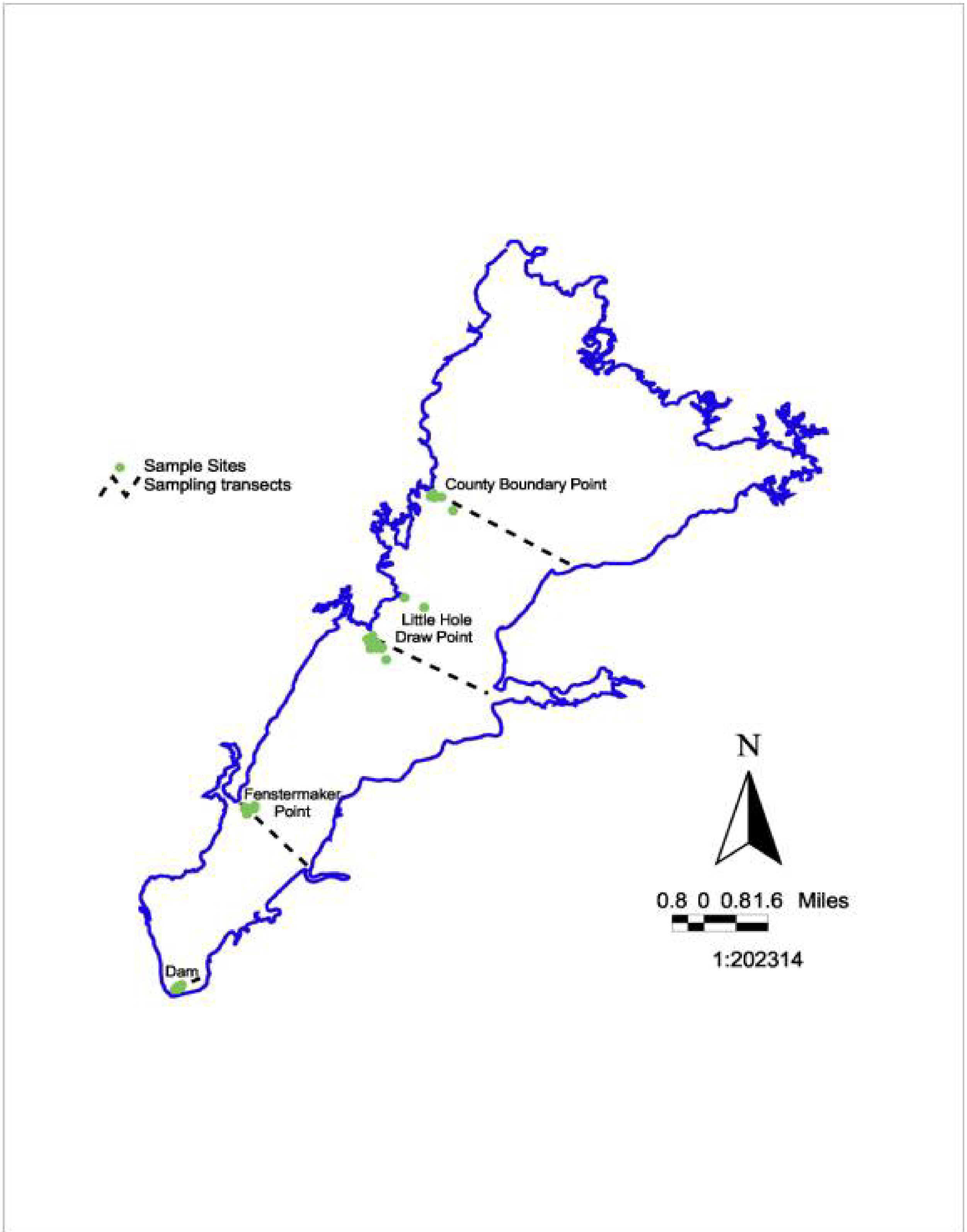


Figure 2-1. DEQ sample sites on American Falls Reservoir. Sites were located on the pictured transects close to the western shore.

Table 2-4. DEQ dissolved oxygen and orthophosphorus (bottom sampling) data from American Falls Reservoir, May 2001 to August 2003.

		Dam			Fenstermaker Point			Little Hole Draw Point			County Boundary Point		
Date	Sampling condition[1]	Depth (m)	DO (mg/L)	Dissolved ortho P (mg/L)	Depth (m)	DO (mg/L)	Dissolved ortho P (mg/L)	Depth (m)	DO (mg/L)	Dissolved ortho P (mg/L)	Depth (m)	DO (mg/L)	Dissolved ortho P (mg/L)
11-May-01	2nd deepest FP meas.	18	9.86					10	10.22		7	11.37	
	Deepest FP meas.	19	9.87					11	10.12		8	11.6	
	Bottom sample	19		0.007				11		< 0.003	8		0.005
	Reservoir bottom	20						12			8.9		
23-May-01	2nd deepest FP meas.	17	7.98					10	5.45		6	6.33	
	Deepest FP meas.	18	8.01					11	5.51		7	6.42	
	Bottom sample	18		< 0.003				11		0.036	7		0.044
	Reservoir bottom	19						12			8		
6-Jun-01	2nd deepest FP meas.	15	6.47								5	6.68	
	Deepest FP meas.	16	6.39								6	5.77	
	Bottom sample	16		0.055							none		
	Reservoir bottom	17									6.6		
20-Jun-01	2nd deepest FP meas.	14	5.31					8	5.96		6	5.57	
	Deepest FP meas.	15	5.32					9	6		7	5.5	
	Bottom sample	15		0.051				8.5		0.02	7		0.017
	Reservoir bottom	16						9.4			7.8		
3-Jul-01	2nd deepest FP meas.	13	4.91					6	5.39		5	4.25	
	Deepest FP meas.	14	5.04					7	4.27		6	2.87	
	Bottom sample	13		0.049				6.5		0.058	5		0.036
	Reservoir bottom	14						7.3			6.1		
12-Jul-01	2nd deepest FP meas.	11	2.6					4	5.55		1	6.93	
	Deepest FP meas.	12	1.97					5	5.58		2	6.9	
	Bottom sample	12		0.184				5.3		0.053	2.5		0.016
	Reservoir bottom	13						6.4			3		
19-Jul-01	2nd deepest FP meas.	11	3.67										
	Deepest FP meas.	12	2.37										
	Bottom sample	12		0.208									
	Reservoir bottom	13											
25-Jul-01	2nd deepest FP meas.	10	5.7					4	5.92		2	7.49	
	Deepest FP meas.	11	5.67					5	5.56		3	7.41	
	Bottom sample	11		0.083				5		0.048	3		0.015
	Reservoir bottom	12						5.6			3.9		
2-Aug-01	2nd deepest FP meas.	9	7.79					3	6.45		1	7.14	
	Deepest FP meas.	10	7.78					4	4.32		2	7.14	
	Bottom sample	10		0.058				3.5		0.042	2.2		0.011
	Reservoir bottom	11						4.2			2.6		
8-Aug-01	2nd deepest FP meas.	8	5.46		4	7.61		2	6.89				
	Deepest FP meas.	9	5.45		5	7.23		3	3.91				
	Bottom sample	9		0.095	5		0.046	3		0.06			
	Reservoir bottom	10			6			3.4					
4-Jun-02	2nd deepest FP meas.	15	9.44		12	8.65		8	7.3		5	9.21	
	Deepest FP meas.	16	9.16		13	7.49		9	7.33		6	9.2	
	Bottom sample	16		0.014	13		0.03	9		0.038	6		0.013
	Reservoir bottom	17			14			10			6.9		
20-Jun-02	2nd deepest FP meas.	14	8.12					7	9.76		6	10.87	
	Deepest FP meas.	15	8.01					8	9.54		7	10.65	
	Bottom sample	15		0.039				8.5		0.029	7		0.016
	Reservoir bottom	16						9.5			7.5		
2-Jul-02	2nd deepest FP meas.	12	1.83		10	8.08		7	8.09		5	7.4	
	Deepest FP meas.	13	1.81		11	8.06		8	8.1		6	7.4	
	Bottom sample	13		0.153	11		0.04	8		0.034	6		0.02
	Reservoir bottom	14			12			8.5			6.5		
15-Jul-02	2nd deepest FP meas.	10	2		8	7.02		4	6.69		3	6.9	
	Deepest FP meas.	11	1.75		9	5.01		5	6.76		4	6.84	
	Bottom sample	11		0.107	9		0.05	5		0.086	none		
	Reservoir bottom	12			10			5.9			4.3		
31-Jul-02	2nd deepest FP meas.	8	6.02										
	Deepest FP meas.	9	5.98										
	Bottom sample	9		0.076									
	Reservoir bottom	10											
28-May-03	2nd deepest FP meas.	15	8.41					9	6.71		7	8.35	
	Deepest FP meas.	16	8.28					10	4.11		8	8.24	
	Bottom sample	16		0.009				9		0.038	8		0.043
	Reservoir bottom	17						10			8.5		
9-Jun-03[2]	2nd deepest FP meas.	14	7.74					7	6.53		6	7.96	
	Deepest FP meas.	15	7.73					8	6.43		7	7.89	
	Bottom sample	15		0.035				8.5		0.04	6.5		0.018
	Reservoir bottom	16						9			7.5		
26-Jun-03	2nd deepest FP meas.	12	6.68		9	6.62		6	6.31		4	9.85	
	Deepest FP meas.	13	6.66		10	6.61		7	4.26		5	9.58	
	Bottom sample	13		0.061	10		0.061	6		0.051	5		0.005
	Reservoir bottom	14			11			7.2			5.7		
23-Jul-03	2nd deepest FP meas.	8	3.37		6	6.66		2	7.37				
	Deepest FP meas.	9	2.67		7	5.27		3	7.29				
	Bottom sample	9		0.129	7		0.082	3		0.05			
	Reservoir bottom	10			7.5			3.6					
5-Aug-03	2nd deepest FP meas.	6	7.39		3	7.47		1	8.56				
	Deepest FP meas.	7	7.52		4	7.91		2	8.64				
	Bottom sample	7.5		0.097	5		0.049	none					
	Reservoir bottom	8			5.1			2.2					

[1]FP=field parameter, meas.=measurement

[2]recalibrated barometric pressure, difference was approximately 5 mm (sonde was reading about 5 mm high)

Nitrogen varied within the reservoir and within years based on the species (Table 2-3). Nitrate-nitrite was higher at the two up reservoir sites compared to the two down reservoir sites. Over three years of DEQ sampling, ammonia was highest at the dam. Except for Fenstermaker Point, total Kjeldahl nitrogen (TKN) was generally consistent at the other three sites. In 2001 and 2002, the lowest concentrations of TKN were observed at Fenstermaker Point while the highest concentrations were collected there in 2003. Differences between column and bottom samples did not exhibit any trend for nitrate+nitrite or TKN, but bottom samples showed consistently higher concentrations of ammonia than column samples. Over the three-year period, except for nitrate+nitrite in 2000, averages were relatively consistent.

Levels of chlorophyll *a* ranged from less than 0.001 mg/L to almost 0.070 mg/L (Table 2-3). Average chlorophyll by site by year ranged from 0.0085 to 0.0323 mg/L. There appeared to be no trend within years among sites or over time (Figures 2-2, 2-3, and 2-4).

Data (Appendix B) collected by DEQ in 2001 showed two general trends in the phytoplankton community. First, phytoplankton species richness (number of species present), diversity, and evenness (a measure of how evenly each species is represented) peaked in July with both June and August numbers less than those seen in July (Table 2-5). A slightly different trend was observed at the county boundary site where the phytoplankton community remained at similar levels at the end of July through the beginning of August. Secondly, overall richness and diversity, but not evenness, increased up-reservoir from the dam to the county boundary. The diatom community showed similar trends (Table 2-6).

Phosphorus was elevated over suggested thresholds for lakes and reservoirs. EPA (1986) recommended a total phosphorus concentration not exceed 0.025 mg/L in their 1986 Water Quality Criteria guidance. BOR and DEQ data show concentrations consistently up to double that level. In 2000, EPA published Ambient Water Quality Criteria Recommendations in Nutrient Ecoregion III (Xeric West) for rivers and streams (EPA 2000), and lakes and reservoirs (2001) both of which will be referred to as EPA Ambient Criteria for this report. They reported aggregate reference conditions for total phosphorus in lakes and reservoirs to be 0.017 mg/L.

Levels of total nitrogen in American Falls Reservoir fell within the range of concentrations reported for reference conditions in Xeric West lakes and reservoirs. EPA Ambient Criteria found total nitrogen ranging from 0.15 to 1.44 mg/L for lakes and reservoirs based on the 25th percentile of water bodies examined. Annual average total nitrogen concentrations in American Falls Reservoir were 0.6 mg/L in 2002 and 0.63 mg/L in 2001 and 2003 (Table 2-3).

Typically, phosphorus is the limiting nutrient in freshwater ecosystems (NRCS 1999). Rose and Minshall (1972) in their work on American Falls Reservoir indicated than phosphorus appeared to be the limiting nutrient in the reservoir. Nitrogen is usually considered to be limiting when the nitrogen to phosphorus ratio is less than 10:1 (UNEP Web site). When the ratio exceeds 20:1, phosphorus is considered limiting. The ratio of total nitrogen to phosphorus never exceeded 15:1 in the summers of 2001-2003 (Table 2-7). Except at the County Boundary site, the ratio of bioavailable nitrogen (total inorganic nitrogen) to phosphorus (orthophosphorus) commonly was below 10:1. Generally, high (greater than 0.020 mg/L) chlorophyll *a* levels corresponded to lower total inorganic nitrogen to orthophosphorus ratios. These average N:P ratios, compared to general "rules of thumb" about nutrient limitation, suggest that nitrogen could be limiting phytoplankton growth in American Falls Reservoir. However, Ben Cope and Peter Leinenbach of EPA (personal communication) concluded phosphorus is probably the limiting nutrient in the reservoir, based on several factors, including algal community structure, temporal nitrogen:phosphorus ratios, and nutrient saturation concentrations. DEQ agrees that site-specific information for this reservoir points to phosphorus as the most likely limiting nutrient.

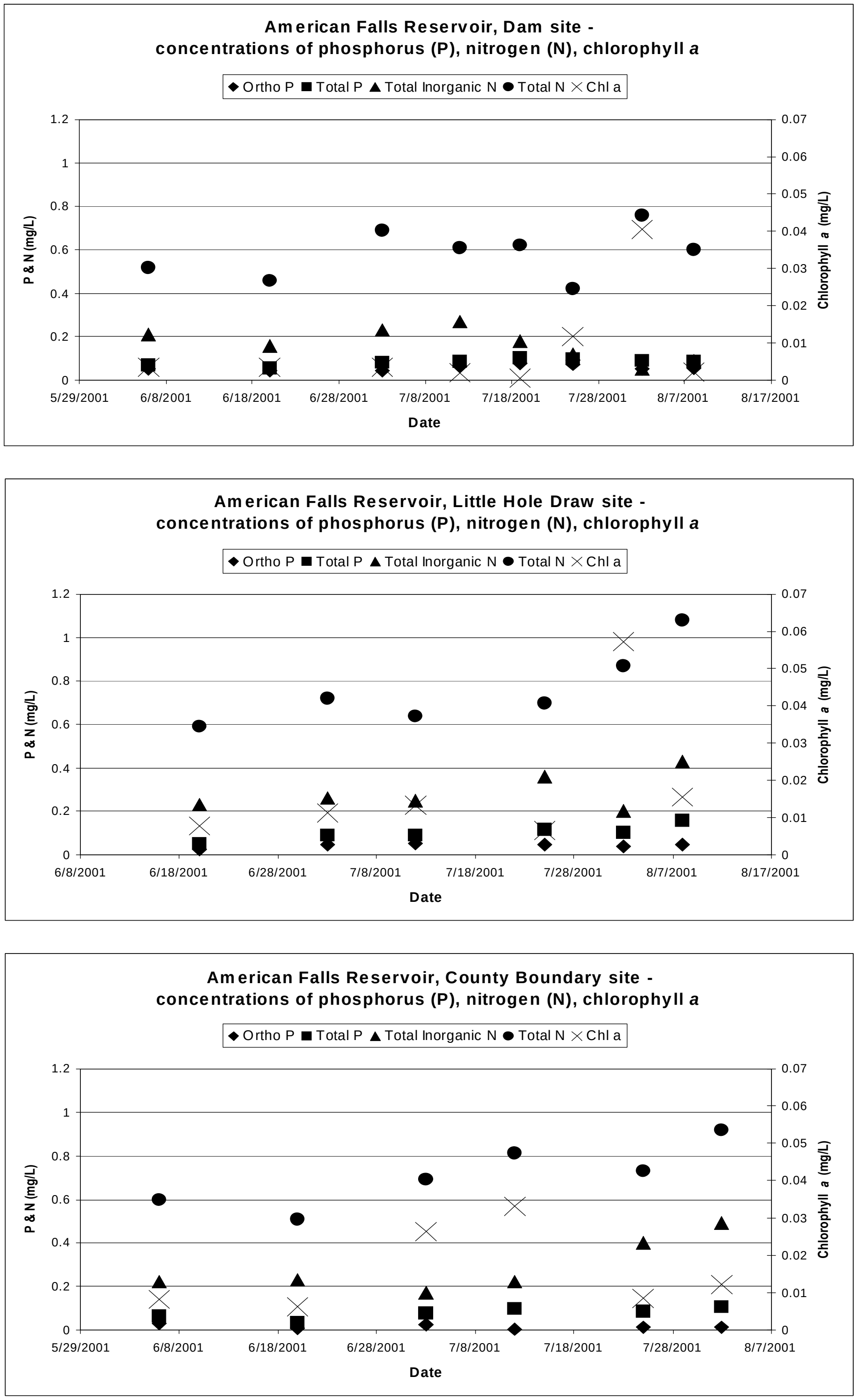
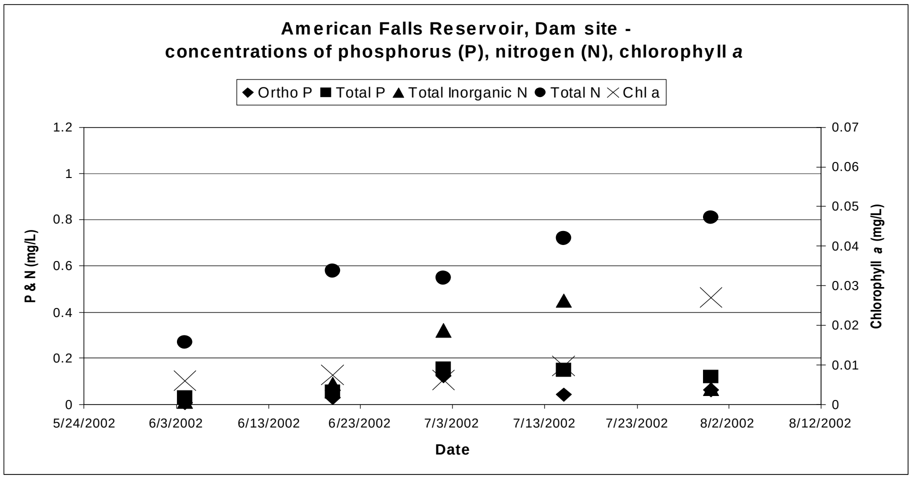
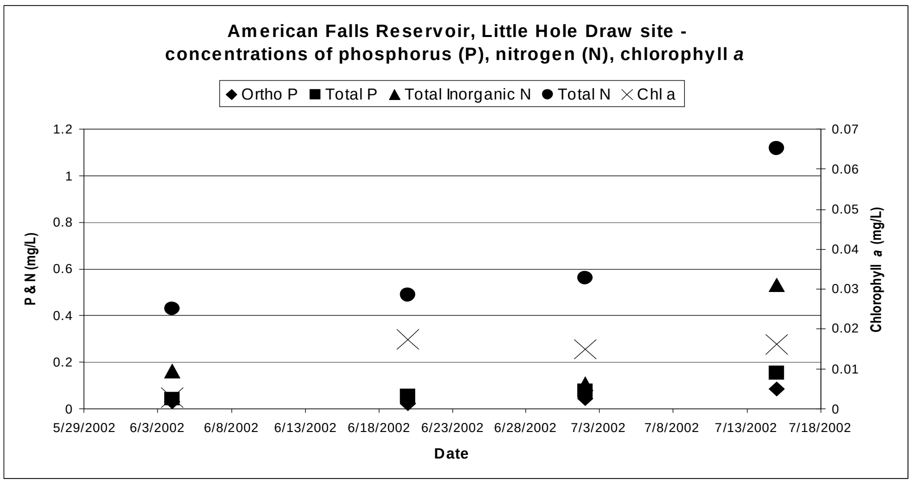


Figure 2-2. Phosphorus, nitrogen, and chlorophyll *a* levels at three sites in American Falls Reservoir, 2001.





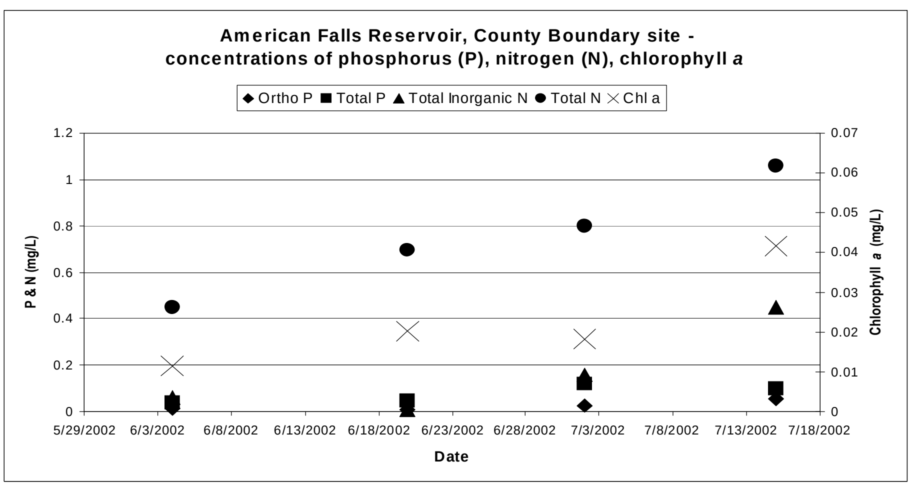


Figure 2-3. Phosphorus, nitrogen, and chlorophyll *a* levels at three sites in American Falls Reservoir, 2002.

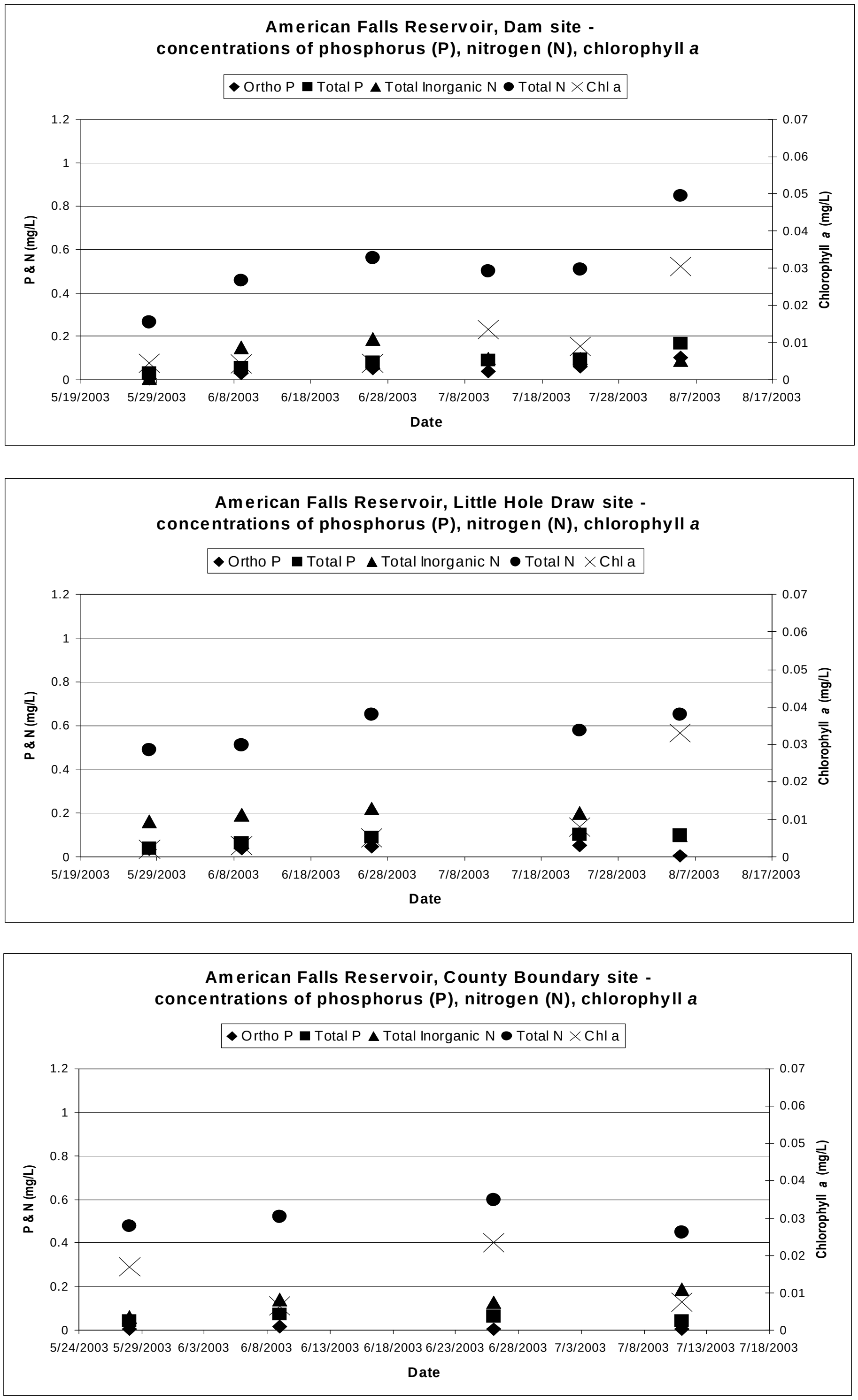


Figure 2-4. Phosphorus, nitrogen, and chlorophyll *a* levels at three sites in American Falls Reservoir, 2003.

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Table 2-5. Indices from phytoplankton sampling by DEQ in American Falls Reservoir in 2001.

Site	Date	Richness	Maximum diversity	Shannon Diversity - standard algal concentration	Shannon Diversity - standard algal cell concentration	Shannon Diversity - small sample algal concentration	Shannon Diversity - small sample algal cell concentration	McIntosh u - algal concentration	McIntosh u - algal cell concentration	Evenness (based Shannon standard algal concentration)	Evenness (based Shannon standard algal cell concentration)	Evenness (based Shannon small sample algal concentration)	Evenness (based Shannon small sample algal cell concentration)
Dam	6-Jun-01	14	2.6391	1.5047	1.5357	1.4325	1.4649	58891	58907	0.5702	0.5819	0.4299	0.4396
Dam	20-Jun-01	18	2.8904	1.1449	1.2539	1.1305	1.24	3111250	3112877	0.3961	0.4338	0.3155	0.346
Dam	3-Jul-01	21	3.0445	1.6314	1.874	1.5912	1.8467	292977	471763	0.5359	0.6155	0.4257	0.4941
Dam	12-Jul-01	31	3.434	1.9064	2.4672	1.8126	2.411	156800	202152	0.5552	0.7185	0.4392	0.5842
Dam	19-Jul-01	24	3.1781	1.9828	1.8631	1.8925	1.8314	60512	655097	0.6239	0.5863	0.4889	0.4731
Dam	25-Jul-01	18	2.8904	1.4872	0.2778	1.4558	0.2763	473829	543428981	0.5145	0.0961	0.4063	0.0771
Dam	2-Aug-01	15	2.7081	1.0857	0.127	1.0812	0.1269	21488207	26910743298	0.4009	0.0469	0.3179	0.0373
Dam	8-Aug-01	19	2.9444	1.7343	0.9247	1.6608	0.9112	83011	5572392	0.589	0.314	0.4566	0.2505
Fenstermaker	8-Aug-01	30	3.4012	1.9455	1.4749	1.9327	1.4706	5410016	78641212	0.572	0.4336	0.472	0.3592
Little Hole Draw	20-Jun-01	20	2.9957	1.2949	1.5887	1.2848	1.5811	6913658	8456516	0.4323	0.5303	0.3483	0.4286
Little Hole Draw	3-Jul-01	29	3.3673	1.7331	2.21	1.7009	2.1925	1095781	1794733	0.5147	0.6563	0.4189	0.54
Little Hole Draw	12-Jul-01	25	3.2189	1.7896	0.998	1.7376	0.9912	233554	33148034	0.556	0.3101	0.4442	0.2534
Little Hole Draw	25-Jul-01	45	3.8067	1.7537	2.2504	1.7379	2.2383	11753288	12350907	0.4607	0.5912	0.3862	0.4974
Little Hole Draw	2-Aug-01	10	2.3026	0.6817	0.1083	0.6661	0.1078	1064512	1385059860	0.296	0.047	0.2224	0.036
Little Hole Draw	8-Aug-01	8	2.0794	0.6171	0.0886	0.6123	0.0884	6623329	9452473495	0.2968	0.0426	0.2208	0.0319
County Boundary	6-Jun-01	17	2.8332	1.8791	0.7893	1.7284	0.7799	12376	8417688	0.6632	0.2786	0.4901	0.2212
County Boundary	20-Jun-01	29	3.3673	1.6128	1.7503	1.6097	1.7475	115861760	116847941	0.4789	0.5198	0.3964	0.4304
County Boundary	3-Jul-01	21	3.0445	1.7729	1.9416	1.7697	1.9392	37035703	55271802	0.5823	0.6377	0.4735	0.5188
County Boundary	12-Jul-01	39	3.6636	2.0059	2.3432	2.0011	2.3392	59673984	62982444	0.5475	0.6396	0.4593	0.5369
County Boundary	25-Jul-01	37	3.6109	1.9078	2.1875	1.8998	2.1803	20494377	20748075	0.5284	0.6058	0.4414	0.5066
County Boundary	2-Aug-01	37	3.6109	2.1191	2.442	2.0934	2.4271	1735036	3396277	0.5869	0.6763	0.4864	0.5639

Table 2-5. Continued.

Site	Date	Variation (based Shannon standard algal concentration)	Variation (based Shannon standard algal cell concentration)	Berger Parker - algal concentration	Berger Parker - algal cell concentration	Margalef diversity algal concentration	Margalef diversity algal cell concentration	Simpson diversity algal concentration	Simpson diversity algal cell concentration	Evenness (based Simpsons diversity algal concentration)	Evenness (based Simpsons diversity algal cell concentration)	Palmer Water Quality Index (based on algae)	Alpha algal concentration	Alpha algal cell concentration
Dam	6-Jun-01	3.8974	4.0334	1.6818	1.6958	2.1751	2.172	2.6386	2.6821	0.1885	0.1916	4	2.8323	2.8264
Dam	20-Jun-01	3.1062	3.5756	1.4406	1.478	2.1754	2.1683	1.9708	2.0734	0.1095	0.1152	4	2.628	2.6165
Dam	3-Jul-01	3.8669	4.56	2.8703	3.6465	2.8729	2.7267	3.8007	4.9807	0.181	0.2372	8	3.7151	3.442
Dam	12-Jul-01	5.1345	7.0054	2.4851	3.941	4.4696	4.1823	4.312	8.411	0.1391	0.2713	3	6.3673	5.702
Dam	19-Jul-01	4.9238	4.9739	3.0598	2.13	3.6234	3.1203	5.3899	3.8562	0.2246	0.1607	3	5.0709	4.0102
Dam	25-Jul-01	3.8581	1.2609	1.7261	1.0472	2.4183	1.6827	2.6942	1.0962	0.1497	0.0609	0	3.0402	1.9029
Dam	2-Aug-01	2.8114	0.675	1.4441	1.0184	1.5953	1.1641	1.9513	1.0371	0.1301	0.0691	9	1.8364	1.2728
Dam	8-Aug-01	4.1165	2.681	2.2311	1.2845	2.8383	2.2478	3.8845	1.6195	0.2044	0.0852	9	3.7872	2.7097
Fenstermaker	8-Aug-01	5.6562	4.562	2.2343	1.5977	3.4363	3.0454	3.9542	2.3738	0.1318	0.0791	15	4.2965	3.6456
Little Hole Draw	20-Jun-01	3.771	4.1471	1.5201	2.0433	2.3012	2.2216	2.1475	3.1724	0.1074	0.1586	0	2.7619	2.6374
Little Hole Draw	3-Jul-01	5.0097	6.173	1.8752	3.3794	3.7232	3.4528	3.1081	6.163	0.1072	0.2125	6	4.8846	4.3701
Little Hole Draw	12-Jul-01	4.3825	3.0078	2.4345	1.3053	3.4787	2.6919	4.2084	1.6732	0.1683	0.0669	6	4.66	3.2283
Little Hole Draw	25-Jul-01	5.2488	7.1124	1.957	2.4771	5.0441	4.9114	3.2107	4.8954	0.0713	0.1088	22	6.5787	6.3245
Little Hole Draw	2-Aug-01	1.8345	0.5415	1.1984	1.0164	1.2651	0.8538	1.4194	1.0329	0.1419	0.1033	0	1.4887	0.9435
Little Hole Draw	8-Aug-01	1.3009	0.4045	1.2398	1.0144	0.8698	0.6087	1.4764	1.0288	0.1846	0.1286	9	0.9932	0.6725
County Boundary	6-Jun-01	4.7251	2.0969	2.5373	1.2736	2.9339	1.9517	4.4088	1.5683	0.2593	0.0923	5	4.2156	2.3093
County Boundary	20-Jun-01	4.479	4.9684	1.9237	2.0341	2.8453	2.8292	3.0465	3.3775	0.1051	0.1165	12	3.3608	3.3364
County Boundary	3-Jul-01	4.1857	4.6774	3.1077	4.0829	2.1136	2.0483	4.4698	5.4791	0.2128	0.2609	10	2.4516	2.3578
County Boundary	12-Jul-01	5.9995	7.357	2.6144	3.1175	3.9219	3.8519	4.3666	5.8829	0.112	0.1508	16	4.8028	4.6871
County Boundary	25-Jul-01	5.3463	6.6287	2.4642	2.7315	3.9405	3.8966	4.2042	5.1024	0.1136	0.1379	21	4.9029	4.8271
County Boundary	2-Aug-01	6.25	7.3743	2.5019	4.042	4.5181	4.2324	4.8029	7.194	0.1298	0.1944	22	5.9866	5.4292

Table 2-6. Indices from phytoplankton (diatoms only) sampling by DEQ in American Falls Reservoir in 2001.

Site	Date	Diatom richness	Maximum diversity	Shannon Diversity - standard algal concentration	Shannon Diversity - standard algal cell concentration	Shannon Diversity - small sample algal concentration	Shannon Diversity - small sample algal cell concentration	McIntosh u - algal concentration	McIntosh u - algal cell concentration	Evenness (based Shannon standard algal concentration)	Evenness (based Shannon standard algal cell concentration)	Evenness (based Shannon small sample algal concentration)	Evenness (based Shannon small sample algal cell concentration)
Dam	6-Jun-01	3	1.0986	0.1054	0.1047	-61.4569	-62.4719	76	76	0.0959	0.0953	-34.2997	-34.8662
Dam	20-Jun-01	2	0.6931	0.1039	0.1019	0.0287	0.0254	2818	2818	0.1499	0.147	0.0207	0.0184
Dam	3-Jul-01	4	1.3863	0.0974	0.1071	-12.6795	-1.3739	136	429	0.0702	0.0772	-6.0975	-0.6607
Dam	12-Jul-01	10	2.3026	0.0967	0.3072	-1512.4542	-3.3045	116	18282	0.042	0.1334	-504.8696	-1.1031
Dam	19-Jul-01	6	1.7918	0.4034	0.2779	-0.0394	-0.6575	4899	5605	0.2252	0.1551	-0.0158	-0.2646
Dam	25-Jul-01	4	1.3863	0.2114	0.0312	-0.038	-2.2035	4631	6306	0.1525	0.0225	-0.0183	-1.0596
Dam	2-Aug-01	1	0	0.174	0.0147	0.1715	0.0118	165835	165835	0	0	0.2474	0.017
Dam	8-Aug-01	2	0.6931	0.3588	0.1149	0.3228	0.0724	4894	4894	0.5176	0.1657	0.2329	0.0523
Fenstermaker	8-Aug-01	8	2.0794	0.6453	0.4834	0.6389	0.4776	4334109	4462486	0.3103	0.2325	0.2304	0.1722
Little Hole Draw	20-Jun-01	7	1.9459	0.2585	0.2508	0.1835	0.1906	17315	21048	0.1329	0.1289	0.0695	0.0722
Little Hole Draw	3-Jul-01	9	2.1972	0.4547	0.741	0.2356	0.7211	15333	543418	0.207	0.3373	0.0815	0.2495
Little Hole Draw	12-Jul-01	5	1.6094	0.1582	0.0367	-5.7856	-211.8131	1172	1251	0.0983	0.0228	-2.5126	-91.9893
Little Hole Draw	25-Jul-01	13	2.5649	0.8343	0.9058	0.8272	0.899	10071244	10115447	0.3253	0.3531	0.2539	0.2759
Little Hole Draw	2-Aug-01	0	0	0	0	0	0	0	0	0	0	0	0
Little Hole Draw	8-Aug-01	2	0.6931	0.0982	0.0055	0.0462	-4.6439	2303	2303	0.1416	0.0079	0.0333	-3.3499
County Boundary	6-Jun-01	7	1.9459	0.5293	0.0731	-0.3252	-44.444	456	499	0.272	0.0376	-0.1232	-16.8409
County Boundary	20-Jun-01	14	2.6391	0.6307	0.7611	0.6255	0.7568	16257837	17234495	0.239	0.2884	0.1877	0.2271
County Boundary	3-Jul-01	11	2.3979	0.6206	0.6008	0.6157	0.5961	13185170	13256190	0.2588	0.2505	0.1992	0.1929
County Boundary	12-Jul-01	14	2.6391	0.8939	0.9158	0.8906	0.9127	38838924	39043054	0.3387	0.347	0.2673	0.2739
County Boundary	25-Jul-01	13	2.5649	0.7619	0.8006	0.7562	0.7952	14730959	14750215	0.297	0.3121	0.2321	0.2441
County Boundary	2-Aug-01	25	3.2189	1.5758	1.3063	1.5539	1.2859	1549197	1575384	0.4896	0.4058	0.3972	0.3287

Table 2-6. Continued.

Site	Date	Variation (based Shannon standard algal cell concentration)	Berger Parker - algal concentration	Berger Parker - algal cell concentration	Margalef Diversity algal concentration	Margalef Diversity algal cell concentration	Simpson Diversity algal concentration	Simpson Diversity algal cell concentration	Evenness (based Simpsons Diversity algal concentration)	Evenness (based Simpsons Diversity algal cell concentration)	Palmer Water Quality Index (based on algae)	Pollution tolerance algal concentration	Pollution tolerance algal cell concentration	Relative abundance achnanthes minutissima algal concentration
Dam	6-Jun-01	0.4444	1.1515	1.1515	0.8687	0.8687	2038.5682	2072.7158	679.5227	690.9053	4	0.3289	0.3289	0
Dam	20-Jun-01	0.432	1.1964	1.1964	0.242	0.242	2176.1703	2290.6475	1088.0851	1145.3238	0	3	3	0
Dam	3-Jul-01	0.5393	2.375	1.8	1.002	0.8572	8197.0398	5479.7826	2049.2599	1369.9457	3	2.8421	2.9048	0
Dam	12-Jul-01	0.9565	1.46	1.125	3.2959	1.7923	5834.8508	93.0023	583.4851	9.3002	3	2.7671	2.8988	0
Dam	19-Jul-01	1.0904	1.3119	1.7393	1.1138	1.048	66.5699	450.679	11.095	75.1132	3	2.233	2.4215	0
Dam	25-Jul-01	0.1992	1.118	1.7816	0.693	0.6256	275.686	94461.6083	68.9215	23615.4021	0	2.0528	2.4056	0
Dam	2-Aug-01	0.0882	1	1	0	0	252.8349	168296.5129	252.8349	168296.5129	0	2	2	0
Dam	8-Aug-01	0.4757	1.25	1.25	0.2252	0.2252	65.8812	1843.8167	32.9406	921.9083	0	2.2	2.2	0
Fenstermaker	8-Aug-01	1.3968	1.1691	1.3145	0.8984	0.8851	4.9357	41.8321	0.617	5.229	6	2.0161	2.125	0
Little Hole Draw	20-Jun-01	1.1359	2.2839	2.8169	1.0965	1.056	857.4751	1274.6059	122.4964	182.0866	0	2.7912	2.8307	0
Little Hole Draw	3-Jul-01	1.9217	2.5002	1.7367	1.4636	1.1381	222.1231	20.3544	24.6803	2.2616	3	2.7071	2.9387	0
Little Hole Draw	12-Jul-01	0.2195	1.2065	1.3716	1.0775	1.0415	838.4611	44342.2681	167.6922	8868.4536	3	2.0856	2.1957	0
Little Hole Draw	25-Jul-01	2.4193	1.2765	1.3606	1.4465	1.4355	3.7469	5.9773	0.2882	0.4598	7	2.0687	2.1263	0
Little Hole Draw	2-Aug-01	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Hole Draw	8-Aug-01	0.0437	2	2	0.2371	0.2371	4245.7032	4222310.584	2122.8516	2111155.292	0	2.5	2.5	0
County Boundary	6-Jun-01	0.4401	2.2272	2.5681	1.6416	1.58	119.5214	26439.0231	17.0745	3777.0033	4	1.602	1.7876	0
County Boundary	20-Jun-01	2.3238	1.3357	1.5861	1.5164	1.4866	21.7111	22.8993	1.5508	1.6357	8	2.1445	2.2796	0
County Boundary	3-Jul-01	1.772	1.2249	1.3033	1.1918	1.183	12.5552	22.8453	1.1414	2.0768	7	1.9358	1.913	0
County Boundary	12-Jul-01	2.7388	1.339	1.4173	1.4412	1.4322	6.709	9.49	0.4792	0.6779	8	2.0391	2.0761	0
County Boundary	25-Jul-01	2.0312	1.297	1.3368	1.4128	1.4077	5.849	7.1772	0.4499	0.5521	9	2.096	2.1167	0.00365595
County Boundary	2-Aug-01	4.293	1.973	2.1376	3.1046	3.0728	5.3791	15.5091	0.2152	0.6204	8	2.0479	1.8987	0.09404574

Table 2-6. Continued.

Site	Date	Relative abundance achnanthes minutissima algal cell concentration	Siltation standard algal concentration	Siltation standard algal cell concentration	Siltation inclusive algal concentration	Siltation inclusive algal cell concentration	RA sensitive algal concentration	RA sensitive algal cell concentration	Generic acc cmn algal concentration	Generic acc cmn algal cell concentration	Centrales Pennales algal concentration	Centrales Pennales algal cell concentration	Alpha algal concentration	Alpha algal cell concentration
Dam	6-Jun-01	0	0.02369033	0.02349438	0.02369033	0.02349438	0.00166819	0.0016544	0.0758	0.0758	0	0	1.4535	1.4535
Dam	20-Jun-01	0	0	0	0	0	0.02516555	0.02452865	0	0	0.8359	0.8359	0.3946	0.3946
Dam	3-Jul-01	0	0	0	0	0	0.01593448	0.01953923	0	0	0	0	1.5049	1.1902
Dam	12-Jul-01	0	0.00051126	0.0003224	0.00051126	0.0003224	0.01687064	0.1121474	0	0	0.0274	0.0028	12.4563	2.4038
Dam	19-Jul-01	0	0	0	0	0	0.0363357	0.03130512	0	0	0.967	0.7294	1.4519	1.3354
Dam	25-Jul-01	0	0	0	0	0	0.00354328	0.00200934	0	0	0.9472	0.5944	0.8995	0.7951
Dam	2-Aug-01	0	0	0	0	0	0	0	0	0	1	1	0.1234	0.1234
Dam	8-Aug-01	0	0	0	0	0	0.02988105	0.0056483	0	0	1	1	0.3672	0.3672
Fenstermaker	8-Aug-01	0	0.0146744	0.00496756	0.0146744	0.00496756	0.01575378	0.02737408	0	0	0.9395	0.8356	1.0307	1.0132
Little Hole Draw	20-Jun-01	0	0	0	0	0	0.04885132	0.04706284	0	0	0.4884	0.396	1.3525	1.2885
Little Hole Draw	3-Jul-01	0	0.00919425	0.00510189	0.00919425	0.00510189	0.09979623	0.32382224	0	0	0.4335	0.0908	1.8531	1.335
Little Hole Draw	12-Jul-01	0	0.00141335	0.00018815	0.00141335	0.00018815	0.00494681	0.00141111	0	0	0.846	0.7441	1.4941	1.4207
Little Hole Draw	25-Jul-01	0	0.0221657	0.01751124	0.0221657	0.01751124	0.0614019	0.08245537	0	0	0.9438	0.8854	1.6703	1.6547
Little Hole Draw	2-Aug-01	0	0	0	0	0	0	0	0	0	0	0	0	0
Little Hole Draw	8-Aug-01	0	0	0	0	0	0.01085201	0.00034412	0	0	1	1	0.3866	0.3866
County Boundary	6-Jun-01	0	0.14866015	0.0095572	0.14866015	0.0095572	0.01407551	0.00253373	0.0757	0.0757	0	0	2.4981	2.332
County Boundary	20-Jun-01	0	0.0083172	0.00786573	0.0083172	0.00786573	0.0489975	0.09623225	0	0	0.9079	0.7646	1.7465	1.7049
County Boundary	3-Jul-01	0	0.00842208	0.00622684	0.00842208	0.00622684	0.00493708	0.0120599	0.6263	0.6263	0.9242	0.8686	1.3609	1.3491
County Boundary	12-Jul-01	0	0.04787521	0.04014837	0.04787521	0.04014837	0.04965728	0.06433544	0.0711	0.0711	0.8609	0.8133	1.6424	1.6301
County Boundary	25-Jul-01	0.00329822	0.04021541	0.03628045	0.04021541	0.03628045	0.07994495	0.08567759	0.0907	0.0907	0.9103	0.8832	1.6229	1.616
County Boundary	2-Aug-01	0.05492377	0.23835041	0.1391993	0.23835041	0.1391993	0.18464327	0.10783373	0.6921	0.6921	0.5077	0.4686	3.9284	3.8708

Table 2-7. Nitrogen phosphorus ratios from DEQ water column sampling of American Falls Reservoir, May 2001 to August 2003.

Site	Statistic	Date sampled	TIN:OP ratio	TN:TP ratio	Chl *a* (mg/m^3)
Dam		6/6/2001	4.0	7.8	3.6
		6/20/2001	3.9	8.2	3.4
		7/3/2001	5.5	8.3	3.5
		7/12/2001	4.2	7.0	2.0
		7/19/2001	2.3	6.1	0.6
		7/25/2001	1.6	4.2	11.7
		8/2/2001	1.0	8.5	40.6
		8/8/2001	1.6	7.1	2.2
	Site average		3.0	7.2	
Fenstermaker		8/8/2001	5.6	9.7	14.0
Little Hole Draw		6/20/2001	9.2	11.8	7.8
		7/3/2001	5.4	8.2	11.2
		7/12/2001	4.9	7.0	13.2
		7/25/2001	7.3	6.1	6.4
		8/2/2001	5.0	8.3	57.2
		8/8/2001	9.3	6.8	15.6
	Site average		6.9	8.0	
County boundary		6/6/2001	7.1	9.5	8.3
		6/20/2001	23.0	15.0	6.2
		7/3/2001	6.8	8.8	26.4
		7/12/2001	36.7	8.1	33.1
		7/25/2001	28.6	8.7	8.4
		8/2/2001	40.8	8.7	12.1
	Site average		23.8	9.8	
All	Annual average		10.2	8.3	
Dam		6/4/2002		8.7	6.0
		6/20/2002	2.8	10.7	7.5
		7/2/2002	2.6	3.5	6.3
		7/15/2002	10.0	4.8	9.7
		7/31/2002	1.1	6.8	26.9
	Site average		4.1	6.9	
Fenstermaker		6/4/2002		9.1	6.0
		7/15/2002	4.3	6.8	17.6
	Site average			8.0	
Little Hole Draw		6/4/2002	5.2	9.8	2.7
		6/20/2002	2.3	8.9	17.5
		7/2/2002		7.2	14.9
		7/15/2002	6.2	7.3	16.2
	Site average		4.5	8.3	
County boundary		6/4/2002	5.5	11.3	11.4
		7/2/2002	6.7	6.8	18.3
		7/15/2002	8.3	10.7	41.6
	Site average		6.8	9.6	
All	Annual average		5.0	8.0	
Dam		6/9/2003	4.8	8.4	4.3
		6/26/2003	3.8	6.8	4.6
		7/11/2003	2.6	5.6	13.4
		7/23/2003	1.7	5.4	9.0
		8/5/2003	0.9	5.1	30.5
	Site average		2.8	6.3	
Fenstermaker		6/26/2003	4.0	7.5	4.1
		7/23/2003	0.6	6.9	24.2
		8/5/2003	0.8	8.5	68.6
	Site average		1.8	7.6	
Little Hole Draw		5/28/2003	5.0	12.3	2.1
		6/9/2003	5.0	8.0	3.0
		6/26/2003	4.6	7.3	5.0
		7/23/2003	3.9	5.6	7.9
		8/5/2003	33.3	6.6	33.0
	Site average		10.4	8.0	
County boundary		5/28/2003	12.0	11.4	17.0
		6/9/2003	7.8	7.1	6.4
		6/26/2003	43.3	9.2	23.4
		7/11/2003	63.3	10.7	7.5
	Site average		31.6	9.6	
All	Annual average		11.6	7.8	

From chlorophyll *a* data, American Falls Reservoir falls in the range (0.009-0.025 mg/L) of eutrophic water bodies (NRCS 1999). EPA Ambient Criteria found an aggregate value of 0.0034 mg/L of chlorophyll *a* for reference conditions in Xeric West ecoregion, which would include American Falls Subbasin. It should be noted that the EPA criterion was based on a fluorometric analysis of chlorophyll values whereas American Falls Reservoir chlorophyll samples were analyzed spectrophotometrically. The State of Oregon uses 0.015 mg/L (based on an average of a minimum three samples collected over any three consecutive months at a minimum of one representative location) to identify water bodies where phytoplankton may impair the recognized beneficial uses (IDEQ and ODEQ 2001). Annual mean densities at all sites show American Falls Reservoir consistently above this criterion (Table 2-3).

It is difficult to make a conclusion on status of American Falls Reservoir when Secchi depth readings (a measure of water clarity) data (Appendix B) are compared to EPA Ambient Criteria. Most (13) Secchi readings recorded at the dam exceeded the aggregate reference condition of 2.7 meters, and 20 of 21 measurements were within or greater than the range of reference conditions (1.4-3.1 meters). Only 1 of 7 readings at Fenstermaker Point was less than the reference condition range, but only 2 were greater than the aggregate reference condition. Slightly over half of the 17 measurements at Little Hole Draw point were higher than the aggregate reference condition, or fell within or exceeded the range of reference conditions. At the County Boundary site, Secchi readings were greater than the aggregate reference condition on only three dates, with slightly less than half of the 16 events within or exceeding the reference conditions range.

Composition of the phytoplankton community is associated with higher levels of organic pollution. Values greater than 20 in the Palmer Water Quality Index (Person 1989) indicate high organic pollution. Scores greater than 20 were observed at Little Hole Draw and county boundary sites in both July and August 2001 (Table 2-5). Phytoplankton at Fenstermaker Point collected during the one sampling event in August scored 15 on the Palmer index indicating probable organic pollution. All scores at the dam site were below 10, signifying less organic pollution.

Excessive nutrients and concomitant vegetative growth often result in increases in pH and decreases in dissolved oxygen. Field parameters were measured every meter in the water column as part of the DEQ reservoir sampling protocol (Appendix B). To check for diurnal trends, DEQ sampled the water column every hour for 24 hours in July 2002 at a site close to American Falls Dam (Appendix B). No pH problems (less than pH 6.5 or greater than pH 9.0) were observed.

Concluding violations of water quality standards for dissolved oxygen are less straightforward. First, the reservoir does not need to meet state water quality standards for DO in the hypolimnion (bottom layer) when the reservoir is stratified or in the bottom 20% at all other times (IDAPA 58.01.02.250.02.a). Second, exceedances of DO standards are not considered a violation if the frequency of those exceedances is less than 10% (Grafe et al. 2002).

From data collected by DEQ in 2001 to 2003 (Appendix B), a comparison of DO concentration at individual sites over a single season indicates violations of water quality standards. On three occasions (12 July 01 at Little Hole Draw Point and 2 July and 15 July 02 at the dam), dissolved oxygen levels either fell below or equaled the 6.0 mg/L water quality standard throughout the water column, or average water column concentration was less than 6 mg/L

(Table 2-8). The low dissolved oxygen levels on 12 July 01 represented 12.5% of the eight sampling events in 2001 at Little Hole Draw Point. At the dam, the 2 July 02 event, where DO concentration at all depths was less than or equal to 6 mg/L, was 20% of the five days sampled in 2002. Considering average water column DO concentration at the dam in 2002, 40% of the sampling events (both 2 July and 15 July) violated water quality standards.

From a different perspective, except for 12 July 01 at Little Hole Draw Point and 2 July 02 at the dam, all other sampling events and sites recorded at least one DO concentration greater than 6 mg/L. Even on 12 July 01 and 2 July 02, sufficient oxygen levels were recorded at two and three other sites, respectively (Table 2-8). Thus, at any time during the three-year period DEQ sampled, at least one site, or 67% of all sites, had DO levels of greater than 6 mg/L at one or more depths (Table 2-9). Assuming that at least fish have the ability to seek refugia (areas of more optimal conditions), then one could deduce that dissolved oxygen standards were not violated. This may well have been the case as no fish kills were reported during this time period (Dr. Richard Scully, Idaho Department of Fish and Game/Pocatello, personal communication).

Like dissolved oxygen, potential problems might also exist for water temperature in American Falls Reservoir. Idaho water quality standards treat temperature criteria in lakes differently from those in streams. The standard states that temperature in lakes shall have no measurable change from natural background conditions (IDAPA 58.01.02.250.02.c). Reservoirs with mean detention times of greater than fifteen days are considered lakes for this purpose. Mean detention time as of 1 October (typically the time of minimum storage) from 1925 to 2004 in American Falls Reservoir was fifteen days or less 23% of the time (Alicia Lane Boyd, Bureau of Reclamation/Burley, personal communication). Therefore, the reservoir was considered a lake for purposes of determining temperature violations of water quality standards.

The question then becomes what are natural background conditions for American Falls Reservoir. Several factors affect temperature in a reservoir (e.g., solar radiation, wind, inflow). Setting aside possible effects of climate change, human influence on natural background conditions in American Falls Reservoir is primarily manifested through temperature changes in the tributaries. In other words, major deviation from natural background in the reservoir primarily results from changes in the tributaries, and changes leading to temperature problems in a tributary may well lead to temperature problems in the reservoir. Conversely, improvement of temperatures in a tributary should lead to improved temperatures in the reservoir. It is assumed, therefore, that as long as tributaries are meeting water quality standards for temperature, American Falls Reservoir is experiencing natural background conditions.

Table 2-8. American Falls Reservoir temperature and dissolved oxygen data by site in relation to water quality standards criteria (from DEQ data). Avg=average, temp=temperature, DO=dissolved oxygen, #=number.

	Dam					Fenstermaker Point					Little Hole Draw Point					County Boundary Point				
Date	Avg temp (°C)	Avg DO (mg/L)	One or more depths with temp ≤22°C	One or more depths with DO>6 mg/L	# of depths where temp ≤22°C & DO>6 mg/L	Avg temp (°C)	Avg DO (mg/L)	One or more depths with temp ≤22°C	One or more depths with DO>6 mg/L	# of depths where temp ≤22°C & DO>6 mg/L	Avg temp (°C)	Avg DO (mg/L)	One or more depths with temp ≤22°C	One or more depths with DO>6 mg/L	# of depths where temp ≤22°C & DO>6 mg/L	Avg temp (°C)	Avg DO (mg/L)	One or more depths with temp ≤22°C	One or more depths with DO>6 mg/L	# of depths where temp ≤22°C & DO>6 mg/L
11-May-01	8.8	10.1	YES	YES	16	NM[1]	NM	NM	NM	NM	10.6	10.3	YES	YES	10	10.8	11.0	YES	YES	8
23-May-01	12.1	8.4	YES	YES	16	NM	NM	NM	NM	NM	13.7	6.1	YES	YES	7	14.4	6.8	YES	YES	7
6-Jun-01	14.0	6.9	YES	YES	14	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	14.3	7.2	YES	YES	6
20-Jun-01	15.4	5.7	YES	YES	1	NM	NM	NM	NM	NM	16.0	6.1	YES	YES	8	16.6	6.0	YES	YES	3
3-Jul-01	ATE[2]	7.7	ATE	YES	ATE	NM	NM	NM	NM	NM	ATE	8.2	ATE	YES	ATE	ATE	8.8	ATE	YES	ATE
12-Jul-01	21.9	7.4	YES	YES	0	NM	NM	NM	NM	NM	22.6	5.5	NO	NO	0	22.1	7.0	NO	YES	0
19-Jul-01	21.1	6.6	YES	YES	9	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
25-Jul-01	20.9	7.2	YES	YES	7	NM	NM	NM	NM	NM	20.0	6.1	YES	YES	4	20.0	7.5	YES	YES	4
2-Aug-01	21.3	9.3	YES	YES	9	NM	NM	NM	NM	NM	20.5	7.5	YES	YES	4	18.1	7.1	YES	YES	3
8-Aug-01	ATE	9.0	ATE	YES	ATE	ATE	8.0	ATE	YES	ATE	ATE	7.3	ATE	YES	ATE	NM	NM	NM	NM	NM
4-Jun-02	15.2	9.9	YES	YES	14	15.2	9.9	YES	YES	12	17.4	7.3	YES	YES	8	18.3	9.4	YES	YES	6
20-Jun-02	17.1	9.1	YES	YES	13	NM	NM	NM	NM	NM	17.6	10.9	YES	YES	8	18.2	11.3	YES	YES	6
2-Jul-02	17.6	3.7	YES	NO	0	20.4	8.5	YES	YES	9	20.5	8.2	YES	YES	7	21.1	7.3	YES	YES	6
15-Jul-02	ATE	5.3	ATE	YES	ATE	ATE	7.9	ATE	YES	ATE	ATE	6.6	ATE	YES	ATE	ATE	6.9	ATE	YES	ATE
31-Jul-02	21.8	8.7	YES	YES	4	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
28-May-03	14.4	9.7	YES	YES	14	NM	NM	NM	NM	NM	15.8	7.9	YES	YES	8	18.0	10.5	YES	YES	7
9-Jun-03	17.1	8.1	YES	YES	13	NM	NM	NM	NM	NM	17.5	7.0	YES	YES	8	18.3	8.0	YES	YES	6
26-Jun-03	18.1	7.4	YES	YES	12	18.1	7.0	YES	YES	9	17.8	7.1	YES	YES	6	15.5	9.7	YES	YES	5
11-Jul-03	ATE	NM	ATE	NM	ATE	ATE	NM	ATE	NM	ATE	ATE	NM	ATE	NM	ATE	ATE	NM	ATE	NM	ATE
23-Jul-03	ATE	7.3	ATE	YES	ATE	ATE	9.4	ATE	YES	ATE	ATE	7.4	ATE	YES	ATE	NM	NM	NM	NM	NM
5-Aug-03	23.2	7.4	NO	YES	0	23.0	7.5	NO	YES	0	21.2	8.6	YES	YES	2	NM	NM	NM	NM	NM

[1]NM=not measured

[2]ATE=air temperature exceeded 90th percentile of the 7-day average daily maximum air temperature.

Table 2-9. American Falls Reservoir temperature and dissolved oxygen data in relation to water quality standards criteria, summary of all sites (from DEQ data). Avg=average, temp=temperature, DO=dissolved oxygen, #=number, %=percentage.

Date	Avg temp[1] (°C)	Avg DO[1] (mg/L)	# of sites with temp ≤ 22°C	% of sites with temp ≤ 22°C	# of sites with DO > 6 mg/L	% of sites with DO > 6 mg/L	# of sites with temp ≤ 22°C & DO > 6 mg/L	% of sites with temp ≤ 22°C & DO > 6 mg/L
11-May-01	10.1	10.5	3	100%	3	100%	3	100%
23-May-01	13.4	7.1	3	100%	3	100%	3	100%
6-Jun-01	14.1	7.1	2	100%	2	100%	2	100%
20-Jun-01	16.0	5.9	3	100%	3	100%	3	100%
3-Jul-01	ATE[2]	8.2	ATE	ATE	3	100%	ATE	ATE
12-Jul-01	22.2	6.6	1	33%	2	67%	0	0%
19-Jul-01	21.1	6.6	1	100%	1	100%	1	100%
25-Jul-01	20.3	6.9	3	100%	3	100%	3	100%
2-Aug-01	20.0	8.0	3	100%	3	100%	3	100%
8-Aug-01	ATE	8.1	ATE	ATE	3	100%	ATE	ATE
4-Jun-02	16.5	9.2	4	100%	4	100%	4	100%
20-Jun-02	17.6	10.4	3	100%	3	100%	3	100%
2-Jul-02	19.9	6.9	4	100%	3	75%	3	75%
15-Jul-02	ATE	6.7	ATE	ATE	4	100%	ATE	ATE
31-Jul-02	21.8	8.7	1	100%	1	100%	1	100%
28-May-03	16.1	9.3	3	100%	3	100%	3	100%
9-Jun-03	17.6	7.7	3	100%	3	100%	3	100%
26-Jun-03	17.4	7.8	4	100%	4	100%	4	100%
11-Jul-03	ATE	NM[3]	ATE	ATE	NM	NM	ATE	ATE
23-Jul-03	ATE	8.0	ATE	ATE	3	100%	ATE	ATE
5-Aug-03	22.4	7.8	1	33%	3	100%	1	33%

[1]average of sites

[2]ATE=air temperature exceeded 90th percentile of the 7-day average daily maximum air temperature

[3]NM=not measured

As natural background conditions in American Falls Reservoir are unknown, a temperature of 22°C (similar to the instantaneous water quality standard for temperature [IDAPA 58.01.02.250.02.b]) was arbitrarily chosen to facilitate evaluation of temperature conditions in the reservoir. High temperatures were noted at Little Hole Draw and County Boundary points on 12 July 01 and the dam and Fenstermaker Point on 5 August 03 (Table 2-8). All temperatures at all depths at the two sites on each day were greater than 22°C. Average water column temperatures at the two sites on 12 July 01 were about a half degree or less above the 22°C criteria. Both sites on 5 August 03 averaged about 23°C. All other sites on all other sampling dates had an average temperature cooler than 22°C, including one other site on 12 July 01 and two other sites on 5 August 03. Thus, on any sampling date there was at least one area of the reservoir that could be used for temperature refugia for fish (Table 2-9). The 24-

hour sampling effort by DEQ showed temperatures consistently above the 22^{o}C threshold (Appendix B). Again, no fish kills were reported during this time period (Dr. Richard Scully, Idaho Department of Fish and Game/Pocatello, personal communication).

Although higher levels of nutrients and algae may be affecting water quality, forage conditions for trout in American Falls Reservoir have been rated excellent. Idaho Department of Fish and Game compared reservoirs throughout Idaho as to zooplankton populations and their potential as trout forage resources (Teuscher 1999). American Falls Reservoir was rated second highest in the state.

These data justify listing of American Falls Reservoir for nutrients, and possibly dissolved oxygen, but not sediment (Table 2-1). It appears that phosphorus levels in the reservoir are high compared to EPA criteria, and phosphorus is most likely the limiting nutrient to vegetative growth in the reservoir. However, some uncertainty exists as to whether nitrogen is at times the limiting nutrient in the reservoir, and it may be that increased levels of either phosphorus or nitrogen will lead to excessive chlorophyll *a* levels. High algal densities contribute to low dissolved oxygen levels observed in the reservoir. Reservoir data are somewhat ambiguous in relation to violations of water quality standards for dissolved oxygen, but regardless, dissolved oxygen will be addressed in this document. Although reports point out that sloughing of shoreline has added to sediment loading in the reservoir, no data were discovered indicating impairment of beneficial uses. The overall estimated reduction in storage is low at least compared to thresholds used in Nebraska to identify reservoirs with concerns about volume loss due to sedimentation. Despite temperature exceedances of water quality standards for cold water aquatic life, cooler water refugia were documented at other sites in the reservoir; these exceedances have not led to any fish kill. Thus, the reservoir will not be considered for listing of temperature on 303(d) list at this time.

2.3.1.2. Snake River

Flow in the section of the Snake River above the reservoir has been greatly modified by the Minidoka Project. Annual flow averages about 4,800 cfs (Table 1-3), ranging from about 1,000 cfs to over 12,000 cfs (Figure 2-5). Highest flows occur in April to June followed by the lowest flows in August and September (Figure 1-5).

The Snake River water quality limited assessment unit is listed as having dissolved oxygen, flow alteration, nutrient, and sediment problems (Table 2-1). DEQ and USGS, working under DEQ contract, began sampling the Snake River in 2000. Sites include bridges at Shelley, Firth, Blackfoot, and Ferry Butte (Tilden Bridge). In November of 2002, sampling at Shelley and Firth wastewater treatment plants was implemented.

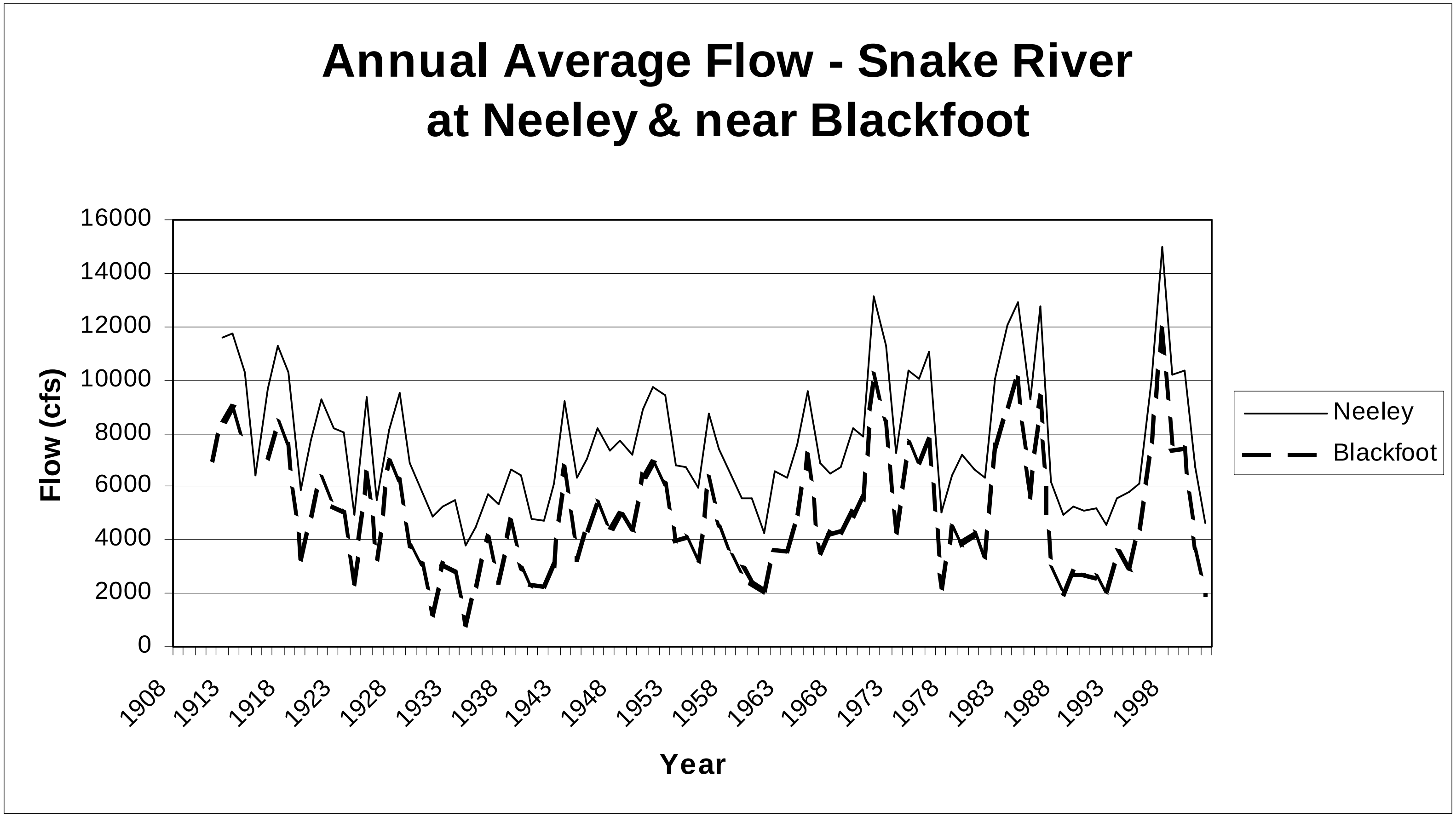

Figure 2-5. Annual (calendar year) average flow in the Snake River at Neeley (13077000) and near Blackfoot (13069500) USGS surface-water stations.

Overall averages from Snake River sampling do not indicate that levels of nutrients or sediment are impairing beneficial uses (Table 2-10, Appendix C). Average total phosphorus did not exceed 0.035 mg/L, which was less than the EPA water quality criteria guidance recommendation of 0.1 mg/L (EPA 1986). Based on EPA Ambient Criteria, total phosphorus is higher than the 25th percentile aggregate value of 0.022 mg/L for reference sites but well within the range (0.010-0.055 mg/L) of those sites. Using similar criteria, total nitrogen (nitrate+nitrite plus total Kjeldahl nitrogen) is close to the aggregate value for reference conditions of 0.38 mg/L, ranging from 0.330 mg/L at Blackfoot to 0.402 mg/L at Ferry Butte (Tilden Bridge).

Total suspended solids/suspended sediment concentration (TSS/SSC) was also low. The highest average TSS/SSC was 15 mg/L at Ferry Butte (Tilden Bridge). A maximum value of 79 mg/L also was observed Ferry Butte. USGS bedload sampling showed most of the sediment load in the Snake River is passing in the suspended state (Table 2-11, Appendix C). Generally, bedload on the sampling dates in 2000 to 2002 was less than 4 mm (< 0.16 in) and greater than 0.25 mm (> 0.01 in); however, higher water years may show a different pattern. For example, flows in 1997 moved tremendous amounts of cobble-sized sediment in the Blackfoot area of the Snake River (Lynn Van Every, Idaho Department of Environmental Quality, personal communication).

Three wastewater treatment plants discharge directly into the Snake River. Although wastewater treatment plants at Blackfoot, Firth, and Shelley are contributing nutrients and sediment to the Snake River (Appendix D), it appears they are having minimal effect on water quality or beneficial uses as assessed at the four bridge sites.

Stormwater runoff from part of the City of Blackfoot drains to the Snake River. Limited stormwater runoff data were available from two sites monitored in June of 2001 and March of 2002 with marked differences in pollutant levels observed between the two events (Table 2-12). Sampling in 2001 and 2002 showed average total phosphorus of 0.42 mg/L and 1.57 mg/L, respectively. Average nitrate+nitrite (no other nitrogen form was analyzed) ranged from 0.26 mg/L in 2001 to 0.90 in 2002. Total suspended solids concentrations averaged 81 mg/L in 2000 and 462 mg/L in 2001. From data collected on the mainstem Snake River by DEQ, it appears that present loads from City of Blackfoot stormwater runoff are having minimal if any effect on water quality or beneficial uses in the river.

Temperature monitoring was conducted by USGS at the Snake River near Shelley and near Blackfoot gage sites (Table 2-13, Appendix C). In 2001, maximum temperatures exceeded 20^{o}C in July and August. The river was warmer in 2002 when maximum values surpassed 20^{o}C in June through September. Mean monthly temperatures were greater than 20^{o}C at both sites in 2002 only.

Temperature violations of water quality standards were observed at both Snake River sites. Only data from 21 June to 21 September, the period of interest for cold water aquatic life, were used in the evaluation (Essig and Mebane 2002). In WY2001, both instantaneous and daily average temperature exceedances topped 10% at the near Shelley and near Blackfoot gage sites (Table 2-14). In WY2000, daily average temperature at the near Blackfoot gage exceeded the 10% violation threshold.

Table 2-10. Descriptive statistics from USGS and DEQ sampling data on Snake River at four bridge sites, April 2000 to July 2003.

Statistic	Tilden	Blackfoot	Firth	Shelley	Tilden	Blackfoot	Firth	Shelley	Tilden	Blackfoot	Firth	Shelley
	Total ammonia as N (mg/L)				**$NO_2 + NO_3$ as N (mg/L)**				**Total Kjeldahl nitrogen (mg/L)**			
Average	0.012	0.024	0.018	0.020	0.110	0.078	0.109	0.142	0.292	0.252	0.239	0.210
St Dev	0.013	0.046	0.013	0.021	0.091	0.095	0.100	0.094	0.145	0.097	0.070	0.059
Count	59	38	37	59	59	38	37	59	59	38	37	59
Maximum	0.080	0.270	0.061	0.094	0.413	0.302	0.334	0.355	1.000	0.530	0.410	0.390
Minimum	0.001	0.003	0.003	0.001	0.023	0.003	0.003	0.030	0.120	0.120	0.120	0.120
Median	0.008	0.011	0.017	0.011	0.078	0.035	0.086	0.109	0.250	0.220	0.240	0.200
	Dissolved orthophosphorus as P (mg/L)				**Total phosphorus (mg/L)**							
Average	0.006	0.007	0.009	0.010	0.035	0.029	0.035	0.029				
St Dev	0.004	0.012	0.007	0.007	0.018	0.014	0.020	0.010				
Count	59	38	37	58	59	38	37	59				
Maximum	0.020	0.074	0.038	0.026	0.096	0.064	0.096	0.064				
Minimum	0.001	0.003	0.003	0.002	0.009	0.008	0.014	0.013				
Median	0.004	0.005	0.008	0.008	0.031	0.026	0.027	0.026				
	TSS/SSC (mg/l)				**Turbidity (mg/L)**							
Average	15.1	6.9	7.3	5.9	5.0	6.1	4.6	4.6				
St Dev	13.8	5.1	6.6	4.9	4.0	3.0	2.8	3.2				
Count	59	38	37	59	39	3	3	38				
Maximum	79	18	30	24	22.0	9.3	7.6	14.0				
Minimum	0.5	0.5	0.5	0.5	0.3	3.2	2.0	0.3				
Median	13.0	5.8	5.2	4.0	4.3	5.7	4.3	3.8				

Table 2-11. USGS bedload sampling at Snake River near Shelly gage site (13060000), 2000 to 2002.

Site	Year	Days sampled (bedload/ suspended sediment)	Mean suspended sediment (tons/day)	Mean bedload sediment (tons/day)	Mean sediment bedload sieve diameter, percent finer than										
					.062 mm	.125 mm	.250 mm	.500 mm	1.00 mm	2.00 mm	4.00 mm	8.00 mm	16.0 mm	32.0 mm	64.0 mm
nr Shelley	2000	4/12	176.83	0.27	0.00	0.63	5.50	68.50	82.50	93.50	100.00	100.00	100.00	100.00	100.00
	2001	4/12	70.55	0.40	0.00	1.50	13.63	59.38	78.50	92.13	100.00	100.00	100.00	100.00	100.00
	2002	4/12	100.78	0.07	14.75	17.79	26.00	60.50	73.63	91.88	100.00	100.00	100.00	100.00	100.00
	Average		116.05	0.25	4.92	6.64	15.04	62.79	78.21	92.50	100.00	100.00	100.00	100.00	100.00
nr Blackfoot	2000	4/12	286.42	17.98	0.00	1.38	7.25	71.00	90.38	93.88	94.75	94.88	97.13	98.50	100.00
	2001	4/12	74.03	0.99	1.00	2.88	15.00	70.50	90.88	97.75	100.00	100.00	100.00	100.00	100.00
	2002	4/12	195.55	2.49	0.79	2.65	14.83	78.13	96.63	98.75	99.50	100.00	100.00	100.00	100.00
	Average		185.33	7.15	0.60	2.30	12.36	73.21	92.63	96.79	98.08	98.29	99.04	99.50	100.00

Table 2-12. Stormwater runoff data from sampling by City of Blackfoot and DEQ for two discharges to the Snake River, June 2001 and March 2002.

Location in Blackfoot	Alkalinity (mg/L)	COD (mg/L)	Total cadmium (u g/l)	Chloride (mg/L)	Total chromium (u g/l)	Total lead (u g/l)	Total nickel (u g/l)	Ortho-phosphate as P (mg/L)	Sulphate as SO4 (mg/L)	Total dissolved solids (mg/L)	Total nitrate as N (mg/L)	Total nitrite as N (mg/L)	Total phosphorus as P (mg/L)	Total suspended solids (mg/L)	Total zinc (u g/l)	Fecal coliform (cfu/100 ml)	*E. coli* (cfu/100 ml)
13-Jun-01																	
Behind Albertsons	124	77	<1	8.99	6	14	<5	0.274	31.8		0.287	0.017	0.507	99	106	200	900
Behind Wal Mart	115	43	<1	7.41	<5	7	<5	0.231	28.8		0.191	0.019	0.332	62	74	1500	200
6-Mar-02																	
Behind Albertsons	51	220	2	69.8	27	46	14	1.33	6.98	240	0.832	0.06	1.71	434	321		
Behind Wal Mart	82	191	2	64.6	25	44	12	1.3	11.9	255	0.842	0.058	1.42	490	275		

Table 2-13. USGS Snake River temperature monitoring data.

Date	Water Year 2000						Water Year 2001					
	Temperature (°C) nr Shelley			Temperature (°C) nr Blackfoot			Temperature (°C) nr Shelley			Temperature (°C) nr Blackfoot		
	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
May	14.9	7.2	11.1	15.6	7.9	12.1	17.7	7.7	12.7	18.2	9.3	14.1
June	18.2	11.2	14.6				20.9	10.2	15.4	22.8	11.3	16.6
July	21.3	15.2	17.8				23.4	17.2	19.7	23.5	17.4	20.3
August	21.8	16.2	18.9	23.1	15.8	19.4	24.3	16.7	20.0	23.0	17.1	20.0
September				19.5	10.2	15	21.2	13.4	16.5	20.3	14.1	16.5

Table 2-14. Temperature exceedances of state water quality standards in Snake River, 21 June to 21 September (from USGS temperature monitoring data).

	WY2000				WY2001			
	near Shelley		near Blackfoot		near Shelley		near Blackfoot	
	Instantaneous (> 22°C)	Daily average (> 19°C)	Instantaneous (> 22°C)	Daily average (> 19°C)	Instantaneous (> 22°C)	Daily average (> 19°C)	Instantaneous (> 22°C)	Daily average (> 19°C)
Number of days sampled	88	88	79	79	93	93	93	93
Number of days ambient air temperature exceeds average maximum[1]	13	13	10	10	6	6	6	6
Number of days water temperature exceeding water quality standards	0	7	4	18	26	52	14	60
Percent of days with water temperature exceedances	0.0	9.3	5.8	26.1	29.9	59.8	16.1	69.0

[1]Idaho Water Quality Standards exempts numeric temperature criteria when air temperature exceeds the 90th percentile of the annual maximum weekly maximum temperatures as determined from the historical record of a nearby weather station (IDAPA 58.01.02.080.04). For Pocatello this temperature is 97.04°F (Essig and Mebane 2002).

In August and September 2002, DEQ deployed continuous (interval=15 minutes) monitoring sondes at four sites in the Snake River for about a one-week period. Temperature and dissolved oxygen data showed no water quality exceedances at the sites (Figure 2-6).

Additional to their work under contract with DEQ, USGS has conducted other monitoring in the Snake River. Sampling of water quality has occurred periodically at both the near Blackfoot and near Shelley gage sites (Appendix C). As part of their *National Water-Quality Assessment* (NAWQA) work, USGS investigated pesticide and organic compound contamination in the upper Snake River Basin (Maret and Ott 1997). Fish collected from the Snake River near Blackfoot and Spring Creek near Fort Hall had detectable concentrations of dichlorodiphenyl-trichloroethane (DDT) metabolites. Snake River fish also showed detectable levels of polychlorinated biphenyls (PCB) and chlordane. No organochlorine compounds were detectable in bed sediment from either site. Observed concentrations fell below recommended maximum concentrations (NAS/NAE 1973 cited in Maret and Ott 1997).

The NAWQA study also analyzed for pesticides at three sites in the subbasin: the Snake River near Shelley and near Blackfoot, and Ross Fork near Fort Hall. Both atrazine and EPTC (s-ethyl dipropylthiocarbamate) were detected (Ott 1997). Atrazine concentrations were less than 0.02 ug/L and EPTC concentrations were less than 0.2 ug/L. Maximum contaminant level (maximum level of certain contaminants permitted in drinking water) for atrazine is 3 ug/L. There is no maximum contaminant level (MCL) for EPTC.

Low and Mullins (1990) studied water quality, bottom sediment, and biota associated with irrigation drainage in the reservoir area. They concluded biotic concentrations for trace elements were low except for mercury and selenium. The authors expressed concern regarding levels of selenium in mallard duck livers. In addition, DDT metabolites were detected in all waterbird eggs (especially cormorant), although concentrations did not exceed criterion for protection of aquatic life.

In conclusion, data do not support listing of the Snake River for dissolved oxygen and nutrients (Table 2-1). Sediment also does not appear to be impairing beneficial uses, but the effect of bedload and water column sediment in average to high water years is unknown. Until such data are collected, or BURP assessment indicates beneficial use support, it is recommended that the Snake River continue to be listed for sediment. As mentioned previously, flow alteration has occurred as the Snake River hydrology has been modified as part of BOR’s Minidoka Project. Data do indicate violations of water quality standards for temperature. Organic compounds, pesticides, and metals have been detected in the subbasin. The greatest concern appears to be the possible effect of these chemicals and metals on waterbird populations. Snake River will be recommended for delisting of dissolved oxygen and nutrients, and should be considered for listing of temperature on the next 303(d) list.

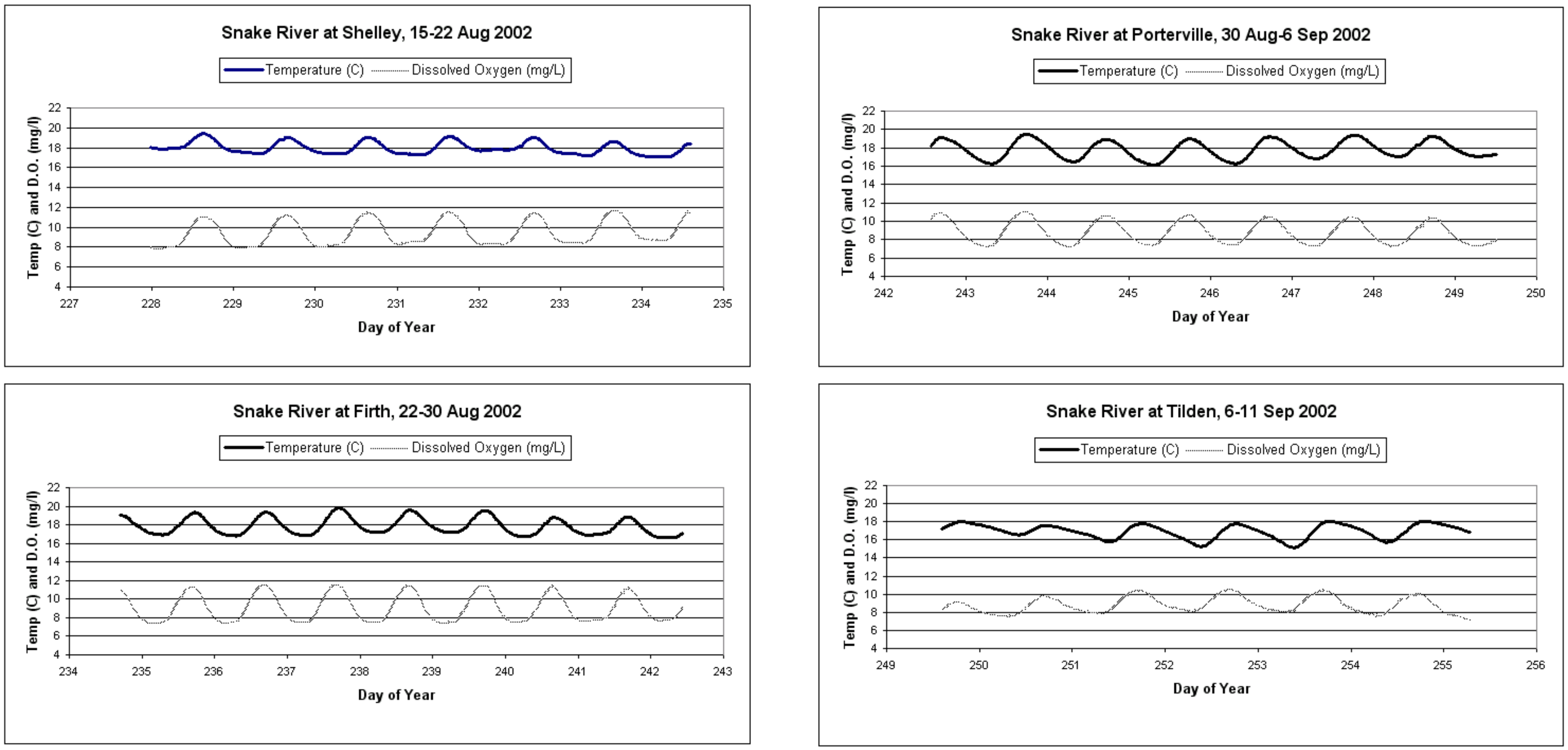

Figure 2-6. DEQ continuous (15-minute interval) monitoring data from Snake River, August, September 2002.

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2.3.1.3. Bannock Creek

Streamflow on Bannock Creek was monitored by USGS from June 1985 to September 1994. Average annual flow during this period of record was 40 cfs (Table 1-3), ranging from 25.1 cfs to 87.2 cfs (USGS Web site). The average annual hydrograph showed peak runoff occurring early in the year in February and March (Figure 2-7) and lowest flows occurring in August. Tributary information on flow was limited. Average annual flow in 1988 in Rattlesnake and West Fork creeks was 12.4 and 8.6 cfs, respectively (USGS Web site). No data were available for flows in Moonshine or Knox creeks.

Data assessment completed on Bannock Creek watershed supports inclusion of Bannock Creek watershed on the 303(d) list. Bannock Creek was listed on the 1998 303(d) list for bacteria, nutrients, and sediment. Data collected from BURP showed high levels of surface sediment in both Bannock and Rattlesnake creeks (Table 1-7) and lower levels of sediment were found in Knox Creek. BOR monitoring of Bannock Creek showed high levels of suspended sediment averaging 73 mg/L over the sample period (Table 2-15, Appendix E). Total nitrogen and total phosphorus averaged 1.69 and 0.36 mg/L, respectively. For Xeric West streams, both of these levels exceeded the 25th percentile aggregate nutrient reference conditions although the total phosphorus concentration was within the range of reference conditions (EPA 2000). Assessment of BURP data following DEQ's water body assessment guidance (Grafe et al. 2002) indicated none of these three streams were supporting beneficial uses for cold water aquatic life (Table 2-16). Additionally, Rattlesnake and Knox creeks have high levels of sediment, which likely contributed to a listing of not supporting cold water aquatic life. BURP monitoring data has not been collected on Moonshine Creek or West Fork due to access restrictions. Nutrient and sediment data from Shoshone-Bannock Tribes' 2003 sampling program are summarized in Table 2-17.

While the 1998 303(d) list identified bacteria as a problem in Bannock Creek, lack of data prohibits an adequate use impairment determination or a pollutant load allocation from being conducted. Only two samples were collected in Bannock Creek in June 2000 both of which occurred at a site outside of the Fort Hall boundary. While the two samples had a geometric mean of 420 *E. coli* colonies/100 ml of water, exceeding the state water quality standard of 126 colonies/100 ml, lack of the required number of samples (i.e., five samples within a 30-day period) resulted in insufficient data to conduct an adequate assessment of primary or secondary contact recreation use existing or designated for Bannock Creek. The Shoshone-Bannock Tribes and DEQ recommend a collaborative monitoring effort to collect more bacteria data that is representative of water quality conditions in Bannock Creek, prior to developing a TMDL.

Evaluation of the fish community in Bannock Creek watershed is limited. Fish distribution surveys were conducted by USFS in August 2001 on two tributaries to Rattlesnake Creek, Crystal and Midnight creeks (USFS 2001). On that sampling date both surveys revealed no running water in either stream and both were deemed non-fish sustaining water bodies.

2.3.1.4. Other tributaries

Amongst other tributaries, only McTucker Creek is on the 303(d) list. BOR sampling indicated an average flow of 187 cfs (Table 2-18). A high flow of 300 cfs was observed in both June 2002 and July 2003. The lowest flow recorded was in June of 2001 at 17 cfs; however, this recording is suspect as next lowest recorded flow was 120 cfs in November 2002. Excluding the 17 cfs value, flow averaged 199 cfs.

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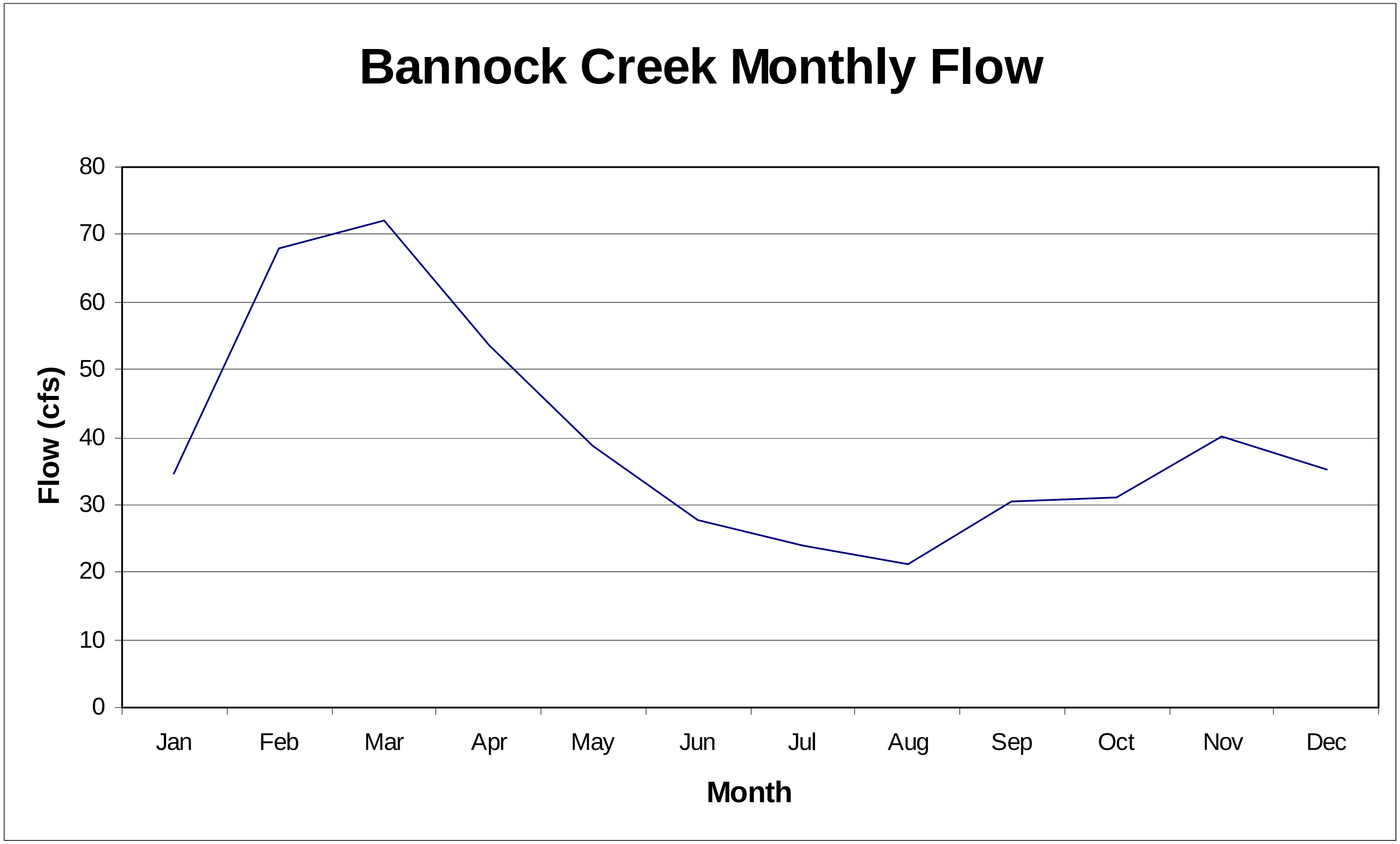

Figure 2-7. Average monthly flow at Bannock Creek USGS surface-water station (13076200), June 1985 to September 1994.

Table 2-15. Descriptive statistics from BOR sampling of American Falls Reservoir tributaries, springs, and drains.

Waterbody	Statistic[1]	Flow (cfs)	Ortho P (mg/L)	Total P (mg/L)	NH_3 (mg/L)	NO_3+NO_2 (mg/L)	TKN (mg/L)	TN (mg/L)	SS (mg/L)
Bannock Cr	Average	34.8	0.268	0.361	0.027	1.238	0.421	1.688	73.4
	Count	23	23	23	23	23	22	22	23
	Standard Deviation	20.3	0.268	0.260	0.022	0.778	0.368	0.780	162.0
	Maximum	104.0	0.803	0.850	0.100	2.650	1.990	3.000	778.0
	Minimum	12.0	0.019	0.081	0.005	0.410	0.180	0.680	2.0
	Median	32.8	0.126	0.300	0.020	1.030	0.355	1.590	24.0
Cedar Spillway	Average	31.1	0.002	0.027	0.012	0.027	0.253	0.280	7.6
	Count	6	10	10	10	10	10	10	10
	Standard Deviation	19.5	0.001	0.016	0.007	0.061	0.112	0.131	7.0
	Maximum	54.0	0.004	0.068	0.020	0.200	0.520	0.525	22.0
	Minimum	7.8	0.002	0.013	0.005	0.005	0.150	0.155	0.5
	Median	34.0	0.002	0.022	0.008	0.005	0.210	0.218	5.5
Clear Cr	Average	37.2	0.010	0.029	0.016	1.499	0.221	1.740	10.0
	Count	13	22	22	22	22	21	21	22
	Standard Deviation	31.7	0.003	0.019	0.014	0.141	0.199	0.253	12.7
	Maximum	120.0	0.016	0.077	0.060	1.730	0.880	2.510	48.0
	Minimum	15.0	0.006	0.005	0.005	1.070	0.050	1.440	0.5
	Median	20.0	0.011	0.027	0.010	1.515	0.160	1.620	4.5
Colburn wasteway	Average	5.2	0.013	0.051	0.095	0.648	0.757	1.405	10.1
	Count	15	23	23	23	23	23	23	23
	Standard Deviation	4.7	0.017	0.034	0.186	0.866	0.457	0.830	8.8
	Maximum	18.0	0.073	0.155	0.920	3.000	2.460	3.320	32.0
	Minimum	1.5	0.002	0.005	0.010	0.005	0.280	0.540	2.0
	Median	3.0	0.007	0.046	0.030	0.220	0.670	1.150	6.0
Crystal wasteway	Average	49.1	0.020	0.048	0.067	1.675	0.362	2.025	11.2
	Count	34	34	34	34	34	33	33	34
	Standard Deviation	11.4	0.012	0.018	0.035	0.290	0.131	0.321	17.1
	Maximum	90.0	0.041	0.094	0.130	2.130	0.940	2.800	101.0
	Minimum	17.0	0.002	0.020	0.005	0.880	0.200	1.170	2.0
	Median	50.0	0.023	0.046	0.070	1.680	0.350	2.010	6.0
Danielson Cr	Average	56.2	0.010	0.035	0.032	0.719	0.250	0.955	9.9
	Count	34	34	34	34	34	33	33	34
	Standard Deviation	8.7	0.006	0.010	0.028	0.251	0.071	0.271	5.1
	Maximum	69.5	0.025	0.054	0.130	1.170	0.420	1.440	22.0
	Minimum	36.0	0.002	0.017	0.005	0.310	0.160	0.530	4.0
	Median	56.0	0.009	0.036	0.020	0.705	0.220	0.910	8.0
Hazard Cr/Little Hole Draw	Average	16.7	0.196	0.248	0.489	1.782	1.137	2.852	9.9
	Count	30	34	34	34	34	33	33	34
	Standard Deviation	18.8	0.221	0.238	0.848	1.936	1.381	2.810	10.3
	Maximum	63.0	0.727	0.820	2.770	5.860	5.400	8.200	49.0
	Minimum	1.0	0.002	0.034	0.005	0.020	0.220	0.350	2.0
	Median	6.8	0.049	0.101	0.040	0.495	0.510	0.960	7.0
McTucker Cr	Average	196.2	0.011	0.034	0.017	0.991	0.220	1.200	7.4
	Count	14	31	31	31	31	30	30	31
	Standard Deviation	83.2	0.009	0.010	0.010	0.463	0.077	0.442	5.4
	Maximum	300.0	0.038	0.061	0.040	2.900	0.370	3.020	21.0
	Minimum	17.0	0.002	0.013	0.005	0.410	0.080	0.660	0.5
	Median	200.0	0.010	0.034	0.020	1.060	0.210	1.210	6.0
Seagull Bay tributary	Average	5.4	0.074	0.216	0.044	0.234	0.577	0.811	138.3
	Count	11	14	14	14	14	14	14	13
	Standard Deviation	5.5	0.061	0.227	0.024	0.234	0.281	0.367	360.8
	Maximum	20.0	0.203	0.980	0.090	0.710	1.380	1.510	1337.0
	Minimum	0.5	0.002	0.087	0.005	0.005	0.320	0.340	10.0
	Median	4.0	0.051	0.157	0.040	0.155	0.500	0.750	52.0
Spring Cr	Average	315.1	0.010	0.025	0.015	1.000	0.143	1.112	8.2
	Count	21	21	21	21	21	20	20	21
	Standard Deviation	23.8	0.004	0.008	0.023	0.163	0.098	0.143	5.4
	Maximum	351.0	0.017	0.044	0.110	1.630	0.500	1.560	24.0
	Minimum	272.0	0.005	0.012	0.005	0.840	0.080	0.930	2.0
	Median	313.0	0.010	0.024	0.010	0.990	0.110	1.100	7.0
Sterling wasteway	Average	5.5	0.020	0.081	0.101	1.116	0.581	1.678	37.2
	Count	21	33	33	33	33	32	32	33
	Standard Deviation	3.5	0.018	0.077	0.234	0.463	0.632	0.855	52.2
	Maximum	14.0	0.083	0.390	1.360	1.800	3.720	5.140	198.0
	Minimum	0.9	0.002	0.022	0.005	0.110	0.230	0.490	3.0
	Median	5.3	0.015	0.051	0.050	1.240	0.425	1.660	14.0
Sunbeam Cr	Average	4.4	0.045	0.246	0.081	0.231	0.762	0.993	95.1
	Count	16	20	20	20	20	20	20	19
	Standard Deviation	3.0	0.029	0.218	0.169	0.317	0.601	0.893	77.3
	Maximum	10.0	0.109	1.080	0.780	1.360	2.720	4.080	332.0
	Minimum	1.0	0.007	0.072	0.005	0.005	0.240	0.275	16.0
	Median	4.0	0.037	0.190	0.035	0.135	0.585	0.735	81.0

[1] statistics not calculable if no data (count=0); standard deviation not calculable with only one data point (count=1)

Table 2-16. BURP data analysis and water body assessment of American Falls Subbasin tributaries.

Waterbody	Site	Year sampled	Index[1] score				Beneficial use[2] support							
			SMI	SFI	SHI	Average	CWAL	SaSp	PCR	SCR	AWS	IWS	W	A
303(d) listed streams														
McTucker Creek		1996	2	1	1	1.33	NS				NA	NA	NA	NA
Bannock Creek	lower	1996	0		1	0	NS	NA			FS	FS	FS	FS
Rattlesnake Creek	upper	1996	0		1	0	NS				NA	NA	NA	NA
	lower	1996	1		1	1	NS				NA	NA	NA	NA
Knox Creek		1996	0		3	0	NS				NA	NA	NA	NA
Non-303(d) listed streams														
Danielson Creek		1998	1		1	1	NS	NS		NA	FS	FS	FS	FS
Hazard Creek/ Little Hole Draw		1998	0		1	0	NS	NS		NA	FS	FS	FS	FS
Michaud Creek	upper	1997	3		2	2.5	FS	FS		FS	FS	FS	FS	FS
	lower	1997	3		1	2								
Crystal Creek		1998	2		3	2.5	FS	FS		NA	FS	FS	FS	FS
Sunbeam Creek		1998	0		1	0	NS				NA	NA	NA	NA

[1]SMI=stream macroinvertebrate index, SFI=stream fish index, SHI=stream habitat index; index score average defaults to 0 if any index score is 0

[2]CWAL=coldwater aquatic life, SaSp=salmonid spawning, PCR=primary contact recreation, SCR=secondary contact recreation, AWS=agriculture water supply, IWS=industrial water supply, W=wildife, A=aesthetics, NS=not supported, NA=not assessed, FS=fully supported

Table 2-17. Shoshone-Bannock Tribes nutrient sampling results from Bannock Creek watershed.

Site	Date	Parameter						
		Total Kjeldahl nitrogen (mg/L)	Ammonia nitrogen (mg/L)	Nitrate+ nitrite (mg/L)	Total nitrogen (mg/L)[1]	Total phosphorus (mg/L)	Ortho-phosphorus (mg/L)	Total suspended solids (mg/L)
West Fork Bannock Creek	Apr-03	0.5	0.02	0.02	0.52	0.02	ND	6
	Jul-03	ND	ND	ND	ND	0.0122	ND	6.2
Lower Bannock Creek	Apr-03	0.5	0.02	0.549	1.05	0.0279	0.07	12.8
	Jul-03	3.71	ND	1.19	4.9	0.467	0.28	23.4
Upper Moonshine Creek	Apr-03	1.12	0.02	0.396	1.52	0.408	ND	454
	Jul-03	1.2	0.108	0.697	1.897	0.487	0.14	251
Lower Moonshine Creek	Apr-03	0.5	0.02	0.02	0.52	0.0202	ND	12
	Jul-03	ND	ND	0.0531	ND	0.015	ND	6.06
Upper Rattlesnake Creek	Apr-03	1.19	0.03	0.13	1.32	0.707	0.06	734
	Jul-03	ND	ND	0.0419	ND	0.145	0.08	14.2
Lower Rattlesnake Creek	Apr-03	0.5	0.02	0.04	0.54	0.124	ND	75.9
	Jul-03	ND	ND	ND	ND	0.0883	0.05	2.2

[1]total nitrogen = total Kjeldahl nitrogen + nitrate+nitrite

Table 2-18. BOR flow data from McTucker Creek near ponds.

Date	Flow (cfs)	Comments
11-Jun-01	17	
1-May-02	140	
4-Jun-02	300	Estimate
26-Jun-02	220	Estimate
9-Jul-02	270	Estimate
13-Aug-02	200	Estimate
9-Oct-02	160	Estimate
29-Oct-02	130	Estimate
29-Oct-02	130	Estimate
25-Nov-02	120	Estimate
25-Nov-02	121	Estimate
12-Mar-03	280	Estimate
1-Apr-03	200	Estimate
24-Apr-03	140	Estimate
12-May-03	270	Estimate
8-Jul-03	300	Estimate

McTucker Creek is listed for sediment problems (Table 2-1). BURP data indicated levels of streambed surface fines in the 60% range (Table 1-7). Average suspended sediment concentration collected by BOR was only 7.44 mg/L with a high of 21 mg/L (Table 2-15, Appendix E). Water body assessment of McTucker Creek BURP data showed nonsupport of cold water aquatic life (Table 2-16). Streambed sediment levels are high, although data indicate water column suspended sediment is not. This could be a result of historic sediment loading which, due to the low gradient and spring-like nature of McTucker Creek, has yet to be transported out of the system.

Three entities monitor streams, springs, and drains that flow into American Falls Reservoir. In addition to Bureau of Reclamation, Neil and Marita Poulson through funding from various sources (Idaho State University, Aberdeen-Springfield Canal Company, DEQ, and others) have been monitoring on reservoir’s west side. Some water bodies are sampled as part of both efforts. Although these water bodies are not on the 303(d) list, they could contribute to both nutrient and sediment loading in the reservoir. Idaho Power has tracked flow in waste drains since October 2001.

A summary of BOR data for water bodies with at least ten sampling events is presented in Table 2-15 (see Appendix E for all data from May 2001 to July 2003). Water bodies with high levels of sediment were Seagull Bay tributary, Sterling wasteway, and Sunbeam Creek. All three creeks averaged 4-5 cfs flow (Appendix E). Higher concentrations of total nitrogen (> 1.0 mg/L) were recorded in Clear Creek, Colburn wasteway, Crystal wasteway, Hazard Creek/Little Hole Draw, Spring Creek, and Sterling wasteway. Hazard Creek/Little Hole Draw, Seagull Bay tributary, and Sunbeam Creek all had total phosphorus concentrations greater than 0.2 mg/L whereas no other water body exceeded 0.081 mg/L. These data indicate many of these water bodies are contributing to sediment and nutrient loads in American Falls Reservoir.

The Poulsons' work focused on nutrients and sediment from water bodies entering the reservoir's west side, nutrients in ground water, and nutrients and sediment in Aberdeen-Springfield Canal (Poulson et al. 2001). Initial sampling took place in late 1996 and the project proceeded in earnest in 1997 (Appendix E). High levels of phosphorus (phosphate [PO_4] or total phosphorus greater than 0.05 mg/L) were observed in Cedar Spill, Colburn wetland, Hazard Creek/Little Hole Draw, Smith Spring, and Spring Hollow (Table 2-19). Big Hole springs complex, Colburn wetland, Crystal Springs, Danielson Creek, Smith Spring, Spring Hollow, and Sterling wetland all had nitrogen (nitrate+nitrite and total nitrogen) levels greater than 1.0 mg/L with Spring Hollow the highest at about 10 mg/L.

Data from the Poulsons' efforts were sufficient to derive several conclusions (Poulson et al. 2003). The Aberdeen-Springfield Canal does not represent a large portion of study area nutrient loading to the reservoir. Suspended solids from the canal are of the same order of magnitude as the TSS target. Springs are a major source of nitrogen into the reservoir. Largest contributors of nitrogen were Crystal spring, Spring Hollow drain, and Danielson Creek (Poulson et al. 2001). Phosphorus levels at all sites were rarely greater than target levels (0.05 mg/L).

Contribution of nitrogen from those water bodies whose flow is highly dependent on ground water is not surprising. The Fort Hall area has been identified as having degraded ground water quality due to high nitrate levels (DEQ 2001a).

Idaho Power has monitored flow in Sterling waste, Tarter waste, and Aberdeen waste drain (Hazard Creek/Little Hole Draw) beginning in October 2001 (Appendix E). Annual average flow for 2002 and 2003 water years was 5.0 and 5.6 cfs at Sterling waste, 5.4 and 3.5 cfs at Tarter waste, and 16.8 and 17.1 cfs at Aberdeen waste, respectively. The average flows are in line with those reported by BOR for Sterling and Aberdeen wastes (Table 2-15).

Other than Danielson Creek, Hazard Creek/Little Hole Draw, and Sunbeam Creek, it is unknown if pollutants in these water bodies are affecting beneficial uses in the water bodies themselves. Assessment of BURP data for Danielson Creek, Hazard Creek/Little Hole Draw, and Sunbeam Creek showed impairment of beneficial use support of cold water aquatic life (Table 2-16).

Table 2-19. Descriptive statistics from streams, canals, and wetlands on north and west sides of American Falls Reservoir, 1997 to 2002.

Waterbody	Statistic[1]	Flow (cfs)	PO_4 (mg P/L)	Total P (mg/L)	NO_3+NO_2 (mg N/L)	Total N (mg/L)	Suspended sediment (mg/L)
Big Hole springs complex	Average	0.71	0.040		4.484		1.7
	Count	1	6	0	7	0	5
	Standard deviation		0.038		1.012		1.6
	Maximum	0.71	0.100		5.659		3.8
	Minimum	0.71	0.000		2.924		0.0
	Median	0.71	0.032		4.660		1.4
Cedar Spill	Average		0.053	0.011	0.694	0.179	86.4
	Count	0	34	8	34	8	34
	Standard deviation		0.204	0.008	3.601	0.417	414.4
	Maximum		1.200	0.025	20.997	1.200	2430.5
	Minimum		0.000	0.000	0.000	0.000	2.0
	Median		0.006	0.013	0.008	0.000	12.4
Colburn (Orth) wetland	Average	13.07	0.032	0.170	0.466	1.740	23.7
	Count	6	19	1	19	1	19
	Standard deviation	13.53	0.043		0.548		23.3
	Maximum	37.08	0.160	0.170	1.962	1.740	70.0
	Minimum	2.12	0.000	0.170	0.000	1.740	0.0
	Median	6.36	0.019	0.170	0.214	1.740	14.6
Crystal Springs	Average	149.95	0.020	0.028	2.407	2.890	17.6
	Count	5	20	3	21	3	20
	Standard deviation	140.44	0.028	0.013	0.934	0.357	27.7
	Maximum	381.40	0.085	0.040	4.410	3.130	90.0
	Minimum	31.78	0.000	0.015	0.943	2.480	0.0
	Median	132.43	0.007	0.030	2.169	3.060	6.0
Danielson Creek	Average	60.39	0.021	0.040	0.828	1.470	14.5
	Count	4	20	1	20	1	20
	Standard deviation	35.09	0.030		0.377		17.3
	Maximum	84.76	0.090	0.040	1.615	1.470	63.5
	Minimum	8.48	0.000	0.040	0.365	1.470	0.0
	Median	74.16	0.007	0.040	0.782	1.470	9.3
Hazard Creek/Little Hole Draw	Average	77.98	0.075		0.250		25.7
	Count	9	25	0	25	0	25
	Standard deviation	35.24	0.124		0.367		32.3
	Maximum	148.32	0.619		1.800		159.7
	Minimum	17.76	0.000		0.005		6.2
	Median	79.46	0.030		0.150		15.0
Nash Spill	Average		0.002	0.013	0.006	0.094	9.5
	Count	0	3	4	3	4	3
	Standard deviation		0.000	0.010	0.003	0.067	8.0
	Maximum		0.002	0.025	0.009	0.170	18.5
	Minimum		0.002	0.000	0.003	0.030	3.0
	Median		0.002	0.013	0.007	0.088	7.0
R Spill	Average		0.008	0.016	0.008	0.196	10.6
	Count	0	6	7	6	7	6
	Standard deviation		0.007	0.007	0.005	0.296	6.8
	Maximum		0.021	0.025	0.013	0.705	19.0
	Minimum		0.004	0.005	0.001	0.000	0.5
	Median		0.005	0.015	0.009	0.030	12.8
Smith Spring	Average	5.10	0.063	0.095	0.333	1.145	15.3
	Count	6	21	1	21	1	21
	Standard deviation	5.50	0.143		0.620		18.6
	Maximum	14.13	0.660	0.095	2.560	1.145	88.0
	Minimum	0.64	0.000	0.095	0.000	1.145	0.0
	Median	2.61	0.011	0.095	0.040	1.145	8.7
Spring Hollow Hwy 39	Average	5.30	0.036	0.142	10.341	9.931	153.2
	Count	2	25	6	26	6	24
	Standard deviation	1.50	0.064	0.119	8.664	2.764	216.7
	Maximum	6.36	0.300	0.360	35.615	13.940	706.3
	Minimum	4.24	0.000	0.020	2.920	6.975	0.0
	Median	5.30	0.015	0.130	7.000	9.758	53.2
Sterling Wetland	Average	14.69	0.029		1.178		15.3
	Count	6	17	0	18	0	17
	Standard deviation	8.36	0.041		0.772		21.9
	Maximum	27.55	0.150		2.880		80.3
	Minimum	5.65	0.000		0.160		0.0
	Median	12.98	0.010		1.169		5.7

[1]statistics not calculable if no data (count=0); standard deviation not calculable with only one data point (count=1)

2.3.1.5. Point sources

Data for point sources were available from Discharge Monitoring Reports (DMRs) for Aberdeen, Blackfoot, Firth and Shelley wastewater treatment plants (WWTP). No data were available for Crystal Springs Trout Farm, however, water quality data collected by the Bureau of Reclamation (see Table E-1), just below the hatchery on Crystal Springs Creek, was used to calculate wasteload allocations. Discharges from the four WWTPs are low. Blackfoot discharge averaged 3.06 cfs, while Aberdeen, Firth, and Shelley all averaged less than 0.66 cfs (Table 2-20).

Wastewater treatment plants in Blackfoot, Firth, and Shelley all contribute directly to the Snake River (Appendix D). The Aberdeen WWTP discharges into Hazard Creek/Little Hole Draw, which flows into American Falls Reservoir. Total phosphorus concentrations in the effluent of the four WWTPs ranged from 1.28 mg/L at Aberdeen to 2.75 mg/L at Firth WWTP (Table 2-20). The majority of the total phosphorus discharged by the plants is in the form of orthophosphorus, which is the form most readily used by plants.

The form of nitrogen discharged into the receiving water bodies varies by WWTP (Table 2-20). Most nitrogen discharged at Firth is in the form of ammonia while Blackfoot primarily discharges nitrate+nitrite. Aberdeen has a mix of ammonia and nitrate+nitrite. Both nitrate+nitrite and ammonia are readily available for uptake by plants. Much of Shelley's effluent is in the form of organic nitrogen (total Kjeldahl nitrogen minus total ammonia represents the amount of organic nitrogen in the effluent), which is nitrogen tied up in plant or animal tissue.

Loading of total suspended solids does not appear to be significant. None of the four WWTPs discharged effluent at concentrations greater than 45 mg/L and concentrations at both Aberdeen and Blackfoot were less than 12 mg/L TSS (Table 2-20).

2.4. Data Gaps

Seldom is there enough data to confidently predict, without hesitation, exactly what is occurring in an ecological system. Invariably, there are certain areas where more data would be useful in order to make more accurate predictions of ecological ramifications. The most basic data gap is natural background levels for sediment and nutrients – they are unknown.

Table 2-20. Water quality data from wastewater treatment plants in American Falls Subbasin, Jan. 2000 – Sept. 2003, Blackfoot 2003-2009 (Discharge Monitoring Reports).

		Wastewater treatment plant			
Parameter	Statistic	Aberdeen	Blackfoot	Firth	Shelley
Flow (cfs)	Average	0.65	3.06	0.18	0.47
	Count	45	70	45	41
	Standard deviation	0.17	0.73	0.16	0.12
	Maximum	1.07	5.06	0.79	0.67
	Minimum	0.36	2.11	0.00	0.20
	Median	0.65	2.99	0.14	0.48
Total orthophosphate (mg/L)	Average		2.13	1.91	1.43
	Count		68	6	11
	Standard deviation		3.19	0.36	0.59
	Maximum		19.8	2.40	2.45
	Minimum		0.05	1.28	0.14
	Median		1.06	1.91	1.51
Total phosphorus (mg/L)	Average	1.28	2.36	2.75	2.74
	Count	8	69	6	11
	Standard deviation	0.29	3.36	0.59	1.20
	Maximum	1.70	22.2	3.91	5.72
	Minimum	0.86	0.05	2.24	0.87
	Median	1.27	1.22	2.63	2.61
Total ammonia (mg/L)	Average	5.04		12.53	6.10
	Count	8		6	11
	Standard deviation	3.07		2.86	4.32
	Maximum	8.90		15.20	12.50
	Minimum	0.03		7.46	0.03
	Median	5.10		13.50	5.91
Total nitrate+nitrite (mg/L)	Average	3.79	18.60	0.09	0.55
	Count	8	31	6	11
	Standard deviation	2.67	6.23	0.12	0.51
	Maximum	8.60	31.30	0.33	1.60
	Minimum	0.87	6.63	0.02	0.03
	Median	3.17	17.80	0.05	0.49
Total Kjeldahl nitrogen (mg/L)	Average	5.79	4.53	16.68	14.84
	Count	8	31	6	11
	Standard deviation	3.23	6.41	2.36	3.90
	Maximum	9.10	30.30	19.80	21.80
	Minimum	1.30	0.05	13.90	7.28
	Median	7.40	2.48	16.80	15.30
Turbidity (mg/L)	Average		5.30	25.35	31.10
	Count		31	2	2
	Standard deviation		3.93	5.16	5.80
	Maximum		20.10	29.00	35.20
	Minimum		0.00	21.70	27.00
	Median		4.66	25.35	31.10
Total suspended solids (mg/L)	Average	11.35	10.85	22.47	42.24
	Count	45	11	45	41
	Standard deviation	4.55	2.47	18.75	39.66
	Maximum	19	14	67	231
	Minimum	2.4	6.7	0.0	2.5
	Median	11.0	10.9	19.0	33.0

Much of the recent data in American Falls Subbasin has been amassed during low water years. Although impossible to collect for this TMDL, information from average and high water years would be helpful. Bedload sediment estimates from average to high water years would be beneficial for the Snake River along with bedload information for the tributaries.

Key data gaps involve the reservoir. The past several years, during which much of the sampling has been done, have had below-normal precipitation. Data are needed from more average water years and in seasons with less reservoir elevation fluctuation. There are no data on phosphorus recycling. Even with a reduction of phosphorus loading from tributaries, phosphorus internal to the reservoir may delay the expected recovery process. Addition of more sampling sites would further define dissolved oxygen and temperature problems in the reservoir. Finally, to facilitate future reservoir modeling, data appropriate to a chosen model should be collected. At minimum, improved bathymetric information should be gathered.

Springs dot the reservoir landscape. No data are extant on the contribution of pollutants of many of these springs. This lack of data is especially true for those springs generally inundated by the reservoir.

More data from water bodies on Fort Hall Reservation are needed to accurately estimate loads (e.g., Ross Fork) and/or determine beneficial use support (i.e., Bannock Creek, Moonshine Creek and lower Rattlesnake Creek). The paucity of data (chemical, biological, physical) for Bannock Creek and its tributaries, both temporally and spatially, significantly impedes the ability to conduct a comprehensive water quality assessment of the designated uses in the watershed. The limited existing data also increases the level of uncertainty for watershed loading models used to support these TMDLs. Additional sampling is needed for Bannock Creek and its tributaries to establish a more definitive baseline for stream bank stability, and existing and desired sediment bedload. The Shoshone-Bannock Tribes have begun to address some of these data gaps through its water quality monitoring program.

Streamflow discharge data is also inadequate within the American Falls Subbasin. USGS streamflow exists for Bannock Creek; however, flow data are minimal or non-existent for tributaries such as McTucker Creek, West Fork, Moonshine Creek, Rattlesnake Creek, and Knox Creek.

Due to the limited number of bacteria sampling events, further bacteria sampling is necessary on Bannock Creek. Although the two available samples indicated elevated bacteria levels, a significant amount of *E. coli* data, collected in accordance with DEQ water quality standards, is necessary to verify contact recreation use attainment. Section 251 of DEQ surface water quality standards stipulates that both primary and secondary contact recreation use assigned to Bannock Creek is assessed by using a geometric mean of 126 *E. coli* organisms per 100 ml based on a minimum of five samples taken every three to five days over a 30-day period.

Given the uncertainty of whether or not contact recreation use is impaired in Bannock Creek, DEQ and the Shoshone-Bannock Tribes are committed to conducting a coordinated sampling effort in 2004 to collect additional *E. coli* samples. An initial recommendation for an *E. coli* monitoring approach would entail the collection of a minimum of ten samples at each of three stations (one off-reservation, two on-reservation) located along Bannock Creek during June and August. DEQ and the Shoshone-Bannock Tribes will work together to prepare a *quality assurance project plan* (QAPP) that will more explicitly define the sampling approach and analytical protocols to be used, prior to initiating sampling.

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3. Subbasin Assessment – Pollutant Source Inventory

Pollutants in American Falls Subbasin originate from both point and nonpoint sources. Nonpoint sources are the largest contributors to subbasin water quality problems.

3.1. Sources of Pollutants of Concern

3.1.1. Point Sources

Water chemistry data from monitoring at bridges below wastewater treatment facilities (Blackfoot, Firth, and Shelley) that discharge to the Snake River have indicated little measurable effect of nutrients from these sources. The amount of pollutant contributed by a wastewater treatment plant is dependent on both the plant's effluent flow and pollutant concentration in the effluent, so a high concentration of a pollutant in the effluent may not represent a significant source in the receiving water if WWTP effluent flows are low. Effluent flows at Shelley and Firth from January 2000 to September 2003 averaged less than 1 cfs (Table 2-20), while average effluent flow at Blackfoot, for the same period, was 2.45 cfs. In contrast, flows in the Snake River near Blackfoot averaged 4,840 cfs (Water Years 1910-2002; Brennan et al. 2003); it is understandable why these point sources do not impact Snake River water quality to any significant degree.

Aberdeen WWTP discharges directly to Hazard Creek/Little Hole Draw, a tributary to American Falls Reservoir. Work by BOR and the Poulsons documented high nutrient levels in Hazard Creek/Little Hole Draw. Aberdeen WWTP is a source of both nitrogen and phosphorus in Hazard Creek/Little Hole Draw.

3.1.2. Nonpoint Sources and Pollutant Transport

Agriculture is a major source of nutrient loading in the upper Snake River Basin, which includes American Falls Subbasin. Clark (1994) studied nutrients in the upper Snake River Basin, segregating sites into unaffected or minimally-affected, agriculturally-affected, or mainstem categories. He found significantly ($p<0.05$) higher concentrations of nitrite plus nitrate, total nitrogen, dissolved orthophosphate, and total phosphorus at agriculturally-affected and mainstem river stations than at unaffected river stations. Concentrations of nitrite plus nitrate, total nitrogen, and total phosphorus at agriculturally-affected stations were significantly higher than at mainstem stations. In subsequent work, Clark (1997) found significantly ($p<0.05$) lower levels of nutrients and sediment in watersheds with less than 10% agricultural land use than in watersheds where agricultural land use was greater than 10%.

DEQ (2001a) identified agriculture as the major source of nitrates in ground water in the state. Agricultural sources (fertilizer, manure, legumes) were estimated to contribute 93% of the nitrates while septic systems and other sources were responsible for 1% and 5%, respectively.

Water quality monitoring by the Poulsons and BOR provided data used to quantify nutrient and sediment contributions to American Falls Reservoir from tributaries, drains, and springs. These water bodies include Clear Creek, Crystal wasteway, Danielson Creek, Hazard Creek/Little Hole Draw, Seagull Bay tributary, Sterling wasteway, Spring Creek, Spring Hollow drain, and Sunbeam Creek.

A major contributor of both sediment and nutrients to American Falls Reservoir is an out-of-subbasin tributary, Portneuf River. Clark (1997) in his study of nutrients, suspended sediment, and pesticides in the upper Snake River Basin, found that concentrations of nutrients and suspended sediment were generally smaller at sites above American Falls Reservoir than at sites below the reservoir. Of the above-reservoir sites sampled, Portneuf River contained the highest levels of nutrients and sediment.

Bushnell (1969) noted two airborne sources of nutrients into the reservoir: rainfall and waterfowl feces. Rainfall can be a source of several nutrients: analysis of rain collected in gages at Pocatello Airport, Aberdeen Experiment Station, and American Falls Dam showed levels of ortho and total phosphate, ammonia, nitrate, and organic nitrogen. American Falls Reservoir is home to resident waterfowl in addition to being a major stop for migratory birds; resulting feces deposits can be a source of phosphorus to the system.

Waterfowl have been documented as a source of nutrients in lakes and reservoirs (Manny et al. 1975, Manny et al. 1994, Marion et al. 1994, Bureau of Reclamation 2001). Manny et al. (1994) estimated that an average Canada goose contributed 1.57 grams of nitrogen and 0.49 grams of phosphorus per day (based on a defecation rate of 28 times per day) to Wintergreen Lake, Michigan. For ducks, it was assumed that their nutrient contribution was proportional by body weight to that of Canada geese. From the data available, it was estimated that waterfowl annually contribute 0.85 tons of phosphorus and 2.73 tons of nitrogen (Table 3-1).

Several factors conspire to make these waterfowl nutrient loadings very coarse estimates. It was assumed that all the nutrient contribution was from off reservoir (i.e., waterfowl fed off reservoir but all defecation occurred on reservoir). The defecation rate used by Manny et al. (1994) was 28 times per day though they cited another study with a goose defecation rate of 92 times per day. Bird counts only occur twice a year and the spring count is only of nesting geese. No counts were made of other birds (e.g., gulls), which can also be a source of nutrient loading. Despite the inherent error with the estimates, the numbers were so low that until more data are available, waterfowl do not appear to be a significant source of nutrients to the reservoir.

Another source of phosphorus exists within the reservoir in the bottom sediments. Internal recycling of phosphorus occurs when low dissolved oxygen levels at the bottom of the reservoir create conditions where phosphorus attached to sediments is released into the water column.

A large amount of sediment found in American Falls Reservoir originates within the reservoir. Wind driven waves have created 20 to 40 foot high cliffs and eroded the shore by hundreds of feet (Hoag and Short 1992). The pattern of filling and drawdown in the reservoir has also contributed to shoreline instability (Young 1988). Much of the land lost was high value cropland

Table 3-1. Waterfowl nutrient loading in American Falls Reservoir. It was assumed that nutrients were ingested off reservoir and deposited on reservoir.

Species	Status	Number of birds	Number of days present[1]	Equivalent effective goose days[2]	Mean total phosphorus/ goose/day (g)[3]	Total phosphorus load (tons/yr)	Mean total nitrogen/ goose/day (g)[3]	Total nitrogen load (tons/yr)
Geese/swans	Migrant	8,378[4]	120	1,005,360	0.49	0.54	1.57	1.74
Ducks/coots	Migrant	10,249[4,5]	120	522,699	0.49	0.28	1.57	0.90
Canada goose	Resident	140[6]	365	51,100	0.49	0.03	1.57	0.09
Total						0.85		2.73

[1]migrants assumed to stay from November to February - Carl Anderson, wildlife biologist, Idaho Department of Fish and Game, personal communication

[2]calculated by dividing the average weight of dabblers (1.18 kg) and divers (1.01 kg) by average weight of Canada goose (2.56 kg) for rates of 0.46 and 0.39, respectively, times the number of days present - Manny et al. 1994

[3]from Manny et al. 1994

[4]numbers from Jan 02 & 03 counts on reservoir - Carl Anderson, wildlife biologist, Idaho Department of Fish and Game, personal communication

[5]assume half of duck/coot numbers are dabblers and half are divers

[6]numbers from annual spring count of nesting pairs of geese on reservoir 1999 to 2003 counts on reservoir - Carl Anderson, wildlife biologist, Idaho Department of Fish and Game, personal communication

Another source of sediment in the Snake River is stream bank erosion. Sampson et al. (2001) and BOR (2002) in their studies of the river between Ferry Butte and American Falls Reservoir noted extreme erosion in certain areas (e.g., Fort Hall Monument site). Although changes to the Snake River in this reach have been a result of human impacts, the river's behavior in relation to these impacts has not been outside the norm.

3.1.3. Pollutant Sources in Bannock Creek Watershed

There are no point source dischargers located in Bannock Creek watershed. Thus, all pollutants originate from non-point sources.

A number of factors coalesce in Bannock Creek watershed resulting in excessive sediment and nutrient loading to Bannock Creek. The major land uses in the watershed are rangeland along with dryland and irrigated agriculture. Land management activities, considered nonpoint pollutant sources, caused increased loading of nutrients and sediment into Bannock Creek and its tributaries. Increased erosion of stream banks along Moonshine, Knox and Rattlesnake creeks is a chronic source of elevated levels of turbidity, deposition of fine sediment within the streambed, and the loss of habitat diversity. Stream bank stability has been degraded, primarily as a result of historic grazing practices, which have had a significant impact on the riparian vegetation and stream bank slopes. It is important to note that while West Fork Bannock Creek is listed on the 1998 303(d) list, this tributary presently displays significant water quality and habitat improvement. These improvements are directly related to the management measures (fencing of riparian corridor) that have been implemented in the subwatershed. This improvement in water and habitat quality is deemed significant enough to consider West Fork a viable target for gaging the level of improvement necessary in other 303(d) listed water bodies within Bannock Creek watershed. Table 1-9 shows land uses of Bannock Creek watershed and its tributaries.

Based on existing data, unimproved roadways throughout Bannock Creek watershed are not considered significant sources of sediment loading. Because development of a TMDL for contact recreation will be deferred until additional *E. coli* data are collected, no assessment of potential bacteria sources was conducted as part of this subbasin assessment.

3.2. Data Gaps

Data gaps, for point sources and nonpoint sources, are described in the following.

3.2.1. Point Sources

Monitoring by NPDES dischargers has been minimal, especially for nutrients. Additional monitoring for nutrients in the point source outfall and ambient monitoring both upstream and downstream of the source are needed. Collection of such data will improve nutrient loading estimates for the respective permit holders.

3.2.2. Nonpoint Sources

While the nutrient and sediment TMDLs required for Bannock Creek watershed focus only on nonpoint source pollutants (since there are no point source dischargers in the watershed), added information on nonpoint source loadings would be beneficial to better categorize nutrient and sediment loading by land use category. More data could validate the significance of unimproved roads within Bannock Creek as sources of sediment. Additional chemical, biological, and physical data collected on Bannock Creek and its tributaries would be useful to refine estimates that differentiate sediment loading contributed by the watershed from the sediment loading coming from stream reaches with poor stream bank stability. To adequately determine the spatial and temporal extent of impairment caused by sediment loading, and to refine TMDL reductions for sediments, a comprehensive approach is necessary to measure a variety of stream habitat variables. Variables to evaluate should include, but not be limited to, stream profile, instream vegetation composition, bank vegetation composition/stability, and pool:riffle ratio. The collection of additional nutrient and sediment data should also be considered to more adequately depict spatial and seasonal variation in pollutant loading, which will ultimately aid in refining pollutant reduction goals and improving the targeting and design of best management practices. Consideration should also be given to evaluating the biomass of algae affecting Bannock Creek and its tributaries as well as documentation of the limiting nutrient(s) to the algal community.

Other data gaps also warrant consideration. The source of sediment in McTucker Creek is unknown. While Knox Creek was added to the 1998 303(d) list as not supporting cold water aquatic life use, further water quality data are necessary to identify a specific pollutant of concern. More bacteria data are required for Bannock Creek (off reservation and on reservation) to adequately assess contact recreation use. Identification and monitoring of all springs that flow into the reservoir is needed. The contribution, primarily nutrients, of springs inundated by the reservoir during high storage periods needs to be refined. The extent to which windblown sediment contributes to sediment loads in the reservoir is unknown. Another possible source of nutrient input is errant irrigation water laden with fertilizer (i.e., chemigation); the extent of this problem is not known.

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

The extent to which implementation of the NPDES program has reduced pollutant wasteloads in the subbasin is unknown, but most likely substantial. The program has, at the very least, caused dischargers to be cognizant of the constituent make-up of their effluent. The recent requirement by EPA that construction activities, which disturb more than one acre, control their stormwater through an NPDES permit will also reduce pollutant loads to nearby surface waters.

Much work has been expended to reduce shoreline erosion in American Falls Reservoir and the resulting loss of valuable cropland. BOR tried several methods (e.g., posts/tires and posts/fence) to control shoreline erosion. A combination of geotextile material and rock rip-rapping had the most success, but proved expensive (Hoag and Short 1992). To reduce costs, BOR began work with the NRCS Plant Materials Center in Aberdeen to find a vegetative solution to erosion control. Willow plantings have been successful in some areas, and the two agencies continue to work on refining planting techniques to reduce costs and increase plant survival. Of the 85 miles of shoreline around the reservoir that has been identified as being in highly erodible soils, 53 miles are considered to be highly erosive (Alicia Lane Boyd, Bureau of Reclamation/Burley, personal communication). BOR has placed 15 miles of rock or other nonerodible material in these areas, and performed erosion control work on an additional 20 miles of shoreline. Another 18 miles of shoreline is scheduled to have erosion control work done in the future.

Sampson et al. (2001) and Bureau of Reclamation (2002) quantified and evaluated stream bank erosion and channel changes in the Snake River. Some recommendations in Sampson et al. (2001) were implemented such as rock barbs and constructed log jams (Candon Tanaka, Shoshone-Bannock Tribes, personal communication).

Water quality in Bannock Creek watershed has benefited from a couple of projects and programs. Considerable improvement in stream bank stability has been achieved in the West Fork subwatershed of Bannock Creek since the riparian corridor has been completely fenced off from livestock (Candon Tanaka, Shoshone-Bannock Tribes, personal communication). The federal Conservation Reserve Program has resulted in a decrease in the acreage of dryland farming in the uplands (off reservation) at the headwaters of Bannock Creek, which most likely has decreased sediment and nutrient loading to the creek.

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5. Total Maximum Daily Loads

To assure water quality standards are met, a TMDL prescribes an upper limit for discharge of a pollutant from all sources. It allocates this upper limit, or *load capacity* (LC), among the various sources of the pollutant. Pollutant sources fall into two broad classes: point sources, each of which receives a *wasteload allocation* (WLA); and nonpoint sources, which receive a load allocation (LA). Subbasin point sources discharge into the Snake River or the reservoir; there are no point source dischargers in Bannock Creek or McTucker Creek watersheds. Natural background (NB), when present, is considered part of the load allocation, but is often identified individually because it represents part of the load not subject to control. Estimates of NB can be difficult in highly modified water bodies, such as those found in American Falls Subbasin. Sometimes, natural background levels of reference streams (similar streams with little human impact) can be used as a surrogate for the stream of interest. Unfortunately, finding reference streams in southern Idaho is difficult, especially for a stream the size of the Snake River. For American Falls Subbasin TMDLs, it was assumed that natural background levels are included in target concentrations chosen for nutrients and sediment.

Because of uncertainties regarding quantification of loads and the relation of specific loads to attainment of water quality standards, rules regarding TMDLs (Water quality planning and management, 40 CFR 130) require a margin of safety (MOS) be a part of the TMDL. Practically, both NB and MOS are reductions in the load capacity that would otherwise be available for allocation to human-caused sources of pollutants.

The TMDL can be summarized symbolically as the equation: LC = MOS + NB + LA + WLA = TMDL. The equation is written in this order because it represents the logical order in which a loading analysis is conducted. First LC is determined, and then LC is broken down into its components: the necessary MOS is determined and subtracted; then NB, if relevant, is quantified and subtracted; and then the remainder is allocated among pollutant sources. When the breakdown and allocation is completed, a TMDL results must equal LC.

There are several additional aspects to the loading analysis including quantification of pollutant loading by source and consideration of critical conditions. Quantification of current pollutant loads by source allows for specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary in order for pollutant trading to occur. A requirement of the loading analysis is that LC be based on critical conditions – the conditions when water quality standards are most likely to be violated. Critical conditions are expected to recur on a regular basis such as calculating flows based on 7Q10 (the lowest streamflow for 7 consecutive days that occurs on average once every 10 years). If protective under critical conditions, a TMDL will be more protective under other conditions. Because both LC and pollutant source loads vary, sometimes independently, determination of critical conditions can become fairly complicated.

A load is fundamentally a quantity of a pollutant discharged over some period, and is the product of concentration and flow. Due to the diverse nature of various pollutants, and the difficulty of strictly dealing with loads, federal rules allow for “other appropriate measures” to be used when necessary. These “other measures” must still be quantifiable, and relate to water quality standards, but they allow flexibility to deal with pollutant loading in more practical and tangible ways. The rules also recognize the particular difficulty of quantifying nonpoint loads, allowing "gross allotment" as a load allocation where available data or appropriate predictive techniques limit more accurate estimates. For pollutants whose effects are long term, such as sediment and nutrients, EPA allows for seasonal or annual loads.

The goal of TMDLs established in this report is to restore "full support of designated beneficial uses" of water quality limited assessment units in American Falls Subbasin (Idaho Code 39.3611, 3615). As detailed in Section 2, these TMDLs are necessary to restore and maintain cold water aquatic life, salmonid spawning, and contact recreation beneficial uses designated in Idaho Water Quality Standards (see Section 2.2) for those 303(d)-listed water bodies in the subbasin. Nutrients and sediment are defined under state water quality standards by narrative, rather than numeric, criteria. For these pollutants, DEQ and the Shoshone-Bannock Tribes have collaborated to derive surrogates or numeric translators as instream water quality targets to establish TMDLs. These surrogates relate to DEQ's goal of supporting beneficial uses by establishing a threshold above which it appears that concentrations or loads of nutrients and sediment have a recognizable impact on aquatic life. Surrogates also create the basis for DEQ and Shoshone-Bannock Tribes to aim their water quality management strategies at "a quantifiable measure" rather than a qualitative measure as is subjectively defined in existing narrative criteria. Surrogate instream water quality targets outlined below for nutrients and sediment allow the flexibility necessary to address characteristics of both nonpoint and point sources of pollutants in more practical and tangible ways.

The following sections of this report present TMDLs required to address excessive pollutant loads in American Falls Subbasin. TMDLs addressing nutrients (phosphorus) were written for the Snake River, Bannock Creek, and various tributaries, springs, and drains discharging to American Falls Reservoir. Sediment TMDLs were prepared for the Snake River, Bannock Creek, West Fork Bannock Creek, Moonshine Creek, Rattlesnake Creek, McTucker Creek, and Sunbeam Creek. Wasteload allocations were developed for subbasin point sources. Problems not addressed in this report include flow alteration in Snake River and bacteria in Bannock Creek. Algal densities and the resulting decay exacerbate dissolved oxygen problems in American Falls Reservoir, and it is assumed a reduction in chlorophyll *a* will lead to support of appropriate dissolved oxygen levels in the reservoir.

5.1. Instream Water Quality Targets

End points are set with the idea that their attainment will support beneficial uses. To achieve beneficial use support, end points include both water quality standards and targets. Standards are codified in DEQ's Water Quality Standards and Wastewater Treatment Rules (58.01.02).

Targets are recommended for narrative standards, those standards that do not specify a numeric value necessary to achieve beneficial use support. Targets are proposed that, if achieved, have a great likelihood of leading to support of beneficial uses. The ultimate goal is to support beneficial uses, not to meet target criteria. Should reductions in pollutant loading result in achievement of beneficial uses prior to meeting the recommended target, then there may be no need to reduce loads further to meet the target (except to allow for a margin of safety). Equally, if the target were to be met and beneficial uses not supported, the chosen target would be reexamined and possibly made more stringent.

5.1.1. Design Conditions/Seasonal Variation

Critical periods are not proposed for dissolved oxygen, bacteria, or sediment. Water quality standards for dissolved oxygen and bacteria do not account for seasonality. Effects of sediment in aquatic systems are not limited to a particular time of year, whether they are water column effects from abrasion or decreasing visibility, or sediment accumulation filling interstitial substrate spaces, degrading the area for salmonid spawning use.

For the Bannock Creek watershed analysis, to qualify the seasonal and annual variability and critical timing of sediment loading, climate and hydrology must be considered. This sediment analysis characterizes sediment loads using average annual rates determined from empirical characteristics developed over time within the influence of peak and base flow conditions. While deriving these estimates, it is difficult to account for seasonal and annual variation within a particular time frame; however, seasonal and annual variation is accounted for over the longer time frame under which observed conditions have developed. Annual erosion and sediment delivery are primarily a function of climate where wet water years typically produce highest sediment loads. Additionally, annual average sediment load is not distributed equally throughout the year. Erosion typically occurs during a few critical months. For example, in Bannock Creek watershed, most stream bank erosion occurs during spring runoff while most hillslope erosion occurs during summer thunderstorms and spring runoff. Given the variability of sediment loading, these TMDLs are expressed as annual average loads.

The critical period for nutrients affecting beneficial uses generally is the warmer months of summer and early fall. Nutrients promote growth of aquatic vegetation, which usually is at highest density in late summer - a time of high recreational use. When vegetative matter such as algae dies, it sinks to the bottom where microbial action uses oxygen to breakdown organic matter. Warmer water temperatures occur in summer, and because saturation levels of gases decline as temperature increases, decreased concentrations of dissolved oxygen result. These conditions stress aquatic biota when oxygen levels are low, and respiration of dense aquatic vegetation pushes dissolved oxygen concentrations lower. The target concentration for chlorophyll *a* in American Falls Reservoir will be an average concentration for July and August – times of greatest concern for high densities of algae and dissolved oxygen problems.

The extent to which either nitrogen or phosphorus exceeds seasonal load capacity is unknown. The tendency for the uptake of phosphorus as phosphates by sediment creates the potential for phosphorus availability throughout the growing season regardless of time of input. Phosphorus in sediment is directly available for uptake by rooted aquatic vegetation, and becomes available to algae or surface vegetative growth when phosphorus adsorbed to sediment is released into the water column under anoxic (no oxygen) conditions. Conversely, nitrogen tends to remain dissolved and will “flow through” in lotic, or stream, systems. Lentic waters (e.g., lakes and reservoirs) act as sinks for nutrients, especially phosphorus, increasing the available time for uptake by aquatic vegetation. Thus, phosphorus or nitrogen that entered a stream in February could be bioavailable to aquatic vegetation in a reservoir in July when conditions are conducive to algal or macrophytic growth. Due to concern about American Falls Reservoir, which is on the 303(d) list for nutrients, no allowance for seasonal variation in nutrient loading is made.

Loads are calculated on a mass per unit time basis. An actual total maximum daily load is too refined (i.e., daily basis) to be practical for nonpoint source pollutants. At the other extreme, a total maximum annual load may mask short, intense periods (i.e., spring runoff or episodic storm events), when loads are excessive and need to be controlled, followed by longer periods of relative inactivity. Therefore, some period between daily and annual loads is needed.

For American Falls Subbasin, mass per unit time varied by pollutant. Bacteria loads were based on a geometric mean of five samples collected over a 30-day period per state water quality standards. Sediment loads were based on a two-week average concentration, not to exceed the annual load allocation. Nutrient loads were allocated on an annual basis, not to exceed in any one month the prorated annual load allocation.

5.1.2. Target Selection

Selection of appropriate end points to support beneficial uses in American Falls Subbasin incorporated current water quality standards for bacteria and dissolved oxygen, or targets for nutrients and sediment. Selected targets were chosen based on suggested literature values (e.g., EPA-recommended criteria) or values used in TMDLs written for similar water bodies.

5.1.2.1. Flow Alteration

The Snake River is listed for flow alteration. Although the river is at times impaired due to lack of flow, EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required for water bodies impaired by pollution but not pollutants, a TMDL for flow alteration has not been established for the Snake River.

5.1.2.2. Dissolved Oxygen

Dissolved oxygen is listed as a problem in American Falls Reservoir and the Snake River from Ferry Butte to the Bingham-Bonneville county line. Dissolved oxygen standards vary between streams and lakes or reservoirs (IDAPA 58.01.02.250.02.a). To support cold water aquatic life in streams, dissolved oxygen levels must exceed 6 mg/L at all times. For lakes and reservoirs, the 6 mg/L DO standard also applies to the top 80% of water depth where depths are 35 m or less (e.g., American Falls Reservoir). In stratified lakes and reservoirs, the standard applies to the top layers of water (epilimnion and metalimnion), but not to the bottom layer (hypolimnion).

5.1.2.3. Bacteria

Only Bannock Creek has any indication of possible impairment from bacteria. State water quality standards for primary and secondary contact recreation require levels of *E. coli* not exceed a 30-day geometric mean (based on 5 samples) of 126 organisms/100 ml of water (IDAPA 58.01.02.251).

5.1.2.4. Nutrients

American Falls Reservoir, the Snake River, and Bannock Creek are listed for impairment of beneficial uses due to nutrients. It is presumed that phosphorus is the limiting nutrient, therefore a target has been set only for phosphorus.

EPA has issued several documents providing guidance on nutrients, especially phosphorus, in aquatic systems. The EPA (1986) “Gold Book” recommended, for streams that do not discharge into lakes or reservoirs, a target of 0.1 mg/L of total phosphorus. For those reaches that discharge into a lake or reservoir, the Gold Book suggests a threshold of total phosphorus of 0.05 mg/L. In EPA Ambient Criteria, total phosphorus in reference sites, based on the 25th percentile, ranged from 0.010 to 0.055 mg/L. The recommended target of 0.05 mg/L for stream reaches represents a 9% reduction from the upper end of the reference site range. It also is in line with the "Gold Book" recommendation of total phosphorus not exceeding 0.05 mg/L for reaches discharging into lakes or reservoir. (Note: this total phosphorus target is a change from that recommended in the original TMDL for the Portneuf River [DEQ 2001b] and was reflected in the TMDL when it was revised in 2009.)

DEQ acknowledges uncertainties and data gaps regarding the 0.05 mg/L total phosphorus target. Within 5 years after the approval of this TMDL, DEQ will gather additional data and conduct additional analysis. Until the TMDL is reevaluated, and while the additional data is being gathered, an interim water quality target of 0.07 mg/L total phosphorus must be met. DEQ has selected this interim target based upon data comparing median chlorophyll *a* concentration with median total phosphorus concentration data for lakes and reservoirs in the Pacific Northwest. These data suggest that, for the water bodies evaluated, total phosphorus concentrations of 0.07 mg/L correlate with chlorophyll *a* concentrations of 15ug/L or less.

Although phosphorus is most likely the limiting nutrient in American Falls Reservoir, there is uncertainty as to the role nitrogen plays in nutrient dynamics. At this time, no target will be considered for nitrogen.

A target concentration of 0.015 mg/L of chlorophyll *a* is recommended for American Falls Reservoir. EPA Ambient Criteria found that reference conditions (based on the 25th percentile of evaluated water bodies) for chlorophyll *a* ranged from 0 to 0.0246 mg/L. The 0.015 mg/L target falls closer to the middle of this range, although EPA did note 0.0246 mg/L appeared to be "inordinately high." Oregon uses a criterion of 0.015 mg/L of chlorophyll *a* (based on an average of a minimum three samples collected over any three consecutive months at a minimum of one representative location) to identify water bodies where phytoplankton may impair recognized beneficial uses (IDEQ and ODEQ 2004), and a slightly lower, site-specific target of 0.014 mg/L was adopted for the Snake River-Hells Canyon TMDL (IDEQ and ODEQ 2004). For American Falls Reservoir, this target is an average concentration of at least two samples per month at three sites (lower, mid, and upper reservoir) for July and August.

5.1.2.5. Sediment

Sediment is a problem throughout American Falls Subbasin. Except for Bannock Creek watershed, an average concentration not to exceed 60 mg/L of suspended sediment over a 14-day period is recommended for water bodies in American Falls Subbasin listed for sediment problems. This target concentration falls within the range, 25-80 mg/L, of suspended solids recommended by the *European Inland Fisheries Advisory Commission* (EIFAC 1964) for maintaining good to moderate fisheries.

In addition to the EIFAC (1964) report, which linked excess sedimentation to use impairment, the 60 mg/L suspended sediment target is in line with other "local" standards and targets. Nevada (NDEP Web site) has state standards for suspended solids in rivers and creeks that range from 25 to 80 mg/L. Joy and Patterson (1997) set targets at 56 mg/L in tributaries and return drains in the Yakima River in Washington for TSS. In the Bear River in Utah, TSS targets were 35 mg/L for smaller streams and 90 mg/L for larger streams (Ecosystem Research Institute 1995). DEQ has established seasonal targets of 50 mg/L and 80 mg/L for TSS in several subbasins (Boise River [Division of Environmental Quality 1999], Portneuf River [DEQ 2001b], Blackfoot River [DEQ 2001c]).

Bannock Creek is not included in this target because the paucity of long-term biological, chemical, and physical data on Bannock Creek and its tributaries hampers any attempt at developing numeric translators that reflect representative water quality conditions and appropriate uses. As is the case with the development of all water quality standards or numeric translators, significant amounts of water body-specific data are desired to adequately reflect background, historical, and current biological, chemical, and physical conditions of the water body. The more data available, the more accurately water quality criteria and designated uses can be linked and designed to reflect site-specific water quality conditions and seasonal variation. Therefore, to establish surrogates for sediment in Bannock Creek watershed, it is necessary to utilize water quality targets established by DEQ for similar streams in Idaho where more site-specific data are available.

As such, sediment TMDLs for Bannock Creek and its tributaries (West Fork, Moonshine Creek, Rattlesnake Creek) will focus on use of stream bank stability as the qualitative goal for restoring cold water aquatic life use. Stream bank erosion reductions can be quantitatively linked to sediment reduction. Other DEQ TMDLs (e.g., Little Lost River [DEQ 2000b], Blackfoot River [DEQ 2001c], Palisades [DEQ 2001d]) established a stream bank stability of 80% as an acceptable target, which was believed sufficient to support beneficial uses including cold water aquatic life and salmonid spawning. Bannock Creek watershed is sufficiently similar to these subbasins to justify use of an 80% stream bank stability target. Bannock Creek is in the same ecoregion (Northern Basin and Range) as Blackfoot River and borders the Middle Rockies Ecoregion of Little Lost River and Palisades subbasins. Geology, soils, and climates are generally similar between the two ecoregions (EPA et al. 2000). An inferential link is identified to show how sediment load allocations will reduce subsurface fine sediment to or below target levels. This link assumes that reducing chronic sources of sediment will decrease subsurface fine sediment and ultimately restore beneficial uses.

Stream bank stability estimates for Bannock and Rattlesnake creeks were derived from DEQ BURP data collected in June 1996 and July 2001. Table 1-7 indicates Bannock Creek mainstem had an average bank stability of 80%. This average was derived from BURP data that represented a portion of Bannock Creek outside of Fort Hall Reservation. Rattlesnake Creek, which has had historical erosion problems, has 34% average bank stability. No bank stability data were available for West Fork and Moonshine Creek.

While limited data exists on stream bank stability conditions of Bannock, Rattlesnake, and Moonshine creeks, field reconnaissance evaluations of West Fork indicate stream bank stability exceeds 80%. These improved conditions in West Fork are the result of careful management of this subwatershed over the past four years, specifically through the installation of fencing along the riparian corridor. These high quality habitat conditions are also substantiated by the low levels of TSS in West Fork estimated from model analysis. Therefore, the 80% stream bank stability and 31.11 mg/L TSS concentrations associated with West Fork provide suitable reference conditions from which to calculate TMDLs for sediment in the Bannock Creek watershed. Despite the fact that West Fork is on the 303(d) list, the significant improvement in water and habitat quality warrants consideration of West Fork as a viable target for gaging the level of improvement necessary in other 303(d) listed water bodies within Bannock Creek watershed. The TMDL calculations for Bannock Creek watershed assume an acceptable correlation exists between stream bank stability and instream TSS concentrations. The combination of these two surrogates provides reasonable measures from which sediment loading can be evaluated to achieve the prescribed reductions.

5.1.2.6. Point sources

Recommended targets for point sources followed those for nonpoint sources, or were based on the operator's NPDES permit, whichever was the more restrictive target. For example, permit requirements for suspended solids at Aberdeen and Blackfoot WWTPs are monthly average of 30 mg/L and weekly average of 45 mg/L. Permit requirements for Firth and Shelley were monthly average of 45 mg/L and weekly average of 65 mg/L. The monthly average concentrations were used to estimate target loads at the WWTPs. Suspended sediment data from the Bureau of Reclamation sampling (see Table E-1) was used to set limits for Crystal Springs Trout Farm. No point source had total nitrogen or total phosphorus limits in their NPDES permit, so a recommended target of 0.05 mg/L or 0.07 mg/L (interim) of total phosphorus was applied where applicable. Blackfoot WWTP has a specific ammonia limit, but all the facilities are subject to state water quality standards for un-ionized ammonia, which is toxic to aquatic life.

5.1.3. Margin of Safety

To account for uncertainty associated with insufficient data, and the relationship between pollutant loads and beneficial use impairment, a margin of safety (MOS) is included in development of load analyses. There are several ways to implement a margin of safety. For American Falls Subbasin, it was decided to choose conservative targets, which convey an inherent margin of safety when estimating load and wasteload allocations. The assumption was made that whenever targets were based on NPDES permits, requirements in the permit already included a margin of safety.

The MOS factored into load allocations for Bannock Creek watershed is implicit. Conservative assumptions made as part of the sediment loading analysis include: 1) desired bank erosion rates are representative of background conditions of 80% stream bank stability; 2) the *Generalized Watershed Loading Functions* (GWLF) modeling effort utilized transport and chemical parameters obtained by general procedures described in the GWLF manual. These procedures are conservative in nature as illustrated by the following:

- The GWLF model describes nonpoint sources with a distributed model for runoff, erosion and urban wash off, and a lumped parameter linear reservoir ground water model.
- Water balances are computed from daily weather data but flow routing is not considered. Hence, daily values are summed to provide monthly estimates of streamflow, sediment, and nutrient fluxes.
- All precipitation is assumed to exit the watershed in evapotranspiration or streamflow; assuming the rate constant for deep seepage loss is zero.
- During periods of streamflow recession, it is assumed that runoff is negligible, and hence streamflow consists of ground water discharge.
- Nutrient losses from plant cover are assumed to be 75% of the nutrient uptake of plants.
- Sediment transport capacity is proportional to runoff to the 5/3 power.

- Conservative Curve Numbers are selected by soil type and land use.

5.1.4. Monitoring Points

The objectives of a monitoring effort are to demonstrate long-term recovery, better understand natural variability, track implementation of projects and best management practices (BMPs) once they are developed, and oversee effectiveness of TMDL implementation. This monitoring and feedback mechanism is a major component of the “reasonable assurance of implementation” for the TMDL implementation plan. To the extent possible, DEQ, Shoshone-Bannock Tribes, BOR and others will collaborate to define data quality objectives that will guide monitoring throughout implementation of American Falls Subbasin TMDLs. Some of these watershed monitoring objectives will include the following:

- Evaluate watershed pollutant sources
- Refine baseline conditions and pollutant loading
- Evaluate trends in water quality data
- Evaluate the collective effectiveness of implementation actions in reducing sediment and nutrient loading to the reservoir, river, and/or tributaries
- Gather information and fill data gaps to more accurately determine pollutant loading

5.1.4.1. American Falls Reservoir

Monitoring within the reservoir should include the following:

- Documentation of the limiting nutrient(s) to the plankton community
- Bathymetric work for use in a reservoir model
- Identification of a reservoir model
- Collection of appropriate data to run the chosen model

5.1.4.2. Point sources

Data do not indicate that point sources (i.e., Blackfoot, Firth, and Shelley WWTPs) discharging into the Snake River are adversely affecting water quality. However, sampling sites are not immediately downstream of WWTP discharge points. Monitoring of the Snake River within a short distance below the discharge points would verify any effect of WWTPs on water quality in the river.

5.1.4.3. Bannock Creek

Downstream and upstream monitoring sites in each subwatershed should be established and used to determine total loading into Bannock Creek. Load capacity can then be estimated by calculating monthly loading at each downstream site. Upstream sites may be used to determine natural background loads, and any loading contributions from livestock grazing and dirt roads. Seasonal loads may be used to more accurately characterize loading variations and allocate reductions accordingly.

Monitoring parameters should include instream water column TSS, stream substrate fine sediment (depth fines), flow, sinuosity, width:depth and pool:riffle ratios, and stream bank erosion rates. Documentation of the limiting nutrient(s) to the algal community should be considered. In all streams, continued monitoring is necessary to ensure that characterization of these watersheds is complete; guarantee that appropriate BMPs (once developed) are used; and quantify BMP efficiency as sediment and nutrient reductions are made. Moreover, the TMDL process is iterative to assure refinements to management strategies can be made as needed.

5.2. Load Capacity, Estimates of Existing Pollutant Loads, Load Allocation

Load analyses were developed for nutrients and sediment. Nutrient and sediment analyses were done for the Snake River, Bannock Creek, and other tributaries, springs, and drains. A chlorophyll *a* target was recommended for American Falls Reservoir. Concomitant with attaining the chlorophyll *a* target is the assumption that dissolved oxygen water quality standards will be met. Wasteload analyses were completed for point sources. Several models were used to assist in load analyses.

5.2.1. Models

Models developed for this subbasin assessment are described in the following.

5.2.1.1. American Falls Reservoir

To evaluate the effects of phosphorus loading on phytoplankton and dissolved oxygen, a model was developed for American Falls Reservoir by Ben Cope of EPA. Based on a similar model used on Winchester Lake, Idaho and developed using STELLA software, the model is a one-dimensional (two cells in the vertical) dynamic framework, including modules for heat budgets, phosphorus cycling, phytoplankton kinetics, and dissolved oxygen (Cope 2004a). Data sources for parameters used in the model include DEQ, BOR, USGS, and National Weather Service.

Most models, however, have incomplete data and require certain assumptions in the analyses. There were several data gaps associated with the American Falls Reservoir model (these are listed in Table 5-1), and the following assumptions were necessary to run the model:

- Each layer (top and bottom) is a completely mixed volume. (The model assumes slight vertical stratification.)
- There is a single phytoplankton community (blue-green algae).
- There is no wind mixing (general mixing is captured in the diffusion coefficient).
- The temperature/density gradient occurs at 5-meter depth.
- There is no phosphorus loading from sediments.

The model was developed using 2001 observations of the system. Conditions were modeled for 1997, 1999, and 2001. The years were considered high-, mid high-, and low-flow years, respectively. For example, percentile rank for mean annual flow (1970-2003) at the Snake River near Blackfoot (Ferry Butte) for these water years showed rankings of 1.00 for 1997, 0.70 for 1999, and 0.00 for 2001 (Table 5-2). In other words, 1997 had the highest flow for the period; only 30% of the years had a higher flow than 1999; and, no year had a lower flow than 2001.

Generally, the model predicts observed patterns of water quality in American Falls Reservoir for June through early August. Several conclusions resulted from the modeling effort.

- The American Falls water quality model provides useful information for assessment of water quality dynamics in the reservoir as a whole, despite the observed heterogeneity in water quality across sampling locations. The model parameters estimated for 2001 resulted in reasonable estimates for chlorophyll, temperature, and dissolved oxygen in 2001 and 1968 (modeled because of high phosphorus concentrations observed in Snake and Portneuf rivers) during the July/August period of interest.
- Observations and simulations suggest that release of phosphorus from sediments is a significant source of phosphorus to the system during periods of stratification in July and August.
- A spring diatom bloom and subsequent settling may be contributing to diminished oxygen levels at depth during periods of stratification, thus contributing to release of orthophosphate from sediments.
- Portneuf River and a number of ungaged tributaries carry relatively high loadings of orthophosphate and total phosphorus to the reservoir, at times exceeding the loading from Snake River in a low water year (2001).
- Simulations suggest that, with zero phosphorus release from sediments and consumption of surplus orthophosphate in late July, phosphorus loadings from the tributaries would be sufficient to drive measurable productivity for the remainder of the summer and fall.
- Model simulations indicate periods of low flow (low water supply) and reservoir elevation (e.g., 2001) may not represent worst-case conditions for water quality in the reservoir.

Table 5-1. American Falls Reservoir model data gaps.

Parameter(s)	Problem	Model Assumptions or Estimation	Comments
water quality profiles in reservoir	no information prior to May or after early August	none	cannot evaluate simulations of spring or late summer conditions
Snake inflows of phosphorus	2001 sampling focused on summer months	interpolation used in winter/spring; constant values assumed in fall	simulated orthophosphate in reservoir suggest that inputs are reasonable
Portneuf inflows of phosphorus	no sampling in 2001; grab sampling over long term	long term average used	does not account for long term changes in average phosphorus
ground water & ungaged tributary phosphorus	very limited or no sampling	assumed equal to Snake River levels	higher levels known to exist in Portneuf - this is addressed by data at Tyhee gauge
ground water flows	no sampling	constant value assumed and water balance checked for 1999 and 2001	constant value (2,285 cfs) resulted in good water balance
Portneuf flows at mouth	Tyhee gauge not operated in 1997 and 1999	constant value added to Pocatello flows; checked years when both gauges operated	constant value (215 cfs) resulted in reasonable agreement at Tyhee

Table 5-2. Average flow and percentile rank for data from USGS Snake River gages.

		near Blackfoot (13069500)		at Blackfoot (13062500)		near Shelley (13060000)	
Year(s)	**Category**	Flow (cfs)	Percentile rank (WY1970-2003)[1]	Flow (cfs)	Percentile rank (WY1979-2003)[1]	Flow (cfs)	Percentile rank (WY1970-2003)[1]
1910-2002	water year avg	4,840	0.56				
1978-2002	water year avg			5,074	0.65		
1915-2002	water year avg					5,954	0.55
2000-2003	sample avg [2]	2,727	0.25	2,494	0.16	4,803	0.37
1989	water year	2,672	0.21	2,684	0.25	4,056	0.21
1989	sample avg [3]	2,570	0.19				
1990	water year	2,681	0.24	2,725	0.29	4,179	0.27
1990	sample avg [3]	2,442	0.16				
1991	water year	2,544	0.18	2,517	0.17	3,967	0.15
1991	sample avg [3]					4,066	0.22
1992	water year	2,113	0.09	2,293	0.08	3,548	0.06
1992	sample avg [3]	1,842	OR4				
1993	water year	3,464	0.36	3,484	0.46	4,769	0.36
1993	sample avg [3]	5,091	0.57			5,136	0.38
1994	water year	2,920	0.30	2,893	0.38	4,417	0.30
1994	sample avg [3]	2,630	0.20				
1995	water year	4,408	0.52	4,488	0.63	5,713	0.55
1995	sample avg [3]	6,223	0.62			7,656	0.63
1996	water year	7,633	0.76	7,618	0.79	9,014	0.79
1996	sample avg [3]	10,015	0.94				
1997	water year	11,910	1.00	11,630	1.00	12,800	1.00
1997	sample avg [3]	No sampling					
1998	water year	7,347	0.67	7,109	0.71	8,489	0.67
1998	sample avg [3]	7,998	0.83				
1999	water year	7,408	0.70	7,477	0.75	8,659	0.70
1999	sample avg [3]	No sampling					
2000	water year	3,667	0.39	3,775	0.50	5,358	0.42
2000	sample avg [3]	4,238	0.49	2,300	0.09	6,845	0.61
2001	water year	1,947	0.00	2,191	0.04	3,502	0.03
2001	sample avg [3]	1,906	OR[4]	2,062	0.02	3,758	0.13
2002	water year	2,085	0.06	2,326	0.13	3,595	0.12
2002	sample avg [3]	2,364	0.15	2,639	0.23	4,178	0.27
2003	water year	2,366	0.15	2,592	0.21	3,969	0.18
2003	sample avg [2]	2,620	0.20	2,899	0.38	4,807	0.37

[1]represents percentile rank of measured flow compared to annual average flows for water years 1970 or 1978 to 2003

[2]average flow for calendar year water quality sampling events; 2003 sampling January to July

[3]average flow for calendar year water quality sampling events

[4]OR = out of range - flow was outside the range of annual average flows from 1970 to 2003

5.2.1.2. Snake River

The Simple Method model was used to estimate stormwater runoff for the City of Blackfoot (Appendix D). Stormwater from an estimated 485 acres in the City of Blackfoot drains to the Snake River. Annual precipitation was 10.0 inches (25.4 cm) annually (Table 1-1). Loads were estimated for total phosphorus, nitrate+nitrite, and total suspended solids using event mean concentrations from data collected locally (Table 2-12).

5.2.1.3. Bannock Creek

Existing nonpoint source loads were estimated using the Generalized Watershed Loading Functions (GWLF) model. The model estimates dissolved and total nitrogen and phosphorus loads in surface runoff from complex watersheds. Both surface runoff and ground water sources are included, as well as nutrient loads from point and nonpoint sources and on-site wastewater disposal (septic) systems. Nutrient loads from septic systems were not modeled due to lack of data.

The GWLF model requires daily precipitation and temperature data, runoff sources and transport, and chemical parameters. Transport parameters include areas, runoff curve numbers for antecedent moisture condition II, and the erosion product USLEP (Universal Soil Loss Equation parameters) for each runoff source. Required watershed transport parameters are ground water recession and seepage coefficients, available water capacity of the unsaturated zone, sediment delivery ratio, monthly values for evapotranspiration cover factors, average daylight hours, growing season indicators, and rainfall erosivity coefficients. Initial values must also be specified for unsaturated and shallow saturated zones, snow cover, and 5-day antecedent rainfall plus snowmelt.

Input nutrient data for rural source areas are dissolved nitrogen and phosphorus concentrations in runoff and solid-phase nutrient concentrations in sediment. Daily nutrient accumulation rates are required for each urban land use. Remaining nutrient data are dissolved nitrogen and phosphorus concentrations in ground water.

For modeling purposes, Bannock Creek watershed was divided into subwatersheds: West Fork, Moonshine, Rattlesnake, and the remaining watershed (including Knox Creek). The model was run for each subwatershed separately using a five-year period, January 1998 - December 2002, and first year results were ignored to eliminate effects of arbitrary initial conditions. Daily precipitation and temperature records for the period were obtained from the Western Regional Climate Center (Web site c). All transport and chemical parameters were obtained by general procedures described in the GWLF manual (Haith et al. 1996), and values used in the model are in Appendix F. Parameters needed for land use were provided by DEQ, and those for soils were obtained from the State Soil Geographic (STATSGO) Database compiled by Natural Resources Conservation Service (NRCS). Figures 5-1 and 5-2 show land use and soils distributions within the watershed. For each land use area, NRCS Curve Number (CN), length (L), and gradient of the slope (S) were estimated from intersected electronic geographic information systems (GIS) land use and soil type layers. Soil erodibility factors (Kk) were obtained from the STATSGO database. Cover factors (C) were selected from tables provided in the GWLF manual (Haith et al. 1996). Supporting practice factors of P = 1 were used for all source areas for lack of detailed data. Area-weighted CN and Kk, (LS)k, Ck, and Pk values were calculated for each land use area. Coefficients for daily rainfall erosivity were selected from tables provided in the GWLF manual. Nutrient concentrations and accumulation rates were estimated from tables provided in the GWLF manual. Model inputs variables are listed in Table 5-3.

5.2.2. Bacteria

As discussed previously in Section 2.4, additional *E. coli* data are necessary to assess attainment status of contact recreation in Bannock Creek. A quality assurance project plan will be prepared through a collaborative effort between DEQ and Shoshone-Bannock Tribes to define an effective water quality monitoring approach to be implemented in 2004. These additional data are necessary to determine if a TMDL for *E. coli* is warranted.

5.2.3. Dissolved oxygen

American Falls Reservoir is listed as having dissolved oxygen concerns in the reservoir. The assumption is that control of nutrients and subsequent reduction in algal densities will lead to attainment of water quality standards for dissolved oxygen. To help confirm this assumption, dissolved oxygen conditions in the reservoir were modeled under three scenarios of total phosphorus loading: current conditions; future condition when recommended load reductions are met (Table 5-4); and, future condition when recommended load reductions are met, but loads in the Snake River increase to the target concentration of 0.05 mg/L of total phosphorus. Model results (Cope 2004b) show virtually no difference amongst the three scenarios in dissolved oxygen levels in the upper 5-meter layer in the reservoir (Table 5-5). A change (increased concentration of over 1 mg/L of dissolved oxygen) is observed under average and high flow conditions in the bottom 5 meters of water under both future condition scenarios.

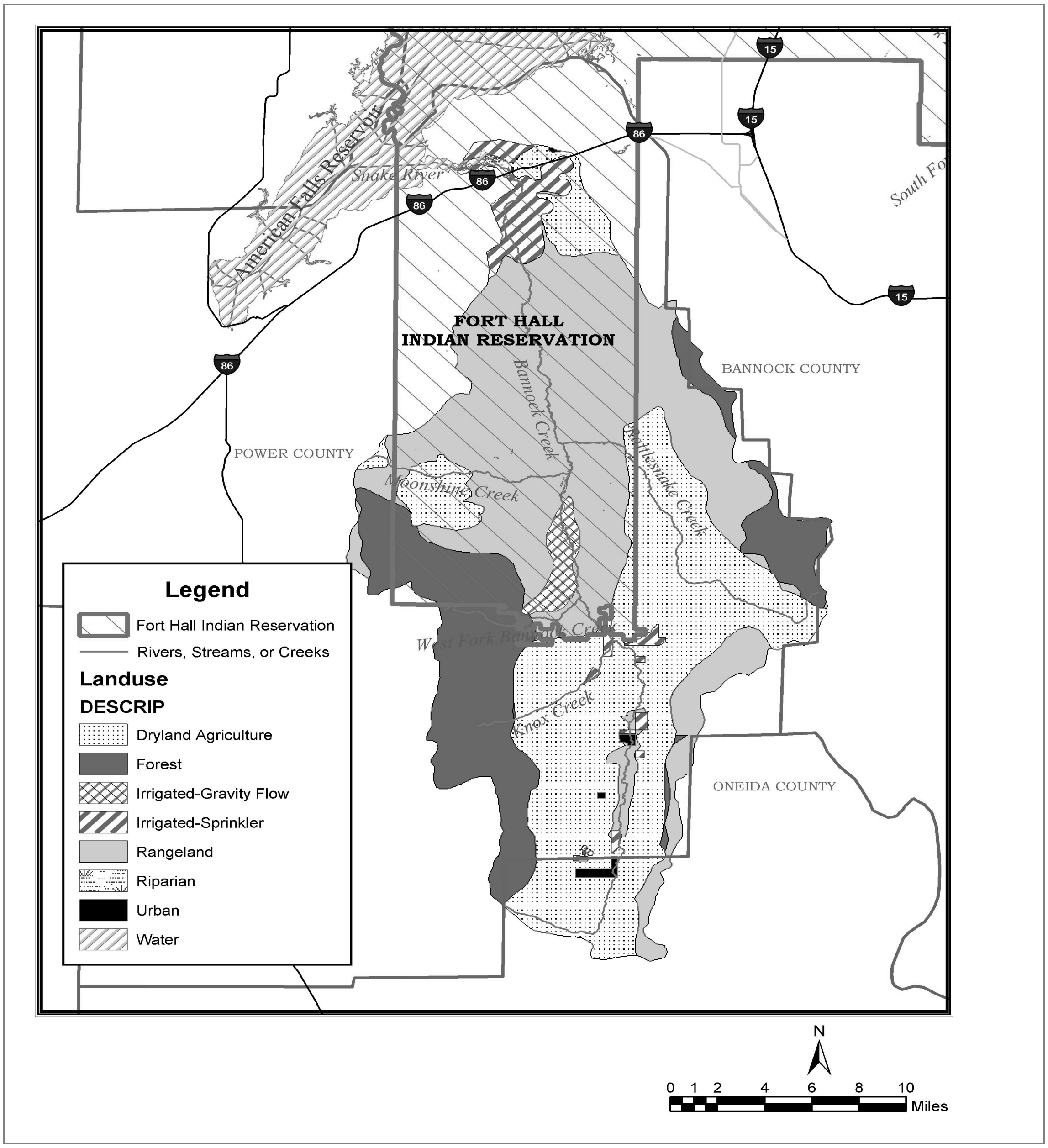

Figure 5-1. Bannock Creek watershed land use.

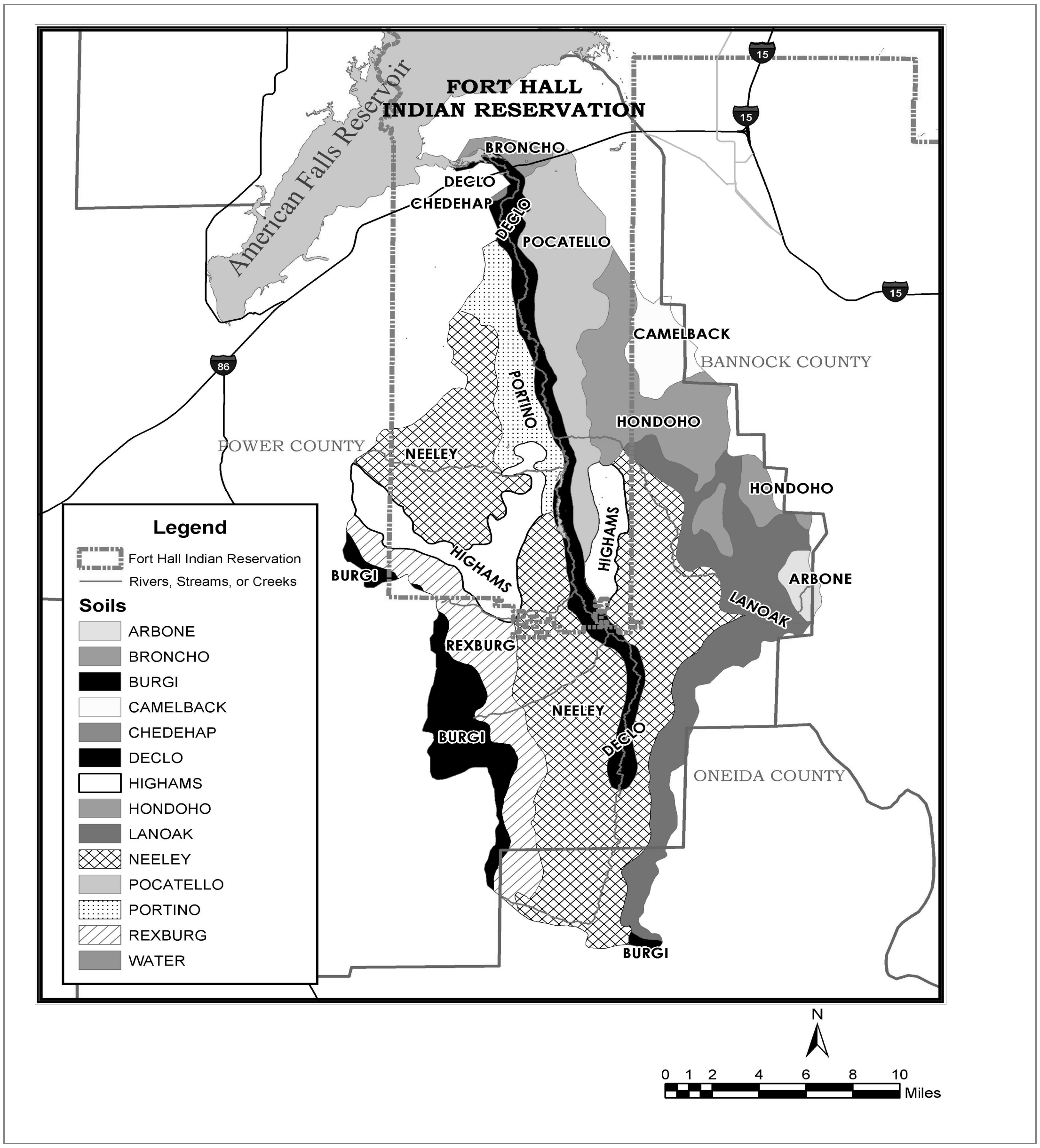

Figure 5-2. Bannock Creek watershed soil.

Table 5-3. Bannock Creek watershed modeling input variables and outputs.

Water body	Drainage area (hectare)	Stream flow (cm)	Streamflow (m^3)	TN (mg)	TN (mg/L)	TP (mg)	TP (mg/L)	Sediment (mg)	Sediment (mg/L)	Sediment (tons)	Sediment load capacity (tons)	Percent reduction
West Fork	3,901	4.12	1,607,212	1.4	0.87	0.18	0.11	50	31.11	55.1	55.1	0
Knox Creek	6,038	4.18	2,523,884	2.18	0.86	0.03	0.01	90	35.66	99.2	86.6	12.8
Moonshine Creek	11,680	4.2	4,905,600	4.3	0.88	0.6	0.12	350	71.35	385.8	168.2	56.4
Rattlesnake Creek	21,054	4.25	8,947,950	7.3	0.82	1.05	0.12	575	64.26	633.8	306.9	51.6
Bannock Creek	64,290	4.3	27,644,700[1]	40.3	1.46	4.08	0.15	950	34.36	1047.2	948.0	9.5
Total	106,963		45,629,346		1.22		0.13		44.16	2,221.157		

[1]average flow at mouth = 51.1 cfs

Table 5-4. Modeled TMDL target concentrations for total phosphorus based on average flow.

Source	TMDL target load (lbs/year)	Average flow (cfs)	TMDL target concentration (mg/l)
Snake River	334,000	4,800	0.035
Portneuf River	43,500	440	0.05
Smaller creeks, including Bannock Creek	51,000	750	0.035
Ground water	75,500	1,540	0.025

Notes:

- Ground water values based on assumed TP concentration of 0.025 mg/l. This concentration is used only for modeling purposes and does not reflect any attempt to establish a ground water standard for total phosphorus.
- DEQ has developed a specific target loading for Bannock Creek

Table 5-5. American Falls Reservoir model results for three TMDL scenarios.

	Minimum depth-averaged dissolved oxygen (mg/L) July through August						**Mean chlorophyll *a* concentration (mg/L) July through August**		
	Top 5 meters			Bottom 5 meters					
Scenario	2001 (low flow year)	1999 (mid-high flow year)	1997 (high flow year)	2001 (low flow year)	1999 (mid-high flow year)	1997 (high flow year)	2001 (low flow year)	1999 (mid-high flow year)	1997 (high flow year)
Existing conditions	6.9	7.0	6.9	6.0	4.2	3.2	0.010	0.034	0.035
Load allocations achieved	6.9	7.0	7.0	6.0	5.1	4.2	0.007	0.014	0.019
Load allocations achieved, Snake River load increased to target TP concentration of 0.05 mg/L	6.9	7.0	6.9	6.0	5.3	4.5	0.008	0.017	0.023

Notes:

- 2001 weather data used for all model simulations
- TMDL simulations assume constant input concentrations of target total phosphorus (Table 5-4)
- existing conditions simulations include time variable, Snake River phosphorus based on 2001 sampling, average concentration for year = 0.027 mg/L
- all simulations assume existing ratios of total phosphorus/ortho-phosphorus
- July/August mean is mean of 62 daily chlorophyll *a* values
- assumes no internal loading
- like flows, reservoir surface elevations generally low in 2001 and high in 1997

There are few options available to increase dissolved oxygen other than control of aquatic vegetative growth through nutrient input. Until data show otherwise, the working premise for improvement of dissolved oxygen in American Falls Reservoir will be reduction of nutrients loads and concomitant decreases in algal densities.

No data were encountered to indicate that dissolved oxygen was a problem or that water quality standards were being violated in the Snake River. Therefore, no TMDL will be written for dissolved oxygen in the Snake River.

5.2.4. Nutrients

Nutrient loadings for each of the water bodies are discussed in the following.

5.2.4.1. American Falls Reservoir

Only tributaries, drains, and springs to the reservoir will receive loads; reservoir loads and associated internal recycling will not be addressed at this time. However, a target concentration for chlorophyll *a* is recommended. The assumption is that reduction in nutrient loadings to the reservoir by contributing tributaries, springs, and drains will result in meeting the chlorophyll *a* target concentration of 0.015 mg/L. Meeting an average chlorophyll *a* concentration will in turn be sufficient to support beneficial uses within the reservoir.

The reservoir model was used to predict chlorophyll *a* levels under various scenarios (Cope 2004b). It was assumed that internal loading would eventually be reduced to zero due to phosphorus reductions and resulting improvements to DO concentrations near the bottom. Modeling of existing conditions resulted in a range of chlorophyll *a* from 0.010 mg/L under low flow conditions to 0.035 mg/L under high flow conditions (Table 5-5). If load allocations outlined in this TMDL are met (Table 5-4), then resultant chlorophyll *a* concentrations should meet the target concentration of 0.015 mg/L in both low and mid-high flow years (Table 5-5). During high flow years, the model predicted a concentration of 0.019 mg/L of chlorophyll *a*, slightly higher than the target concentration, but much reduced from existing conditions. Based on modeling results, it is encouraging that target concentrations for chlorophyll *a* are projected to be met in a majority of flow scenarios (1999 mean annual flow was in the 70th percentile of all flows for water years 1970 to 2003) if proposed load reductions are met (Table 5-2).

Currently, the Snake River is below the total phosphorus target concentration of 0.05 mg/L (Table 5-6). To account for future growth and the expectation that phosphorus loading to the river will increase, such a scenario was modeled. The assumptions were that load allocations would be met in all other water bodies, and the load in the Snake River would increase to the target concentration of 0.05 mg/L. Under this growth scenario, the reservoir will meet its target chlorophyll *a* concentration only during low flows (Table 5-5). Thus, effects on the reservoir by any potential significant increase in nutrient loading to the Snake River should be considered prior to approval of such discharge.

Table 5-6. Load analyses for American Falls Subbasin water bodies.

Site/ water body	Avg flow (cfs)	Total phosphorus					Suspended sediment				
		Average concentration (mg/L)	Load (tons/yr)	Target load (tons/yr)	Load allocation[1] (tons/yr)	Load reduction (tons/yr)	Average concentration (mg/L)	Load (tons/yr)	Target load (tons/yr)	Load allocation[2] (tons/yr)	Load reduction (tons/yr)
Snake River											
nr Blackfoot (Ferry Butte) USGS gage	4,840[2]	0.035	167	239	167	0	26.8	164,471	368,218	164,471	0
at Blackfoot USGS gage	5,074[2]	0.029	146	250	146	0					
nr Shelley USGS gage	5,954[2]	0.029	171	294	171	0	15.7	118,286	453,009	118,286	0
Portneuf River											
Tyhee USGS gage	NA[3]	1.205/ 0.810	387	22, 31[5]	22, 31[5]	365, 356[5]	49.6	21,602			
Bannock Creek											
Bannock Creek at mouth	51.1	0.13	6.5	2.6, 3.6[5]	2.6, 3.6[5]	3.9, 3.1[5]	NA[4]	1,047	948	948	99
West Fork Bannock Creek at mouth							NA[4]	55	55	55	0
Moonshine Creek at mouth							NA[4]	386	168	168	218
Rattlesnake Creek at mouth							NA[4]	634	307	307	327
Other tributaries, springs, and drains											
Clear Creek	37.2	0.029	1.07	1.83	1.07	0.00	10.0	365.7			
Danielson Creek	56.2	0.035	1.92	2.77	1.92	0.00	9.9	548.1	3,327.6	548.1	0.0
Hazard Creek (Little Hole Draw)	16.7	0.248	4.09	0.82, 1.16[5]	0.82, 1.16[5]	3.26, 2.95[5]	9.9	163.6	987.2	163.6	0.0
McTucker Creek	196.2	0.034	6.51	9.68	6.51	0.00	7.4	1,438.8	11,610.1	1,438.8	0.0
Seagull Bay tributary	5.4	0.216	1.16	0.27, 0.38[5]	0.27, 0.38[5]	0.89, 0.78[5]	138.3	740.3			
Spring Creek	356.6	0.025	8.62	17.58	8.62	0.00	8.2	2,897.0			
Sunbeam Creek	4.4	0.246	1.07	0.22, 0.31[5]	0.22, 0.31[5]	0.85, 0.77[5]	95.1	413.6	261.1	261.1	152.5
Big Hole	0.7						1.7	1.2			
Cedar spillway	31.1	0.027	0.49	0.90	0.49	0.00	7.6	136.6			
Colburn wasteway	5.2	0.051	0.26	0.26	0.26	0.00	10.1	52.1			
Crystal springs	49.1	0.048	2.34	2.42	2.34	0.00	11.2	541.0			
Nash spill	1.3	0.013	0.009	0.038	0.009	0.00	9.5	7.1			
R spill	0.3	0.016	0.003	0.009	0.003	0.00	10.6	1.8			
Spring Hollow	5.3	0.142	0.74	0.26, 0.37[5]	0.26, 0.37[5]	0.48, 0.38[5]	153.2	800.1			
Sterling wasteway	5.5	0.081	0.44	0.27, 0.38[5]	0.27, 0.38[5]	0.17, 0.06[5]	37.2	200.7			

[1] where current loads were less than target loads, load allocations were set at current loads

[2] period of record: Ferry Butte, WY1910-2002; Blackfoot, WY1978-2002; Shelley, WY1915-2002 (from Brennan et al. 2003)

[3] loads at Tyhee USGS gage on Portneuf River based on monthly flows rather than annual average flow

[4] sediment loads in Bannock Creek watershed based on GWLF model

[5] Interim target load and load reduction based on TP concentration of 0.07 mg/L

5.2.4.2. Snake River

No data were encountered to indicate nutrients were a problem or that water quality standards were being violated in the Snake River. However, the Snake River is a major contributor of nutrients to American Falls Reservoir. Load allocations for the Snake River are recommended at Ferry Butte (Tilden Bridge), Blackfoot, and Shelley (Table 5-6). Annual total phosphorus load allocations are 167 tons at Ferry Butte, 146 tons at Blackfoot, and 171 tons at Shelley. These load allocations represent no increase above current loads, thus no load reductions are required.

Data used to estimate these load allocations were from 2000 to 2003, all low water years. For calendar years 1970 to 2003, percentile ranks for flows at Ferry Butte from 2000 to 2003 ranged from 0 to 39th (Table 5-2). (In other words, flows at Ferry Butte gage in 2001 were the lowest for the period 1970 to 2003, and 39% of all flows were less than those measured in 2000.) Average flow for all sampling events (calculated from mean daily flows the day of each event) during this time period was 2,727 cfs, which would rank in the 25th percentile. At Shelley, flows for the same years varied from 3rd to 42nd, while average flow (4,803 cfs) during sampling events would rank in the 37th percentile. For the period of record up to WY2002, average flows were 4,840 cfs at Ferry Butte, 5,074 cfs at Blackfoot, and 5,954 cfs near Shelley, which rank in the 56th, 65th, and 55th percentiles of all flows from 1970 to 2003, respectively.

To compare the recommended load allocations to other water years, loads were estimated from data collected by USGS at the near Blackfoot (Ferry Butte) and near Shelley gages (USGS Web site; Appendix C). In general, the recommended nutrient load allocation at Ferry Butte of 167 tons per year of phosphorus was similar to the load estimated at about median flows (Table 5-7). The annual load allocation at Shelley for phosphorus (171 tons) is below loads estimated from USGS data (Table 5-8). It should be noted that these Shelley loads were projected from only five sampling events.

The recommended load allocations for the Snake River are based on slightly greater than median flows (56th and 55th percentiles for Ferry Butte and Shelley, respectively) for nutrient loading into American Falls Reservoir. In order to refine these load allocations, there remains a need to collect more data from higher water years.

Because nutrients do not appear to be affecting beneficial uses in the Snake River, no nutrient wasteload reductions are recommended for Blackfoot, Firth, and Shelley wastewater treatment plants or for stormwater runoff from City of Blackfoot. Phosphorus wasteload allocations for the three WWTPs are 7.10, 0.48, and 1.26 tons per year of total phosphorus, respectively (Table 5-9). The wasteload allocation for stormwater runoff from City of Blackfoot is set at 0.33 tons per year of total phosphorus (Table 5-10).

Wasteload allocations reflect a no overall increase from current loading. It is likely these areas will see future population growth. To calculate future growth, population was projected to increase 2% per year. Each additional person was estimated to use 100 gallons of water per day. Future wasteloads were calculated by adding the current wasteload to the product of the change in flow and a total phosphorus concentration of 0.05 mg/L (the target TP concentration set in the American Falls TMDL) converted to tons per year. This method allows for growth but, requires treatment beyond current levels to achieve this. Wasteloads for 10 and 20 years in the future are presented in Table 5-11. Should Blackfoot, Firth, or Shelley see increases in population to these levels, or other increased demands on the WWTP, consideration will be made to revise the TMDL to account for the required new capacity.

Table 5-7. Estimated phosphorus and sediment loads at Snake River near Blackfoot (Ferry Butte) surface-water station (13069500).

Year	Number of sampling events	Average annual flow (cfs)	Flow percentile rank (1970-2003)[1]	Average total phosphorus concentration (mg/L)	Total phosphorus load (tons/yr)	Number of sampling events	Average suspended sediment concentration (mg/L)	Suspended sediment load (tons/yr)
1989	4	2,672	21	0.024	60	4	13.3	33,582
1990	5	2,681	24	0.033	79	3	13.3	32,110
1992	5	2,113	9	0.049	89	4	10.3	18,619
1993	12	3,464	36	0.026	132	12	24.8	124,675
1994	13	2,920	30	0.017	44	13	8.5	21,947
1995	10	4,408	52	0.021	126	10	26.8	164,471
1996	6	7,633	76	0.033	321	6	37.7	372,016
1998	6	7,347	67	0.023	177	6	24.0	189,306

[1] represents percentile rank of measured flow compared to annual average flow for calendar years 1970 to 2003

Table 5-8. Estimated phosphorus and sediment loads at Snake River near Shelley surface-water station (13060000).

Year	Number of sampling events	Average annual flow (cfs)	Flow percentile rank (1970-2003)[1]	Average total phosphorus concentration (mg/L)	Total phosphorus load (tons/yr)	Number of sampling events	Average suspended sediment concentration (mg/L)	Suspended sediment load (tons/yr)
1991	5	3,967	15	0.036	144	4	8.0	32,078
1993	5	4,769	36	0.032	162	3	15.3	77,663
1995	5	5,713	55	0.028	211	3	15.7	118,286

[1] represents percentile rank of measured flow compared to annual average flow for calendar years 1970 to 2003

Table 5-9. Wasteload analyses for point source (wastewater treatment plants and fish hatcheries) dischargers in American Falls Subbasin.

Point source	Average flow Or (Permitted Flow) in cfs	Total phosphorus					Suspended sediment				
		Average concentration (mg/L)	Wasteload (tons/yr)	Target wasteload (tons/yr)	Wasteload allocation[1] (tons/yr)	Wasteload reduction (tons/yr)	Average concentration (mg/L)	Wasteload (tons/yr)	Target wasteload[2] (tons/yr)	Wasteload allocation[1] (tons/yr)	Wasteload reduction (tons/yr)
Aberdeen WWTP	0.65	1.28	0.822	0.160	0.160	0.662	11	7.3	19.3	7.3	0.00
Blackfoot WWTP	3.06	2.36	7.103	0.151	7.103	0.000	11	33.1	72.5	72.5	0.00
Firth WWTP	0.18	2.75	0.487	0.009	0.487	0.000	22	4.0	8.0	8.0	0.00
Shelley WWTP	0.47	2.74	1.267	0.023	1.267	0.000	42	19.7	21.0	21.0	0.00
IDFG Springfield Hatchery[3]	(50)	0.033	1.63	2.46	1.63	0.000	8.4	347	2956.5	347	0.00
Sho-Ban Tribes Crystal Spgs Hatchery[3]	(24)	0.033	0.78	1.18	0.78	0.000	8.4	166	1419.1	166	0.00

[1] where current wasteloads were less than target wasteloads, wasteload allocations were set at current wasteloads based on Idaho Antidegradation Policy

[2] based on NPDES max monthly avg. concentration limits of 30 mg/L for Aberdeen and Blackfoot, and 45 mg/L for Firth and Shelley; current NPDES required max concentration for fish hatcheries is unknown so 60 mg/L target concentration used

[3] specific seasonal or flow –based limits may be needed for these conservation hatcheries but were not readily available for this analysis, annual WLA's based on net difference (effluent minus influent water quality concentrations)

Table 5-10. Load analyses for City of Blackfoot stormwater runoff. Estimated loads based on Simple Method model.

Parameter	Load (tons/yr)	Target load (tons/yr)	Load allocation (tons/yr)	Load reduction (tons/yr)
Total phosphorus	0.33	0.02	0.33	0
Total suspended solids	90	22	22	68

Table 5-11. Wasteload allocations for total phosphorus based on change in facilities management plans and growth (2% per year) for wastewater treatment plants (WWTP) in American Falls Subbasin.

WWTP	Current		10 years hence			20 years hence		
	Service area (population estimate as of 1 Jul 02)	Daily flow (gal/day)	Population estimate[1]	Daily flow (gal/day)[2]	Total phosphorus wasteload allocation (tons/yr)	Population estimate[1]	Daily flow (gal/day)[2]	Total phosphorus wasteload allocation (tons/yr)
Aberdeen	1,839	421,556	2,242	461,829	0.175	2,733	510,921	0.194
Blackfoot[3]	10,552	1,974,611	12,863	2,205,711	7.120	15,680	2,256,311	7.142
Firth[4]	838	116,022	1,022	134,422	0.488	1,245	138,322	0.490
Shelley	3,838	306,341	4,679	390,441	1.273	5,703	408,741	1.281

[1] based on a 2% annual increase in population

[2] future flow calculated as current flow plus 100 gal/capita/day for each additional person

[3] these figures use TP average concentrations from Aug 03 to May 09 after the new selector basin came on line in Aug 03; [4] includes Basalt

5.2.4.3. *Bannock Creek*

DEQ has set a water quality target for average concentrations of total phosphorus (TP) at 0.05 mg/L, with an interim target of 0.07 mg/L. Table 5-12 illustrates the resultant calculation of the annual average load capacities for Bannock Creek, which are 2.6 and 3.6 tons, respectively.

Table 5-12. Bannock Creek annual average phosphorus load capacities.

Parameter	Target concentration (mg/L)	Annual average flow (cfs)	Load capacity (tons/yr)
TP	0.05, 0.07[1]	51	2.6, 3.6[2]

[1] Interim target concentration [2] Interim load capacity based on target TP concentration of 0.07mg/L

The GWLF model was used to estimate existing annual average concentrations from nonpoint sources in Bannock Creek watershed. Average concentrations were 1.22 mg/L for total nitrogen and 0.13 mg/L for total phosphorus.

Since there are no point source discharges of nutrients in Bannock Creek watershed, calculation of the TMDL only provides a load allocation for nonpoint sources. The load allocation is expressed as a percent reduction in existing loads to correspond to the calculated load capacities. Table 5-13 shows that a 62% reduction of total phosphorus is required to meet water quality target goals for nutrients in Bannock Creek watershed. Table 5-14 expresses nutrients as an annual average load.

Table 5-13. Bannock Creek phosphorus annual average concentration and percent reduction required.

Parameter	Current annual average concentration (mg/L)	Water quality target (mg/L)	Reduction required
TP	0.13	0.05, 0.07[1]	62%, 46%[2]

[1] Interim target concentration [2] reduction required based on interim target TP concentration of 0.07mg/L

Table 5-14. Bannock Creek phosphorus annual average loading and percent reduction required.

Parameter	Current average load (tons/year)	Load capacity (tons/year)	Reduction required
TP	6.5	2.6, 3.6[1]	62%, 46%[2]

[1] Load capacity based on interim TP target of 0.07mg/L [2] reduction required based on interim target TP concentration of 0.07mg/L

5.2.4.4. *Other tributaries*

Although no other water bodies are listed for nutrients on the 303(d) list, load allocations are recommended for tributaries, springs, and drains that directly contribute to nutrient loads in American Falls Reservoir. Reductions in total phosphorus loads are recommended for Hazard Creek/Little Hole Draw, Seagull Bay tributary, Sunbeam Creek, Spring Hollow, and Sterling wasteway (Table 5-6). All phosphorus load reductions are less than 1 ton per year except Hazard Creek/Little Hole Draw, which needs a 3.26 tons per year reduction to meet its load allocation.

A major source of phosphorus in American Falls Reservoir is Portneuf River for which a TMDL was completed in 2001 (DEQ 2001b). The City of Pocatello has been monitoring water quality in the river just upstream of the USGS gage at Tyhee since 1999 (Table 5-15). From these data and flows at Tyhee gage, total phosphorus loads from Portneuf River were estimated at 386.5 tons per year (Table 5-16). Load allocation of 21.8 tons per year for total phosphorus necessitates load reduction of 365 tons per year (Table 5-6). This Portneuf River load allocation is different than that recommended in the 2001 TMDL when nutrient load allocations necessary to support beneficial uses in American Falls Reservoir were not known. In addition, since the original Portneuf River TMDL was completed, more data have been collected allowing for refinement of pollutant loads in the river. These changes will be reflected in the Portneuf River TMDL when it is revisited.

The City of Aberdeen's wastewater treatment plant is a source of nutrients into Hazard Creek/Little Hole Draw, and subsequently American Falls Reservoir. Load reduction for phosphorus has been recommended for Hazard Creek/Little Hole Draw (Table 5-6). To help meet these nutrient load reductions, wasteload allocation of 0.160 tons per year of total phosphorus has been recommended for Aberdeen WWTP (Table 5-9).

To account for potential future growth in population in Aberdeen, future wasteload allocations are estimated. Population was expected to increase at a 2% annually with a 100 gallon per capita usage rate for each new person. Target concentrations were used to estimate the future wasteloads, which are presented in Table 5-11. Should Aberdeen see increases in population to these levels, or other increased demands on the WWTP, consideration will be made to revise the TMDL to account for the required new capacity.

The Idaho Department of Fish and Game (IDFG) and the Shoshone-Bannock Tribes (SBT) have acquired fish hatchery facilities within a complex of surface water springs in the Springfield area. This complex of springs has historically been used for fish production. The IDFG has acquired rights to 50 cfs of high quality spring water for their Springfield Hatchery with the goal of producing endangered Sockeye salmon and triploid rainbow trout to supplement resident fisheries. The SBT have also acquired 24 cfs of water rights within the Crystal Springs complex for their Crystal Springs Hatchery with the goal of producing endangered Chinook salmon and Yellowstone cutthroat trout to supplement resident fisheries. The best available record of water quality data for the Crystal Springs Hatchery production facility (prior to ownership of these facilities by IDFG and/or the SBT) was collected by the Bureau of Reclamation from 2001-2003. These data indicated an annual average phosphorus load at 2.38 tons/year and an average annual suspended sediment load of 513 tons/year into a tributary of American Falls Reservoir. Based on these data and the fact that the estimated average phosphorus concentration from the hatchery was below the target concentration of 0.05 mg/L (Table E-1) this annual load of phosphorus and suspended sediment is allocated to these two Conservation Fish Hatcheries as such: Total phosphorus wasteload allocation, IDFG – Springfield Hatchery at 1.63 tons/year; SBT – Crystal Springs Hatchery at 0.78 tons/year; Suspended sediment wasteload allocation, IDFG – Springfield Hatchery at 347 tons/year, SBT – Crystal Springs Hatchery at 166 tons/year. The wasteload allocation of 2.38 tons per year of total phosphorus shared between these two facilities represents no increase over current expected wasteloads, and thus requires no load reductions (Table 5-9). Seasonal effluent limits for both facilities will be variable based on production cycles, however total discharge values will not exceed annual wasteload allocation limits for each facility. Because production levels are not yet established for each facility, the intent of the WLA is to provide discharge flexibility based on either monthly production or flow-based schedules, while still providing an annual limit for total load.

Table 5-15. City of Pocatello sampling on Portneuf River at Siphon Road, February 1999 to August 2003.

Time period	Statistic	Ortho P (mg/L)	Total P (mg/L)	NH_3 (mg/L)	NO_3+NO_2 (mg/L)	TKN (mg/L)	Total inorganic N (mg/L)	Total N (mg/L)	TSS (mg/L)
Jan-Dec	Average	1.03	0.96	0.38	2.23	0.90	2.63	3.08	49.62
	Count	48	46	36	46	36	36	36	25
	Standard Deviation	0.61	0.29	0.52	0.43	0.36	0.67	0.50	71.75
	Maximum	3.8	1.59	3.2	2.97	1.8	5.87	4.21	340
	Minimum	0.06	0.2	0.1	0.93	0.5	1.21	2.11	11
	Median	0.95	0.925	0.2	2.275	0.85	2.545	3.02	22
Jun-Sep	Average	1.23	1.20	0.42	2.49	0.76	2.88	3.23	41.86
	Count	19	18	13	18	13	13	13	7
	Standard Deviation	0.77	0.23	0.84	0.44	0.22	1.03	0.46	53.03
	Maximum	3.8	1.59	3.2	2.97	1.1	5.87	3.97	160
	Minimum	0.06	0.52	0.1	1.01	0.5	1.21	2.11	13
	Median	1.3	1.2475	0.2	2.66	0.7	2.81	3.26	17
Oct-May	Average	0.90	0.81	0.36	2.06	0.98	2.48	3.00	52.64
	Count	29	28	23	28	23	23	23	18
	Standard Deviation	0.44	0.22	0.21	0.32	0.40	0.28	0.51	79.00
	Maximum	2.73	1.43	0.8	2.51	1.8	3.21	4.21	340
	Minimum	0.15	0.2	0.1	0.93	0.5	1.85	2.4	11
	Median	0.88	0.81	0.4	2.0875	0.9	2.46	2.84	24

Table 5-16. Load analyses for Portneuf River.

Month	Average flow (cfs)[1]	Total phosphorus Load (tons)[2]	Total phosphorus Load by period (tons)[3]	Total phosphorus Target load (tons)	Total suspended solids Load (tons)[2]
January	492.8	39.8	33.4	2.1, 2.9[4]	2,046.7
February	547.1	40.2	33.8	2.1, 2.9[4]	2,070.6
March	648.4	52.3	43.9	2.7, 3.8[4]	2,692.9
April	634.9	49.6	41.6	2.6, 3.6[4]	2,551.8
May	502.3	40.5	34.0	2.1, 2.9[4]	2,086.1
June	258.8	20.2	25.3	1.0, 1.5[4]	1,040.2
July	188.2	15.2	19.0	0.8, 1.1[4]	781.6
August	274.1	22.1	27.6	1.1, 1.6[4]	1,138.4
September	325.6	25.4	31.8	1.3, 1.8[4]	1,308.7
October	440.8	35.6	29.9	1.8, 2.6[4]	1,830.7
November	496.7	38.8	32.6	2.0, 2.8[4]	1,996.3
December	495.4	40.0	33.6	2.1, 2.9[4]	2,057.5
Total (annual)		419.8	386.5	21.8, 30.5[4]	21,601.6

[1]for WY1985-2002 (from Brennan et al. 2003)

[2]based on annual average concentration, see Table 5-15

[3]based on Jun-Sep average concentration of 1.20 mg/L total phosphorus, Oct-May average concentration of 0.81 mg/L, see Table 5-15

[4]Interim target load based on target TP concentration of 0.07mg/L

5.2.5. Sediment

Sediment data for each water body is addressed in the following.

5.2.5.1. American Falls Reservoir

No data were encountered indicating sediment was a problem or that water quality standards were being violated in the reservoir. Therefore, a TMDL is not necessary for sediment in American Falls Reservoir.

5.2.5.2. Snake River

Although no data were encountered indicating that sediment was a problem in the Snake River, more data are needed during average and high flows, along with a sediment assessment to show status of support of beneficial uses, to confidently conclude sediment is not a problem. Thus, a load allocation is recommended until such time it is determined that sediment is not impairing beneficial uses in the Snake River.

Several approximations of sediment load were made. The most comprehensive data set was collected by DEQ and USGS from 2000 to 2003. From the historical average flow (Table 5-2) and average suspended sediment concentration for the 2000 to 2003 sampling period (Table 2-10), overall average annual loads for suspended sediment were calculated for Ferry Butte, Blackfoot, and Shelley at 74,074 tons, 34,619 tons, and 34,573 tons, respectively. However, flows at both Ferry Butte and Shelley were below normal with 2001 to 2003 flows ranking in the bottom 15% and 18% of all flows from 1970 to 2003, respectively (Table 5-2).

Sediment loads were also estimated from USGS data collected at Ferry Butte and Shelley from 1989 to 1998 (Tables 5-7 and 5-8; Appendix C). Higher flow years at Ferry Butte during this collection period included 1995, 1996, and 1998 at 52nd, 76th, and 67th percentile ranks of flows from 1970 to 2003 (Table 5-7). Annual loads from these four years ranged from 124,675 to 372,016 tons (Table 5-7). Annual average flow in 1995, the only year above median flow, at Shelley ranked in the 55th percentile for the 1970-2003 period (Table 5-8). Sediment load at Shelley gage in 1995 was estimated at 118,286 tons.

As opposed to nutrient loads, suspended sediment loads based on historical average flow and average concentrations from DEQ and USGS sampling from 2000 to 2003 differ substantially from flows calculated during higher flow years. The drawback to these pre-2000 data is some of the loads are a product of six or less sampling events. However, as it is yet unknown whether suspended sediment is affecting beneficial uses in the Snake River and, unlike nutrients, does not appear to be impairing beneficial uses in American Falls Reservoir, recommended load allocations are based on data from 1995 at Ferry Butte and at Shelley (annual average flows in the 52nd and 55th percentile rankings, respectively [Table 5-2]). It is believed that these data load allocations 164,471 tons per year at Ferry Butte and 118,286 tons per year at Shelley (Table 5-6) will be protective of beneficial uses until such time that impairment of beneficial uses due to excessive sediment can be established.

These recommended load allocations represent no overall increase and require no load reductions. In addition, the load allocations for the Snake River are conservative and thus add an additional margin of safety. Conversely, the need to collect more data from higher water years is essential to better refine annual loads.

Point sources were not a significant source of sediment into the Snake River, except possibly for City of Blackfoot stormwater runoff. All three WWTPs – Blackfoot, Firth, and Shelley – had average effluent concentrations of total suspended solids well below the Snake River target concentration of 60 mg/L and their respective NPDES maximum concentration limits (Table 5-9). Wasteload allocations are based on no overall increase of current wasteloads into the Snake River. The Simple Method model estimated the City of Blackfoot stormwater runoff was contributing 90 tons per year of sediment into the Snake River, well above a target load based on 60 mg/L (Table 5-10, Appendix D). The load allocation for stormwater runoff is set at the target load of 22 tons per year.

5.2.5.3. Bannock Creek

As indicated in Table 1-7, portions of Bannock Creek are currently achieving the target bank stability criterion of 80%. More importantly, as discussed in Section 5.1 above, the significant improvements in water and habitat quality of West Fork Bannock Creek suggest that aquatic life use in this subwatershed are being attained. Therefore, West Fork Bannock Creek provides an acceptable reference condition from which sediment loading capacity calculations can be derived for other impaired water bodies in Bannock Creek watershed. Table 5-17 illustrates the resultant calculation of load capacities for sediment in Bannock Creek, West Fork, Moonshine Creek, and Rattlesnake Creek subwatersheds.

Table 5-17. Bannock Creek, West Fork, Moonshine Creek, and Rattlesnake Creek annual sediment load capacities.

Water body	Target erosion rate (tons/mile/year)	Creek length (miles)	Load capacity (tons/year)
Bannock Creek	17.9	53.1	948
West Fork	7.8	7.09	55
Moonshine Creek	17.35	9.68	168
Rattlesnake Creek	16.5	18.65	307

Results from GWLF for modeling existing sediment loads from nonpoint sources in Bannock, West Fork, Moonshine and Rattlesnake subwatersheds are shown in Table 5-18.

Table 5-18. Existing annual average sediment loads from nonpoint sources in Bannock Creek, West Fork, Moonshine Creek, and Rattlesnake Creek.

	Bannock Creek	West Fork	Moonshine Creek	Rattlesnake Creek
Average sediment load (tons/yr)	1047	55	386	634

Since there are no point sources of sediment in Bannock Creek watershed, TMDL calculations provide load allocations for nonpoint sources only. Load allocations are expressed as a percent reduction in existing loads to correspond to calculated load capacities. Table 5-19 shows that 9, 0, 56 and 52% reductions in sediment loads are recommended for Bannock, West Fork, Moonshine and Rattlesnake creeks, respectively. Table 5-3 provides a summary of modeling input variables and outputs for sediment that support calculations presented in Tables 5-17, 5-18, and 5-19.

Table 5-19. Bannock Creek, West Fork, Moonshine Creek, and Rattlesnake Creek sediment load allocations.

Water body	Existing sediment load (tons/year)	Load capacity (tons/year)	Percent reduction
Bannock Creek	1,047	948	9%
West Fork	55	55	0%
Moonshine Creek	386	168	56%
Rattlesnake Creek	634	307	52%

5.2.5.4. Other tributaries

Although listed as having sediment problems, data indicate that total suspended solids in McTucker Creek averaged 7.4 mg/L, well below the target concentration of 60 mg/L (Table 5-6). Therefore, the sediment load allocation for McTucker Creek is based on a no overall increase of 1,439 tons per year. Such low levels of water column sediment in McTucker Creek point out the need for further work to identify the source of the sediment problem.

Only three tributaries exceeded the 60 mg/L target concentration for sediment (Table 5-6). None of the three water bodies - Seagull Bay tributary, Spring Hollow, and Sunbeam Creek – are listed on the 303(d) list. As sediment is not impairing beneficial uses in the reservoir, load allocations are not recommended for Seagull Bay tributary and Spring Hollow. Both of these water bodies should be considered for future monitoring through DEQ's BURP effort. BURP data indicate impairment of water quality in Sunbeam Creek, Danielson Creek, and Hazard Creek/Little Hole Draw (Table 2-16). In anticipation of a future listing of Sunbeam Creek on the 303(d) list for non-support of beneficial uses, a load allocation of 261 tons per year of sediment is recommended (Table 5-6). This allocation will require an annual load reduction of 153 tons per year. For Danielson Creek and Hazard Creek/Little Hole Draw load allocations are based on current load estimates.

Neither Aberdeen WWTP nor Crystal Springs Hatchery Complex is a significant source of sediment. Both had average or estimated average TSS concentrations in their effluent well below their NPDES permit maximum concentration limit or the target concentration of 60 mg/L (Table 5-9). Wasteload allocations for these two point sources are based on no overall increase of current loading.

5.2.6. Temperature

Although not listed on the 303(d) list, temperature exceedances of water quality standards have been documented in American Falls Reservoir and the Snake River. Both of these water bodies are large enough that exceedances of state water quality standards for temperature would not be unexpected. Violations of state water quality standards were documented in the Snake River and it may be recommended the water body be listed for temperature on future 303(d) lists. More data are needed to determine if these temperature excursions are impairing beneficial uses in both water bodies.

5.2.7. Construction Stormwater and TMDL Wasteload Allocations

5.2.7.1. Construction Stormwater

The Clean Water Act requires operators of construction sites to obtain permit coverage to discharge stormwater to a water body or municipal storm sewer. In Idaho, EPA has issued a general permit for stormwater discharges from construction sites. In the past, stormwater was treated as a nonpoint source of pollutants. However, because stormwater 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 Pollutant Discharge Elimination System (NPDES) permit.

5.2.7.2. The Construction General Permit

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

5.2.7.3. Stormwater Pollution Prevention Plan

In order to obtain the CGP, operators must develop a site-specific SWPPP. Operators must document the erosion, sediment, and pollution controls they intend to use; inspect the controls periodically; and maintain best management practices (BMPs) through the life of the project.

5.2.7.4. Construction Stormwater Requirements

When a stream is on Idaho's §303(d) list and has a TMDL developed, DEQ may incorporate a gross WLA for anticipated construction stormwater activities. TMDLs developed in the past that did not have a WLA for construction stormwater activities or new TMDLs will also be considered in compliance with provisions of the TMDL if they obtain a CGP under the NPDES program and implement the appropriate BMPs.

Typically, there are specific requirements operators must follow to be consistent with any local pollutant allocations. Many communities throughout Idaho are currently developing rules for post-construction stormwater management. Sediment is usually the main pollutant of concern in stormwater from construction sites. The application of specific BMPs from Idaho's *Catalog of Stormwater Best Management Practices for Idaho Cities and Counties* is generally sufficient to meet the standards and requirements of the CGP, unless local ordinances have more stringent and site-specific standards that are applicable (DEQ 2005).

5.2.8. Reasonable Assurance

The U. S. Environmental Protection Agency (EPA) requires that Total Maximum Daily Loads (TMDL), 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 American Falls Subbasin TMDL will be achieved through state authority within the Idaho Nonpoint Source Management Program.

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 Agricultural Water Quality Program
- 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 American Falls Watershed Advisory Group (upon their approval to continue as a committee), with the assistance of appropriate local, state, tribal, and federal agencies, will begin formulating specific pollution control actions for achieving water quality targets listed in the American Falls Subbasin Total Maximum Daily Load plan. The plan is scheduled for completion within eighteen months of finalization and approval of the TMDL by EPA.

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 American Falls

Subbasin. Like the TMDL, the goal of the implementation plan is to reduce pollutant loading to support beneficial uses. DEQ recognizes implementation strategies for TMDL's 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, should monitoring show beneficial uses are being supported prior to attainment of TMDL targets, less restrictive load and wasteload allocations will be considered.

Any implementation plan will concentrate on reducing nutrients and sediment. For point sources, such as wastewater treatment plants, it is anticipated that future NPDES permits will include recommended reductions in nutrients (i.e., phosphorus). Reduction in pollutant loadings for nonpoint sources will most likely require a mix of policy changes, program initiatives, and implementation of Best Management Practices.

5.3.1. Time Frame

No time frame is proposed for attainment of beneficial uses in American Falls Subbasin as changes in programs and policies and implementation of practices are highly dependent on many factors. Modifications in current agency operations often require amending 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. Implementation of Best Management Practices may not be rapid as on-the-ground projects, in addition to proper planning, require willing landowners and, often, some type of financial help.

Adding to the problem of predicting when beneficial uses might be obtained are the vagaries of nature. For example, streams that maintain high levels of subsurface sediment are dependent on geofluvial processes to mobilize smaller sediment and move it out of the system. Flows required for such mobilization are dependent on precipitation and resultant runoff, neither of which can be predicted with any certainty next year, let alone years in the future.

The reservoir model assumed recommended reductions in nutrient loading would lead to elimination of phosphorus available for recycling in the reservoir. Currently, there is uncertainty as to how much phosphorus is recycled in the reservoir. Equally unknown is the length of time needed to reduce internal recycling of phosphorus once nutrient loads to the reservoir are reduced. Both of these factors will most likely affect any timetable for attainment of beneficial use support in the reservoir.

Despite the challenges listed above, substantial progress is expected within 10 years of the execution of the implementation plan. Development of a proper monitoring plan should allow a statistical evaluation of that progress.

5.3.2. 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). 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 Soil Conservation Commission. Public road construction activities fall under the auspices of

Transportation Department. Department of Agriculture has responsibility for aquaculture. All other activities are under the purview of DEQ.

As new information is gathered, data may indicate federal lands as a source of nonpoint pollutant loading in the American Falls Subbasin. It is expected that federal agencies will write their own implementation plans as to how they intend to reduce pollutant loading from lands under their jurisdiction.

Point sources will also be asked to write implementation plans on how they will meet TMDL wasteload allocations. In addition, it is expected that any allocations set forth in this TMDL will eventually be incorporated into the point sources' NPDES permits.

5.3.2.1 Interim Targets, Load Allocations, and a Phased TMDL Approach

Phased TMDLs are appropriate for situations in which the state expects, because of data gaps, to revise the TMDL, including the loading capacity and allocation scheme, as additional information is collected. Clarification Regarding "Phased" Total Maximum Daily Loads, August 2, 2006 ("Clarification"), at page 3. A prime example of when a phased TMDL is appropriate is a TMDL for phosphorous in a lake watershed where there are uncertain loadings from the major land uses and limited knowledge of the in-lake processes. Id. Even where there is little data uncertainty, TMDLs may contain provisions for adaptive implementation using flexible load allocation/wasteload allocation schemes.

The Idaho Water Quality Act, Idaho Code § 39-3611(7), requires DEQ to review and reevaluate each TMDL, including the water quality criteria used, instream targets, pollution allocations, and the underlying assumptions and analysis, at intervals no greater than five years.

With respect to the AF TMDL, DEQ acknowledges uncertainties and data gaps regarding the model used in connection with setting tributary targets and load allocations. Uncertainty regarding loading and a limited knowledge of in-reservoir processes required the use of certain assumptions and estimates in the model, which in turn affect the certainty of the load reductions necessary to meet water quality standards. See AF TMDL, pages 122-125. More data and more sophisticated or detailed analytical techniques may increase DEQ's ability to predict water quality conditions and set load allocations that will achieve water quality standards. Since the development of the original TMDL, DEQ has already begun the process of collecting additional data and information regarding water quality in the AF reservoir and the significant tributaries. Given these circumstances and the applicable Idaho law, DEQ intends to reevaluate, and as appropriate revise, the targets and load allocations set forth in this TMDL within 5 years of its issuance.

Within the next 5 years additional data will be gathered that measures AF Reservoir water quality conditions, tracks progress in attaining TMDL objectives, and fills data gaps. DEQ shall form a Technical Advisory Committee to develop a work plan for additional monitoring and analysis. The work plan will be reviewed/revised on an annual basis. The work plan may include more refined modeling and DEQ expects at a minimum the work plan will include the measurement of water column total phosphorus, chlorophyll a, and dissolved oxygen within each segment addressed by the TMDL during time frames that represent high, low and average flow conditions, if possible. The work plan will also establish a timetable for revision of the TMDL, as appropriate, within the 5 year time period required by Idaho Code 39-3611(7).

Until the TMDL is reevaluated, and while the additional data is being gathered, DEQ believes an interim water quality target of 0.07 mg/l total phosphorus for the tributaries is appropriate. Load allocations based on this target are set out below. DEQ has selected this interim water quality target of 0.07 mg/l total phosphorus based upon data comparing median chlorophyll a concentration with median total phosphorous concentration data for lakes and reservoirs in the Pacific Northwest. See Snake River Hells Canyon TMDL, Figure 3.2.13.b. This data suggests that, for the water bodies evaluated, total phosphorous concentrations of 0.07 mg/l correlate with chlorophyll a concentrations of 13 ug/l or less. Please note that where current loads are lower than the target, the load allocations are set at the current loads.

5.3.2.2 Adaptive Implementation

As noted, TMDLs may use an iterative implementation approach that makes progress toward achieving water quality goals while using any new data and information to reduce uncertainty and adjust implementation activities. Clarification at page 3-4. Implementation can also be staged.

The Idaho Water Quality Act provides that TMDLs should be implemented through pollution control strategies, which are defined as cost-effective actions in TMDL implementation plans to control the discharge of pollutants that can reasonably be taken to improve the water quality within the physical, operational, economic and other constraints that affect individual enterprises and communities. Idaho Code § 39-3602 (5); 39-3611(4).

DEQ intends to facilitate development of an Implementation Plan for the AF TMDL within 18 months of the TMDL's approval by EPA. The Implementation Plan will take into account the fact that long-term targets and allocations will be reevaluated within five years, and that interim water quality goals have been set. In the case of sources on the Portneuf River, load allocations, wasteload allocations and implementation will be controlled by the Portneuf River TMDL and an implementation plan developed by DEQ and other designated agencies in consultation with the WAG for that tributary.

The Implementation Plan should consider the following principles:

1. Attainable water quality goals should reflect control strategies that are feasible on a broad, watershed basis. Highest cost management practices should not be the basis for water quality planning. For example, it is not reasonable to expect sources to achieve zero discharge, or to expect all of irrigated agriculture to convert to sprinkler irrigation, or to expect all point sources to retrofit with the most expensive pollution control technology available.

2. After completing an implementation plan, site-specific analyses must be performed to determine the most appropriate and effective control strategies for particular locations and land use actives. The time required for ground-level planning and project approval process varies widely depending upon then nature of the land and related hydrology, the land use, the parties involved, the type of treatment selected, and other factors.

3. Construction and implementation of management practices follows project approval. As with the planning and approval process, the time required to complete a project and realize water quality improvements varies from more immediate, as with introduction of rotational grazing as a management practice, to longer term, as with stream bank re-vegetation and created wetlands (6-7 years may be necessary to establish vegetation that will produce adequate results).

4. In addition to the time required to achieve effective reductions, the time required for the river and reservoirs to fully respond to the improvement in inflowing water quality and process the existing pollutant loads already in place within the system must also be recognized.

5. Data collection will continue throughout the implementation process to determine progress and improve understanding of the AF TMDL system. As this TMDL is a phased process, it is projected that the goals and objectives of this TMDL will be revisited periodically to evaluate new information and assure that the goals and milestones are consistent with the overall goal of meeting water quality standards in the AF TMDL reach.

6. The load allocation mechanism established and implemented through tributary TMDLs should allow attainment of water quality targets through (to the extent possible) fair and equitable distribution of the identified pollutant loads, and result in productive implementation without causing undue hardship on any single pollutant source.

7. The adaptive implementation process will address the use of water quality trading.

5.3.2.3 Implementation of the American Falls TMDL and the Portneuf TMDL

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.

5.3.2.4 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.

5.3.2.5 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 by the Idaho Department of Environmental Quality or its designated entity.

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 wasteload 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.

5.3.2.6 Watershed Specific Environmental Protection

Trades must be implemented so that the overall water quality of the water bodies covered by the TMDL is 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.

5.3.2.7 Trading Framework

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 Water Quality Trading Guidance (July, 2010)

As of this writing, the only two watersheds that have yet developed a pollutant trading framework are the Lower Boise River watershed and the Upper Snake Rock/Mid Snake TMDL watershed. DEQ believes pollutant trading may be a viable option and tool for implementation of the American Falls TMDL. Should DEQ and the American Falls 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.

5.3.3. Responsible parties

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

- Tribal Government – Shoshone-Bannock Tribes
- Federal Government – Bureau of Reclamation, Natural Resources Conservation Service, U. S. Forest Service, Bureau of Land Management, Bureau of Indian Affairs
- State Government – Departments of Environmental Quality, Lands, Transportation, Fish and Game, and Agriculture, Soil Conservation Commission
- County Government – Power, Bingham, Bannock counties
- Local Government – Cities of American Falls, Aberdeen, Blackfoot, Firth, Shelley
- Quasi-Government – Power and Bingham Soil Conservation districts,
- Irrigation Companies – Aberdeen-Springfield Canal Company
- Conservation Fish Hatcheries – IDFG Springfield Hatchery, SBT Crystal Springs Hatchery
- Numerous private individuals

5.3.4. Monitoring Strategy

DEQ will monitor BMP implementation through annual reports submitted as part of any implementation program. Due to constraints of money, time, and personnel, DEQ does not expect to directly monitor BMP effectiveness. Funding agencies should include monitoring as part of project funding requests. Tributary monitoring at the affected streams' confluences would help determine watershed BMP effectiveness.

DEQ is responsible for monitoring both mainstem and tributaries for compliance with TMDL allocations and progress toward supporting beneficial uses. The Beneficial Use Reconnaissance Program monitoring will help determine support of beneficial uses for cold water aquatic life, salmonid spawning, and contact recreation. Ambient water quality monitoring will be dependent on money, time, and personnel available to DEQ. Point sources will be monitored through their Discharge Monitoring Reports submitted monthly to DEQ.

5.4. Conclusions

The data support nutrient TMDLs for tributaries, springs, and drains into American Falls Reservoir. Load allocations were developed for nonpoint sources (Snake River, Portneuf River, Bannock Creek, several other tributaries, springs, and drains) and wasteload allocations were recommended for point sources (Aberdeen, Blackfoot, Firth, and Shelley WWTPs, Crystal Springs Trout Farm, City of Blackfoot stormwater runoff) for phosphorus. Reservoir modeling predicts that if the phosphorus load is reduced as recommended, the target level of 0.015 mg/L of chlorophyll *a* will be achieved under all but the highest annual flow conditions. The model also predicts that if target chlorophyll *a* levels are achieved, dissolved oxygen water quality standards will be met in the top five meters and improved in the bottom five meters of the reservoir.

Data examined did not indicate nutrients, sediment, or dissolved oxygen is impairing beneficial uses in the Snake River itself. However, more information is required to verify that sediment is not impairing beneficial uses. As a tributary to the reservoir, phosphorus loads from the river contribute to nutrient problems in the reservoir. Therefore, allocations for the Snake River and point sources discharging to it were made based on no increase above current loads and wasteloads, respectively. It will be recommended that the Snake River be delisted for nutrients and dissolved oxygen on future 303(d) lists.

The Generalized Watershed Loading Functions (GWLF) model was used to determine nutrient and sediment load allocations for Bannock Creek. Sediment loads were also established for West Fork Bannock Creek, Moonshine Creek, and Rattlesnake Creek. Bacteria data in Bannock Creek were insufficient to ascertain its status. DEQ and Shoshone-Bannock Tribes will cooperate in a study to identify bacteria conditions in the watershed.

Sediment load allocations were recommended for McTucker Creek, Danielson Creek, Hazard Creek/Little Hole Draw, and Sunbeam Creek. The load allocation for McTucker Creek represents no increase above current loading, as data imply that water column sediment is not a problem. More study is needed to identify the source of the sediment problem in McTucker Creek.

Exceedances of state water quality standards for temperature were documented in American Falls Reservoir and the Snake River, but only the Snake River excursions resulted in violation of state water quality standards. Continuous temperature sampling should be conducted to determine if the Snake River exceeds temperature standards during the critical summer months.

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GIS Coverages

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Glossary

305(b)	Refers to section 305 subsection "b" of the Clean Water Act. 305(b) generally describes a report of each state's water quality, and is the principle means by which the U.S. Environmental Protection Agency, Congress, and the public evaluate whether U.S. waters meet water quality standards, the progress made in maintaining and restoring water quality, and the extent of the remaining problems.
303(d), §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.
ADB (Assessment Database)	The ADB is a relational database application designed for the U.S. Environmental Protection Agency for tracking water quality assessment data, such as use attainment and causes and sources of impairment. States need to track this information and many other types of assessment data for thousands of water bodies, and integrate it into meaningful reports. The ADB is designed to make this process accurate, straightforward, and user-friendly for participating states, territories, tribes, and basin commissions.
Adfluvial	Describes fish whose life history involves seasonal migration from lakes to streams for spawning.

Adjunct	In the context of water quality, adjunct refers to areas directly adjacent to focal or refuge habitats that have been degraded by human or natural disturbances and do not presently support high diversity or abundance of native species.
Alevin	A newly hatched, incompletely developed fish (usually a salmonid) still in nest or inactive on the bottom of a water body, living off stored yolk.
Algae	Non-vascular (without water-conducting tissue) aquatic plants that occur as single cells, colonies, or filaments.
Alluvium	Unconsolidated recent stream deposition.
Ambient	General conditions in the environment. In the context of water quality, ambient waters are those representative of general conditions, not associated with episodic perturbations, or specific disturbances such as a wastewater outfall (Armantrout 1998, EPA 1996).
Anadromous	Fish, such as salmon and sea-run trout, that live part or the majority of their lives in the salt water but return to fresh water to spawn.
Anaerobic	Describes the processes that occur in the absence of molecular oxygen and describes the condition of water that is devoid of molecular oxygen.
Anoxia	The condition of oxygen absence or deficiency.
Anthropogenic	Relating to, or resulting from, the influence of human beings on nature.
Antidegradation	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 of water to wells or springs.

Assemblage (aquatic)	An association of interacting populations of organisms in a given water body; for example, a fish assemblage, or a benthic macroinvertebrate assemblage (also see Community) (EPA 1996).
Assimilative Capacity	The ability to process or dissipate pollutants without ill effect to beneficial uses.
Autotrophic	An organism is considered autotrophic if it uses carbon dioxide as its main source of carbon. This most commonly happens through photosynthesis.
Batholith	A large body of intrusive igneous rock that has more than 40 square miles of surface exposure and no known floor. A batholith usually consists of coarse-grained rocks such as granite.
Bedload	Material (generally sand-sized or larger sediment) that is carried along the streambed by rolling or bouncing.
Beneficial Use	Any of the various uses of water, including, but not limited to, aquatic biota, recreation, water supply, wildlife habitat, and aesthetics, which are recognized in water quality standards.
Beneficial Use Reconnaissance Program (BURP)	A program for conducting systematic biological and physical habitat surveys of water bodies in Idaho. BURP protocols address lakes, reservoirs, and wadeable streams and rivers
Benthic	Pertaining to or living on or in the bottom sediments of a water body
Benthic Organic Matter.	The organic matter on the bottom of a water body.
Benthos	Organisms living in and on the bottom sediments of lakes and streams. Originally, the term meant the lake bottom, but it is now applied almost uniformly to the animals associated with the lake and stream bottoms.
Best Management Practices (BMPs)	Structural, nonstructural, and managerial techniques that are effective and practical means to control nonpoint source pollutants.
Best Professional Judgment	A conclusion and/or interpretation derived by a trained and/or technically competent individual by applying interpretation and synthesizing information.
Biochemical Oxygen Demand (BOD)	The amount of dissolved oxygen used by organisms during the decomposition (respiration) of organic matter, expressed as mass of oxygen per volume of water, over some specified period.

Biological Integrity	1) The condition of an aquatic community inhabiting unimpaired water bodies of a specified habitat as measured by an evaluation of multiple attributes of the aquatic biota (EPA 1996). 2) The ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the natural habitats of a region (Karr 1991).
Biomass	The weight of biological matter. Standing crop is the amount of biomass (e.g., fish or algae) in a body of water at a given time. Often expressed as grams per square meter.
Biota	The animal and plant life of a given region.
Biotic	A term applied to the living components of an area.
Clean Water Act (CWA)	The Federal Water Pollution Control Act (commonly known as the Clean Water Act), as last reauthorized by the Water Quality Act of 1987, establishes a process for states to use to develop information on, and control the quality of, the nation’s water resources.
Coliform Bacteria	A group of bacteria predominantly inhabiting the intestines of humans and animals but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms (also see Fecal Coliform Bacteria).
Colluvium	Material transported to a site by gravity.
Community	A group of interacting organisms living together in a given place.
Conductivity	The ability of an aqueous solution to carry electric current, expressed in micro (μ) mhos/cm at 25 °C. Conductivity is affected by dissolved solids and is used as an indirect measure of total dissolved solids in a water sample.
Cretaceous	The final period of the Mesozoic era (after the Jurassic and before the Tertiary period of the Cenozoic era), thought to have covered the span of time between 135 and 65 million years ago.
Criteria	In the context of water quality, numeric or descriptive factors taken into account in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels, and to limit the number of violations per year. EPA develops criteria guidance; states establish criteria.

Cubic Feet per Second	A unit of measure for the rate of flow or discharge of water. One cubic foot per second is the rate of flow of a stream with a cross-section of one square foot flowing at a mean velocity of one foot per second. At a steady rate, once cubic foot per second is equal to 448.8 gallons per minute and 10,984 acre-feet per day.
Cultural Eutrophication	The process of eutrophication that has been accelerated by human-caused influences. Usually seen as an increase in nutrient loading (also see Eutrophication).
Culturally Induced Erosion	Erosion caused by increased runoff or wind action due to the work of humans in deforestation, cultivation of the land, overgrazing, and disturbance of natural drainages; the excess of erosion over the normal for an area (also see Erosion).
Debris Torrent	The sudden down slope movement of soil, rock, and vegetation on steep slopes, often caused by saturation from heavy rains.
Decomposition	The breakdown of organic molecules (e.g., sugar) to inorganic molecules (e.g., carbon dioxide and water) through biological and non biological processes.
Depth Fines	Percent by weight of particles of small size within a vertical core of volume of a streambed or lake bottom sediment. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 6.5 mm depending on the observer and methodology used. The depth sampled varies but is typically about one foot (30 cm).
Designated Uses	Those water uses identified in state water quality standards that must be achieved and maintained as required under the Clean Water Act.
Discharge	The amount of water flowing in the stream channel at the time of measurement. Usually expressed as cubic feet per second (cfs).
Dissolved Oxygen (DO)	The oxygen dissolved in water. Adequate DO is vital to fish and other aquatic life.
Disturbance	Any event or series of events that disrupts ecosystem, community, or population structure and alters the physical environment.
E. coli	Short for Escherichia Coli, E. coli are a group of bacteria that are a subspecies of coliform bacteria. Most E. coli are essential to the healthy life of all warm-blooded animals, including humans. Their presence is often indicative of fecal contamination.

Ecology	The scientific study of relationships between organisms and their environment; also defined as the study of the structure and function of nature.
Ecological Indicator	A characteristic of an ecosystem that is related to, or derived from, a measure of a biotic or abiotic variable that can provide quantitative information on ecological structure and function. An indicator can contribute to a measure of integrity and sustainability. Ecological indicators are often used within the multimetric index framework.
Ecological Integrity	The condition of an unimpaired ecosystem as measured by combined chemical, physical (including habitat), and biological attributes (EPA 1996).
Ecosystem	The interacting system of a biological community and its non-living (abiotic) environmental surroundings.
Effluent	A discharge of untreated, partially treated, or treated wastewater into a receiving water body.
Endangered Species	Animals, birds, fish, plants, or other living organisms threatened with imminent extinction. Requirements for declaring a species as endangered are contained in the Endangered Species Act.
Environment	The complete range of external conditions, physical and biological, that affect a particular organism or community.
Eocene	An epoch of the early Tertiary period, after the Paleocene and before the Oligocene.
Eolian	Windblown, referring to the process of erosion, transport, and deposition of material by the wind.
Ephemeral Stream	A stream or portion of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no long continued supply from melting snow or other sources. Its channel is at all times above the water table. (American Geologic Institute 1962).
Erosion	The wearing away of areas of the earth's surface by water, wind, ice, and other forces.
Eutrophic	From Greek for "well nourished," this describes a highly productive body of water in which nutrients do not limit algal growth. It is typified by high algal densities and low clarity.

Eutrophication	1) Natural process of maturing (aging) in a body of water. 2) The natural and human-influenced process of enrichment with nutrients, especially nitrogen and phosphorus, leading to an increased production of organic matter.
Exceedance	A violation (according to DEQ policy) of the pollutant levels permitted by water quality criteria.
Existing Beneficial Use or Existing Use	A beneficial use actually attained in waters on or after November 28, 1975, whether or not the use is designated for the waters in Idaho's Water Quality Standards and Wastewater Treatment Requirements (IDAPA 58.01.02).
Exotic Species	A species that is not native (indigenous) to a region.
Extrapolation	Estimation of unknown values by extending or projecting from known values.
Fauna	Animal life, especially animals characteristic of a region, period, or special environment.
Fecal Coliform Bacteria	Bacteria found in the intestinal tracts of all warm-blooded animals or mammals. Their presence in water is an indicator of pollution and possible contamination by pathogens (also see Coliform Bacteria).
Fecal Streptococci	A species of spherical bacteria including pathogenic strains found in the intestines of warm-blooded animals.
Feedback Loop	In the context of watershed management planning, a feedback loop is a process that provides for tracking progress toward goals and revising actions according to that progress.
Fixed-Location Monitoring	Sampling or measuring environmental conditions continuously or repeatedly at the same location.
Flow	See Discharge.
Fluvial	In fisheries, this describes fish whose life history takes place entirely in streams but migrate to smaller streams for spawning.
Focal	Critical areas supporting a mosaic of high quality habitats that sustain a diverse or unusually productive complement of native species.
Fully Supporting	In compliance with water quality standards and within the range of biological reference conditions for all designated and exiting beneficial uses as determined through the Water Body Assessment Guidance (Grafe et al. 2002).

Fully Supporting Cold Water	Reliable data indicate functioning, sustainable cold water biological assemblages (e.g., fish, macroinvertebrates, or algae), none of which have been modified significantly beyond the natural range of reference conditions (EPA 1997).
Fully Supporting but Threatened	An intermediate assessment category describing water bodies that fully support beneficial uses, but have a declining trend in water quality conditions, which if not addressed, will lead to a "not fully supporting" status.
Geographical Information Systems (GIS)	A georeferenced database.
Geometric Mean	A back-transformed mean of the logarithmically transformed numbers often used to describe highly variable, right-skewed data (a few large values), such as bacterial data.
Grab Sample	A single sample collected at a particular time and place. It may represent the composition of the water in that water column.
Gradient	The slope of the land, water, or streambed surface.
Ground Water	Water found beneath the soil surface saturating the layer in which it is located. Most ground water originates as rainfall, is free to move under the influence of gravity, and usually emerges again as streamflow.
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 streamflow. 2) A stream that has a period of zero flow for at least one week during most years.
Interstate Waters	Waters that flow across or form part of state or international boundaries, including boundaries with Indian nations.
Irrigation Return Flow	Surface (and subsurface) water that leaves a field following the application of irrigation water and eventually flows into streams.
Key Watershed	A watershed that has been designated in Idaho Governor Batt’s State of Idaho Bull Trout Conservation Plan (1996) as critical to the long-term persistence of regionally important trout populations.

Knickpoint	Any interruption or break of slope.
Land Application	A process or activity involving application of wastewater, surface water, or semi-liquid material to the land surface for the purpose of treatment, pollutant removal, or ground water recharge.
Limiting Factor	A chemical or physical condition that determines the growth potential of an organism. This can result in a complete inhibition of growth, but typically results in less than maximum growth rates.
Limnology	The scientific study of fresh water, especially the history, geology, biology, physics, and chemistry of lakes.
Load Allocation (LA)	A portion of a water body's load capacity for a given pollutant that is given to a particular nonpoint source (by class, type, or geographic area).
Load(ing)	The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. Loading is the product of flow (discharge) and concentration.
Loading Capacity (LC)	A determination of how much pollutant a water body can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, and a margin of safety, it becomes a total maximum daily load.
Loam	Refers to a soil with a texture resulting from a relative balance of sand, silt, and clay. This balance imparts many desirable characteristics for agricultural use.
Loess	A uniform wind-blown deposit of silty material. Silty soils are among the most highly erodible.
Lotic	An aquatic system with flowing water such as a brook, stream, or river where the net flow of water is from the headwaters to the mouth.
Luxury Consumption	A phenomenon in which sufficient nutrients are available in either the sediments or the water column of a water body, such that aquatic plants take up and store an abundance in excess of the plants' current needs.
Macroinvertebrate	An invertebrate animal (without a backbone) large enough to be seen without magnification and retained by a 500µm mesh (U.S. #30) screen.

Macrophytes	Rooted and floating vascular aquatic plants, commonly referred to as water weeds. These plants usually flower and bear seeds. Some forms, such as duckweed and coontail (*Ceratophyllum* sp.), are free-floating forms not rooted in sediment.
Margin of Safety (MOS)	An implicit or explicit portion of a water body's loading capacity set aside to allow the uncertainly about the relationship between the pollutant loads and the quality of the receiving water body. This is a required component of a total maximum daily load (TMDL) and is often incorporated into conservative assumptions used to develop the TMDL (generally within the calculations and/or models). The MOS is not allocated to any sources of pollution.
Mass Wasting	A general term for the down slope movement of soil and rock material under the direct influence of gravity.
Mean	Describes the central tendency of a set of numbers. The arithmetic mean (calculated by adding all items in a list, then dividing by the number of items) is the statistic most familiar to most people.
Median	The middle number in a sequence of numbers. If there is an even number of numbers, the median is the average of the two middle numbers. For example, 4 is the median of 1, 2, 4, 14, 16; and 6 is the median of 1, 2, 5, 7, 9, 11.
Metric	1) A discrete measure of something, such as an ecological indicator (e.g., number of distinct taxon). 2) The metric system of measurement.
Milligrams per liter (mg/L)	A unit of measure for concentration in water, essentially equivalent to parts per million (ppm).
Million gallons per day (MGD)	A unit of measure for the rate of discharge of water, often used to measure flow at wastewater treatment plants. One MGD is equal to 1.547 cubic feet per second.
Miocene	Of, relating to, or being an epoch of, the Tertiary between the Pliocene and the Oligocene periods, or the corresponding system of rocks.
Monitoring	A periodic or continuous measurement of the properties or conditions of some medium of interest, such as monitoring a water body.
Mouth	The location where flowing water enters into a larger water body.

National 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	A condition indistinguishable from that without human-caused disruptions.
Nitrogen	An element essential to plant growth, and thus is considered a nutrient.
Nodal	Areas that are separated from focal and adjunct habitats, but serve critical life history functions for individual native fish.
Nonpoint Source	A dispersed source of pollutants, generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernable point or origin. They include, but are not limited to, irrigated and non-irrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.
Not Assessed (NA)	A concept and an assessment category describing water bodies that have been studied, but are missing critical information needed to complete an assessment.
Not Attainable	A concept and an assessment category describing water bodies that demonstrate characteristics that make it unlikely that a beneficial use can be attained (e.g., a stream that is dry but designated for salmonid spawning).
Not Fully Supporting	Not in compliance with water quality standards or not within the range of biological reference conditions for any beneficial use as determined through the Water Body Assessment Guidance (Grafe et al. 2002).
Not Fully Supporting Cold Water	At least one biological assemblage has been significantly modified beyond the natural range of its reference condition (EPA 1997).
Nuisance	Anything, which is injurious to the public health or an obstruction to the free use, in the customary manner, of any waters of the state.
Nutrient	Any substance required by living things to grow. An element or its chemical forms essential to life, such as carbon, oxygen, nitrogen, and phosphorus. Commonly refers to those elements in short supply, such as nitrogen and phosphorus, which usually limit growth.

Nutrient Cycling	The flow of nutrients from one component of an ecosystem to another, as when macrophytes die and release nutrients that become available to algae (organic to inorganic phase and return).
Oligotrophic	The Greek term for “poorly nourished.” This describes a body of water in which productivity is low and nutrients are limiting to algal growth, as typified by low algal density and high clarity.
Organic Matter	Compounds manufactured by plants and animals that contain principally carbon.
Orthophosphate	A form of soluble inorganic phosphorus most readily used for algal growth.
Oxygen-Demanding Materials	Those materials, mainly organic matter, in a water body that consume oxygen during decomposition.
Parameter	A variable, measurable property whose value is a determinant of the characteristics of a system, such as temperature, dissolved oxygen, and fish populations are parameters of a stream or lake.
Partitioning	The sharing of limited resources by different races or species; use of different parts of the habitat, or the same habitat at different times. Also the separation of a chemical into two or more phases, such as partitioning of phosphorus between the water column and sediment.
Pathogens	Disease-producing organisms (e.g., bacteria, viruses, parasites).
Perennial Stream	A stream that flows year-around in most years.
Periphyton	Attached microflora (algae and diatoms) growing on the bottom of a water body or on submerged substrates, including larger plants.
Pesticide	Substances or mixtures of substances intended for preventing, destroying, repelling, or mitigating any pest. Also, any substance or mixture intended for use as a plant regulator, defoliant, or desiccant.
pH	The negative log10 of the concentration of hydrogen ions, a measure which in water ranges from very acid (pH=1) to very alkaline (pH=14). A pH of 7 is neutral. Surface waters usually measure between pH 6 and 9.

Phased TMDL	A total maximum daily load (TMDL) that identifies interim load allocations and details further monitoring to gauge the success of management actions in achieving load reduction goals and the effect of actual load reductions on the water quality of a water body. Under a phased TMDL, a refinement of load allocations, wasteload allocations, and the margin of safety is planned at the outset.
Phosphorus	An element essential to plant growth, often in limited supply, and thus considered a nutrient.
Physiochemical	In the context of bioassessment, the term is commonly used to mean the physical and chemical factors of the water column that relate to aquatic biota. Examples in bioassessment usage include saturation of dissolved gases, temperature, pH, conductivity, dissolved or suspended solids, forms of nitrogen, and phosphorus. This term is used interchangeable with the terms "physical/chemical" and "physicochemical."
Plankton	Microscopic algae (phytoplankton) and animals (zooplankton) that float freely in open water of lakes and oceans.
Point Source	A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable "point" of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.
Pollutant	Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.
Pollution	A very broad concept that encompasses human-caused changes in the environment, which alter the functioning of natural, processes and produce undesirable environmental and health effects. This includes human-induced alteration of the physical, biological, chemical, and radiological integrity of water and other media.
Population	A group of interbreeding organisms occupying a particular space; the number of humans or other living creatures in a designated area.
Pretreatment	The reduction in the amount of pollutants, elimination of certain pollutants, or alteration of the nature of pollutant properties in wastewater prior to, or in lieu of, discharging or otherwise introducing such wastewater into a publicly owned wastewater treatment plant.

Primary Productivity	The rate at which algae and macrophytes fix carbon dioxide using light energy. Commonly measured as milligrams of carbon per square meter per hour.
Protocol	A series of formal steps for conducting a test or survey.
Qualitative	Descriptive of kind, type, or direction.
Quality Assurance (QA)	A program organized and designed to provide accurate and precise results. Included are the selection of proper technical methods, tests, or laboratory procedures; sample collection and preservation; the selection of limits; data evaluation; quality control; and personnel qualifications and training. The goal of QA is to assure the data provided are of the quality needed and claimed (Rand 1995, EPA 1996).
Quality Control (QC)	Routine application of specific actions required to provide information for the quality assurance program. Included are standardization, calibration, and replicate samples. QC is implemented at the field or bench level (Rand 1995, EPA 1996).
Quantitative	Descriptive of size, magnitude, or degree.
Reach	A stream section with fairly homogenous physical characteristics.
Reconnaissance	An exploratory or preliminary survey of an area.
Reference	A physical or chemical quantity whose value is known, and thus is used to calibrate or standardize instruments.
Reference Condition	1) A condition that fully supports applicable beneficial uses with little affect from human activity and represents the highest level of support attainable. 2) A benchmark for populations of aquatic ecosystems used to describe desired conditions in a biological assessment and acceptable or unacceptable departures from them. The reference condition can be determined through examining regional reference sites, historical conditions, quantitative models, and expert judgment (Hughes 1995).
Reference Site	A specific locality on a water body that is minimally impaired and is representative of reference conditions for similar water bodies.
Representative Sample	A portion of material or water that is as similar in content and consistency as possible to that in the larger body of material or water being sampled.
Resident	A term that describes fish that do not migrate.

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

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

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

Riparian Habitat Conservation Area (RHCA) A U.S. Forest Service description of land within the following number of feet up-slope of each of the banks of streams:
- 300 feet from perennial fish-bearing streams
150 feet from perennial non-fish-bearing streams
100 feet from intermittent streams, wetlands, and ponds in priority watersheds.

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

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

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

Settleable Solids The volume of material that settles out of one liter of water in one hour.

Species 1) A reproductively isolated aggregate of interbreeding organisms having common attributes and usually designated by a common name. 2) An organism belonging to such a category.

Spring Ground water seeping out of the earth where the water table intersects the ground surface.

Stagnation The absence of mixing in a water body.

Stenothermal Unable to tolerate a wide temperature range.

Stratification A Department of Environmental Quality classification method used to characterize comparable units (also called classes or strata).

Stream	A natural water course containing flowing water, at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.
Stream Order	Hierarchical ordering of streams based on the degree of branching. A first-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher order streams result from the joining of two streams of the same order.
Storm Water Runoff	Rainfall that quickly runs off the land after a storm. In developed watersheds the water flows off roofs and pavement into storm drains that may feed quickly and directly into the stream. The water often carries pollutants picked up from these surfaces.
Stressors	Physical, chemical, or biological entities that can induce adverse effects on ecosystems or human health.
Subbasin	A large watershed of several hundred thousand acres. This is the name commonly given to 4th field hydrologic units (also see Hydrologic Unit).
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 mm depending on the observer and methodology used. Results are typically expressed as a percentage of observation points with fine sediment.
Surface Runoff	Precipitation, snow melt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants in rivers, streams, and lakes. Surface runoff is also called overland flow.
Surface Water	All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors that are directly influenced by surface water.

Suspended Sediments	Fine material (usually sand size or smaller) that remains suspended by turbulence in the water column until deposited in areas of weaker current. These sediments cause turbidity and, when deposited, reduce living space within streambed gravels and can cover fish eggs or alevins.
Taxon	Any formal taxonomic unit or category of organisms (e.g., species, genus, family, order). The plural of taxon is taxa (Armantrout 1998).
Tertiary	An interval of geologic time lasting from 66.4 to 1.6 million years ago. It constitutes the first of two periods of the Cenozoic Era, the second being the Quaternary. The Tertiary has five subdivisions, which from oldest to youngest are the Paleocene, Eocene, Oligocene, Miocene, and Pliocene epochs.
Thalweg	The center of a stream's current, where most of the water flows.
Threatened Species	Species, determined by the U.S. Fish and Wildlife Service, which are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.
Total Maximum Daily Load (TMDL)	A TMDL is a water body's loading capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual basis. TMDL = Loading Capacity = Load Allocation + Wasteload Allocation + Margin of Safety. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.
Total Dissolved Solids	Dry weight of all material in solution in a water sample as determined by evaporating and drying filtrate.
Total Suspended Solids (TSS)	The dry weight of material retained on a filter after filtration. Filter pore size and drying temperature can vary. American Public Health Association Standard Methods (Greenborg, Clescevi, and Eaton 1995) call for using a filter of 2.0 micron or smaller; a 0.45 micron filter is also often used. This method calls for drying at a temperature of 103-105 °C.

Toxic Pollutants
Materials that cause death, disease, or birth defects in organisms that ingest or absorb them. The quantities and exposures necessary to cause these effects can vary widely.

Tributary
A stream feeding into a larger stream or lake.

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

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Dry weight of all material in solution in a water sample as determined by evaporating and drying filtrate.

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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 assessment units 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, streamflow, and inflow water quality.
Water Quality Standards	State-adopted and EPA-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.
Water Table	The upper surface of ground water; below this point, the soil is saturated with water.

Watershed	1) All the land, which contributes runoff to a common point in a drainage network, or to a lake outlet. Watersheds are infinitely nested, and any large watershed is composed of smaller "subwatersheds." 2) The whole geographic region, which contributes water to a point of interest in a water body.
Water Body Identification Number (WBID)	A number that uniquely identifies a water body in Idaho, 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.

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Appendix A: State of Idaho Water Quality Standards

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Table A-1. State of Idaho water quality numeric standards (from Idaho Department of Environmental Quality Water Quality Standards and Wastewater Treatment Requirements)

Beneficial use	Criteria						
	pH	Dissolved gas[1]	Chlorine[2]	Toxic substances[3]	Ammonia	Intergravel dissolved oxygen	Radioactivity
Cold Water Biota	>= 6.5 and <= 9.5	<= 110% saturation	19.0 ug/l, 1-hr avg; 11.0 ug/l, 4-day avg	<= CMC or CCC; <= Human Health criteria[5]	varies[4]		
Warm Water Biota	>= 6.5 and <= 9.5	<= 110% saturation	19.0 ug/l, 1-hr avg; 11.0 ug/l, 4-day avg	<= CMC or CCC; <= Human Health criteria[5]	varies[4]		
Salmonid Spawning	>= 6.5 and <= 9.5	<= 110% saturation	19.0 ug/l, 1-hr avg; 11.0 ug/l, 4-day avg	<= CMC or CCC; <= Human Health criteria[5]	varies[4]	>= 5.0 mg/l, 1-day min >= 6.0 mg/l, 7-day avg mean	
Primary & Secondary Contact Recreation				<= Human Health criteria[5]			
Domestic Water Supply				<= Human Health criteria[6]			varies[7]

[1]at atmospheric pressure at point of collection

[2]total residual chlorine

[3]criteria from 40 CFR 131.36(b)(1) as modified by Section 250.07 of the Water Quality Standards and Wastewater Treatment Requirements; CMC (Criteria Maximum Concentration) - maximum concentration for one hour, CCC (Criteria Continuous Concentration) - maximum concentration for four days

[4]varies according to temperature and pH

[5]for consumption of organisms only

[6]for consumption of water and organisms

[7]varies based on results; criteria from Idaho Department of Health and Welfare (nda) Idaho Rules for Public Drinking Water Systems based on 40 CFR 141.15 and 16

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Appendix B: Reservoir Information

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Table B-1. BOR sampling of American Falls Reservoir, August 1995 to July 2003.

Date sampled	Repli-cate	Time sampled	NO_3+NO_2 (mg/L)	Ortho P (mg/L)	Total P (mg/L)	NH_3 (mg/L)	TKN (mg/L)	CO_3 (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	Cl (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	TDS SUM (mg/L)	SAR	SiO_2 (mg/L)	Fecal (ct/100mL)	Strep (ct/100mL)	*E. coli* (ct/100mL)	Chl *a* (mg/L)	COD (mg/L)	TOC (mg/L)	SS (mg/L)	Lab pH (SU)	Turbidity (NTU)
American Falls Reservoir																											
8/14/1995		15:40	0.02	0.061	0.082	0.12	0.41	3.91	173	28	15.2	43.7	13.5	16.1	2.7	229	0.5	16.8	< 1	< 1		0.0072	13	3.3	2		1
8/14/1995		15:42																									
8/14/1995		15:44																									
8/14/1995		15:46																									
8/14/1995		15:48																									
8/14/1995		15:50																									
8/14/1995		15:53																									
8/14/1995		15:55																									
8/14/1995		15:57																									
8/14/1995		16:00	0.02	0.063	0.074	0.12	0.25	0	180	28.6	15.2	43.7	13.4	16	2.7	229	0.5	17	5	1			10	3.1	2		1
8/4/1997	Y	13:55	0.01	0.004	0.036	0.07	0.76	6.16	148	19.2	9.7	39.7	10.5	10.7	2.3	183	0.4	9	16	2k		0.0521	14	4.5	5	8.7	4
8/4/1997		13:55	0.02	0.004	0.034	0.07	0.86	7.11	145	22.1	9.4	39.5	10.3	10.6	2.3	184	0.4	8.6	18	2k		0.0522	11	4.6	4	8.7	5
8/4/1997		13:57																									
8/4/1997		13:59																									
8/4/1997		14:01																									
8/4/1997		14:03																									
8/4/1997		14:05																									
8/4/1997		14:07																									
8/4/1997		14:09																									
8/4/1997		14:10																									
8/4/1997		14:11																									
8/4/1997		14:13	0.27	0.129	0.156	0.09	0.18	0	160	20.4	9.6	40.3	10.1	10	2.2	186	0.4	11.3	14	2k			5	3.2	2	8.3	3
7/13/1998		15:30	0.04	0.005	0.005	0.04	0.29	3.31	160	30.2	10.8	40.5	11.8	12.5	2.2	205	0.4	11.8	2K	2K		0.0032	9	3.2	1	8.5	1
7/13/1998		15:33																									
7/13/1998		15:35																									
7/13/1998		15:37																									
7/13/1998		15:38																									
7/13/1998		15:41																									
7/13/1998		15:43																									
7/13/1998		15:45																									
7/13/1998		15:47																									
7/13/1998		15:49																									
7/13/1998		15:50	0.15	0.07	0.088	0.12	0.25	0	170	26.4	10.4	41.5	12.3	12.5	2.3	208	0.4	16.1	2K	2K			8	2.9	4	8.1	2
6/26/2000		14:50	0.09	0.051	0.065	0.06	0.28	5.19	173	33.1	16.8	45.7	14.8	17.2	2.9	239	0.6	14.5	2K		2K	0.0058	16	2.3	2	8.5	2
6/26/2000		14:52																									
6/26/2000		14:54																									
6/26/2000		14:56																									
6/26/2000		14:59																									
6/26/2000		15:02																									
6/26/2000		15:05																									
6/26/2000		15:07																									
6/26/2000		15:09																									
6/26/2000		15:12	0.1	0.057	0.064	0.08	0.3	2.36	177	35.5	16.8	45.3	14.7	17.4	2.9	240	0.6	14.5	2K		2K		16	2.2	2	8.4	2
7/15/2003		14:00	0.07	0.052	0.082	0.05	0.43	2.95	198	43.7	21.1	47.3	16.5	21.4	3.6	278	0.7	20	< 2		< 2	0.0061	12	3.2	5	8.5	4
7/15/2003		14:04																									
7/15/2003		14:07																									
7/15/2003		14:09																									
7/15/2003		14:12																									
7/15/2003		14:14	0.1	0.089	0.113	0.19	0.51	0	205	43.3	20.9	47.7	16.3	21.6	3.6	281	0.7	23	< 2		< 2		13	2.9	4	8.3	3
Snake River																											
8/14/1995		16:35	0.02	0.067	0.079	0.13	0.32	3.91	172	28	14.9	43.5	13.4	16.1	2.7	228	0.5	16.9	3	2			10	3.2	2		1
8/4/1997		15:15	0.06	0.009	0.051	0.08	0.55	1.9	157	21.6	9.7	39.3	10.1	10.6	2.3	185	0.4	9.1	10	12			7	3.7	3	8.5	2
7/13/1998		16:33	0.09	0.022	0.053	0.08	0.22	1.42	164	28.8	10.5	40.9	11.9	12.4	2.2	205	0.4	12.9	2K	12			8	3	2	8.4	1
6/26/2000		15:50	0.1	0.056	0.069	0.09	0.41	4.24	175	33.1	17	45.1	14.7	17.5	2.9	239	0.6	14.6	16		2		15	2.3	2	8.5	2
7/15/2003		14:45	0.1	0.068	0.102	0.11	0.42	1.97	200	43.7	21.2	46.9	16.6	24.5	3.6	283	0.8	22.2	40		4			3.1	4	8.4	3

Table B-1. Continued.

Date sampled	Repli-cate	Time sampled	Boron (u g/L)	Fl (mg/L)	As (u g/L)	Se (u g/L)	Hg (u g/L)	Cd (u g/L)	Cr (u g/L)	Cu (u g/L)	Pb (u g/L)	Fe (u g/L)	Mn (u g/L)	Zn (u g/L)	Secchi (meters)	Sam. Depth (feet)	Field Temp (°C)	DO (mg/L)	Field pH (SU)	Field EC (u S/cm)	ORP (mv)	Flow (cfs)	BP (mm Hg)	Diss. gas (%)	N_2-Ar gas (%)
American Falls Reservoir																									
8/14/1995		15:40	0	0.58	3	< 2	< 0.2	< 1	< 2	< 2	< 2	< 20	30	< 5	3.1	3.3	20.3	8.6	8.53	364	82		25.71		
8/14/1995		15:42														9.8	19.9	7.3	8.38	366	84				
8/14/1995		15:44														16.4	19.8	6.8	8.32	366	86				
8/14/1995		15:46														23	19.7	6.6	8.31	366	86				
8/14/1995		15:48														29.5	19.7	6.5	8.3	368	86				
8/14/1995		15:50														36.1	19.6	6.4	8.29	370	85				
8/14/1995		15:53														42.6	19.6	6.4	8.29	368	85				
8/14/1995		15:55														49.2	19.6	6.4	8.29	370	85				
8/14/1995		15:57														55.8	19.2	2.7	7.8	374	99				
8/14/1995		16:00	0	0.58	3	< 2	< 0.2	< 1	< 2	< 2	< 2	50	50	< 5		59.4	18.8	2.3	7.73	376	98				
8/4/1997	Y	13:55	60	0.46	4	< 2	< 0.2	< 1	< 2	< 2	< 2	20	< 10	< 5		3.3									
8/4/1997		13:55	50	0.46	4	< 2	< 0.2	< 1	< 2	< 2	< 2	20	< 10	< 5	1.6	3.3	21.9	9.4		321	126		663		
8/4/1997		13:57														9.6	21.8	9.1		322	126		662		
8/4/1997		13:59														16	21.6	8.5		324	126		665		
8/4/1997		14:01														22.4	21.4	8.4		324	126		662		
8/4/1997		14:03														28.8	21.2	8.1		325	126		662		
8/4/1997		14:05														35.2	20.5	6.7		326	131		662		
8/4/1997		14:07														41.6	18.2	3.6		332	139		662		
8/4/1997		14:09														48	17.7	2.1		332	113		662		
8/4/1997		14:10														54.4	17.6	1.4		334	114		662		
8/4/1997		14:11														60.8	17.4	1.2		333	145		662		
8/4/1997		14:13	50	0.48	4	< 2	< 0.2	< 1	< 2	< 2	< 2	80	160	< 5		65.3	17.4	1.1		334	145		662		
7/13/1998		15:30	50U	0.52	2	< 2	< 0.2	< 1	< 2	< 2	< 2	60	10.0U	< 5	4.5	3.3	22.6	8.2		350	175		654		
7/13/1998		15:33														9.8	21.8	8.3	8.15	350	161				
7/13/1998		15:35														16.4	20.4	8	8.32	353	162				
7/13/1998		15:37														23	19.2	7.5	8.35	355	162				
7/13/1998		15:38														29.5	18.4	6.8	8.3	357	164				
7/13/1998		15:41														36.1	17.6	5.9	8.45	359	155				
7/13/1998		15:43														42.6	17.5	5.7	8.43	360	155				
7/13/1998		15:45														49.2	16.8	5.2	8.4	364	157				
7/13/1998		15:47														55.8	15.9	3.8	8.3	366	162				
7/13/1998		15:49														62.3	15.8	3.2	8.23	369	164				
7/13/1998		15:50	50U	0.51	3	< 2	< 0.2	< 1	< 2	< 2	< 2	100	40	< 5		67.6	15.7	3		370	168				
6/26/2000		14:50	69	0.72	4	< 2	< 0.2	< 1	< 2	< 2	< 2	60	30	< 5	3.7	3.3	19.6	8.3	8.49	395	149		658		
6/26/2000		14:52														9.8	18.9	8.4	8.49	393	147				
6/26/2000		14:54														16.4	18.2	8	8.47	393	148				
6/26/2000		14:56														23	17.5	7.6	8.45	393	148				
6/26/2000		14:59														29.5	17.2	7	8.41	399	149				
6/26/2000		15:02														36.1	17.1	7	8.4	395	149				
6/26/2000		15:05														42.7	16.9	6.7	8.37	394	150				
6/26/2000		15:07														49.2	16.8	6.6	8.35	395	150				
6/26/2000		15:09														55.8	16.7	6.4	8.31	395	142				
6/26/2000		15:12	< 50	0.72	3	< 2	< 0.2	< 1	< 2	< 2	< 2	60	40	20		57.7	16.7	6.3	8.31	395	143				
7/15/2003		14:00	100	0.84	NE[1]	NE[1]	< 0.2	NE[1]	NE[1]	NE[1]	NE[1]	NE[1]	NE[1]	NE[1]	2.1	3.3	23.2	7.7	8.61	454	89		655		
7/15/2003		14:04														9.8	22.2	7.8	8.67	454	78				
7/15/2003		14:07														16.4	21.8	6.8	8.59	454	79				
7/15/2003		14:09														23	21.6	6.4	8.51	455	80				
7/15/2003		14:12														29.5	21.1	4.9	8.31	458	82				
7/15/2003		14:14	130	0.85	NE[1]	NE[1]	< 0.2	NE[1]	NE[1]	NE[1]	NE[1]	NE[1]	NE[1]	NE[1]		35.8	20.4	1.3	7.94	461	-35				
Snake River																									
8/14/1995		16:35	0	0.58	3	< 2	< 0.2	< 1	< 2	< 2	< 2	30	60	< 5			20.1	6.4	8.37	366	72	12690		96.9	101.6
8/4/1997		15:15	60	0.47	3	< 2	< 0.2	< 1	< 2	< 2	< 2	30	20	< 5			21	8.2		124	132		662	180	103.5
7/13/1998		16:33	50U	0.51	2	< 2	< 0.2	< 1	< 2	< 2	< 2	60	20	5			19.7	6.8		358	173	12510	654	101.6	102.4
6/26/2000		15:50	53	0.73	4	< 2	< 0.2	< 1	< 2	< 2	< 2	70	40	< 5			17.9	7.5	8.46	393	175	13420	658	100.6	
7/15/2003		14:45	110	0.85	NE[1]	NE[1]	< 0.2	NE[1]	NE[1]	NE[1]	NE[1]	NE[1]	NE[1]	NE[1]			22.3	6.7	8.57	453	86		657	99.5	

[1]NE=not entered

Table B-2. DEQ sampling of American Falls Reservoir, May 2001 to August 2003.

Site sample	Date sampled	Time sampled	NO_3+NO_2 (mg/L)	Ortho P (mg/L)	Total P (mg/L)	NH_3 (mg/L)	TKN (mg/L)	HCO_3 (mg/L)	TDS-180 (mg/L)	Alkalinity (mg/L)	Chl *a* (mg/L)	SS (mg/L)	Lab pH (SU)	Lab EC (*u* S/cm)	Turbidity (NTU)	Comments
near Dam																
Column	5/11/2001	9:30	0.14	0.006	0.03	0.02	0.32	189	274	161		9	8.5	449	3	
Bottom	5/11/01	9:40	0.16	0.007	0.044	0.03	0.4	190	275	161		11	8.4	452	4	
Column	5/23/2001	10:00	0.02	< 0.003	< 0.01	0.01	0.27	182	245	152		2	8.4	433	2	
Bottom	5/23/01	10:15	0.03	< 0.003	0.015	0.03	0.29	183	247	152		4	8.4	436	2	
Column	6/6/2001	9:45	0.06	0.052	0.067	0.15	0.46	188	259	154	0.0036	3	8.2	446	3	
Bottom	6/6/2001	9:45	0.06	0.055	0.073	0.17	0.44	189	252	155		6	8.1	446	5	
Column	6/20/2001	10:15	0.08	0.041	0.056	0.08	0.38	190	256	156	0.0034	3		449	2	
Bottom	6/20/2001	10:30	0.08	0.051	0.075	0.1	0.37	190	253	156		7		451	5	
Column	7/3/2001	12:30	0.12	0.042	0.083	0.11	0.57	197	278	162	0.0035	4		455	3	
Bottom	7/3/2001	12:45	0.11	0.049	0.06	0.12	0.4	197	273	162		2		450	2	
Column	7/12/2001	11:00	0.13	0.064	0.087	0.14	0.48	199	264	163	0.002	3	8.3	459	4	
Bottom	7/12/2001	11:00	0.09	0.184	2.14	0.34	0.62	203	280	166		6	8.1	461	6	
Column	7/19/2001	9:30	0.08	0.078	0.101	0.1	0.54	194	273	164	0.0006	2	8.4	460	< 1	
Bottom	7/19/2001	9:45	0.06	0.208	0.22	0.4	0.62	205	277	168		3	7.9	467	< 1	
Column	7/25/2001	11:45	0.05	0.075	0.099	0.07	0.37	193	277	164	0.0117	6	8.6	460	< 1	
Bottom	7/25/2001	12:00	0.06	0.083	0.101	0.1	0.37	191	276	165		8	8.6	460	1	
Column	8/2/2001	10:45	0.04	0.05	0.089	0.01	0.72	185	270	166	0.0406	7	8.6	459	4	loose lids
Bottom	8/2/2001	10:50	0.05	0.058	0.088	0.03	0.44	187	272	166		9	8.6	461	4	loose lids
Column	8/8/2001	9:45	0.03	0.055	0.085	0.06	0.57	193	275	166	0.0022	2	8.5	464	2	
Bottom	8/8/2001	9:55	0.05	0.095	0.115	0.17	0.42	201	275	167		4	8.4	467	2	
Column	6/4/2002	14:45	0.01	0.007	0.031	< 0.01	0.26	181	255	156	0.006	3	8.7	449	2	
Bottom	6/4/2002	14:30	0.02	0.014	0.042	< 0.01	0.34	180	252	155		5	8.7	451	2	
Column	6/20/2002	10:45	0.04	0.032	0.054	0.05	0.54	179	255	154	0.0075	3	8.5	448	2	
Bottom	6/20/2002	10:30	0.02	0.039	0.056	0.08	0.41	185	259	155		2	8.4	450	2	
Column	7/2/2002	12:00	0.02	0.124	0.155	0.3	0.53	191	262	157	0.0063	3	8.3	453	< 1	
Bottom	7/2/2002	11:50	0.02	0.153	0.186	0.43	0.63	195	263	160		2	8.2	455	1	
Column	7/15/2002	11:05	0.06	0.045	0.149	0.39	0.66	190	256	160	0.0097	2	8.5	443	2	
Bottom	7/15/2002	10:55	0.2	0.107	0.113	0.12	0.52	197	258	162		3	8.3	455	2	
Column	7/31/2002	8:50	0.03	0.065	0.12	0.04	0.78	183	270	162	0.0269	6	8.7	440	5	
Bottom	7/31/2002	8:00	0.05	0.076	0.104	0.08	0.43	189	270	163		8	8.6	444	6	
Column	5/28/2003	11:00	< 0.01	0.006	0.031	< 0.01	0.26	188		160	0.0045	2	8.5	459	< 1	
Bottom	5/28/2003	10:50	0.01	0.009	0.029	0.01	0.28	192		160		8	8.4	459	1	
Column	6/9/2003	10:00	0.04	0.031	0.055	0.11	0.42	196		161	0.0043	2	8.3	474	2	
Bottom	6/9/2003	9:45	0.04	0.035	0.055	0.11	0.4	197		162		2	8.3	475	2	
Column	6/26/2003	10:10	0.06	0.05	0.082	0.13	0.5	202		166	0.0046	2	8.3	491	2	
Bottom	6/26/2003	9:55	0.07	0.061	0.09	0.16	0.51	202		166		2	8.3	490	3	
Column	7/11/2003	11:15	0.06	0.038	0.09	0.04	0.44	203		166	0.0134	4	8.3	459	2	received past holding times
Bottom	7/11/2003	11:00	0.06	0.043	0.079	0.08	0.4	203		166		3	8.3	460	2	received past holding times
Column	7/23/2003	10:15	0.04	0.058	0.094	0.06	0.47	191		161	0.009	3	8.4	429	3	
Bottom	7/23/2003	10:00	0.07	0.129	0.161	0.21	0.54	197		162		2	8.1	431	3	
Column	8/5/2003	9:50	0.02	0.104	0.166	0.07	0.83	183		152	0.0305	8	8.4	406	5	
Bottom	8/5/2003	9:40	0.03	0.097	0.149	0.07	0.71	182		151		8	8.4	404	7	
24-hour sampling event near dam																
	7/18/2002	18:30			0.088	0.09	0.54				0.0115					Fixed and Chl-a Sample Only, Received Late
	7/19/2002	6:30			0.082	0.08	0.6				0.0202					Fixed and Chl-a Sample Only, Received Late
	7/19/2002	12:30			0.078	0.05	0.42				0.0092					Fixed Sample Only Rec'd Late, Chlorophyll labeled 7/15/02
off Fenstermaker Point																
Column	8/8/2001	8:15	0.16	0.041	0.06	0.07	0.42	200	276	164	0.014	5	8.3	463	2	
Bottom	8/8/2001	8:35	0.14	0.046	0.063	0.08	0.35	201	285	165		3	8.3	465	2	
Column	6/4/2002	13:55	0.01	0.003	0.034	< 0.01	0.3	182	238	155	0.006	3	8.6	450	2	
Bottom	6/4/2002	13:45	0.02	0.03	0.053	< 0.01	0.27	190	253	157		3	8.4	453	2	
Column	7/2/2002	13:25	< 0.01	0.049	0.078	0.04	0.38	183	254	158	0.0054	4	8.5	446	1	
Bottom	7/2/2002	13:45	0.02	0.04	0.086	0.24	0.38	178	255	157		5	8.5	447	1	
Column	7/15/2002	10:00	0.06	0.03	0.079	0.07	0.48	182	256	161	0.0176	3	8.7	447	2	
Bottom	7/15/2002	9:50	0.2	0.05	0.136	0.37	0.72	194	257	163		4	8.5	453	2	
Column	6/26/2003	9:30	0.07	0.06	0.096	0.17	0.65	201		165	0.0041	2	8.3	489	2	
Bottom	6/26/2003	9:10	0.07	0.061	0.097	0.18	0.61	202		166		3	8.2	491	3	
Column	7/23/2003	9:15	0.01	0.051	0.103	0.02	0.7	178		162	0.0242	6	8.6	432	8	
Bottom	7/23/2003	9:00	0.04	0.082	0.144	0.07	0.44	191		160		11	8.4	425	9	
Column	8/5/2003	7:50	0.02	0.049	0.152	0.02	1.27	173		144	0.0686	15	8.4	388	12	
Bottom	8/5/2003	7:35	0.03	0.049	0.157	0.03	1.04	173		145		14	8.4	388	12	

Table B-2. Continued.

Site sample	Date sampled	Time sampled	NO_3+NO_2 (mg/L)	Ortho-P (mg/L)	T-Phos (mg/L)	NH_3 (mg/L)	TKN (mg/L)	HCO_3 (mg/L)	TDS-180 (mg/L)	Alkalinity (mg/L)	Chl *a* (mg/L)	SS (mg/L)	Lab pH (SU)	Lab EC (*u* S/cm)	Turbidity (NTU)	Comments
off Little Hole Draw point																
Column	5/11/2001	8:10	< 0.01	0.004	0.026	< 0.01	0.4	178	258	148		10	8.4	430	4	
Bottom	5/11/01	8:20	< 0.01	< 0.003	0.025	< 0.01	0.32	177	256	148		10	8.4	430	4	
Column	5/23/2001	8:25	0.05	0.032	0.054	0.19	0.52	188	261	157		2	8.4	448	1	
Bottom	5/23/01	8:45	0.02	0.036	0.054	0.19	0.5	186	255	154		2	8.4	441	2	
Column	6/20/2001	9:15	0.16	0.025	0.05	0.07	0.43	196	260	161	0.0078	3		448	3	
Bottom	6/20/2001	9:15	0.15	0.02	0.044	0.05	0.37	197	265	162		2		455	2	
Column	7/3/2001	9:30	0.14	0.048	0.088	0.12	0.58	199	272	163	0.0112	6		459	5	
Bottom	7/3/2001	10:00	0.14	0.058	0.094	0.16	0.53	200	275	164		8		449	7	
Column	7/12/2001	9:00	0.12	0.051	0.091	0.13	0.52	193	270	162	0.0132	10	8.4	446	9	
Bottom	7/12/2001	9:00	0.12	0.053	0.096	0.15	0.58	197	276	162		15	8.2	444	10	
Column	7/25/2001	9:30	0.27	0.049	0.114	0.09	0.43	200	281	168	0.0064	38	8.5	465	12	
Bottom	7/25/2001	9:45	0.28	0.048	0.105	0.08	0.47	198	281	168		34	8.5	464	10	
Column	8/2/2001	8:30	0.15	0.04	0.105	0.05	0.72	199	274	165	0.0572	15	8.4	458	13	loose lids
Bottom	8/2/2001	8:50	0.18	0.042	0.136	0.08	0.75	199	272	165		22	8.4	458	13	loose lids
Column	8/8/2001	7:30	0.35	0.046	0.158	0.08	0.73	206	283	169	0.0156	12	8.1	471	7	
Bottom	8/8/2001	7:45	0.32	0.06	0.119	0.16	0.93	210	287	172		17	8.1	476	10	
Column	6/4/2002	12:15	0.03	0.031	0.044	0.13	0.4	186	250	155	0.0027	< 1	8.5	448	1	
Bottom	6/4/2002	12:00	0.04	0.038	0.049	0.15	0.47	187	254	155		< 1	8.4	446	1	
Column	6/20/2002	8:45	0.03	0.022	0.055	0.02	0.46	175	256	157	0.0175	4	8.7	443	2	
Bottom	6/20/2002	8:30	0.04	0.029	0.078	0.03	0.42	183	254	158		4	8.5	446	2	
Column	7/2/2002	9:40	0.1	0.041	0.078	< 0.01	0.46	181	247	157	0.0149	7	8.5	433	2	
Bottom	7/2/2002	9:30	< 0.01	0.034	0.085	< 0.01	0.45	181	244	157		6	8.5	433	2	
Column	7/15/2002	9:05	0.36	0.086	0.154	0.17	0.76	188	257	161	0.0162	8	8.5	450	5	
Bottom	7/15/2002	8:55	0.33	0.086	0.142	0.18	0.82	190	273	163		7	8.6	450	4	
Column	5/28/2003	9:15	0.03	0.032	0.04	0.13	0.46	197		162	0.0021	< 1	8.3	465	1	
Bottom	5/28/2003	9:10	0.03	0.038	0.059	0.19	0.47	197		162		< 1	8.3	466	1	
Column	6/9/2003	8:25	0.05	0.038	0.064	0.14	0.46	197		162	0.003	3	8	472	2	
Bottom	6/9/2003	8:10	0.05	0.04	0.065	0.14	0.7	197		162		2	8.3	474	2	
Column	6/26/2003	8:40	0.07	0.048	0.089	0.15	0.58	200		164	0.005	3	8.3	486	3	
Bottom	6/26/2003	8:30	0.07	0.051	0.086	0.16	0.58	200		164		4	8.3	488	4	
Column	7/23/2003	7:30	0.13	0.051	0.103	0.07	0.45	190		159	0.0079	7	8.4	422	8	
Bottom	7/23/2003	7:20	0.14	0.05	0.089	0.07	0.48	189		158		5	8.4	419	8	
Column	8/5/2003	8:30	0.08	0.003	0.098	0.02	0.57	160		133	0.033	48	8.4	351	24	
upreservoir from Big Hole along Bingham-Bannock county line																
Column	5/11/2001	7:30	< 0.01	0.009	0.039	< 0.01	0.37	183	263	152		8	8.4	438	4	
Bottom	5/11/01	7:45	< 0.01	0.005	0.033	0.01	0.41	184	268	152		9	8.4	438	4	
Column	5/23/2001	7:45	0.07	0.033	0.06	0.21	0.76	191	260	158		2	8.4	447	1	
Bottom	5/23/01	7:50	0.06	0.044	0.076	0.24	0.61	192	258	159		2	8.4	449	2	
Column	6/6/2001	7:45	0.1	0.031	0.063	0.12	0.5	193	262	161	0.0083	7	8.4	457	4	
Column	6/20/2001	7:45	0.19	0.01	0.034	0.04	0.32	186	247	153	0.0062	7		425	6	
Bottom	6/20/2001	7:45	0.22	0.017	0.046	0.08	0.36	177	253	145		9		442	7	
Column	7/3/2001	8:00	0.04	0.025	0.078	0.13	0.65	192	275	157	0.0264	12		446	10	
Bottom	7/3/2001	8:15	0.19	0.036	0.094	0.2	0.68	192	267	157		12		427	10	
Column	7/12/2001	7:45	0.19	0.006	0.1	0.03	0.62	173	229	142	0.0331	55	8.3	364	28	
Bottom	7/12/2001	7:45	0.25	0.016	0.104	0.09	0.61	180	240	148		53	8.3	397	31	
Column	7/25/2001	8:15	0.33	0.014	0.084	0.07	0.4	176	245	148	0.0084	39	8.5	407	10	
Bottom	7/25/2001	8:40	0.35	0.015	0.082	0.08	0.37	179	239	149		41	8.5	408	10	
Column	8/2/2001	9:25	0.41	0.012	0.106	0.08	0.51	183	227	150	0.0121	75	8.2	401	15	loose lids
Bottom	8/2/2001	9:40	0.3	0.011	0.096	0.09	0.46	187	229	153		109	8.2	402	31	loose lids
Column	6/4/2002	10:45	0.04	0.011	0.04	0.02	0.41	179	250	155	0.0114	6	8.7	437	3	
Bottom	6/4/2002	11:00	0.04	0.013	0.045	0.02	0.42	177	243	154		5	8.7	439	3	
Column	6/20/2002	8:00	< 0.01	0.01	0.047	< 0.01	0.69	170	252	154	0.0203	6	8.7	428	2	
Bottom	6/20/2002	7:45	0.03	0.016	0.059	< 0.01	0.58	169	250	156		8	8.7	435	3	
Column	7/2/2002	8:15	0.1	0.024	0.118	0.06	0.7	191	262	157	0.0183	26	8.4	454	7	
Bottom	7/2/2002	8:00	0.11	0.02	0.114	0.06	0.92	188	261	157		28	8.4	452	5	
Column	7/15/2002	8:15	0.37	0.054	0.099	0.08	0.69	177	230	147	0.0416	23	8.4	390	9	
Column	5/28/2003	8:15	0.04	0.005	0.042	0.02	0.44	183		155	0.017	1	8.5	435	2	
Bottom	5/28/2003	8:00	0.06	0.043	0.078	0.1	0.53	195		160		2	8.3	450	2	
Column	6/9/2003	7:35	0.07	0.018	0.073	0.07	0.45	173		145	0.0064	5	8.5	396	2	
Bottom	6/9/2003	7:20	0.08	0.018	0.049	0.07	0.44	174		145		3	8.4	399	2	
Column	6/26/2003	7:40	0.11	0.003	0.065	0.02	0.49	171		140	0.0234	10	8.3	388	5	
Bottom	6/26/2003	7:30	0.08	0.005	0.072	0.02	0.51	175		144		14	8.3	404	7	
Column	7/11/2003	7:45	0.13	0.003	0.042	0.06	0.32	168		138	0.0075	19	8.2	350	8	received past holding times
Blanks																
	5/11/2001	9:45	0.03	< 0.003	< 0.01	< 0.01	< 0.03	1	< 5	0.82		< 1	5.7	< 2	< 1	
	7/12/2001	11:00	0.06	< 0.003	< 0.01	< 0.01	< 0.03	2	< 5	1.64		< 1	5.9	< 2	3	
	8/8/2001	10:00	0.04	< 0.003	< 0.01	< 0.01	< 0.03	7	< 5	5.74		< 1	6.4	< 2	< 1	
	6/4/2002	15:00	0.02	< 0.003	< 0.01	< 0.01	< 0.03	1	6	0.82		< 1	5.9	2	< 1	
	7/15/2002	11:15	< 0.01	< 0.003	< 0.01	0.12	0.71	3	5	2.46		< 1	6.2	< 2	< 1	
Duplicates																
	6/20/2001	7:45	0.18	0.009	0.034	0.04	0.37	187	242	153		9		422	6	Boundary site
	8/2/2001	8:45	0.15	0.039	0.112	0.05	0.64	197	274	165		19	8.4	457	13	loose lids
	7/15/2002	10:10	0.13	0.038	0.086	0.11	0.68	182	256	161		5	8.7	448	2	Fenstermaker

Table B-3. DEQ field parameter sampling in American Falls Reservoir, May 2001 to August 2003. Temp = temperature, Cond = conductivity, DO = dissolved oxygen, Turb = turbidity.

		Dam					Fenstermaker Point					Little Hole Draw Point					County Boundary Point				
Date	Depth (meters)	Temp (°C)	pH	Cond (u S/cm)	DO (mg/l)	Turb (NTU)	Temp (°C)	pH	Cond (u S/cm)	DO (mg/l)	Turb (NTU)	Temp (°C)	pH	Cond (u S/cm)	DO (mg/l)	Turb (NTU)	Temp (°C)	pH	Cond (u S/cm)	DO (mg/l)	Turb (NTU)
11-May-01	0.3	9.05	8.76	298	10.27							10.71	8.69	298	10.25		10.92	8.55	300	10.81	
	1	9.01	8.75	298	10.37							10.7	8.69	298	10.28		10.93	8.54	300	10.84	
	2	8.93	8.74	297	10.39							10.69	8.68	298	10.29		10.92	8.53	301	10.84	
	3	8.9	8.73	297	10.34							10.69	8.68	298	10.29		10.78	8.52	301	10.94	
	4	8.91	8.73	297	10.29							10.63	8.67	297	10.29		10.77	8.51	301	11.02	
	5	8.89	8.73	297	10.26							10.63	8.66	297	10.3		10.77	8.51	301	11.09	
	6	8.89	8.72	297	10.19							10.61	8.67	297	10.3		10.76	8.49	302	11.26	
	7	8.9	8.72	297	10.08							10.61	8.66	297	10.27		10.76	8.48	301	11.37	
	8	8.89	8.71	297	10.07							10.55	8.66	296	10.3		10.76	8.46	302	11.6	
	9	8.88	8.71	297	9.98							10.52	8.66	296	10.27						
	10	8.86	8.71	297	9.91							10.48	8.66	296	10.22						
	11	8.85	8.7	297	9.87							10.48	8.66	296	10.12						
	12	8.76	8.69	297	9.85																
	13	8.76	8.69	297	9.81																
	14	8.73	8.68	297	9.78																
	15	8.68	8.67	296	9.79																
	16	8.62	8.67	296	9.8																
	17	8.56	8.66	296	9.84																
	18	8.55	8.65	296	9.86																
	19	8.56	8.65	296	9.87																
23-May-01	0.3	13.75	8.56	337	8.23							14.15	8.25	356	6.49		14.56	8.29	357	7	
	1	13.7	8.56	337	8.36		15.16	8.26	363	6.42		14.11	8.25	356	6.44		14.58	8.29	357	6.94	
	2	13.56	8.57	335	8.44							14.08	8.25	355	6.4		14.58	8.29	357	6.86	
	3	13.41	8.57	334	8.39		14.45	8.25	355	6.38		14.05	8.24	354	6.32		14.5	8.27	357	6.78	
	4	13.22	8.57	332	8.39							14.02	8.23	354	6.23		14.35	8.24	354	6.72	
	5	13.07	8.55	331	8.47		14.22	8.24	356	6.29		13.92	8.21	352	6.16		14.22	8.23	354	6.67	
	6	12.84	8.54	329	8.55							13.78	8.19	350	6.05		14.15	8.22	353	6.33	
	7	12.21	8.57	323	8.67							13.73	8.19	349	5.91		14.09	8.19	355	6.42	
	8	11.78	8.58	320	8.7							13.68	8.18	348	5.57						
	9	11.65	8.57	319	8.68		13.42	8.23	341	6.26		13.58	8.16	347	5.41						
	10	11.63	8.57	319	8.57							12.72	8.16	335	5.45						
	11	11.58	8.56	318	8.46							12.66	8.14	334	5.51						
	12	11.52	8.55	318	8.28																
	13	11.38	8.51	317	8.1																
	14	11.23	8.48	317	7.99																
	15	11.21	8.47	317	7.94																
	16	10.97	8.46	315	7.98																
	17	10.88	8.44	315	7.98																
	18	10.87	8.44	315	8.01																
6-Jun-01	0.3	14.11	8.14	351	7.06												14.25	8.29	360	7.48	
	1	14.1	8.13	351	7.1												14.27	8.28	360	7.42	
	2	14.04	8.13	350	7.1												14.27	8.27	361	7.36	
	3	14.02	8.12	350	7.1												14.3	8.26	360	7.24	
	4	14.02	8.11	350	7.08												14.29	8.25	361	7.07	
	5	14.02	8.11	350	7.04												14.31	8.23	361	6.68	
	6	14.01	8.11	350	7.02												14.26	8.21	360	5.77	
	7	14	8.1	350	7																
	8	14	8.1	350	6.94																
	9	13.99	8.1	350	6.87																
	10	14	8.09	350	6.77																
	11	14	8.09	350	6.68																
	12	13.96	8.07	350	6.56																
	13	13.94	8.06	350	6.51																
	14	13.8	8.03	349	6.51																
	15	13.79	8.02	349	6.47																
	16	13.79	8.02	349	6.39																
20-Jun-01	0.3	16.6	8.32	375	6.1							16.66	8.44	375	6.2		17.12	8.47	353	6.68	
	1	16.49	8.31	374	5.94							16.6	8.44	375	6.21		17.11	8.47	352	6.5	
	2	15.73	8.29	367	5.76							16.55	8.44	374	6.21		17.08	8.46	350	6.29	
	3	15.54	8.28	365	5.72							16.5	8.42	373	6.06		16.97	8.44	348	5.65	
	4	15.34	8.26	364	5.73							16.4	8.41	374	6.05		16.34	8.37	355	5.64	
	5	15.26	8.25	363	5.73							15.84	8.43	372	6.09		16.06	8.34	368	5.66	
	6	15.22	8.24	363	5.7							15.6	8.42	370	6.11		16	8.32	359	5.57	
	7	15.17	8.24	363	5.68							15.52	8.41	369	6.02		15.95	8.29	361	5.5	
	8	15.14	8.24	363	5.66							15.48	8.41	369	5.96						
	9	15.15	8.23	363	5.62							15.22	8.38	367	6						
	10	15.12	8.22	363	5.5																
	11	15.07	8.21	363	5.43																
	12	15.04	8.2	362	5.35																
	13	15.04	8.19	362	5.31																
	14	15.01	8.18	362	5.31																
	15	14.97	8.17	362	5.32																

Table B-3. Continued.

		Dam					Fenstermaker Point					Little Hole Draw Point					County Boundary Point				
Date	Depth (meters)	Temp (°C)	pH	Cond (u S/cm)	DO (mg/l)	Turb (NTU)	Temp (°C)	pH	Cond (u S/cm)	DO (mg/l)	Turb (NTU)	Temp (°C)	pH	Cond (u S/cm)	DO (mg/l)	Turb (NTU)	Temp (°C)	pH	Cond (u S/cm)	DO (mg/l)	Turb (NTU)
3-Jul-01	0.3	21.66	8.61	427	8.34	0.5						22.61	8.66	426	8.42	2	24.28	8.69	409	9.01	12.6
	1	21.56	8.61	426	8.34	0.3						22.55	8.66	426	8.42	2.8	24.29	8.68	410	9	12.2
	2	21.22	8.6	426	8.29	0.3						22.49	8.65	426	8.38	2.8	24.29	8.68	409	8.96	13.1
	3	20.98	8.59	426	8.19	0.4						22.43	8.64	426	8.21	2.8	24.1	8.61	417	8.13	17.3
	4	20.87	8.59	426	8.17	0.5						22.39	8.61	427	8.01	3.9	22.76	8.15	402	4.13	18.4
	5	20.24	8.55	427	7.89	0.2						22.34	8.6	427	8.01	4.1	22.58	8.16	399	4.25	14.6
	6	19.91	8.54	426	7.88	1.4						21.42	8.33	434	5.39	7.2	22.14	7.98	415	2.87	12
	7	19.65	8.56	426	8.04	1.3						21.18	8.14	438	4.27	10.2					
	8	19.31	8.5	427	7.45	2.3															
	9	18.56	8.46	425	7.2	1.3															
	10	18.44	8.37	426	6.39	0.8															
	11	18.24	8.38	426	6.32	0.3															
	12	17.91	8.3	427	5.63	0.3															
	13	17.72	8.23	429	4.91	0.3															
	14	17.68	8.24	428	5.04	0.3															
12-Jul-01	0.3	23.14	8.73	429	7.62	0.4						22.61	8.48	423	5.57	15.5	22.08	8.58	349	7.06	65.5
	1	23	8.74	429	7.63	0.4						22.57	8.47	423	5.49	16.1	22.06	8.5	356	6.93	68
	2	22.82	8.74	429	7.59	0.4						22.54	8.47	423	5.48	16.9	22.05	8.45	352	6.9	64.2
	3	22.74	8.73	429	7.56	0.7						22.54	8.47	423	5.53	16.1					
	4	22.68	8.73	429	7.5	1						22.54	8.48	423	5.55	15.6					
	5	22.63	8.72	429	7.44	2						22.53	8.48	423	5.58	16.5					
	6	22.6	8.72	429	7.42	1.5															
	7	22.52	8.71	429	7.4	3															
	8	22.44	8.7	429	7.13	2.9															
	9	22.32	8.68	428	6.92	2															
	10	19.87	8.3	433	3.84	4															
	11	18.96	8.13	434	2.6	6.5															
	12	18.48	8.06	434	1.97	8.5															
19-Jul-01	0.3	21.29	8.69	429	7.01	2.1															
	1	21.28	8.69	429	7.03	1.2															
	2	21.3	8.69	429	6.96	1.3															
	3	21.3	8.68	429	6.9	1.6															
	4	21.29	8.68	429	6.9	3.1															
	5	21.29	8.68	429	6.88	1.5															
	6	21.29	8.68	429	6.96	6.1															
	7	21.28	8.68	429	6.88	1.3															
	8	21.24	8.65	430	6.61	1.6															
	9	21.05	8.6	431	5.75	2.7															
	10	20.72	8.48	432	4.85	4.4															
	11	20.41	8.4	434	3.67	5.5															
	12	20.01	8.17	436	2.37	6.7															
25-Jul-01	0.3	21.17	8.82	426	7.86	2.3						20.02	8.48	433	6.2	47.9	20.03	8.61	377	7.52	47.2
	1	21.14	8.82	426	7.83	3.5						20.02	8.48	433	6.16	49.8	20.06	8.61	377	7.5	46.9
	2	21.09	8.8	426	7.83	4.4						20.03	8.48	433	6.17	49.6	20.04	8.6	377	7.49	48
	3	21.08	8.81	426	7.8	4.8						19.98	8.47	433	6.09	52.3	19.91	8.56	385	7.41	53.6
	4	21.06	8.81	426	7.77	3.1						19.93	8.46	433	5.92	53.3					
	5	21.05	8.81	426	7.8	3						19.87	8.42	433	5.56	58.5					
	6	20.98	8.79	427	7.4	3.8															
	7	20.74	8.68	429	5.84	7.5															
	8	20.69	8.65	429	5.76	7.8															
	9	20.67	8.64	429	5.71	8.7															
	10	20.66	8.64	429	5.7	8.5															
	11	20.65	8.64	430	5.67	8.9															
2-Aug-01	0.3	21.89	8.8	418	10.22	4.8						21	8.58	418	8.08	29.3	18.18	8.35	366	7.16	53
	1	21.77	8.86	418	10.34	8						21	8.58	418	7.97	26.3	18.13	8.35	366	7.14	65
	2	21.66	8.86	417	10.14	7.4						20.98	8.56	419	7.63	32.7	18.13	8.35	366	7.14	80
	3	21.48	8.77	419	8.92	6						20.68	8.44	419	6.45	401					
	4	21.43	8.77	420	8.84	5.5						19.01	8.15	415	4.32	1770					
	5	21.28	8.76	420	8.78	5.8															
	6	21.2	8.76	419	8.79	7.9															
	7	21.19	8.76	420	8.78	5.6															
	8	21.16	8.75	420	8.71	8															
	9	20.9	8.69	421	7.79	14.4															
	10	20.87	8.69	421	7.78	15.5															
8-Aug-01	0.3	22.95	8.84	422	10.5	6	21.69	8.55	423	8.19	8.2	22.32	8.43	430	7.58	26.7					
	1	22.95	8.84	422	10.48	1.1	21.7	8.55	423	8.19	7.9	22.33	8.42	430	7.47	26.9					
	2	22.95	8.84	422	10.47	5.8	21.7	8.55	423	8.17	7.3	22.26	8.38	432	6.89	29.6					
	3	22.93	8.83	422	10.33	3	21.65	8.55	424	8.05	8.2	21.45	8.07	442	3.91	48.1					
	4	22.47	8.72	423	8.78	7.4	21.57	8.52	424	7.61	7.9										
	5	21.89	8.69	423	8.44	2.6	21.48	8.49	425	7.23	9.4										
	6	21.46	8.56	426	6.43	2.7															
	7	21.28	8.55	426	6.21	3.4															
	8	21.09	8.49	427	5.46	5.5															
	9	21.08	8.49	427	5.45	5.8															

Table B-3. Continued.

Date	Depth (meters)	Dam Temp (°C)	Dam pH	Dam Cond (u S/cm)	Dam DO (mg/l)	Dam Turb (NTU)	Fenstermaker Point Temp (°C)	Fenstermaker Point pH	Fenstermaker Point Cond (u S/cm)	Fenstermaker Point DO (mg/l)	Fenstermaker Point Turb (NTU)	Little Hole Draw Point Temp (°C)	Little Hole Draw Point pH	Little Hole Draw Point Cond (u S/cm)	Little Hole Draw Point DO (mg/l)	Little Hole Draw Point Turb (NTU)	County Boundary Point Temp (°C)	County Boundary Point pH	County Boundary Point Cond (u S/cm)	County Boundary Point DO (mg/l)	County Boundary Point Turb (NTU)
4-Jun-02	0.3	17.4	8.72	461	9.8	0	17.94	8.81	460	10.4	0	18.19	8.43	462	7.37	0	18.65	8.67	448	9.63	0
	1	17.15	8.73	461	9.81	0	16.55	8.82	460	10.64	0	17.83	8.42	461	7.34	0	18.41	8.67	449	9.7	0.2
	2	16.25	8.74	461	10.01	0	15.81	8.83	459	10.83	0	17.49	8.41	461	7.36	0	18.23	8.64	452	9.48	0.1
	3	15.25	8.78	460	10.22	0	15.55	8.83	459	10.82	0	17.37	8.41	460	7.36	0	18.17	8.63	453	9.3	0
	4	15.23	8.78	460	10.25	0	15.41	8.82	459	10.76	0	17.28	8.41	460	7.36	0	18.12	8.64	451	9.23	0.4
	5	15.21	8.78	460	10.25	0	15.34	8.81	459	10.57	0	17.26	8.4	460	7.33	0	18.11	8.63	451	9.21	0.6
	6	15.2	8.78	460	10.22	0	15.29	8.78	460	10.25	0	17.17	8.4	460	7.29	0	18.09	8.61	451	9.2	0.9
	7	14.92	8.78	460	10.28	0	15.03	8.71	461	9.52	0	17.15	8.39	460	7.3	0					
	8	14.88	8.76	461	9.97	0	14.88	8.67	461	8.92	0	17.14	8.39	460	7.3	0					
	9	14.84	8.74	461	9.69	0	14.76	8.67	462	8.99	0	17.04	8.4	460	7.33	0					
	10	14.75	8.72	462	9.42	0	14.53	8.64	463	8.73	0										
	11	14.68	8.74	461	9.71	0	14.5	8.62	463	8.63	0										
	12	14.58	8.74	462	9.68	0	14.31	8.6	464	8.65	0										
	13	14.41	8.73	462	9.51	0	13.55	8.52	466	7.49	0										
	14	14.38	8.73	463	9.49	0															
	15	14.37	8.72	463	9.44	0															
	16	14.27	8.69	464	9.16	0.5															
20-Jun-02	0.3	17.26	8.63	462	9.19	0						17.82	8.85	457	11.24	0	18.3	8.95	437	11.4	0
	1	17.26	8.63	462	9.19	0						17.82	8.85	457	11.21	0	18.3	8.95	437	11.39	0
	2	17.25	8.63	462	9.17	0						17.8	8.84	457	11.19	0	18.29	8.95	437	11.36	0
	3	17.24	8.63	462	9.17	0						17.83	8.84	457	11.2	0	18.29	8.95	438	11.29	0
	4	17.25	8.63	462	9.16	0						17.78	8.82	457	11	0	18.22	8.93	441	11.23	0
	5	17.24	8.63	462	9.15	0						17.69	8.8	458	10.85	0	18.17	8.92	443	11.07	0
	6	17.24	8.62	462	9.14	0						17.54	8.76	459	10.41	0	18.05	8.88	447	10.87	0
	7	17.23	8.62	462	9.11	0						17.18	8.69	459	9.76	0	17.61	8.84	454	10.65	0.4
	8	17.23	8.62	462	9.11	0						17.13	8.66	459	9.54	0					
	9	17.23	8.61	462	9.1	0															
	10	17.21	8.61	462	9.02	0															
	11	17.17	8.6	462	9	0															
	12	17.09	8.57	462	8.82	0															
	13	17.04	8.55	462	8.68	0															
	14	16.69	8.49	464	8.12	0															
	15	16.62	8.48	464	8.01	0															
2-Jul-02	0.3	19.29	8.46	471	5.69	0	22.11	8.87	465	8.75	0	20.54	8.85	451	8.21	0	21.13	8.65	472	7.34	10.6
	1	18.38	8.5	470	5.92	0	21.03	8.9	464	8.95	0	20.56	8.84	451	8.2	0	21.13	8.66	473	7.3	11.3
	2	18.36	8.49	470	6	0	20.77	8.94	463	9.18	0	20.56	8.84	451	8.19	0	21.12	8.67	472	7.29	11.7
	3	18.11	8.48	470	5.76	0	20.55	8.91	464	8.84	0	20.54	8.84	451	8.16	0	21.13	8.68	473	7.3	11.2
	4	17.6	8.38	471	4.62	0	20.4	8.92	464	8.92	0	20.54	8.88	451	8.15	0	21.11	8.69	471	7.29	13.2
	5	17.5	8.29	473	3.52	0	20.21	8.86	465	8.02	0	20.53	8.83	451	8.14	0	21.07	8.75	467	7.4	12.6
	6	17.42	8.25	473	3.1	0	20.11	8.85	465	7.99	0	20.49	8.81	450	8.11	0.1	21.04	8.77	465	7.4	15
	7	17.33	8.21	473	2.32	0	20.05	8.87	464	8.26	0	20.47	8.8	450	8.09	0					
	8	17.28	8.17	474	2.07	0	20.02	8.87	465	8.27	0	20.47	8.7	450	8.1	0					
	9	17.11	8.19	474	2.01	0	19.98	8.86	465	8.14	0										
	10	17.11	8.19	474	2.02	0	19.96	8.85	465	8.08	0										
	11	17.11	8.2	475	1.89	0	19.87	8.85	465	8.06	0.1										
	12	17.09	8.22	475	1.83	0															
	13	17.08	8.23	475	1.81	0															
15 Jul 02[1]	0.3	24.3	8.78	357	8.46	0	23.54	8.73	359	8.25	0	23.67	8.52	363	6.59	2.9	23.99	8.29	317	6.94	7.7
	1	24.07	8.78	357	8.48	3.2	23.53	8.73	359	8.22	0	23.62	8.52	363	6.58	1.3	23.99	8.29	317	6.92	7.9
	2	23.67	8.72	358	7.73	1.5	23.5	8.72	359	8.16	0	23.59	8.51	362	6.59	0	24.01	8.3	317	6.9	8.3
	3	23.56	8.65	360	6.87	0	23.44	8.7	360	7.99	0	23.52	8.51	362	6.67	1.6	24.01	8.31	317	6.9	8.3
	4	23..04	8.5	362	5.4	0	23.43	8.69	360	7.87	0	23.5	8.5	362	6.69	1.5	23.96	8.32	318	6.84	8.5
	5	22.34	8.39	364	4.2	0	23.4	8.68	360	7.71	0	23.48	8.49	362	6.76	1					
	6	21.61	8.26	365	3.07	0	23.35	8.66	360	7.45	0										
	7	21.58	8.26	365	3.11	0	23.25	8.65	361	7.28	0										
	8	21.49	8.24	366	2.93	0	23.09	8.6	361	7.02	0										
	9	21.15	8.16	366	2.3	0	22.56	8.41	364	5.01	0										
	10	20.95	8.13	366	2	0															
	11	20.83	8.11	367	1.75	0															
31-Jul-02	0.3	22	8.76	457	9.45	14.6															
	1	22.02	8.74	457	9.27	5															
	2	22.02	8.73	457	9.13	3															
	3	22.02	8.73	457	9.26	4.3															
	4	22.02	8.74	457	9.16	5															
	5	22	8.71	457	9.05	4															
	6	21.95	8.6	457	8.35	3															
	7	21.54	8.44	462	6.16	0															
	8	21.4	8.44	461	6.02	1															
	9	21.37	8.43	461	5.98	1.9															

Table B-3. Continued.

		Dam					Fenstermaker Point					Little Hole Draw Point					County Boundary Point				
Date	Depth (meters)	Temp (°C)	pH	Cond (u S/cm)	DO (mg/l)	Turb (NTU)	Temp (°C)	pH	Cond (u S/cm)	DO (mg/l)	Turb (NTU)	Temp (°C)	pH	Cond (u S/cm)	DO (mg/l)	Turb (NTU)	Temp (°C)	pH	Cond (u S/cm)	DO (mg/l)	Turb (NTU)
28-May-03	0.3	16.86	8.71	452	9.8							16.69	8.39	458	7.97		19.36	8.72	423	10.82	
	1	16.83	8.71	452	9.81							16.68	8.39	458	7.96		19.38	8.72	423	10.8	
	2	16.83	8.71	452	9.8							16.68	8.39	458	7.96		19.33	8.72	424	10.76	
	3	16.81	8.71	452	9.8							16.64	8.39	458	7.94		19.18	8.7	426	10.61	
	4	16.77	8.71	452	9.81							16.58	8.39	458	7.92		18.83	8.67	432	10.48	
	5	16.7	8.71	452	9.82							16.51	8.39	458	7.86		17.87	8.66	428	10.38	
	6	16.65	8.71	452	9.84							16.1	8.36	458	7.7		16.82	8.49	445	9.45	
	7	16.57	8.72	452	9.86							15.28	8.36	458	7.52		15.92	8.33	450	8.35	
	8	14.53	8.71	451	10.22							14.52	8.32	459	7.11		15.62	8.28	451	8.24	
	9	13.77	8.69	451	10.16							14.39	8.29	459	6.71						
	10	12.75	8.67	450	9.96							13.66	7.94	471	4.11						
	11	11.91	8.56	452	8.96																
	12	11.81	8.57	451	9.02																
	13	11.8	8.56	452	8.93																
	14	11.67	8.54	452	8.71																
	15	11.56	8.51	452	8.41																
	16	11.47	8.47	452	8.28																
9-Jun-03[2]	0.3	17.74	8.5	460	8.12							17.96	8.48	452	7.15		18.24	8.67	387	8.02	
	1	17.74	8.49	459	8.12							17.96	8.47	452	7.18		18.28	8.67	387	8.02	
	2	17.73	8.5	460	8.12							17.95	8.48	452	7.21		18.27	8.67	387	8.04	
	3	17.72	8.5	459	8.08							17.85	8.47	452	7.29		18.28	8.68	387	8.03	
	4	17.69	8.5	460	8.08							17.72	8.48	454	7.09		18.28	8.68	387	8.01	
	5	17.54	8.48	460	8.12							17.52	8.46	455	6.97		18.27	8.66	384	7.96	
	6	17.11	8.47	460	7.98							17.18	8.43	459	6.78		18.26	8.68	383	7.96	
	7	16.96	8.47	460	8.04							16.63	8.38	462	6.53		18.23	8.69	383	7.89	
	8	16.87	8.46	460	7.97							16.56	8.39	462	6.43						
	9	16.82	8.47	460	8.05																
	10	16.79	8.47	460	8.11																
	11	16.78	8.48	460	8.15																
	12	16.64	8.46	460	7.81																
	13	16.58	8.44	461	7.68																
	14	16.58	8.44	460	7.74																
	15	16.55	8.44	460	7.73																
26-Jun-03	0.3	18.52	8.52	464	7.91	0	18.23	8.45	464	7.33	0	18.14	8.44	462	7.43	0.7	16.02	8.46	356	9.3	1.9
	1	18.47	8.52	464	7.81	0	18.23	8.45	465	7.34	0	18.07	8.43	462	7.31	0.9	16.01	8.45	356	9.4	2.1
	2	18.27	8.51	463	7.76	0	18.2	8.45	464	7.13	0	17.79	8.42	462	7.25	0.6	16.01	8.48	358	9.56	2.2
	3	18.22	8.5	464	7.67	0	18.16	8.44	464	7.3	0	17.77	8.42	462	7.16	0.5	15.75	8.62	374	10.25	6.4
	4	18.2	8.5	464	7.55	0	18.14	8.44	464	7.18	0	17.73	8.4	461	6.99	0.7	14.86	8.52	382	9.85	7
	5	18.17	8.49	464	7.44	0	18.08	8.41	464	6.9	0	17.6	8.35	461	6.57	1.3	14.62	8.54	388	9.58	7
	6	18.15	8.48	464	7.41	0	18.05	8.39	464	6.82	0	17.58	8.33	462	6.31	1.4					
	7	18.12	8.47	464	7.35	0.2	18.02	8.39	465	6.76	0.1	17.48	8.12	456	4.26	8.8					
	8	18.06	8.46	464	7.23	0	17.98	8.38	465	6.67	0										
	9	18	8.44	464	7.08	0	17.96	8.37	466	6.62	0.4										
	10	17.94	8.43	464	6.99	0.3	17.93	8.37	466	6.61	1										
	11	17.92	8.41	465	6.85	0.5															
	12	17.9	8.4	465	6.68	1															
	13	17.87	8.38	465	6.66	0.7															
11-Jul-03	0.3	21.87	8.69	456		0.4											20	8.43	348		9.1
	1	21.87	8.69	456		1.1											20.01	8.42	348		9.8
	1.5																20.03	8.42	348		9.7
	2	21.86	8.69	456		0.3															
	3	21.83	8.68	456		1.4															
	4	21.8	8.66	456		0.8															
	5	21.78	8.66	456		0.5															
	6	21.72	8.62	457		0.6															
	7	21.6	8.59	457		2.7															
	8	21.56	8.58	457		3.3															
	9	21.3	8.57	457		0.7															
	10	21	8.54	457		0															
23-Jul-03	0.3	24.78	8.71	440	8.86	2.4	24.72	8.84	436	10.37	12.1	24.61	8.48	425	7.4	6.7					
	1	24.77	8.71	440	8.84	1.9	24.71	8.84	436	10.33	6.1	24.6	8.48	425	7.36	8.1					
	2	24.66	8.7	440	8.69	4.7	24.68	8.83	436	10.2	6.9	24.61	8.48	425	7.37	7.6					
	3	23.83	8.63	439	8.18	2.4	24.59	8.78	437	9.54	15.8	24.6	8.45	421	7.29	7					
	4	23.56	8.51	437	7.28	1.9	24.46	8.69	437	8.16	7.5										
	5	23.37	8.36	428	5.95	0.8	24.11	8.61	431	7.6	0.9										
	6	23.24	8.3	421	5.57	0.7	23.94	8.52	428	6.66	6										
	7	23.08	8.2	420	4.72	0.7	23.74	8.38	428	5.27	9										
	8	22.76	8.03	423	3.37	1															
	9	22.48	7.97	430	2.67	1															
5-Aug-03	0.3	23.22	8.48	403	7.53	10	22.94	8.48	384	7.29	17	21.16	8.42	347	8.58	30					
	1	23.2	8.48	403	7.44	11	22.95	8.47	384	7.29	14	21.16	8.41	347	8.56	30.2					
	2	23.21	8.48	403	7.49	13.1	22.94	8.46	384	7.41	14.2	21.16	8.38	347	8.64	31					
	3	23.21	8.47	403	7.4	8.7	22.96	8.46	384	7.47	10.6										
	4	23.21	8.47	403	7.41	14.2	22.96	8.44	384	7.91	28										
	5	23.2	8.47	402	7.43	7.1															
	6	23.17	8.46	403	7.39	5.9															
	7	23.2	8.45	402	7.52	6.5															

[1]turbidity had not been calibrated recently and conductivity was only calibrated with 447 uS/cm instead of 1000 uS/cm resulting in conductivity levels below what was normally observed

[2]recalibrated barometric pressure, difference was approximately 5 mm (sonde was reading about 5 mm high)

Table B-4. DEQ Secchi disk data, May 2001 to August 2003.

Date	Elevation at forebay (ft)	Storage capacity (acre-feet)	Percent full[1]	Depth (m)			
				Dam	Fenstermaker Point	Little Hole Draw Point	County Boundary Pt
11 May 01	4351.6	1,508,449	90.3%	1.1		1.1	1.1
23-May-01	4348.4	1,335,724	79.9%	3.5		6	6.5
6-Jun-01	4344.3	1,128,509	67.5%	3.9			1.9
20-Jun-01	4340.5	958,014	57.3%	6.8		3.4	1.1
3-Jul-01	4335.4	749,628	44.9%	6.1		2.9	0.9
12-Jul-01	4332.1	633,090	37.9%	5.25		0.95	0.3
19-Jul-01	4330.1	566,095	33.9%	3.9			
25-Jul-01	4327.8	495,087	29.6%	2.3		0.4	0.4
2-Aug-01	4324.0	389,744	23.3%	2.2		0.5	0.5
8-Aug-01	4321.0	312,849	18.7%	2.4	1.7	0.9	
4-Jun-02	4344.1	1,120,335	67.0%	2.1	2.25	8.3	1.95
20-Jun-02	4339.9	932,542	55.8%	4.5		5.5	1.9
2-Jul-02	4335.6	757,527	45.3%	6.2	4	4	0.8
15-Jul-02	4329.4	545,684	32.7%	2.3	1.9	1.5	0.6
31-Jul-02	4323.7	380,378	22.8%	1.6			
28-May-03	4343.5	1,093,096	65.4%	4.5		7.5	3.5 [2]
9-Jun-03	4339.9	932,141	55.8%	5		6.5	3.5
26-Jun-03	4333.6	685,208	41.0%	6	6	4	1.6
11-Jul-03	4326.9	469,218	28.1%	3.1			0.8
23-Jul-03	4322.1	341,203	20.4%	3	1.75	1.25	
5-Aug-03	4318.0	246,330	14.7%	2	0.8	0.5	

[1]based on full storage capacity of 1,671,300 acre-feet at 4,354.5 ft elevation (from Bureau of Reclamation website a)

[2]estimate

Table B-5. Results of phytoplankton sampling by DEQ in American Falls Reservoir in 2001. The following columns, common to all samples, were left out of the table. Calculation type = phytoplankton-grab, replicate = 1, fraction = none, biovolume = no, taxa level = species, organism = algae.

Site	Sample date	Taxa identification	Division	Class	Order	Family	Genus	Species	Variety	Morph	Coloniality	Customer requested units	Concentration	Relative concentration	Algal cell concentration	Relative algal cell concentration
Dam	6/6/2001	3069	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	rostratiformis			Cell-Motile	Cells/ml	19.0697	0.04837584	19.0697	0.04797571
Dam	6/6/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	6.5757	0.01668118	6.5757	0.0165432
Dam	6/6/2001	2071	Chlorophyta	Chlorophyceae	Chlorococcales	Characiaceae	Characium	limneticum			Cell-Nonmotile	Cells/ml	0.6576	0.00166819	0.6576	0.0016544
Dam	6/6/2001	2462	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Quadrigula	lacustris			Colonial-Nonmotile	Cells/ml	1.3151	0.00333613	3.9454	0.00992587
Dam	6/6/2001	1115	Bacillariophyta	Bacillariophyceae	Cymbellales	Cymbellaceae	Cymbella	minuta			Cell-Nonmotile	Cells/ml	0.6576	0.00166819	0.6576	0.0016544
Dam	6/6/2001	101930	Chlorophyta	Chlorophyceae	Ulotrichles	Ulotrichaceae	Geminella	interrupta			Filament	Cells/ml	0.6576	0.00166819	1.3151	0.00330854
Dam	6/6/2001	1214	Bacillariophyta	Bacillariophyceae	Naviculales	Naviculaceae	Navicula	cryptocephala			Cell-Motile	Cells/ml	0.6576	0.00166819	0.6576	0.0016544
Dam	6/6/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	43.4057	0.11011119	43.4057	0.10920041
Dam	6/6/2001	2683	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae				2-9.9 um spherical	Cell-Nonmotile	Cells/ml	17.3623	0.04404453	17.3623	0.04368021
Dam	6/6/2001	2491	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	judayi			Cell-Nonmotile	Cells/ml	234.3908	0.59460049	234.3908	0.58968227
Dam	6/6/2001	4285	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae				>1 um spherical	Cell-Nonmotile	Cells/ml	17.3623	0.04404453	17.3623	0.04368021
Dam	6/6/2001	7140	Miscellaneous							Microflagellate	Cell-Motile	Cells/ml	26.0434	0.06606666	26.0434	0.0655202
Dam	6/6/2001	2492	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	setigera			Cell-Nonmotile	Cells/ml	17.3623	0.04404453	17.3623	0.04368021
Dam	6/6/2001	1220	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia				Cell-Motile	Cells/ml	8.6811	0.02202214	8.6811	0.02183998
Dam	6/20/2001	3069	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	rostratiformis			Cell-Motile	Cells/ml	20.4579	0.00826171	20.4579	0.00805262
Dam	6/20/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	350.7065	0.14162918	350.7065	0.13804481
Dam	6/20/2001	6034	Pyrrhophyta	Dinophyceae	Gymnodinales	Gymnodiniaceae	Gymnodinium	sp. 3			Cell-Motile	Cells/ml	1.4613	0.00059013	1.4613	0.0005752
Dam	6/20/2001	2080	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas				Cell-Motile	Cells/ml	1.4613	0.00059013	1.4613	0.0005752
Dam	6/20/2001	2491	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	judayi			Cell-Nonmotile	Cells/ml	70.1413	0.02832584	70.1413	0.02760896
Dam	6/20/2001	2085	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	platystigma			Cell-Motile	Cells/ml	149.0503	0.06019242	149.0503	0.05866906
Dam	6/20/2001	1328	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	cyclopum			Cell-Nonmotile	Cells/ml	10.2289	0.00413084	10.2289	0.00402629
Dam	6/20/2001	2492	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	setigera			Cell-Nonmotile	Cells/ml	11.6902	0.00472097	11.6902	0.00460149
Dam	6/20/2001	3065	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	gracilis			Cell-Motile	Cells/ml	21.9192	0.00885184	21.9192	0.00862782
Dam	6/20/2001	2082	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	globosa			Cell-Motile	Cells/ml	2.9226	0.00118026	2.9226	0.00115039
Dam	6/20/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	4.3838	0.00177035	4.3838	0.00172555
Dam	6/20/2001	2462	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Quadrigula	lacustris			Colonial-Nonmotile	Cells/ml	2.9226	0.00118026	2.9226	0.00115039
Dam	6/20/2001	2641	Chlorophyta	Chlorophyceae	Tetrasporales	Palmellopsidaceae	Sphaerocystis	schroeteri			Colonial-Nonmotile	Cells/ml	2.9226	0.00118026	23.3804	0.00920297
Dam	6/20/2001	2590	Chlorophyta	Chlorophyceae	Ulotrichles	Ulotrichaceae	Ulothrix				Filament	Cells/ml	1.4613	0.00059013	23.3804	0.00920297
Dam	6/20/2001	10220	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Anabaena	augstumalis			Complex-Filament	Cells/ml	1.4613	0.00059013	23.3804	0.00920297
Dam	6/20/2001	4285	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae				>1 um spherical	Cell-Nonmotile	Cells/ml	1718.8658	0.69414612	1718.8658	0.67657858
Dam	6/20/2001	1446	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus	1		Cell-Nonmotile	Cells/ml	52.0868	0.02103471	52.0868	0.02050236
Dam	6/20/2001	2683	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae				2-9.9 um spherical	Cell-Nonmotile	Cells/ml	52.0868	0.02103471	52.0868	0.02050236
Dam	7/3/2001	2085	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	platystigma			Cell-Motile	Cells/ml	30.4766	0.02888139	30.4766	0.01988198
Dam	7/3/2001	1328	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	cyclopum			Cell-Nonmotile	Cells/ml	8.4073	0.00796724	8.4073	0.00548466
Dam	7/3/2001	2492	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	setigera			Cell-Nonmotile	Cells/ml	2.1018	0.00199179	2.1018	0.00137115
Dam	7/3/2001	10220	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Anabaena	augstumalis			Complex-Filament	Cells/ml	1.0509	0.00099589	42.0367	0.02742342
Dam	7/3/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	24.1711	0.02290593	24.1711	0.01576847
Dam	7/3/2001	2491	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	judayi			Cell-Nonmotile	Cells/ml	35.7312	0.03386095	35.7312	0.02330991
Dam	7/3/2001	3069	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	rostratiformis			Cell-Motile	Cells/ml	22.0693	0.02091414	22.0693	0.01439732
Dam	7/3/2001	1127	Chrysophyta	Chrysophyceae	Ochromonadales	Dinobryaceae	Dinobryon	divergens			Colonial-Motile	Cells/ml	1.0509	0.00099589	1.0509	0.00068557
Dam	7/3/2001	4269	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae	Microcystis	wesenbergii			Colonial-Nonmotile	Cells/ml	1.0509	0.00099589	420.3674	0.27423448
Dam	7/3/2001	3065	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	gracilis			Cell-Motile	Cells/ml	6.3055	0.00597546	6.3055	0.00411351
Dam	7/3/2001	8101	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Pyramichlamys	dissecta			Cell-Motile	Cells/ml	1.0509	0.00099589	1.0509	0.00068557
Dam	7/3/2001	2363	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Oocystis	parva			Colonial-Nonmotile	Cells/ml	1.0509	0.00099589	2.1018	0.00137115
Dam	7/3/2001	2082	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	globosa			Cell-Motile	Cells/ml	2.1018	0.00199179	2.1018	0.00137115
Dam	7/3/2001	8011	Chlorophyta	Chlorophyceae	Chlorococcales	Actinodiscaceae	Deasonia	Gigantica			Cell-Nonmotile	Cells/ml	1.0509	0.00099589	1.0509	0.00068557
Dam	7/3/2001	1434	Bacillariophyta	Coscinodiscophyceae	Aulacoseirales	Aulacoseriaceae	Aulacoseira	italica			Filament	Cells/ml	7.3564	0.00697135	18.3911	0.01199778
Dam	7/3/2001	1315	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	ulna			Cell-Nonmotile	Cells/ml	3.1528	0.00298778	3.1528	0.00205679
Dam	7/3/2001	1021	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Asterionella	formosa			Colonial-Nonmotile	Cells/ml	1.0509	0.00099589	3.1528	0.00205679
Dam	7/3/2001	2369	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Oocystis	lacustris			Colonial-Nonmotile	Cells/ml	1.0509	0.00099589	4.2037	0.00274236
Dam	7/3/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	339.3571	0.32159441	339.3571	0.22138591
Dam	7/3/2001	2683	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae				2-9.9 um spherical	Cell-Nonmotile	Cells/ml	367.6368	0.34839389	367.6368	0.2398347
Dam	7/3/2001	1731	Chrysophyta	Chrysophyceae	Ochromonadales	Ochromonadaceae	Erkenia	subaequiciliata			Cell-Motile	Cells/ml	197.9583	0.18759673	197.9583	0.12914177
Dam	7/12/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	18.9165	0.02300526	18.9165	0.014507
Dam	7/12/2001	6034	Pyrrhophyta	Dinophyceae	Gymnodinales	Gymnodiniaceae	Gymnodinium	sp. 3			Cell-Motile	Cells/ml	0.4204	0.00051127	0.4204	0.0003224
Dam	7/12/2001	3065	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	gracilis			Cell-Motile	Cells/ml	9.0079	0.01095494	9.0079	0.00690813
Dam	7/12/2001	3069	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	rostratiformis			Cell-Motile	Cells/ml	9.0079	0.01095494	9.0079	0.00690813
Dam	7/12/2001	2462	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Quadrigula	lacustris			Colonial-Nonmotile	Cells/ml	0.2102	0.00025563	0.8407	0.00064473
Dam	7/12/2001	4041	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Aphanizomenon	flos-aquae			Multi-Filament	Cells/ml	5.0444	0.00613474	96.6549	0.07412431
Dam	7/12/2001	1434	Bacillariophyta	Coscinodiscophyceae	Aulacoseirales	Aulacoseriaceae	Aulacoseira	italica			Filament	Cells/ml	10.5092	0.01278074	134.7803	0.10336254
Dam	7/12/2001	9397	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria	capucina	vaucheriae		Lateral-Filament	Cells/ml	0.4204	0.00051127	0.8407	0.00064473
Dam	7/12/2001	2381	Chlorophyta	Chlorophyceae	Chlorococcales	Hydrodictyaceae	Pediastrum				Colonial-Nonmotile	Cells/ml	2.7324	0.003323	91.0795	0.06984855
Dam	7/12/2001	10220	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Anabaena	augstumalis			Complex-Filament	Cells/ml	2.9426	0.00357864	59.1784	0.04538371
Dam	7/12/2001	2491	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	judayi			Cell-Nonmotile	Cells/ml	50.9036	0.0619063	50.9036	0.03903779
Dam	7/12/2001	2492	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	setigera			Cell-Nonmotile	Cells/ml	0.8407	0.00102242	0.8407	0.00064473
Dam	7/12/2001	8332	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Tetraedron	muticum			Cell-Nonmotile	Cells/ml	1.0509	0.00127805	1.0509	0.00080593
Dam	7/12/2001	9818	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	medius			Cell-Nonmotile	Cells/ml	0.4204	0.00051127	0.4204	0.0003224
Dam	7/12/2001	1328	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	cyclopum			Cell-Nonmotile	Cells/ml	0.4204	0.00051127	0.4204	0.0003224
Dam	7/12/2001	9687	Bacillariophyta	Bacillariophyceae	Naviculales	Naviculaceae	Navicula	viridula	germainii		Cell-Motile	Cells/ml	0.2102	0.00025563	0.2102	0.0001612
Dam	7/12/2001	4011	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Anabaena	circinalis			Complex-Filament	Cells/ml	1.4713	0.00178932	59.1457	0.04535863
Dam	7/12/2001	2369	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Oocystis	lacustris			Colonial-Nonmotile	Cells/ml	0.2102	0.00025563	0.2102	0.0001612
Dam	7/12/2001	1152	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria	crotonensis			Lateral-Filament	Cells/ml	2.1018	0.0025561	9.9837	0.00765646
Dam	7/12/2001	1220	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia				Cell-Motile	Cells/ml	0.2102	0.00025563	0.2102	0.0001612

Table B-5. Continued.

Site	Sample date	Taxa identification	Division	Class	Order	Family	Genus	Species	Variety	Morph	Coloniality	Customer requested units	Concentration	Relative concentration	Algal cell concentration	Relative algal cell concentration
Dam	7/12/2001	1271	Bacillariophyta	Bacillariophyceae	Cymbellales	Rhoicospheniaceae	Rhoicosphenia	curvata			Cell-Nonmotile	Cells/ml	0.2102	0.00025563	0.2102	0.0001612
Dam	7/12/2001	1021	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Asterionella	formosa			Colonial-Nonmotile	Cells/ml	0.4204	0.00051127	0.6306	0.0004836
Dam	7/12/2001	9045	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria	construens			Lateral-Filament	Cells/ml	0.4204	0.00051127	3.9234	0.00300884
Dam	7/12/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	330.8731	0.40239058	330.8731	0.25374543
Dam	7/12/2001	2861	Chlorophyta	Prasinophyceae	Prasinocladales	Pedinomonadaceae	Monomastix	astigmata			Cell-Motile	Cells/ml	76.3553	0.09285933	76.3553	0.05855661
Dam	7/12/2001	7140	Miscellaneous							Microflagellate	Cell-Motile	Cells/ml	16.9679	0.02063547	16.9679	0.01301262
Dam	7/12/2001	2683	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae				2-9.9 um spherical	Cell-Nonmotile	Cells/ml	76.3553	0.09285933	76.3553	0.05855661
Dam	7/12/2001	4321	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae	Synechococcus	elongatus			Cell-Nonmotile	Cells/ml	178.1625	0.21667193	178.1625	0.1366322
Dam	7/12/2001	4285	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae				>1 um spherical	Cell-Nonmotile	Cells/ml	16.9679	0.02063547	16.9679	0.01301262
Dam	7/12/2001	4264	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae	Microcystis	aeruginosa			Colonial-Nonmotile	Cells/ml	0	0	50.9036	0.03903779
Dam	7/12/2001	2082	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	globosa			Cell-Motile	Cells/ml	8.4839	0.01031768	8.4839	0.00650627
Dam	7/19/2001	3065	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	gracilis			Cell-Motile	Cells/ml	11.7703	0.02060999	11.7703	0.00740548
Dam	7/19/2001	4041	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Aphanizomenon	flos-aquae			Multi-Filament	Cells/ml	42.4571	0.07434308	746.2134	0.46949238
Dam	7/19/2001	2381	Chlorophyta	Chlorophyceae	Chlorococcales	Hydrodictyaceae	Pediastrum				Colonial-Nonmotile	Cells/ml	3.3629	0.00588849	146.7082	0.09230387
Dam	7/19/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	10.0888	0.01766565	10.0888	0.00634753
Dam	7/19/2001	2641	Chlorophyta	Chlorophyceae	Tetrasporales	Palmellopsidaceae	Sphaerocystis	schroeteri			Colonial-Nonmotile	Cells/ml	0.8407	0.00147208	6.7259	0.00423171
Dam	7/19/2001	1293	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	niagarae			Cell-Nonmotile	Cells/ml	1.2611	0.00220821	1.2611	0.00079344
Dam	7/19/2001	1434	Bacillariophyta	Coscinodiscophyceae	Aulacoseirales	Aulacoseriaceae	Aulacoseira	italica			Filament	Cells/ml	1.2611	0.00220821	5.4647	0.00343821
Dam	7/19/2001	1315	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	ulna			Cell-Nonmotile	Cells/ml	0.4204	0.00073613	0.4204	0.0002645
Dam	7/19/2001	2491	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	judayi			Cell-Nonmotile	Cells/ml	1.2611	0.00220821	1.2611	0.00079344
Dam	7/19/2001	2085	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	platystigma			Cell-Motile	Cells/ml	0.8407	0.00147208	0.8407	0.00052894
Dam	7/19/2001	4172	Cyanophyta	Cyanophyceae	Oscillatoriales	Oscillatoriaceae	Oscillatoria	limnetica			Filament	Cells/ml	0.4204	0.00073613	5.3501	0.0033661
Dam	7/19/2001	3069	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	rostratiformis			Cell-Motile	Cells/ml	1.6815	0.00294433	1.6815	0.00105794
Dam	7/19/2001	8011	Chlorophyta	Chlorophyceae	Chlorococcales	Actinodiscaceae	Deasonia	Gigantica			Cell-Nonmotile	Cells/ml	0.8407	0.00147208	0.8407	0.00052894
Dam	7/19/2001	2082	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	globosa			Cell-Motile	Cells/ml	0.4204	0.00073613	0.4204	0.0002645
Dam	7/19/2001	6021	Pyrrhophyta	Dinophyceae	Peridinales	Glenodiniaceae	Glenodinium	quadridens			Cell-Motile	Cells/ml	0.4204	0.00073613	0.4204	0.0002645
Dam	7/19/2001	2492	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	setigera			Cell-Nonmotile	Cells/ml	0.4204	0.00073613	0.4204	0.0002645
Dam	7/19/2001	1152	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria	crotonensis			Lateral-Filament	Cells/ml	1.2611	0.00220821	26.0628	0.01639784
Dam	7/19/2001	4261	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae	Microcystis	aeruginosa			Colonial-Nonmotile	Cells/ml	0	0	131.386	0.08266365
Dam	7/19/2001	7140	Miscellaneous							Microflagellate	Cell-Motile	Cells/ml	101.8071	0.17826589	101.8071	0.0640536
Dam	7/19/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	186.6464	0.3268209	186.6464	0.11743164
Dam	7/19/2001	2683	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae				2-9.9 um spherical	Cell-Nonmotile	Cells/ml	84.8393	0.148555	84.8393	0.05337804
Dam	7/19/2001	1446	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus	1		Cell-Nonmotile	Cells/ml	16.9679	0.02971107	16.9679	0.01067563
Dam	7/19/2001	1298	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus			Cell-Nonmotile	Cells/ml	67.8714	0.11884393	67.8714	0.0427024
Dam	7/19/2001	1731	Chrysophyta	Chrysophyceae	Ochromonadales	Ochromonadaceae	Erkenia	subaequiciliata			Cell-Motile	Cells/ml	33.9357	0.05942196	33.9357	0.0213512
Dam	7/25/2001	4041	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Aphanizomenon	flos-aquae			Multi-Filament	Cells/ml	654.5721	0.57933922	23306.7606	0.95490469
Dam	7/25/2001	3065	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	gracilis			Cell-Motile	Cells/ml	10.0087	0.00885836	10.0087	0.00041007
Dam	7/25/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	38.0332	0.03366188	38.0332	0.00155826
Dam	7/25/2001	1434	Bacillariophyta	Coscinodiscophyceae	Aulacoseirales	Aulacoseriaceae	Aulacoseira	italica			Filament	Cells/ml	2.0017	0.00177164	9.0079	0.00036906
Dam	7/25/2001	4261	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae	Microcystis	aeruginosa			Colonial-Nonmotile	Cells/ml	0	0	397.3138	0.0162784
Dam	7/25/2001	2492	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	setigera			Cell-Nonmotile	Cells/ml	2.0017	0.00177164	2.0017	0.00008201
Dam	7/25/2001	2641	Chlorophyta	Chlorophyceae	Tetrasporales	Palmellopsidaceae	Sphaerocystis	schroeteri			Colonial-Nonmotile	Cells/ml	2.0017	0.00177164	16.014	0.00065611
Dam	7/25/2001	6033	Pyrrhophyta	Dinophyceae	Gymnodinales	Gymnodiniaceae	Gymnodinium	sp. 2			Cell-Motile	Cells/ml	2.0017	0.00177164	2.0017	0.00008201
Dam	7/25/2001	2381	Chlorophyta	Chlorophyceae	Chlorococcales	Hydrodictyaceae	Pediastrum				Colonial-Nonmotile	Cells/ml	2.0017	0.00177164	120.105	0.00492084
Dam	7/25/2001	1296	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	hantzschii			Cell-Nonmotile	Cells/ml	4.0035	0.00354336	4.0035	0.00016403
Dam	7/25/2001	2491	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	judayi			Cell-Nonmotile	Cells/ml	4.0035	0.00354336	4.0035	0.00016403
Dam	7/25/2001	1152	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria	crotonensis			Lateral-Filament	Cells/ml	2.0017	0.00177164	40.035	0.00164028
Dam	7/25/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	152.7107	0.13515898	152.7107	0.00625673
Dam	7/25/2001	1298	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus			Cell-Nonmotile	Cells/ml	67.8714	0.06007064	67.8714	0.00278077
Dam	7/25/2001	2085	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	platystigma			Cell-Motile	Cells/ml	16.9679	0.0150177	16.9679	0.00069519
Dam	7/25/2001	2683	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae				2-9.9 um spherical	Cell-Nonmotile	Cells/ml	33.9357	0.03003532	33.9357	0.00139038
Dam	7/25/2001	1000049	Chlorophyta	Chlorophyceae	Bryopsidales	Dichotomosiphonaceae	Dichotomococcus	curvatus			Colonial-Nonmotile	Cells/ml	16.9679	0.0150177	67.8714	0.00278077
Dam	7/25/2001	4285	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae				>1 um spherical	Cell-Nonmotile	Cells/ml	118.775	0.10512366	118.775	0.00486635
Dam	8/2/2001	4261	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae	Microcystis	aeruginosa			Colonial-Nonmotile	Cells/ml	0	0	250.3217	0.00149838
Dam	8/2/2001	4041	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Aphanizomenon	flos-aquae			Multi-Filament	Cells/ml	4483.9192	0.69247014	164039.698	0.98191189
Dam	8/2/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	56.049	0.00865588	56.049	0.0003355
Dam	8/2/2001	2082	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	globosa			Cell-Motile	Cells/ml	28.0245	0.00432794	28.0245	0.00016775
Dam	8/2/2001	2363	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Oocystis	parva			Colonial-Nonmotile	Cells/ml	18.683	0.00288529	112.098	0.000671
Dam	8/2/2001	6011	Pyrrhophyta	Dinophyceae	Gonyaulacales	Certiaceae	Ceratium	hirundinella			Cell-Motile	Cells/ml	9.3415	0.00144265	9.3415	0.00005592
Dam	8/2/2001	8101	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Pyramichlamys	dissecta			Cell-Motile	Cells/ml	28.0245	0.00432794	28.0245	0.00016775
Dam	8/2/2001	3069	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	rostratiformis			Cell-Motile	Cells/ml	9.3415	0.00144265	9.3415	0.00005592
Dam	8/2/2001	4368	Cyanophyta	Cyanophyceae	Oscillatoriales	Oscillatoriaceae	Oscillatoria	amphibia			Filament	Cells/ml	9.3415	0.00144265	424.6131	0.00254166
Dam	8/2/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	1085.9426	0.1677066	1085.9426	0.00650026
Dam	8/2/2001	1298	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus			Cell-Nonmotile	Cells/ml	407.2285	0.06288998	407.2285	0.0024376
Dam	8/2/2001	2683	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae				2-9.9 um spherical	Cell-Nonmotile	Cells/ml	135.7428	0.02096332	135.7428	0.00081253
Dam	8/2/2001	2491	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	judayi			Cell-Nonmotile	Cells/ml	67.8714	0.01048166	67.8714	0.00040627
Dam	8/2/2001	8308	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	serratus			Colonial-Nonmotile	Cells/ml	67.8714	0.01048166	271.4856	0.00162506
Dam	8/2/2001	2884	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	quadricauda			Colonial-Nonmotile	Cells/ml	67.8714	0.01048166	135.7428	0.00081253
Dam	8/8/2001	4041	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Aphanizomenon	flos-aquae			Multi-Filament	Cells/ml	84.0735	0.14805632	2338.773	0.77853448
Dam	8/8/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	12.1907	0.02146824	12.1907	0.00405806
Dam	8/8/2001	4261	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae	Microcystis	aeruginosa			Colonial-Nonmotile	Cells/ml	0	0	160.3522	0.0533783
Dam	8/8/2001	1180	Chrysophyta	Chrysophyceae	Ochromonadales	Synuraceae	Mallomonas				Cell-Motile	Cells/ml	0.8407	0.0014805	0.8407	0.00027985
Dam	8/8/2001	2491	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	judayi			Cell-Nonmotile	Cells/ml	8.4073	0.01480554	8.4073	0.00279864

Table B-5. Continued.

Site	Sample date	Taxa identification	Division	Class	Order	Family	Genus	Species	Variety	Morph	Coloniality	Customer requested units	Concentration	Relative concentration	Algal cell concentration	Relative algal cell concentration
County Boundary	7/25/2001	1432	Bacillariophyta	Coscinodiscophyceae	Aulacoseirales	Aulacoseriaceae	Aulacoseira	granulata			Filament	Cells/ml	19.3369	0.00208319	137.5066	0.01336432
County Boundary	7/25/2001	2021	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Actinastrum	hantzschii			Cell-Nonmotile	Cells/ml	4.2037	0.00045287	23.5406	0.00228792
County Boundary	7/25/2001	2363	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Oocystis	parva			Colonial-Nonmotile	Cells/ml	0.8407	0.00009057	3.3629	0.00032684
County Boundary	7/25/2001	1434	Bacillariophyta	Coscinodiscophyceae	Aulacoseirales	Aulacoseriaceae	Aulacoseira	italica			Filament	Cells/ml	6.7259	0.00072459	24.6618	0.00239689
County Boundary	7/25/2001	2381	Chlorophyta	Chlorophyceae	Chlorococcales	Hydrodictyaceae	Pediastrum				Colonial-Nonmotile	Cells/ml	4.2037	0.00045287	91.6401	0.00890653
County Boundary	7/25/2001	9045	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria	construens			Lateral-Filament	Cells/ml	0.8407	0.00009057	11.2098	0.00108948
County Boundary	7/25/2001	2504	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Selenastrum	gracile			Cell-Nonmotile	Cells/ml	0.8407	0.00009057	3.3629	0.00032684
County Boundary	7/25/2001	2641	Chlorophyta	Chlorophyceae	Tetrasporales	Palmellopsidaceae	Sphaerocystis	schroeteri			Colonial-Nonmotile	Cells/ml	1.6815	0.00018115	8.4073	0.00081711
County Boundary	7/25/2001	1076	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Cyclotella	meneghiniana			Cell-Nonmotile	Cells/ml	0.8407	0.00009057	0.8407	0.00008171
County Boundary	7/25/2001	1180	Chrysophyta	Chrysophyceae	Ochromonadales	Synuraceae	Mallomonas				Cell-Motile	Cells/ml	0.8407	0.00009057	0.8407	0.00008171
County Boundary	7/25/2001	9506	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	ulna	ulna		Cell-Nonmotile	Cells/ml	0.8407	0.00009057	0.8407	0.00008171
County Boundary	7/25/2001	1296	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	hantzschii			Cell-Nonmotile	Cells/ml	0.8407	0.00009057	0.8407	0.00008171
County Boundary	7/25/2001	2462	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Quadrigula	lacustris			Colonial-Nonmotile	Cells/ml	0.8407	0.00009057	3.3629	0.00032684
County Boundary	7/25/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	1968.2709	0.21204491	1968.2709	0.19129696
County Boundary	7/25/2001	1298	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus			Cell-Nonmotile	Cells/ml	3766.8633	0.40581008	3766.8633	0.3661028
County Boundary	7/25/2001	2683	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae				2-9.9 um spherical	Cell-Nonmotile	Cells/ml	1323.4925	0.14258192	1323.4925	0.12863071
County Boundary	7/25/2001	9123	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	palea			Cell-Motile	Cells/ml	271.4856	0.02924757	271.4856	0.02638578
County Boundary	7/25/2001	1222	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	gracilis			Cell-Motile	Cells/ml	33.9357	0.00365595	33.9357	0.00329822
County Boundary	7/25/2001	1013	Bacillariophyta	Bacillariophyceae	Achnanthales	Achnanthaceae	Achnanthes	minutissima			Cell-Nonmotile	Cells/ml	33.9357	0.00365595	33.9357	0.00329822
County Boundary	7/25/2001	1446	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus	1		Cell-Nonmotile	Cells/ml	678.7141	0.07311893	678.7141	0.06596447
County Boundary	7/25/2001	8041	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Monoraphidium	capricornutum			Cell-Nonmotile	Cells/ml	101.8071	0.01096784	101.8071	0.00989467
County Boundary	7/25/2001	1221	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	acicularis			Cell-Motile	Cells/ml	67.8714	0.00731189	67.8714	0.00659645
County Boundary	7/25/2001	8226	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	intermedius			Colonial-Nonmotile	Cells/ml	33.9357	0.00365595	135.7428	0.01319289
County Boundary	7/25/2001	8302	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	quadricauda	longispina		Colonial-Nonmotile	Cells/ml	67.8714	0.00731189	271.4856	0.02638578
County Boundary	7/25/2001	2085	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	platystigma			Cell-Motile	Cells/ml	135.7428	0.01462378	135.7428	0.01319289
County Boundary	7/25/2001	2491	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	judayi			Cell-Nonmotile	Cells/ml	237.5499	0.02559162	237.5499	0.02308756
County Boundary	7/25/2001	2031	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Ankistrodesmus	falcatus			Cell-Nonmotile	Cells/ml	33.9357	0.00365595	33.9357	0.00329822
County Boundary	7/25/2001	2082	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	globosa			Cell-Motile	Cells/ml	101.8071	0.01096784	101.8071	0.00989467
County Boundary	7/25/2001	8101	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Pyramichlamys	dissecta			Cell-Motile	Cells/ml	135.7428	0.01462378	135.7428	0.01319289
County Boundary	7/25/2001	2554	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Tetraedron	minimum			Cell-Nonmotile	Cells/ml	33.9357	0.00365595	33.9357	0.00329822
County Boundary	7/25/2001	4321	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae	Synechococcus	elongatus			Cell-Nonmotile	Cells/ml	101.8071	0.01096784	101.8071	0.00989467
County Boundary	7/25/2001	1731	Chrysophyta	Chrysophyceae	Ochromonadales	Ochromonadaceae	Erkenia	subaequiciliata			Cell-Motile	Cells/ml	67.8714	0.00731189	67.8714	0.00659645
County Boundary	8/2/2001	8030	Chlorophyta	Chlorophyceae	Microsporales	Microsporaceae	Microspora				Filament	Cells/ml	37.366	0.01294401	210.1837	0.04252189
County Boundary	8/2/2001	9045	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria	construens			Lateral-Filament	Cells/ml	5.6049	0.0019416	156.9372	0.03174969
County Boundary	8/2/2001	1271	Bacillariophyta	Bacillariophyceae	Cymbellales	Rhoicospheniaceae	Rhoicosphenia	curvata			Cell-Nonmotile	Cells/ml	1.8683	0.0006472	1.8683	0.00037797
County Boundary	8/2/2001	9397	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria	capucina	vaucheriae		Lateral-Filament	Cells/ml	1.8683	0.0006472	29.8928	0.00604756
County Boundary	8/2/2001	1341	Bacillariophyta	Bacillariophyceae	Thalassiophysales	Catenulaceae	Amphora	ovalis			Cell-Nonmotile	Cells/ml	11.2098	0.0038832	11.2098	0.00226783
County Boundary	8/2/2001	9506	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	ulna	ulna		Cell-Nonmotile	Cells/ml	28.0245	0.00970801	38.5337	0.00779569
County Boundary	8/2/2001	9321	Bacillariophyta	Bacillariophyceae	Cymbellales	Gomphonemataceae	Gomphoneis	herculeana			Cell-Nonmotile	Cells/ml	5.6049	0.0019416	5.6049	0.00113392
County Boundary	8/2/2001	1066	Bacillariophyta	Bacillariophyceae	Achnanthales	Cocconiedaceae	Cocconeis	pediculus			Cell-Nonmotile	Cells/ml	5.6049	0.0019416	5.6049	0.00113392
County Boundary	8/2/2001	1108	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Diatoma	vulgaris	vulgaris		Cell-Nonmotile	Cells/ml	14.9464	0.00517761	14.9464	0.00302378
County Boundary	8/2/2001	1021	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Asterionella	formosa			Colonial-Nonmotile	Cells/ml	5.6049	0.0019416	5.6049	0.00113392
County Boundary	8/2/2001	9118	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	linearis			Cell-Motile	Cells/ml	5.6049	0.0019416	5.6049	0.00113392
County Boundary	8/2/2001	9439	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	sigma			Cell-Motile	Cells/ml	1.8683	0.0006472	1.8683	0.00037797
County Boundary	8/2/2001	4041	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Aphanizomenon	flos-aquae			Multi-Filament	Cells/ml	1.8683	0.0006472	45.2921	0.00916297
County Boundary	8/2/2001	9212	Bacillariophyta	Bacillariophyceae	Achnanthales	Cocconiedaceae	Cocconeis	placentula	lineata		Cell-Nonmotile	Cells/ml	9.3415	0.003236	9.3415	0.00188986
County Boundary	8/2/2001	2884	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	quadricauda			Colonial-Nonmotile	Cells/ml	1.8683	0.0006472	7.4732	0.00151189
County Boundary	8/2/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	5.6049	0.0019416	5.6049	0.00113392
County Boundary	8/2/2001	4421	Cyanophyta	Cyanophyceae	Oscillatoriales	Oscillatoriaceae	Lyngbya	subtilis			Filament	Cells/ml	11.2098	0.0038832	1222.8869	0.2474001
County Boundary	8/2/2001	3069	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	rostratiformis			Cell-Motile	Cells/ml	1.8683	0.0006472	1.8683	0.00037797
County Boundary	8/2/2001	2590	Chlorophyta	Chlorophyceae	Ulotrichles	Ulotrichaceae	Ulothrix				Filament	Cells/ml	1.8683	0.0006472	161.9194	0.03275763
County Boundary	8/2/2001	8101	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Pyramichlamys	dissecta			Cell-Motile	Cells/ml	1.8683	0.0006472	1.8683	0.00037797
County Boundary	8/2/2001	2176	Chlorophyta	Chlorophyceae	Chlorococcales	Coelastraceae	Coelastrum	astroideum			Cell-Nonmotile	Cells/ml	1.8683	0.0006472	14.9464	0.00302378
County Boundary	8/2/2001	1862	Bacillariophyta	Bacillariophyceae	Cymbellales	Cymbellaceae	Cymbella	affinis			Cell-Nonmotile	Cells/ml	1.8683	0.0006472	1.8683	0.00037797
County Boundary	8/2/2001	1161	Bacillariophyta	Bacillariophyceae	Cymbellales	Gomphonemataceae	Gomphonema	parvulum			Cell-Nonmotile	Cells/ml	1.8683	0.0006472	1.8683	0.00037797
County Boundary	8/2/2001	9236	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	constricta			Cell-Motile	Cells/ml	1.8683	0.0006472	1.8683	0.00037797
County Boundary	8/2/2001	1293	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	niagarae			Cell-Nonmotile	Cells/ml	1.8683	0.0006472	1.8683	0.00037797
County Boundary	8/2/2001	4170	Cyanophyta	Cyanophyceae	Oscillatoriales	Oscillatoriaceae	Oscillatoria				Filament	Cells/ml	1.8683	0.0006472	261.562	0.05291615
County Boundary	8/2/2001	1298	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus			Cell-Nonmotile	Cells/ml	1153.814	0.39969447	1153.814	0.23342608
County Boundary	8/2/2001	1369	Bacillariophyta	Bacillariophyceae	Naviculales	Naviculaceae	Navicula	pupula			Cell-Motile	Cells/ml	67.8714	0.02351144	67.8714	0.01373094
County Boundary	8/2/2001	9102	Bacillariophyta	Bacillariophyceae	Naviculales	Naviculaceae	Navicula	tripunctata			Cell-Motile	Cells/ml	67.8714	0.02351144	67.8714	0.01373094
County Boundary	8/2/2001	9123	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	palea			Cell-Motile	Cells/ml	339.3571	0.11755721	339.3571	0.06865474
County Boundary	8/2/2001	1013	Bacillariophyta	Bacillariophyceae	Achnanthales	Achnanthaceae	Achnanthes	minutissima			Cell-Nonmotile	Cells/ml	271.4856	0.09404574	271.4856	0.05492377
County Boundary	8/2/2001	1214	Bacillariophyta	Bacillariophyceae	Naviculales	Naviculaceae	Navicula	cryptocephala			Cell-Motile	Cells/ml	67.8714	0.02351144	67.8714	0.01373094
County Boundary	8/2/2001	9482	Bacillariophyta	Bacillariophyceae	Naviculales	Naviculaceae	Navicula	salinarum			Cell-Motile	Cells/ml	67.8714	0.02351144	67.8714	0.01373094
County Boundary	8/2/2001	1222	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	gracilis			Cell-Motile	Cells/ml	67.8714	0.02351144	67.8714	0.01373094
County Boundary	8/2/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	135.7428	0.04702287	135.7428	0.02746189
County Boundary	8/2/2001	2683	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae				2-9.9 um spherical	Cell-Nonmotile	Cells/ml	407.2285	0.14106864	407.2285	0.08238568
County Boundary	8/2/2001	1343	Bacillariophyta	Bacillariophyceae	Thalassiophysales	Catenulaceae	Amphora	pediculus			Cell-Nonmotile	Cells/ml	67.8714	0.02351144	67.8714	0.01373094

Table B-5. Continued.

Site	Sample date	Taxa identification	Division	Class	Order	Family	Genus	Species	Variety	Morph	Coloniality	Customer requested units	Concentration	Relative concentration	Algal cell concentration	Relative algal cell concentration
County Boundary	6/20/2001	9818	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	medius			Cell-Nonmotile	Cells/ml	8.7677	0.00046667	8.7677	0.00044134
County Boundary	6/20/2001	3069	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	rostratiformis			Cell-Motile	Cells/ml	26.303	0.00140002	26.303	0.00132402
County Boundary	6/20/2001	1314	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	delicatissima			Cell-Nonmotile	Cells/ml	8.7677	0.00046667	8.7677	0.00044134
County Boundary	6/20/2001	8302	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	quadricauda	longispina		Colonial-Nonmotile	Cells/ml	8.7677	0.00046667	35.0707	0.00176536
County Boundary	6/20/2001	1315	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	ulna			Cell-Nonmotile	Cells/ml	17.5353	0.00093334	17.5353	0.00088268
County Boundary	6/20/2001	1021	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Asterionella	formosa			Colonial-Nonmotile	Cells/ml	8.7677	0.00046667	140.2826	0.00706144
County Boundary	6/20/2001	1109	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Diatoma	tenuis			Cell-Nonmotile	Cells/ml	8.7677	0.00046667	8.7677	0.00044134
County Boundary	6/20/2001	2462	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Quadrigula	lacustris			Colonial-Nonmotile	Cells/ml	8.7677	0.00046667	17.5353	0.00088268
County Boundary	7/3/2001	4041	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Aphanizomenon	flos-aquae			Multi-Filament	Cells/ml	108.3614	0.00842208	4262.2106	0.24492187
County Boundary	7/3/2001	6033	Pyrrhophyta	Dinophyceae	Gymnodinales	Gymnodiniaceae	Gymnodinium	sp. 2			Cell-Motile	Cells/ml	1.8683	0.00014521	1.8683	0.00010736
County Boundary	7/3/2001	1221	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	acicularis			Cell-Motile	Cells/ml	31.7611	0.00246854	31.7611	0.00182511
County Boundary	7/3/2001	9504	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	tenera			Cell-Nonmotile	Cells/ml	22.4196	0.0017425	22.4196	0.00128831
County Boundary	7/3/2001	9123	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	palea			Cell-Motile	Cells/ml	74.732	0.00580833	74.732	0.00429437
County Boundary	7/3/2001	1434	Bacillariophyta	Coscinodiscophyceae	Aulacoseirales	Aulacoseriaceae	Aulacoseira	italica			Filament	Cells/ml	57.9173	0.00450146	193.0557	0.01109367
County Boundary	7/3/2001	1152	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria	crotonensis			Lateral-Filament	Cells/ml	5.6049	0.00043562	16.8147	0.00096623
County Boundary	7/3/2001	9506	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	ulna	ulna		Cell-Nonmotile	Cells/ml	3.7366	0.00029042	3.7366	0.00021472
County Boundary	7/3/2001	4172	Cyanophyta	Cyanophyceae	Oscillatoriales	Oscillatoriaceae	Oscillatoria	limnetica			Filament	Cells/ml	1.8683	0.00014521	101.9073	0.00585596
County Boundary	7/3/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	4140.156	0.32178174	4140.156	0.23790817
County Boundary	7/3/2001	1298	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus			Cell-Nonmotile	Cells/ml	3597.1847	0.27958085	3597.1847	0.2067071
County Boundary	7/3/2001	2082	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	globosa			Cell-Motile	Cells/ml	2104.0137	0.16352842	2104.0137	0.12090415
County Boundary	7/3/2001	1018	Bacillariophyta	Bacillariophyceae	Achnanthales	Achnanthaceae	Achnanthes	lanceolata			Cell-Nonmotile	Cells/ml	67.8714	0.00527511	67.8714	0.00390013
County Boundary	7/3/2001	1296	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	hantzschii			Cell-Nonmotile	Cells/ml	475.0999	0.03692578	475.0999	0.02730094
County Boundary	7/3/2001	9436	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	pumila			Cell-Motile	Cells/ml	1.8683	0.00014521	1.8683	0.00010736
County Boundary	7/3/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	475.0999	0.03692578	475.0999	0.02730094
County Boundary	7/3/2001	2085	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	platystigma			Cell-Motile	Cells/ml	1425.2996	0.11077732	1425.2996	0.08190281
County Boundary	7/3/2001	9397	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria	capucina	vaucheriae		Lateral-Filament	Cells/ml	67.8714	0.00527511	203.6142	0.0117004
County Boundary	7/3/2001	1731	Chrysophyta	Chrysophyceae	Ochromonadales	Ochromonadaceae	Erkenia	subaequiciliata			Cell-Motile	Cells/ml	67.8714	0.00527511	67.8714	0.00390013
County Boundary	7/3/2001	8041	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Monoraphidium	capricornutum			Cell-Nonmotile	Cells/ml	67.8714	0.00527511	67.8714	0.00390013
County Boundary	7/3/2001	2031	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Ankistrodesmus	falcatus			Cell-Nonmotile	Cells/ml	67.8714	0.00527511	67.8714	0.00390013
County Boundary	7/12/2001	1434	Bacillariophyta	Coscinodiscophyceae	Aulacoseirales	Aulacoseriaceae	Aulacoseira	italica			Filament	Cells/ml	94.5827	0.00585935	342.8622	0.01781209
County Boundary	7/12/2001	2363	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Oocystis	parva			Colonial-Nonmotile	Cells/ml	3.5031	0.00021702	28.0245	0.00145591
County Boundary	7/12/2001	2211	Chlorophyta	Chlorophyceae	Chlorococcales	Dictyosphaeriaceae	Dictyosphaerium	pulchellum			Colonial-Nonmotile	Cells/ml	14.0122	0.00086805	74.7315	0.00388239
County Boundary	7/12/2001	4041	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Aphanizomenon	flos-aquae			Multi-Filament	Cells/ml	45.5398	0.00282117	1705.6706	0.08861156
County Boundary	7/12/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	129.6133	0.00802948	129.6133	0.00673356
County Boundary	7/12/2001	1220	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia				Cell-Motile	Cells/ml	3.5031	0.00021702	3.5031	0.00018199
County Boundary	7/12/2001	2382	Chlorophyta	Chlorophyceae	Chlorococcales	Hydrodictyaceae	Pediastrum	boryanum			Colonial-Nonmotile	Cells/ml	3.5031	0.00021702	21.0184	0.00109193
County Boundary	7/12/2001	9317	Bacillariophyta	Bacillariophyceae	Surirellales	Surirellaceae	Surirella	brebissonii	kuetzingii		Cell-Motile	Cells/ml	3.5031	0.00021702	3.5031	0.00018199
County Boundary	7/12/2001	2381	Chlorophyta	Chlorophyceae	Chlorococcales	Hydrodictyaceae	Pediastrum				Colonial-Nonmotile	Cells/ml	3.5031	0.00021702	224.196	0.01164724
County Boundary	7/12/2001	2021	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Actinastrum	hantzschii			Cell-Nonmotile	Cells/ml	10.5092	0.00065104	84.0735	0.00436772
County Boundary	7/12/2001	8101	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Pyramichlamys	dissecta			Cell-Motile	Cells/ml	10.5092	0.00065104	10.5092	0.00054597
County Boundary	7/12/2001	3069	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	rostratiformis			Cell-Motile	Cells/ml	3.5031	0.00021702	3.5031	0.00018199
County Boundary	7/12/2001	6034	Pyrrhophyta	Dinophyceae	Gymnodinales	Gymnodiniaceae	Gymnodinium	sp. 3			Cell-Motile	Cells/ml	3.5031	0.00021702	3.5031	0.00018199
County Boundary	7/12/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	4006.2985	0.24818833	4006.2985	0.20813184
County Boundary	7/12/2001	1298	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus			Cell-Nonmotile	Cells/ml	6174.413	0.38250202	6174.413	0.3207679
County Boundary	7/12/2001	9072	Bacillariophyta	Bacillariophyceae	Naviculales	Naviculaceae	Navicula	cryptotenella			Cell-Motile	Cells/ml	11.6769	0.00072338	11.6769	0.00060663
County Boundary	7/12/2001	2085	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	platystigma			Cell-Motile	Cells/ml	424.1963	0.02627876	424.1963	0.02203749
County Boundary	7/12/2001	2683	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae				2-9.9 um spherical	Cell-Nonmotile	Cells/ml	2073.8486	0.12847396	2073.8486	0.10773883
County Boundary	7/12/2001	1446	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus	1		Cell-Nonmotile	Cells/ml	424.1963	0.02627876	424.1963	0.02203749
County Boundary	7/12/2001	9123	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	palea			Cell-Motile	Cells/ml	377.0634	0.0233589	377.0634	0.01958888
County Boundary	7/12/2001	1570	Chrysophyta	Chrysophyceae	Ochromonadales	Ochromonadaceae	Ochromonas				Cell-Motile	Cells/ml	11.6769	0.00072338	11.6769	0.00060663
County Boundary	7/12/2001	2487	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	dimorphus			Colonial-Nonmotile	Cells/ml	47.1329	0.00291986	188.5317	0.00979444
County Boundary	7/12/2001	1296	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	hantzschii			Cell-Nonmotile	Cells/ml	518.4622	0.03211849	518.4622	0.02693471
County Boundary	7/12/2001	8308	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	serratus			Colonial-Nonmotile	Cells/ml	94.2658	0.00583972	188.5317	0.00979444
County Boundary	7/12/2001	9212	Bacillariophyta	Bacillariophyceae	Achnanthales	Cocconiedaceae	Cocconeis	placentula	lineata		Cell-Nonmotile	Cells/ml	47.1329	0.00291986	47.1329	0.00244861
County Boundary	7/12/2001	1731	Chrysophyta	Chrysophyceae	Ochromonadales	Ochromonadaceae	Erkenia	subaequiciliata			Cell-Motile	Cells/ml	188.5317	0.01167945	188.5317	0.00979444
County Boundary	7/12/2001	9504	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	tenera			Cell-Nonmotile	Cells/ml	47.1329	0.00291986	47.1329	0.00244861
County Boundary	7/12/2001	2082	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	globosa			Cell-Motile	Cells/ml	471.3292	0.02919863	471.3292	0.0244861
County Boundary	7/12/2001	1127	Chrysophyta	Chrysophyceae	Ochromonadales	Dinobryaceae	Dinobryon	divergens			Colonial-Motile	Cells/ml	47.1329	0.00291986	47.1329	0.00244861
County Boundary	7/12/2001	8226	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	intermedius			Colonial-Nonmotile	Cells/ml	47.1329	0.00291986	188.5317	0.00979444
County Boundary	7/12/2001	2031	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Ankistrodesmus	falcatus			Cell-Nonmotile	Cells/ml	47.1329	0.00291986	47.1329	0.00244861
County Boundary	7/12/2001	1152	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria	crotonensis			Lateral-Filament	Cells/ml	141.3988	0.00875959	329.9258	0.01714003
County Boundary	7/12/2001	2491	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	judayi			Cell-Nonmotile	Cells/ml	47.1329	0.00291986	47.1329	0.00244861
County Boundary	7/12/2001	2462	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Quadrigula	lacustris			Colonial-Nonmotile	Cells/ml	47.1329	0.00291986	94.2658	0.00489722
County Boundary	7/12/2001	1221	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	acicularis			Cell-Motile	Cells/ml	282.7975	0.01751917	282.7975	0.01469166
County Boundary	7/12/2001	9045	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria	construens			Lateral-Filament	Cells/ml	47.1329	0.00291986	94.2658	0.00489722
County Boundary	7/12/2001	1214	Bacillariophyta	Bacillariophyceae	Naviculales	Naviculaceae	Navicula	cryptocephala			Cell-Motile	Cells/ml	94.2658	0.00583972	94.2658	0.00489722
County Boundary	7/12/2001	6033	Pyrrhophyta	Dinophyceae	Gymnodinales	Gymnodiniaceae	Gymnodinium	sp. 2			Cell-Motile	Cells/ml	47.1329	0.00291986	47.1329	0.00244861
County Boundary	7/12/2001	102793	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	acutus			Colonial-Nonmotile	Cells/ml	47.1329	0.00291986	188.5317	0.00979444
County Boundary	7/25/2001	1021	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Asterionella	formosa			Colonial-Nonmotile	Cells/ml	3.3629	0.00036229	6.7259	0.00065369
County Boundary	7/25/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	22.6998	0.00244549	22.6998	0.0022062
County Boundary	7/25/2001	8030	Chlorophyta	Chlorophyceae	Microsporales	Microsporaceae	Microspora				Filament	Cells/ml	5.8851	0.00063401	17.6554	0.00171593
County Boundary	7/25/2001	2211	Chlorophyta	Chlorophyceae	Chlorococcales	Dictyosphaeriaceae	Dictyosphaerium	pulchellum			Colonial-Nonmotile	Cells/ml	5.0444	0.00054344	62.2142	0.00604662
County Boundary	7/25/2001	4041	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Aphanizomenon	flos-aquae			Multi-Filament	Cells/ml	5.8851	0.00063401	367.376	0.03570541

Table B-5. Continued.

Site	Sample date	Taxa identification	Division	Class	Order	Family	Genus	Species	Variety	Morph	Coloniality	Customer requested units	Concentration	Relative concentration	Algal cell concentration	Relative algal cell concentration
Little Hole Draw	7/25/2001	1000049	Chlorophyta	Chlorophyceae	Bryopsidales	Dichotomosiphonaceae	Dichotomococcus	curvatus			Colonial-Nonmotile	Cells/ml	16.9679	0.00276216	67.8714	0.00872858
Little Hole Draw	7/25/2001	1446	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus	1		Cell-Nonmotile	Cells/ml	339.3571	0.05524314	339.3571	0.04364291
Little Hole Draw	7/25/2001	9123	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	palea			Cell-Motile	Cells/ml	101.8071	0.01657294	101.8071	0.01309287
Little Hole Draw	7/25/2001	2911	Chlorophyta	Chlorophyceae	Ulotrichales	Ulotrichaceae	Stichococcus	bacillaris			Colonial-Nonmotile	Cells/ml	169.6785	0.02762156	169.6785	0.02182145
Little Hole Draw	7/25/2001	8041	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Monoraphidium	capricornutum			Cell-Nonmotile	Cells/ml	33.9357	0.00552431	33.9357	0.00436429
Little Hole Draw	7/25/2001	9504	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	tenera			Cell-Nonmotile	Cells/ml	50.9036	0.00828648	50.9036	0.00654644
Little Hole Draw	7/25/2001	1296	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	hantzschii			Cell-Nonmotile	Cells/ml	296.9374	0.04833774	296.9374	0.03818754
Little Hole Draw	7/25/2001	2085	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	platystigma			Cell-Motile	Cells/ml	67.8714	0.01104863	67.8714	0.00872858
Little Hole Draw	7/25/2001	2082	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	globosa			Cell-Motile	Cells/ml	33.9357	0.00552431	33.9357	0.00436429
Little Hole Draw	7/25/2001	1222	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	gracilis			Cell-Motile	Cells/ml	16.9679	0.00276216	16.9679	0.00218215
Little Hole Draw	7/25/2001	4054	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae	Aphanocapsa	delicatissima			Colonial-Nonmotile	Cells/ml	16.9679	0.00276216	509.0356	0.06546436
Little Hole Draw	7/25/2001	1221	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	acicularis			Cell-Motile	Cells/ml	16.9679	0.00276216	16.9679	0.00218215
Little Hole Draw	7/25/2001	8308	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	serratus			Colonial-Nonmotile	Cells/ml	16.9679	0.00276216	33.9357	0.00436429
Little Hole Draw	7/25/2001	2491	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	judayi			Cell-Nonmotile	Cells/ml	16.9679	0.00276216	16.9679	0.00218215
Little Hole Draw	7/25/2001	4264	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae	Microcystis	aeruginosa			Colonial-Nonmotile	Cells/ml	0	0	33.9357	0.00436429
Little Hole Draw	7/25/2001	2884	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	quadricauda			Colonial-Nonmotile	Cells/ml	33.9357	0.00552431	67.8714	0.00872858
Little Hole Draw	7/25/2001	2031	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Ankistrodesmus	falcatus			Cell-Nonmotile	Cells/ml	33.9357	0.00552431	33.9357	0.00436429
Little Hole Draw	8/2/2001	4041	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Aphanizomenon	flos-aquae			Multi-Filament	Cells/ml	1025.6965	0.83443655	37215.1412	0.98390436
Little Hole Draw	8/2/2001	6011	Pyrrhophyta	Dinophyceae	Gonyaulacales	Certiaceae	Ceratium	hirundinella			Cell-Motile	Cells/ml	2.8024	0.00227984	2.8024	0.00007409
Little Hole Draw	8/2/2001	2381	Chlorophyta	Chlorophyceae	Chlorococcales	Hydrodictyaceae	Pediastrum				Colonial-Nonmotile	Cells/ml	2.8024	0.00227984	168.147	0.00444552
Little Hole Draw	8/2/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	5.6049	0.00455976	5.6049	0.00014818
Little Hole Draw	8/2/2001	4261	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae	Microcystis	aeruginosa			Colonial-Nonmotile	Cells/ml	0	0	228.632	0.00604464
Little Hole Draw	8/2/2001	4285	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae				>1 um spherical	Cell-Nonmotile	Cells/ml	45.2476	0.03681035	45.2476	0.00119627
Little Hole Draw	8/2/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	90.4952	0.07362071	90.4952	0.00239254
Little Hole Draw	8/2/2001	2491	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	judayi			Cell-Nonmotile	Cells/ml	45.2476	0.03681035	45.2476	0.00119627
Little Hole Draw	8/2/2001	4092	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae	Coelosphaerium	naegelianum			Colonial-Nonmotile	Cells/ml	0	0	11.3119	0.00029907
Little Hole Draw	8/2/2001	7140	Miscellaneous							Microflagellate	Cell-Motile	Cells/ml	11.3119	0.00920259	11.3119	0.00029907
Little Hole Draw	8/8/2001	2884	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	quadricauda			Colonial-Nonmotile	Cells/ml	4.6707	0.0014936	18.683	0.00018945
Little Hole Draw	8/8/2001	4041	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Aphanizomenon	flos-aquae			Multi-Filament	Cells/ml	2522.2045	0.80655417	97219.3822	0.98584874
Little Hole Draw	8/8/2001	4261	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae	Microcystis	aeruginosa			Colonial-Nonmotile	Cells/ml	0	0	776.5815	0.00787489
Little Hole Draw	8/8/2001	8101	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Pyramichlamys	dissecta			Cell-Motile	Cells/ml	4.6707	0.0014936	4.6707	0.00004736
Little Hole Draw	8/8/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	509.0356	0.16278013	509.0356	0.00516185
Little Hole Draw	8/8/2001	1298	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus			Cell-Nonmotile	Cells/ml	33.9357	0.01085201	33.9357	0.00034412
Little Hole Draw	8/8/2001	1446	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus	1		Cell-Nonmotile	Cells/ml	33.9357	0.01085201	33.9357	0.00034412
Little Hole Draw	8/8/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	18.683	0.00597448	18.683	0.00018945
County Boundary	6/6/2001	3069	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	rostratiformis			Cell-Motile	Cells/ml	19.7272	0.08445474	19.7272	0.00542951
County Boundary	6/6/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	3.9454	0.01689078	3.9454	0.00108589
County Boundary	6/6/2001	2160	Chlorophyta	Chlorophyceae	Zygnematales	Desmidiaceae	Closterium				Cell-Nonmotile	Cells/ml	8.6811	0.03716493	8.6811	0.00238929
County Boundary	6/6/2001	2462	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Quadrigula	lacustris			Colonial-Nonmotile	Cells/ml	0.6576	0.00281527	0.6576	0.00018099
County Boundary	6/6/2001	101930	Chlorophyta	Chlorophyceae	Ulotrichles	Ulotrichaceae	Geminella	interrupta			Filament	Cells/ml	92.0605	0.39412312	2852.7789	0.78516866
County Boundary	6/6/2001	10220	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Anabaena	augstumalis			Complex-Filament	Cells/ml	15.7818	0.06756396	508.1738	0.13986438
County Boundary	6/6/2001	2683	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae				2-9.9 um spherical	Cell-Nonmotile	Cells/ml	0.6576	0.00281527	0.6576	0.00018099
County Boundary	6/6/2001	1439	Bacillariophyta	Coscinodiscophyceae	Aulacoseirales	Aulacoseriaceae	Aulacoseira	canadensis			Filament	Cells/ml	0.6576	0.00281527	0.6576	0.00018099
County Boundary	6/6/2001	2382	Chlorophyta	Chlorophyceae	Chlorococcales	Hydrodictyaceae	Pediastrum	boryanum			Colonial-Nonmotile	Cells/ml	0.6576	0.00281527	10.5212	0.00289574
County Boundary	6/6/2001	1090	Bacillariophyta	Bacillariophyceae	Cymbellales	Cymbellaceae	Cymbella				Cell-Nonmotile	Cells/ml	1.3151	0.00563012	1.3151	0.00036195
County Boundary	6/6/2001	4290	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Nostoc				Colonial-Nonmotile	Cells/ml	0.6576	0.00281527	131.515	0.0361968
County Boundary	6/6/2001	1152	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria	crotonensis			Lateral-Filament	Cells/ml	0.6576	0.00281527	6.5757	0.00180983
County Boundary	6/6/2001	9212	Bacillariophyta	Bacillariophyceae	Achnanthales	Cocconiedaceae	Cocconeis	placentula	lineata		Cell-Nonmotile	Cells/ml	1.3151	0.00563012	1.3151	0.00036195
County Boundary	6/6/2001	4285	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae				>1 um spherical	Cell-Nonmotile	Cells/ml	52.0868	0.22299045	52.0868	0.01433582
County Boundary	6/6/2001	1221	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	acicularis			Cell-Motile	Cells/ml	8.6811	0.03716493	8.6811	0.00238929
County Boundary	6/6/2001	1222	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	gracilis			Cell-Motile	Cells/ml	8.6811	0.03716493	8.6811	0.00238929
County Boundary	6/6/2001	9123	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	palea			Cell-Motile	Cells/ml	17.3623	0.07433029	17.3623	0.00477862
County Boundary	6/20/2001	2082	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	globosa			Cell-Motile	Cells/ml	208.3474	0.0110896	208.3474	0.01048764
County Boundary	6/20/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	1823.0395	0.09703402	1823.0395	0.09176685
County Boundary	6/20/2001	2683	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae				2-9.9 um spherical	Cell-Nonmotile	Cells/ml	208.3474	0.0110896	208.3474	0.01048764
County Boundary	6/20/2001	1731	Chrysophyta	Chrysophyceae	Ochromonadales	Ochromonadaceae	Erkenia	subaequiciliata			Cell-Motile	Cells/ml	833.3895	0.04435841	833.3895	0.04195056
County Boundary	6/20/2001	2085	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	platystigma			Cell-Motile	Cells/ml	312.5211	0.01663441	312.5211	0.01573146
County Boundary	6/20/2001	4285	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae				>1 um spherical	Cell-Nonmotile	Cells/ml	9766.2829	0.51982511	9766.2829	0.49160813
County Boundary	6/20/2001	1298	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus			Cell-Nonmotile	Cells/ml	3958.6	0.21070245	3958.6	0.19926516
County Boundary	6/20/2001	2491	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	judayi			Cell-Nonmotile	Cells/ml	104.1737	0.0055448	104.1737	0.00524382
County Boundary	6/20/2001	8041	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Monoraphidium	capricornutum			Cell-Nonmotile	Cells/ml	52.0868	0.0027724	52.0868	0.00262191
County Boundary	6/20/2001	1446	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus	1		Cell-Nonmotile	Cells/ml	729.2158	0.03881361	729.2158	0.03670674
County Boundary	6/20/2001	1152	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria	crotonensis			Lateral-Filament	Cells/ml	156.2605	0.0083172	989.6448	0.04981603
County Boundary	6/20/2001	1296	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	hantzschii			Cell-Nonmotile	Cells/ml	104.1737	0.0055448	104.1737	0.00524382
County Boundary	6/20/2001	9123	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	palea			Cell-Motile	Cells/ml	104.1737	0.0055448	104.1737	0.00524382
County Boundary	6/20/2001	1221	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	acicularis			Cell-Motile	Cells/ml	52.0868	0.0027724	52.0868	0.00262191
County Boundary	6/20/2001	6034	Pyrrhophyta	Dinophyceae	Gymnodinales	Gymnodiniaceae	Gymnodinium	sp. 3			Cell-Motile	Cells/ml	52.0868	0.0027724	52.0868	0.00262191
County Boundary	6/20/2001	1153	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria	capucina			Lateral-Filament	Cells/ml	52.0868	0.0027724	52.0868	0.00262191
County Boundary	6/20/2001	1161	Bacillariophyta	Bacillariophyceae	Cymbellales	Gomphonemataceae	Gomphonema	parvulum			Cell-Nonmotile	Cells/ml	52.0868	0.0027724	52.0868	0.00262191
County Boundary	6/20/2001	1411	Chrysophyta	Chrysophyceae	Ochromonadales	Dinobryaceae	Dinobryon	sertularia			Colonial-Motile	Cells/ml	52.0868	0.0027724	104.1737	0.00524382
County Boundary	6/20/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	35.0707	0.00186669	35.0707	0.00176536
County Boundary	6/20/2001	8471	Chlorophyta	Prasinophyceae	Polyblepharidales	Polyblepharidaceae	Nephroselmis				Cell-Motile	Cells/ml	8.7677	0.00046667	8.7677	0.00044134
County Boundary	6/20/2001	1430	Bacillariophyta	Coscinodiscophyceae	Aulacoseirales	Aulacoseriaceae	Aulacoseira				Filament	Cells/ml	26.303	0.00140002	52.606	0.00264804

Table B-5. Continued.

Site	Sample date	Taxa identification	Division	Class	Order	Family	Genus	Species	Variety	Morph	Coloniality	Customer requested units	Concentration	Relative concentration	Algal cell concentration	Relative algal cell concentration
Little Hole Draw	7/3/2001	2363	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Oocystis	parva			Colonial-Nonmotile	Cells/ml	1.4012	0.00075926	5.6049	0.00168528
Little Hole Draw	7/3/2001	1021	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Asterionella	formosa			Colonial-Nonmotile	Cells/ml	2.8024	0.00151851	20.3178	0.00610914
Little Hole Draw	7/3/2001	2381	Chlorophyta	Chlorophyceae	Chlorococcales	Hydrodictyaceae	Pediastrum				Colonial-Nonmotile	Cells/ml	2.8024	0.00151851	141.9909	0.04269371
Little Hole Draw	7/3/2001	2371	Chlorophyta	Chlorophyceae	Volvocales	Volvocaceae	Pandorina	morum			Colonial-Motile	Cells/ml	0.7006	0.00037963	5.6049	0.00168528
Little Hole Draw	7/3/2001	2462	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Quadrigula	lacustris			Colonial-Nonmotile	Cells/ml	0.7006	0.00037963	2.8024	0.00084262
Little Hole Draw	7/3/2001	4041	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Aphanizomenon	flos-aquae			Multi-Filament	Cells/ml	0.7006	0.00037963	7.6431	0.00229812
Little Hole Draw	7/3/2001	2021	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Actinastrum	hantzschii			Cell-Nonmotile	Cells/ml	1.4012	0.00075926	7.0061	0.00210659
Little Hole Draw	7/3/2001	9504	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	tenera			Cell-Nonmotile	Cells/ml	0.7006	0.00037963	0.7006	0.00021066
Little Hole Draw	7/3/2001	1328	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	cyclopum			Cell-Nonmotile	Cells/ml	0.7006	0.00037963	0.7006	0.00021066
Little Hole Draw	7/3/2001	2382	Chlorophyta	Chlorophyceae	Chlorococcales	Hydrodictyaceae	Pediastrum	boryanum			Colonial-Nonmotile	Cells/ml	0.7006	0.00037963	11.2098	0.00337055
Little Hole Draw	7/3/2001	9818	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	medius			Cell-Nonmotile	Cells/ml	0.7006	0.00037963	0.7006	0.00021066
Little Hole Draw	7/3/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	984.1354	0.53326492	984.1354	0.29590906
Little Hole Draw	7/3/2001	2683	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae				2-9.9 um spherical	Cell-Nonmotile	Cells/ml	305.4213	0.16549599	305.4213	0.09183384
Little Hole Draw	7/3/2001	1298	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus			Cell-Nonmotile	Cells/ml	33.9357	0.01838844	33.9357	0.01020376
Little Hole Draw	7/3/2001	7140	Miscellaneous							Microflagellate	Cell-Motile	Cells/ml	33.9357	0.01838844	33.9357	0.01020376
Little Hole Draw	7/3/2001	9123	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	palea			Cell-Motile	Cells/ml	16.9679	0.00919425	16.9679	0.00510189
Little Hole Draw	7/3/2001	1731	Chrysophyta	Chrysophyceae	Ochromonadales	Ochromonadaceae	Erkenia	subaequiciliata			Cell-Motile	Cells/ml	33.9357	0.01838844	33.9357	0.01020376
Little Hole Draw	7/3/2001	1446	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus	1		Cell-Nonmotile	Cells/ml	67.8714	0.03677689	67.8714	0.02040752
Little Hole Draw	7/3/2001	2491	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	judayi			Cell-Nonmotile	Cells/ml	67.8714	0.03677689	67.8714	0.02040752
Little Hole Draw	7/3/2001	2082	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	globosa			Cell-Motile	Cells/ml	16.9679	0.00919425	16.9679	0.00510189
Little Hole Draw	7/12/2001	4041	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Aphanizomenon	flos-aquae			Multi-Filament	Cells/ml	178.6562	0.18020501	5705.3307	0.76609287
Little Hole Draw	7/12/2001	1434	Bacillariophyta	Coscinodiscophyceae	Aulacoseirales	Aulacoseriaceae	Aulacoseira	italica			Filament	Cells/ml	4.2037	0.00424014	9.8084	0.00131704
Little Hole Draw	7/12/2001	8303	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	opoliensis	carinatus		Colonial-Nonmotile	Cells/ml	0.7006	0.00070667	2.8024	0.0003763
Little Hole Draw	7/12/2001	2491	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	judayi			Cell-Nonmotile	Cells/ml	4.9043	0.00494682	4.9043	0.00065853
Little Hole Draw	7/12/2001	2082	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	globosa			Cell-Motile	Cells/ml	1.4012	0.00141335	1.4012	0.00018815
Little Hole Draw	7/12/2001	9123	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	palea			Cell-Motile	Cells/ml	1.4012	0.00141335	1.4012	0.00018815
Little Hole Draw	7/12/2001	2071	Chlorophyta	Chlorophyceae	Chlorococcales	Characiaceae	Characium	limneticum			Cell-Nonmotile	Cells/ml	0.7006	0.00070667	0.7006	0.00009407
Little Hole Draw	7/12/2001	9818	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	medius			Cell-Nonmotile	Cells/ml	0.7006	0.00070667	0.7006	0.00009407
Little Hole Draw	7/12/2001	3069	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	rostratiformis			Cell-Motile	Cells/ml	2.8024	0.00282669	2.8024	0.0003763
Little Hole Draw	7/12/2001	1021	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Asterionella	formosa			Colonial-Nonmotile	Cells/ml	0.7006	0.00070667	0.7006	0.00009407
Little Hole Draw	7/12/2001	8030	Chlorophyta	Chlorophyceae	Microsporales	Microsporaceae	Microspora				Filament	Cells/ml	1.4012	0.00141335	1.4012	0.00018815
Little Hole Draw	7/12/2001	2381	Chlorophyta	Chlorophyceae	Chlorococcales	Hydrodictyaceae	Pediastrum				Colonial-Nonmotile	Cells/ml	1.4012	0.00141335	33.6294	0.00451564
Little Hole Draw	7/12/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	5.6049	0.00565349	5.6049	0.00075261
Little Hole Draw	7/12/2001	2369	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Oocystis	lacustris			Colonial-Nonmotile	Cells/ml	0.7006	0.00070667	0.7006	0.00009407
Little Hole Draw	7/12/2001	4172	Cyanophyta	Cyanophyceae	Oscillatoriales	Oscillatoriaceae	Oscillatoria	limnetica			Filament	Cells/ml	1.4012	0.00141335	15.2861	0.00205257
Little Hole Draw	7/12/2001	2382	Chlorophyta	Chlorophyceae	Chlorococcales	Hydrodictyaceae	Pediastrum	boryanum			Colonial-Nonmotile	Cells/ml	2.1018	0.00212002	49.0428	0.0065853
Little Hole Draw	7/12/2001	2363	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Oocystis	parva			Colonial-Nonmotile	Cells/ml	1.4012	0.00141335	2.8024	0.0003763
Little Hole Draw	7/12/2001	4261	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae	Microcystis	aeruginosa			Colonial-Nonmotile	Cells/ml	0	0	313.128	0.04204579
Little Hole Draw	7/12/2001	2371	Chlorophyta	Chlorophyceae	Volvocales	Volvocaceae	Pandorina	morum			Colonial-Motile	Cells/ml	0.7006	0.00070667	5.6049	0.00075261
Little Hole Draw	7/12/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	407.2285	0.41075885	407.2285	0.05468129
Little Hole Draw	7/12/2001	2683	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae				2-9.9 um spherical	Cell-Nonmotile	Cells/ml	101.8071	0.10268969	101.8071	0.01367032
Little Hole Draw	7/12/2001	1298	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus			Cell-Nonmotile	Cells/ml	33.9357	0.0342299	33.9357	0.00455677
Little Hole Draw	7/12/2001	4285	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae				>1 um spherical	Cell-Nonmotile	Cells/ml	67.8714	0.06845979	67.8714	0.00911355
Little Hole Draw	7/12/2001	2861	Chlorophyta	Prasinophyceae	Prasinocladales	Pedinomonadaceae	Monomastix	astigmata			Cell-Motile	Cells/ml	135.7428	0.13691958	135.7428	0.01822709
Little Hole Draw	7/12/2001	10220	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Anabaena	augstumalis			Complex-Filament	Cells/ml	33.9357	0.0342299	542.9713	0.07290838
Little Hole Draw	7/25/2001	1434	Bacillariophyta	Coscinodiscophyceae	Aulacoseirales	Aulacoseriaceae	Aulacoseira	italica			Filament	Cells/ml	18.4962	0.00301095	136.0781	0.01750028
Little Hole Draw	7/25/2001	1432	Bacillariophyta	Coscinodiscophyceae	Aulacoseirales	Aulacoseriaceae	Aulacoseira	granulata			Filament	Cells/ml	18.4962	0.00301095	162.3557	0.0208797
Little Hole Draw	7/25/2001	3069	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	rostratiformis			Cell-Motile	Cells/ml	1.2611	0.00020529	1.2611	0.00016218
Little Hole Draw	7/25/2001	4041	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Aphanizomenon	flos-aquae			Multi-Filament	Cells/ml	9.6685	0.00157391	508.6195	0.06541084
Little Hole Draw	7/25/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	23.9609	0.00390054	23.9609	0.00308148
Little Hole Draw	7/25/2001	1021	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Asterionella	formosa			Colonial-Nonmotile	Cells/ml	0.8407	0.00013686	3.3629	0.00043248
Little Hole Draw	7/25/2001	9818	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	medius			Cell-Nonmotile	Cells/ml	6.3055	0.00102646	6.3055	0.00081092
Little Hole Draw	7/25/2001	2211	Chlorophyta	Chlorophyceae	Chlorococcales	Dictyosphaeriaceae	Dictyosphaerium	pulchellum			Colonial-Nonmotile	Cells/ml	1.6815	0.00027373	14.5728	0.00187413
Little Hole Draw	7/25/2001	2363	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Oocystis	parva			Colonial-Nonmotile	Cells/ml	0.8407	0.00013686	6.7259	0.00086498
Little Hole Draw	7/25/2001	8101	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Pyramichlamys	dissecta			Cell-Motile	Cells/ml	27.7442	0.00451641	27.7442	0.00356803
Little Hole Draw	7/25/2001	2194	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Crucigenia	crucifera			Colonial-Nonmotile	Cells/ml	0.4204	0.00006844	2.9426	0.00037843
Little Hole Draw	7/25/2001	3065	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	gracilis			Cell-Motile	Cells/ml	0.4204	0.00006844	0.4204	0.00005407
Little Hole Draw	7/25/2001	2371	Chlorophyta	Chlorophyceae	Volvocales	Volvocaceae	Pandorina	morum			Colonial-Motile	Cells/ml	0.8407	0.00013686	13.4518	0.00172996
Little Hole Draw	7/25/2001	8011	Chlorophyta	Chlorophyceae	Chlorococcales	Actinodiscaceae	Deasonia	Gigantica			Cell-Nonmotile	Cells/ml	0.4204	0.00006844	0.4204	0.00005407
Little Hole Draw	7/25/2001	4168	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae	Merismopedia	punctata			Colonial-Nonmotile	Cells/ml	0.4204	0.00006844	3.3629	0.00043248
Little Hole Draw	7/25/2001	9317	Bacillariophyta	Bacillariophyceae	Surirellales	Surirellaceae	Surirella	brebissonii	kuetzingii		Cell-Motile	Cells/ml	0.4204	0.00006844	0.4204	0.00005407
Little Hole Draw	7/25/2001	2021	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Actinastrum	hantzschii			Cell-Nonmotile	Cells/ml	0.4204	0.00006844	1.6815	0.00021625
Little Hole Draw	7/25/2001	2381	Chlorophyta	Chlorophyceae	Chlorococcales	Hydrodictyaceae	Pediastrum				Colonial-Nonmotile	Cells/ml	2.5222	0.00041058	90.7994	0.01167723
Little Hole Draw	7/25/2001	9506	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	ulna	ulna		Cell-Nonmotile	Cells/ml	0.4204	0.00006844	0.4204	0.00005407
Little Hole Draw	7/25/2001	6033	Pyrrhophyta	Dinophyceae	Gymnodinales	Gymnodiniaceae	Gymnodinium	sp. 2			Cell-Motile	Cells/ml	0.8407	0.00013686	0.8407	0.00010812
Little Hole Draw	7/25/2001	2641	Chlorophyta	Chlorophyceae	Tetrasporales	Palmellopsidaceae	Sphaerocystis	schroeteri			Colonial-Nonmotile	Cells/ml	1.2611	0.00020529	15.1332	0.0019462
Little Hole Draw	7/25/2001	5021	Euglenophyta	Euglenophyceae	Euglenales	Euglenaceae	Euglena	gracilis			Cell-Motile	Cells/ml	0.4204	0.00006844	0.4204	0.00005407
Little Hole Draw	7/25/2001	6034	Pyrrhophyta	Dinophyceae	Gymnodinales	Gymnodiniaceae	Gymnodinium	sp. 3			Cell-Motile	Cells/ml	0.8407	0.00013686	0.8407	0.00010812
Little Hole Draw	7/25/2001	2567	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Tetraedron	regulare	incus		Cell-Nonmotile	Cells/ml	0.4204	0.00006844	0.4204	0.00005407
Little Hole Draw	7/25/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	356.3249	0.05800529	356.3249	0.04582505
Little Hole Draw	7/25/2001	2561	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Tetrastrum	staurogeniaeforme			Colonial-Nonmotile	Cells/ml	33.9357	0.00552431	135.7428	0.01745716
Little Hole Draw	7/25/2001	1298	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus			Cell-Nonmotile	Cells/ml	3139.0527	0.51099899	3139.0527	0.40369685
Little Hole Draw	7/25/2001	2683	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae				2-9.9 um spherical	Cell-Nonmotile	Cells/ml	1230.1693	0.20025636	1230.1693	0.15820552

Table B-5. Continued.

Site	Sample date	Taxa identification	Division	Class	Order	Family	Genus	Species	Variety	Morph	Coloniality	Customer requested units	Concentration	Relative concentration	Algal cell concentration	Relative algal cell concentration
Dam	8/8/2001	8101	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Pyramichlamys	dissecta			Cell-Motile	Cells/ml	0.8407	0.0014805	0.8407	0.00027985
Dam	8/8/2001	2363	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Oocystis	parva			Colonial-Nonmotile	Cells/ml	0.4204	0.00074034	1.6815	0.00055974
Dam	8/8/2001	3069	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	rostratiformis			Cell-Motile	Cells/ml	0.4204	0.00074034	0.4204	0.00013994
Dam	8/8/2001	2211	Chlorophyta	Chlorophyceae	Chlorococcales	Dictyosphaeriaceae	Dictyosphaerium	pulchellum			Colonial-Nonmotile	Cells/ml	0.8407	0.0014805	3.3629	0.00111945
Dam	8/8/2001	2884	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	quadricauda			Colonial-Nonmotile	Cells/ml	0.4204	0.00074034	0.8407	0.00027985
Dam	8/8/2001	2082	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	globosa			Cell-Motile	Cells/ml	0.4204	0.00074034	0.4204	0.00013994
Dam	8/8/2001	2085	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	platystigma			Cell-Motile	Cells/ml	0.4204	0.00074034	0.4204	0.00013994
Dam	8/8/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	254.5178	0.44821458	254.5178	0.08472429
Dam	8/8/2001	4285	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae				>1 um spherical	Cell-Nonmotile	Cells/ml	67.8714	0.11952387	67.8714	0.02259314
Dam	8/8/2001	1446	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus	1		Cell-Nonmotile	Cells/ml	16.9679	0.02988105	16.9679	0.0056483
Dam	8/8/2001	2683	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae				2-9.9 um spherical	Cell-Nonmotile	Cells/ml	33.9357	0.05976193	33.9357	0.01129657
Dam	8/8/2001	1298	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus			Cell-Nonmotile	Cells/ml	67.8714	0.11952387	67.8714	0.02259314
Dam	8/8/2001	8308	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	serratus			Colonial-Nonmotile	Cells/ml	16.9679	0.02988105	33.9357	0.01129657
Dam	8/8/2001	2492	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	setigera			Cell-Nonmotile	Cells/ml	0.4204	0.00074034	0.4204	0.00013994
Fenstermaker	8/8/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	155.5359	0.03362825	155.5359	0.01138381
Fenstermaker	8/8/2001	8101	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Pyramichlamys	dissecta			Cell-Motile	Cells/ml	28.0245	0.00605915	28.0245	0.00205114
Fenstermaker	8/8/2001	2363	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Oocystis	parva			Colonial-Nonmotile	Cells/ml	19.6171	0.00424139	106.4936	0.00779436
Fenstermaker	8/8/2001	4041	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Aphanizomenon	flos-aquae			Multi-Filament	Cells/ml	281.6462	0.06089443	8551.8199	0.6259151
Fenstermaker	8/8/2001	1432	Bacillariophyta	Coscinodiscophyceae	Aulacoseirales	Aulacoseriaceae	Aulacoseira	granulata			Filament	Cells/ml	71.4625	0.01545083	365.2518	0.0267331
Fenstermaker	8/8/2001	2211	Chlorophyta	Chlorophyceae	Chlorococcales	Dictyosphaeriaceae	Dictyosphaerium	pulchellum			Colonial-Nonmotile	Cells/ml	11.2098	0.00242366	89.6784	0.00656364
Fenstermaker	8/8/2001	2082	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	globosa			Cell-Motile	Cells/ml	7.0061	0.00151478	7.0061	0.00051278
Fenstermaker	8/8/2001	6034	Pyrrhophyta	Dinophyceae	Gymnodinales	Gymnodiniaceae	Gymnodinium	sp. 3			Cell-Motile	Cells/ml	4.2037	0.00090888	4.2037	0.00030767
Fenstermaker	8/8/2001	3069	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	rostratiformis			Cell-Motile	Cells/ml	5.6049	0.00121183	5.6049	0.00041023
Fenstermaker	8/8/2001	9504	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	tenera			Cell-Nonmotile	Cells/ml	2.8024	0.0006059	2.8024	0.00020511
Fenstermaker	8/8/2001	9506	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	ulna	ulna		Cell-Nonmotile	Cells/ml	2.8024	0.0006059	2.8024	0.00020511
Fenstermaker	8/8/2001	2641	Chlorophyta	Chlorophyceae	Tetrasporales	Palmellopsidaceae	Sphaerocystis	schroeteri			Colonial-Nonmotile	Cells/ml	7.0061	0.00151478	42.0367	0.0030767
Fenstermaker	8/8/2001	4052	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae	Aphanocapsa	koordersi			Colonial-Nonmotile	Cells/ml	1.4012	0.00030295	42.0367	0.0030767
Fenstermaker	8/8/2001	2331	Chlorophyta	Chlorophyceae	Chlorococcales	Micractinaceae	Micractinium	pusillum			Colonial-Nonmotile	Cells/ml	7.0061	0.00151478	63.0551	0.00461506
Fenstermaker	8/8/2001	2021	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Actinastrum	hantzschii			Cell-Nonmotile	Cells/ml	5.6049	0.00121183	39.2343	0.00287159
Fenstermaker	8/8/2001	1180	Chrysophyta	Chrysophyceae	Ochromonadales	Synuraceae	Mallomonas				Cell-Motile	Cells/ml	5.6049	0.00121183	5.6049	0.00041023
Fenstermaker	8/8/2001	1430	Bacillariophyta	Coscinodiscophyceae	Aulacoseirales	Aulacoseriaceae	Aulacoseira				Filament	Cells/ml	1.4012	0.00030295	8.7577	0.00064098
Fenstermaker	8/8/2001	2085	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	platystigma			Cell-Motile	Cells/ml	2.8024	0.0006059	2.8024	0.00020511
Fenstermaker	8/8/2001	1298	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus			Cell-Nonmotile	Cells/ml	2070.078	0.4475694	2070.078	0.1515108
Fenstermaker	8/8/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	916.264	0.19810448	916.264	0.06706215
Fenstermaker	8/8/2001	8041	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Monoraphidium	capricornutum			Cell-Nonmotile	Cells/ml	33.9357	0.0073372	33.9357	0.00248378
Fenstermaker	8/8/2001	1222	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	gracilis			Cell-Motile	Cells/ml	33.9357	0.0073372	33.9357	0.00248378
Fenstermaker	8/8/2001	1296	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	hantzschii			Cell-Nonmotile	Cells/ml	203.6142	0.04402321	203.6142	0.0149027
Fenstermaker	8/8/2001	9123	Bacillariophyta	Bacillariophyceae	Bacillarales	Bacillariaceae	Nitzschia	palea			Cell-Motile	Cells/ml	33.9357	0.0073372	33.9357	0.00248378
Fenstermaker	8/8/2001	2561	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Tetrastrum	staurogeniaeforme			Colonial-Nonmotile	Cells/ml	33.9357	0.0073372	135.7428	0.00993513
Fenstermaker	8/8/2001	2884	Chlorophyta	Chlorophyceae	Chlorococcales	Scenedesmaceae	Scenedesmus	quadricauda			Colonial-Nonmotile	Cells/ml	33.9357	0.0073372	67.8714	0.00496757
Fenstermaker	8/8/2001	1731	Chrysophyta	Chrysophyceae	Ochromonadales	Ochromonadaceae	Erkenia	subaequiciliata			Cell-Motile	Cells/ml	67.8714	0.0146744	67.8714	0.00496757
Fenstermaker	8/8/2001	2911	Chlorophyta	Chlorophyceae	Ulotrichales	Ulotrichaceae	Stichococcus	bacillaris			Colonial-Nonmotile	Cells/ml	237.5499	0.05136042	237.5499	0.01738648
Fenstermaker	8/8/2001	4285	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae				>1 um spherical	Cell-Nonmotile	Cells/ml	101.8071	0.02201161	101.8071	0.00745135
Fenstermaker	8/8/2001	2683	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae				2-9.9 um spherical	Cell-Nonmotile	Cells/ml	237.5499	0.05136042	237.5499	0.01738648
Little Hole Draw	6/20/2001	3069	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	rostratiformis			Cell-Motile	Cells/ml	87.6766	0.02275403	87.6766	0.01692747
Little Hole Draw	6/20/2001	3043	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Rhodomonas	minuta	nannoplanctica		Cell-Motile	Cells/ml	666.3424	0.17293067	666.3424	0.12864883
Little Hole Draw	6/20/2001	3065	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	gracilis			Cell-Motile	Cells/ml	17.5353	0.0045508	17.5353	0.00338549
Little Hole Draw	6/20/2001	2491	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	judayi			Cell-Nonmotile	Cells/ml	29.2255	0.00758467	29.2255	0.00564248
Little Hole Draw	6/20/2001	1298	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus			Cell-Nonmotile	Cells/ml	37.9932	0.00986008	37.9932	0.00733524
Little Hole Draw	6/20/2001	2085	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	platystigma			Cell-Motile	Cells/ml	70.1413	0.01820323	70.1413	0.01354198
Little Hole Draw	6/20/2001	6034	Pyrrhophyta	Dinophyceae	Gymnodinales	Gymnodiniaceae	Gymnodinium	sp. 3			Cell-Motile	Cells/ml	2.9226	0.00075848	2.9226	0.00056426
Little Hole Draw	6/20/2001	10220	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Anabaena	augstumalis			Complex-Filament	Cells/ml	52.606	0.01365243	1238.6341	0.23913956
Little Hole Draw	6/20/2001	2082	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Chlamydomonas	globosa			Cell-Motile	Cells/ml	14.6128	0.00379235	14.6128	0.00282125
Little Hole Draw	6/20/2001	2492	Chlorophyta	Chlorophyceae	Chlorococcales	Chlorococcaceae	Schroederia	setigera			Cell-Nonmotile	Cells/ml	92.5988	0.02403145	92.5988	0.01787779
Little Hole Draw	6/20/2001	1021	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Asterionella	formosa			Colonial-Nonmotile	Cells/ml	5.8451	0.00151693	61.3736	0.01184923
Little Hole Draw	6/20/2001	101930	Chlorophyta	Chlorophyceae	Ulotrichles	Ulotrichaceae	Geminella	interrupta			Filament	Cells/ml	2.9226	0.00075848	87.6766	0.01692747
Little Hole Draw	6/20/2001	1152	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria	crotonensis			Lateral-Filament	Cells/ml	104.1737	0.02703539	104.1737	0.02011252
Little Hole Draw	6/20/2001	1328	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Synedra	cyclopum			Cell-Nonmotile	Cells/ml	8.7677	0.00227541	8.7677	0.00169275
Little Hole Draw	6/20/2001	1153	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria	capucina			Lateral-Filament	Cells/ml	2.9226	0.00075848	2.9226	0.00056426
Little Hole Draw	6/20/2001	1296	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	hantzschii			Cell-Nonmotile	Cells/ml	8.7677	0.00227541	8.7677	0.00169275
Little Hole Draw	6/20/2001	2840	Chlorophyta	Chlorophyceae	Volvocales	Chlamydomonadaceae	Lobomonas				Cell-Motile	Cells/ml	8.7677	0.00227541	8.7677	0.00169275
Little Hole Draw	6/20/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	35.0707	0.00910163	35.0707	0.006771
Little Hole Draw	6/20/2001	4285	Cyanophyta	Cyanophyceae	Chroococcales	Chroococcaceae				>1 um spherical	Cell-Nonmotile	Cells/ml	2534.893	0.65786109	2534.893	0.48940457
Little Hole Draw	6/20/2001	1446	Bacillariophyta	Coscinodiscophyceae	Thalassiosirales	Stephanodiscaceae	Stephanodiscus	parvus	1		Cell-Nonmotile	Cells/ml	69.4491	0.01802359	69.4491	0.01340834
Little Hole Draw	7/3/2001	1152	Bacillariophyta	Fragilariophyceae	Fragilariales	Fragilariaceae	Fragilaria	crotonensis			Lateral-Filament	Cells/ml	18.2159	0.00987049	337.8234	0.10157648
Little Hole Draw	7/3/2001	3015	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	erosa			Cell-Motile	Cells/ml	96.6845	0.05238959	96.6845	0.02907102
Little Hole Draw	7/3/2001	3069	Cryptophyta	Cryptophyceae	Cryptomonadales	Cryptomonadaceae	Cryptomonas	rostratiformis			Cell-Motile	Cells/ml	44.8392	0.02429663	44.8392	0.01348222
Little Hole Draw	7/3/2001	2369	Chlorophyta	Chlorophyceae	Chlorococcales	Oocystaceae	Oocystis	lacustris			Colonial-Nonmotile	Cells/ml	2.1018	0.00113888	11.2097	0.00337052
Little Hole Draw	7/3/2001	1434	Bacillariophyta	Coscinodiscophyceae	Aulacoseirales	Aulacoseriaceae	Aulacoseira	italica			Filament	Cells/ml	94.5827	0.05125071	650.2559	0.19551844
Little Hole Draw	7/3/2001	8011	Chlorophyta	Chlorophyceae	Chlorococcales	Actinodiscaceae	Deasonia	Gigantica			Cell-Nonmotile	Cells/ml	2.1018	0.00113888	2.1018	0.00063197
Little Hole Draw	7/3/2001	10220	Cyanophyta	Cyanophyceae	Nostocales	Nostocaceae	Anabaena	augstumalis			Complex-Filament	Cells/ml	7.0061	0.00379633	386.738	0.11628408
Little Hole Draw	7/3/2001	2641	Chlorophyta	Chlorophyceae	Tetrasporales	Palmellopsidaceae	Sphaerocystis	schroeteri			Colonial-Nonmotile	Cells/ml	2.8024	0.00151851	28.0245	0.00842638
Little Hole Draw	7/3/2001	6034	Pyrrhophyta	Dinophyceae	Gymnodinales	Gymnodiniaceae	Gymnodinium	sp. 3			Cell-Motile	Cells/ml	2.8024	0.00151851	2.8024	0.00084262

Table B-6. DEQ hourly sampling data in American Falls Reservoir near the dam from 4 pm July 18 to 3 pm July 19, 2002. Temp = temperature, Cond = conductivity, DO = dissolved oxygen, Turb = turbidity.

Depth (meters)	Temp (°C)	Cond (uS/cm)	DO - % saturation	DO (mg/l)	pH	Turb (NTU)	Temp (°C)	Cond (uS/cm)	DO - % saturation	DO (mg/l)	pH	Turb (NTU)	Temp (°C)	Cond (uS/cm)	DO - % saturation	DO (mg/l)	pH	Turb (NTU)	Temp (°C)	Cond (uS/cm)	DO - % saturation	DO (mg/l)	pH	Turb (NTU)
			1600						**1700**						**1800**						**1900**			
0.3	24.13	465	107.5	9.02	8.76	0.0	24.18	464	108.7	9.11	8.79	0	24.17	464	110	9.22	8.8	0.9	24.33	464	113.2	9.46	8.8	0.7
1	24.14	465	107.4	9.01	8.77	0.5	24.19	464	108.7	9.11	8.79	2.1	24.2	464	110.1	9.22	8.81	0.3	24.32	464	112.8	9.43	8.8	4
2	24.14	465	107.5	9.02	8.76	5.0	24.19	464	108.8	9.12	8.79	0	24.2	464	109	9.13	8.8	2.5	24.29	464	111	9.28	8.8	0.5
3	24.14	465	107.5	9.01	8.76	0.0	24.19	464	108.6	9.1	8.78	0	24.2	464	109.6	9.18	8.8	0.2	24.27	464	110.8	9.27	8.8	10
4	24.14	465	106.8	8.96	8.76	0.6	24.18	464	108	9.05	8.78	3	24.2	465	108.7	9.11	8.8	2	24.25	464	109.8	9.19	8.8	0
5	24.13	465	107.2	8.99	8.76	0.0	24.17	465	107.1	8.98	8.77	0	24.2	464	108.9	9.12	8.79	4	24.2	464	106.8	8.95	8.8	0
6	24.13	465	107.1	8.98	8.75	1.0	24.15	465	106.2	8.9	8.77	0	24.17	464	107.4	9	8.78	2.9	24.1	465	103.1	8.66	8.8	0
7	23.93	466	99.1	8.35	8.71	0.0	24.01	465	101.6	8.54	8.74	0	23.85	466	94.7	7.98	8.71	0	23.6	467	86.7	7.34	8.7	0
8	23.71	467	89.3	7.55	8.65	0.0	23.68	467	88.3	7.46	8.68	0	23.49	468	79.6	6.76	8.63	0	23.34	469	74.5	6.34	8.6	0
9	23.40	469	79.1	6.72	8.61	0.0	23.32	469	72.5	6.17	8.59	0	23.15	470	71.3	6.09	8.57	0	23.2	469	74.5	6.36	8.6	0
10	23.09	469	73.8	6.31	8.56	0.0	23.16	470	71.6	6.12	8.55	0	23.07	470	70.8	6.06	8.56	0	23.11	469	71.1	6.08	8.6	0
11	23.03	470	70.8	6.07	8.54	0.0	23.01	470	70.3	6.02	8.51	0	23.03	470	69	5.91	8.54	0	22.91	470	65.7	5.64	8.6	0
12																								
			2000						**2100**						**2200**						**2300**			
0.3	24.32	463	115.4	9.65	8.8	1.2	24.26	463	112.5	9.41	8.82	3	24.3	464	110.6	9.25	8.82	1.7	24.2	465	109.2	9.15	8.8	6.8
1	24.35	464	115.4	9.64	8.8	2.5	24.33	464	113.3	9.47	8.83	7.4	24.29	464	110.7	9.26	8.81	4	24.24	465	108.4	9.07	8.8	0.9
2	24.33	464	113.4	9.48	8.8	1.5	24.32	464	112.8	9.43	8.82	3.2	24.3	464	110.1	9.21	8.81	2.5	24.22	465	107.2	8.97	8.8	0
3	24.32	464	113.3	9.47	8.8	2.2	24.31	464	111.1	9.29	8.81	0	24.23	465	107.6	9.01	8.79	0	24.21	465	107	8.96	8.8	0.1
4	24.3	464	112.8	9.43	8.8	2.5	24.26	464	109.1	9.13	8.79	0	24.04	465	100	8.41	8.75	0	24.11	465	102.2	8.57	8.8	0
5	24.24	464	109.9	9.2	8.8	1.4	23.85	466	95.3	8.03	8.72	0	23.97	466	97.9	8.23	8.73	0	24.05	466	99.1	8.34	8.7	0
6	23.69	467	90.4	7.65	8.7	0	23.81	466	93.8	7.92	8.71	0	23.94	466	96.1	8.09	8.72	0	23.97	466	96.2	8.09	8.7	0
7	23.59	467	87.7	7.43	8.7	0	23.64	466	89.2	7.55	8.68	0	23.68	466	89.1	7.54	8.68	0	23.69	467	88.8	7.51	8.7	0
8	23.36	468	80.3	6.83	8.6	0	23.48	467	86.7	7.36	8.66	0	23.55	467	87.6	7.43	8.66	0	23.25	468	77.9	6.64	8.6	0
9	23.32	468	78.7	6.71	8.6	0	23.28	468	79.2	6.75	8.61	0	23.2	468	76.1	6.5	8.58	0	23	469	70.7	6.05	8.5	0
10	23.02	469	71.3	6.11	8.6	0	22.97	469	70.4	6.03	8.53	0	22.83	471	63	5.42	8.47	0	22.89	470	66.5	5.71	8.5	0
11	22.73	472	56.7	4.89	8..48	0	22.52	474	47.4	4.1	8.38	0	22.58	472	53.8	4.64	8.41	0	22.59	472	55.4	4.78	8.4	0
12																								
			2400						**100**						**200**						**300**			
0.3	24.14	464	108.1	9.06	8.8	0.5	24.13	465	107	8.98	8.81	0.3	24.1	465	106.6	8.95	8.81	1.5	24.03	465	105	8.82	8.8	2.8
1	24.19	465	107.5	9.01	8.8	1	24.14	465	106.8	8.96	8.81	0	24.1	465	106.8	8.97	8.81	0.9	24.06	465	105.1	8.83	8.8	1.9
2	24.17	465	106.4	8.91	8.8	0	24.14	464	106.9	8.97	8.81	3.2	24.11	465	106.5	8.94	8.81	0	24.06	465	104.9	8.81	8.8	2.1
3	24.15	465	104	8.72	8.8	0	24.14	465	107	8.98	8.81	3.3	24.1	465	106.4	8.93	8.8	0.7	24.07	465	104.6	8.78	8.8	1
4	24.13	465	103.1	8.65	8.8	0	24.14	465	106	8.89	8.79	1.3	23.9	466	94.5	7.96	8.75	0	24.06	465	103.6	8.7	8.8	2.5
5	24.07	465	99.3	8.34	8.7	0	23.72	467	90	7.61	8.7	0	23.68	467	88.7	7.51	8.7	0	24.03	466	99.1	8.34	8.8	0
6	23.75	467	90.6	7.66	8.7	0	23.53	467	84.8	7.2	8.69	0	23.63	467	88	7.46	8.7	0	23.7	467	89.2	7.55	8.7	0
7	23.38	468	81.2	6.91	8.7	0	23.52	467	83.6	7.09	8.68	0	23.6	467	86.9	7.36	8.69	0	23.54	468	82	6.95	8.7	0
8	23.37	468	80.9	6.89	8.6	0	23.48	468	79.9	6.79	8.65	0	23.39	469	77.3	6.58	8.63	0	23.29	469	79.2	6.74	8.6	0
9	23.2	469	75.6	6.45	8.6	0	23.24	468	77.2	6.59	8.62	0	23.07	469	72	6.16	8.58	0	23.16	469	74.4	6.35	8.6	0
10	23	469	68.5	5.87	8.5	0	22.98	470	68.2	5.85	8.55	0	23	470	70.2	6.02	8.56	0	23.06	469	72	6.16	8.6	0
11	22.48	473	48.4	4.19	8.4	0	22.69	471	58.2	5.01	8.47	0	22.86	471	64.3	5.53	8.52	0	22.48	474	46.2	3.97	8.4	0
12							22.59	472	52.0	4.49	8.43	0.0												

Table B-6. Continued

Depth (meters)	Temp (°C)	Cond (uS/cm)	DO - % saturation	DO (mg/l)	pH	Turb (NTU)	Temp (°C)	Cond (uS/cm)	DO - % saturation	DO (mg/l)	pH	Turb (NTU)	Temp (°C)	Cond (uS/cm)	DO - % saturation	DO (mg/l)	pH	Turb (NTU)	Temp (°C)	Cond (uS/cm)	DO - % saturation	DO (mg/l)	pH	Turb (NTU)
	400						**500**						**600**						**700**					
0.3	24.02	465	104.1	8.75	8.8	2.1	23.97	466	103.1	8.68	8.8	0	23.92	466	102	8.59	8.8	0.4	23.92	466	101.4	8.54	8.8	0
1	24.02	465	104	8.74	8.8	0	23.98	465	103.1	8.67	8.8	1.5	23.95	466	101.9	8.57	8.8	0.1	23.92	466	101.3	8.53	8.8	0
2	24.02	465	103.7	8.72	8.8	0	23.99	465	102.9	8.65	8.8	0	23.95	466	101.8	8.57	8.8	0	23.92	466	101	8.5	8.8	1.2
3	24.03	465	103.7	8.72	8.8	0	23.99	465	102.8	8.64	8.8	0	23.94	466	101.9	8.58	8.8	1.1	23.92	466	100.3	8.45	8.8	1.9
4	24.03	465	103.2	8.67	8.8	0.6	23.99	465	102.7	8.63	8.79	0	23.95	466	101.9	8.58	8.79	0	23.92	466	98.9	8.33	8.8	0
5	23.9	466	96.4	8.12	8.8	0	23.98	465	102.1	8.59	8.77	0.4	23.94	466	101.2	8.52	8.79	0.3	23.82	467	92.8	7.83	8.7	0
6	23.64	468	84.4	7.14	8.7	0	23.69	467	87.4	7.4	8.7	0	23.8	467	92.4	7.79	8.74	0	23.57	468	83.7	7.09	8.7	0
7	23.54	468	83.2	7.05	8.7	0	23.38	468	79.2	6.73	8.65	0	23.39	469	78.6	6.68	8.66	0	23.33	469	76.8	6.55	8.6	0
8	23.26	468	77.7	6.63	8.6	0	23.23	469	76.6	6.53	8.62	0	23.08	470	71.9	6.15	8.59	0	23.09	470	70.1	5.99	8.6	0
9	23.21	468	77.2	6.59	8.6	0	23.13	469	73.8	6.31	8.59	0	23.01	470	68.5	5.87	8.56	0	22.93	471	65.9	5.65	8.5	0
10	22.98	470	69.1	5.92	8.6	0	22.98	470	68.1	5.84	8.54	0	22.54	473	50.7	4.38	8.43	0	22.65	472	56.3	4.86	8.5	0
11	22.46	474	45.9	3.98	8.4	0	22.34	474	43.3	3.76	8.36	0	22.38	474	45.1	3.91	8.38	0	22.36	474	46.5	4.04	8.4	0
12																								
	800						**900**						**1000**						**1100**					
0.3	23.86	467	101.6	8.56	8.8	0	23.91	466	104.2	8.77	8.81	0	24.11	466	106.9	8.97	8.84	0	24.38	465	107.8	9	8.8	0
1	23.88	466	101.6	8.56	8.8	0	23.91	466	104	8.76	8.8	0	24	466	107	8.99	8.84	0	24.04	465	108.6	9.13	8.8	0
2	23.88	466	100.8	8.5	8.8	0.7	23.91	466	103.1	8.69	8.8	0	23.94	466	105.7	8.89	8.84	0	23.93	465	106.6	8.98	8.8	0
3	23.88	466	100.8	8.49	8.8	0	23.89	466	101.4	8.55	8.8	0	23.89	466	103.9	8.75	8.82	0	23.87	465	103.3	8.73	8.8	0
4	23.87	466	101.3	8.54	8.8	0	23.88	466	99.9	8.42	8.78	0	23.84	466	101.2	8.54	8.8	0	23.8	466	99	8.36	8.8	0
5	23.86	466	99.2	8.36	8.8	0	23.86	467	97.5	8.25	8.77	0	23.74	468	92.6	7.82	8.74	0	23.68	467	89.1	7.55	8.7	0
6	23.55	469	82.9	7.02	8.7	0	23.61	468	84.6	7.16	8.68	0	23.55	469	83	7.05	8.68	0	23.54	468	82.4	6.98	8.7	0
7	23.19	470	73.7	6.28	8.6	0	23.24	470	73.7	6.27	8.61	0	23.24	470	73.6	6.31	8.62	0	23.36	469	77.9	6.64	8.7	0
8	23.08	471	69.3	5.93	8.6	0	23.02	471	67.2	5.75	8.56	0	23.02	471	67.1	5.74	8.57	0	23.05	470	68.7	5.87	8.6	0
9	22.98	471	66.6	5.71	8.6	0	22.98	471	66.2	5.69	8.54	0	22.98	471	65.1	5.59	8.54	0	23.02	470	68	5.83	8.6	0
10	22.73	472	55.6	4.78	8.5	0	22.8	472	59.6	5.12	8.47	0	22.71	473	56.9	4.89	8.47	0	22.95	471	65	5.58	8.5	0
11	22.35	474	44.2	3.82	8.4	0	22.4	474	47.1	4.06	8.39	0	22.59	473	52.8	4.53	8.44	0	22.6	473	54.9	4.75	8.5	0
12																								
	1200						**1300**						**1400**						**1500**					
0.3	24.65	465	108.9	9.06	8.8	0	24.38	465	112.5	9.4	8.84	0	24.74	464	116.8	9.7	8.86	0	24.71	465	115	9.53	8.9	0
1	24.36	465	112.5	9.37	8.8	0	24.37	465	112.4	9.39	8.84	0	24.63	464	117.3	9.77	8.86	0	24.72	465	115.2	9.55	8.9	0
2	23.97	464	112	9.42	8.8	0	24.05	464	115.5	9.7	8.85	0	24.36	464	117.1	9.78	8.86	0	24.7	464	116.1	9.66	8.9	0
3	23.88	464	107.7	9.07	8.8	0	23.92	464	112.2	9.47	8.83	1.5	24.13	464	116.7	9.78	8.85	2.3	24.15	464	117.6	9.88	8.9	0
4	23.82	465	103.1	8.71	8.8	0	23.87	465	104.6	8.83	8.79	0	23.95	464	114.4	9.62	8.84	0	23.91	464	111	9.35	8.8	0
5	23.71	467	93	7.91	8.8	0	23.77	466	97.4	8.22	8.76	0	23.84	465	105.1	8.85	8.81	0	23.76	466	97.3	8.21	8.8	0
6	23.58	468	84.4	7.15	8.7	0	23.59	468	83.7	7.1	8.68	0	23.78	466	98.3	8.24	8.75	0	23.64	467	89.6	7.59	8.7	0
7	23.31	469	78.7	6.7	8.7	0	23.48	468	80.7	6.85	8.65	0	23.56	468	85.3	7.23	8.68	0	23.33	468	81.4	6.95	8.7	0
8	23.1	470	71.3	6.08	8.6	0	23.27	469	77.8	6.62	8.61	0	23.3	468	80.2	6.83	8.64	0	23.01	470	72.1	6.17	8.6	0
9	23.02	470	70.2	6.01	8.6	0	23.08	470	71.5	6.12	8.57	0	23.11	469	74.1	6.33	8.61	0	22.96	470	70.5	6.04	8.6	0
10	22.92	471	67.5	5.79	8.6	0	22.93	470	69.5	5.96	8.55	0	22.95	470	70.3	6.02	8.58	0	22.95	470	71	6.08	8.6	0
11	22.82	471	64.8	5.56	8.6	0	22.79	471	63.4	5.45	8.51	0	22.85	470	69.6	5.91	8.55	0	22.92	470	71.5	6.13	8.6	0
12																								

Appendix C: Snake River Information

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Table C-1. USGS and DEQ sampling on Snake River, April 2000 to July 2003. Flows after September 2002 are provisional.

		Tilden Bridge - SR-1								Blackfoot steel bridge - SR-2								Firth - SR-3								Shelley bridge - SR-4							
Date	Sampling agency	Flow (cfs)	Dissolved ortho-phosphorus as P (mg/L)	Total phosphorus as P (mg/L)	Total ammonia as N (mg/L)	Total Kjeldahl nitrogen as N (mg/L)	Total NO_2+NO_3 as N (mg/L)	TSS/ SSC[A] (mg/L)	Tur-bidity (NTU)	Flow (cfs)	Dissolved ortho-phosphorus as P (mg/L)	Total phosphorus as P (mg/L)	Total ammonia as N (mg/L)	Total Kjeldahl nitrogen as N (mg/L)	Total NO_2+NO_3 as N (mg/L)	TSS/ SSC[A] (mg/L)	Tur-bidity (NTU)	Flow (cfs)	Dissolved ortho-phosphorus as P (mg/L)	Total phosphorus as P (mg/L)	Total ammonia as N (mg/L)	Total Kjeldahl nitrogen as N (mg/L)	Total NO_2+NO_3 as N (mg/L)	TSS/ SSC[A] (mg/L)	Tur-bidity (NTU)	Flow (cfs)	Dissolved ortho-phosphorus as P (mg/L)	Total phosphorus as P (mg/L)	Total ammonia as N (mg/L)	Total Kjeldahl nitrogen as N (mg/L)	Total NO_2+NO_3 as N (mg/L)	TSS/ SSC[A] (mg/L)	Tur-bidity (NTU)
14-Apr-00	USGS	7380						50																		8740						24	
27-Apr-00	USGS	7640	0.007	0.065	0.006	1	0.169	45	3.2																								
28-Apr-00	USGS																									9220	0.004	0.03	0.014	0.27	0.106	16	2.5
5-May-00	USGS	3990						26																		7730						12	
18-May-00	USGS	4770	0.002	0.031	0.006	0.22	0.077	14	2.3																								
19-May-00	USGS																									7820	0.003	0.024	0.003	0.18	0.101	10	2.9
25-May-00	USGS	3210	0.004	0.036	0.004	0.25	0.035		2.1																								
26-May-00	USGS																									6880	0.009	0.027	0.005	0.18	0.074		1.2
1-Jun-00	USGS	8290	0.001	0.059	0.006	0.25	0.1		4.9																	11700	0.005	0.036	0.007	0.28	0.098		4.7
8-Jun-00	USGS	5760	0.001	0.028	0.002	0.25	0.049	18	2.6																	9130	0.004	0.026	0.012	0.21	0.094	12	3.5
14-Jun-00	USGS	4880	<0.001	0.025	0.004	0.21	0.058	13	1.6																								
15-Jun-00	USGS																									8160	0.002	0.026	0.01	0.2	0.11	2	2.7
5-Jul-00	USGS	3450	0.003	0.024	<0.002	0.23	0.046	15	2.1																	7000	0.004	0.015	0.002	0.2	0.069	5	2.1
17-Jul-00	USGS																									7240	0.005	0.022	0.008	0.19	0.071	5	2
19-Jul-00	USGS	4170	0.003	0.041	0.008	0.34	0.062	29	3.3																								
10-Aug-00	USGS	2170	0.003	0.016	0.003	0.21	0.059	4	0.9																	4890	0.007	0.019	0.02	0.2	0.068	2	0.9
23-Aug-00	USGS	2110	0.001	0.021	0.006	0.26	0.023	8	<0.5																								
29-Aug-00	USGS																									4370	0.004	0.02	<0.002	0.15	0.039	6	<0.5
13-Sep-00	USGS	1310	0.003	0.014	0.003	0.21	0.106	3	<0.5																								
14-Sep-00	USGS																									3520	0.007	0.021	0.01	0.18	0.046	3	<0.5
27-Sep-00	USGS	2250	0.002	0.02	0.006	0.22	0.063	9	0.6																								
29-Sep-00	USGS																									3580	0.004	0.02	0.008	0.2	0.065	4	0.6
12-Dec-00	DEQ	2190	0.006	0.022	0.007	0.12	0.254	4		2300 E	0.074 [1]	0.026	0.007	0.14	0.258	2			0.009	0.024	0.013	0.13	0.274	2		2700 E	0.015	0.026	0.016	0.13	0.324	2	
23-Jan-01	DEQ																									2400 E	--	0.064	0.064	0.34	0.355	3	
28-Feb-01	DEQ	2480	0.012	0.051	0.033	0.2	0.28	14																		3000 E	0.018	0.035	0.094	0.17	0.266	3	
5-Apr-01	USGS	2120	0.006 E	0.04	0.007	0.39	0.127	29	3																								
6-Apr-01	USGS																									2740	0.008	0.034	0.009	0.26	0.21	19	4.5
10-Apr-01	DEQ	2050	0.005	0.048	0.041	0.36	0.058	9	2.6										0.008	0.091	0.037	0.38	0.109	26									
20-Apr-01	USGS	1260	0.005 E	0.049	0.004	0.51	0.13	19	5.4																	1970	<0.007	0.037	0.012	0.39	0.104	14	5.6
23-Apr-01	DEQ									1450	<0.005	0.047	0.017	0.35	<0.005	8			0.005	0.048	0.016	0.33	0.006	10									
4-May-01	USGS	1370	<0.007	0.047	0.009	0.41	0.209	13	9.9																	3560	<0.007	0.036	0.003	0.27	0.099	9	10
7-May-01	DEQ									1500	<0.005	0.047	0.009	0.31	0.007	15			<0.005	0.046	0.011	0.3	0.039	11									
16-May-01	USGS	1590	<0.007	0.051	0.011	0.42	0.094	14	7.5																								
18-May-01	USGS																									6620	<0.007	0.036	0.006	0.2	0.109	13	9.3
22-May-01	DEQ									1680	0.013	0.04	0.008	0.2	0.048	9			0.038	0.071	<0.005	0.22	0.118	9									
4-Jun-01	DEQ									2390	<0.005	0.038	0.006	0.21	0.099	10			<0.005	0.036	0.007	0.19	0.128	8									
8-Jun-01	USGS	1830	<0.007	0.035	0.012	0.35	0.075	11	6.1																	5290	0.004 E	0.024	0.016	0.18	0.129	5	4.1
20-Jun-01	USGS	1990	<0.007	0.027	0.006	0.25	0.066	10	5																	5070	0.005 E	0.021	0.008	0.18	0.087	4	3.8
26-Jun-01	DEQ									1900	<0.005	0.025	0.01	0.3	0.024	2			<0.005	0.02	0.013	0.2	0.057	2									
2-Jul-01	USGS	1530	<0.007	0.03	0.002	0.36	0.078	15	4																	5210	<0.007	0.016	0.002	0.18	0.081	4	2.9
16-Jul-01	USGS	2160	<0.007	0.03	<0.002	0.26	0.091	10	4.2																	5210	0.007	0.021	0.011	0.22	0.121	4	2.6
2-Aug-01	USGS	1350	<0.007	0.017	0.008	0.24	0.078	5	3.1																	4150	<0.007	0.013	0.01	0.23	0.048	2	2.1
2-Aug-01	DEQ									1720	0.005	0.03	0.126	0.34	0.008	3			0.006	0.027	0.061	0.25	0.014	2									
10-Aug-01	USGS	1160	<0.007	0.018	0.008	0.21	0.086	3	4.7																	4220	0.004 E	0.021	0.009	0.17	0.063	2	4.5
13-Aug-01	DEQ									1840	<0.005	0.019	0.005	0.21	<0.005	4			0.006	0.025	<0.005	0.23	0.038	4									
7-Sep-01	USGS	3830	<0.007	0.032	0.003	0.28	0.037	27	5.8																								
10-Sep-01	USGS																									4320	0.008	0.022	0.004	0.19	0.048	2	11
10-Sep-01	DEQ									2780	<0.005	0.016	0.059	0.2	0.005	2			<0.005	0.028	0.006	0.2	0.014	8									
20-Sep-01	USGS	1880	0.006 E	0.017	0.008	0.16	0.05	3	3.4																								
21-Sep-01	USGS																									4340	0.009	0.021	0.01	0.16	0.03	2	2.6
25-Sep-01	DEQ									2820	<0.005	0.018	0.017	0.2	0.005	3			0.007	0.02	0.013	0.2	0.007	2									
15-Oct-01	DEQ	2190	<0.005	0.017	0.013	0.13	0.035	4		2470	<0.005	0.013	0.009	0.13	0.034	2			<0.005	0.015	0.012	0.22	0.081	1		2870	0.013	0.023	0.03	0.16	0.142	2	
29-Oct-01	DEQ	1780	0.011	0.014	0.014	0.15	0.052	2		2000	0.011	0.011	0.014	0.13	0.022	1			0.014	0.017	0.018	0.24	0.092	2		2150	0.026	0.028	0.036	0.14	0.16	2	
15-Nov-01	DEQ	1890	0.018	0.016	0.034	0.15	0.118	3		2140	0.006	0.015	0.014	0.14	0.133	1			0.006	0.017	0.02	0.12	0.168	<1.0		2280	0.014	0.024	0.029	0.13	0.175	1	
28-Nov-01	DEQ	1840	<0.005	0.013	0.01	0.15	0.19	2		2110	0.005	0.013	0.011	0.13	0.188	2			0.01	0.017	0.007	0.14	0.222	2		2250	0.018	0.029	0.029	0.21	0.248	4	
24-Jan-02	DEQ	1370	0.02	0.031	0.055	0.18	0.413	4																		1700 E	0.024	0.033	0.063	0.15	0.336	2	
28-Feb-02	DEQ	1390	0.019	0.035	0.021	0.2	0.357	5																		1800 E	0.026	0.041	0.081	0.22	0.319	3	
26-Mar-02	DEQ	1840	0.006	0.045	0.02	0.28	0.239	24		2050	<0.005	0.03	0.012	0.22	0.24	9			0.006	0.025	0.017	0.17	0.249	4		2210	0.016	0.025	0.056	0.18	0.281	2	
4-Apr-02	USGS	1880	0.006 E	0.049	0.014 E	0.37	0.242	18	4.9																	2090	0.01	0.032	0.038	0.28	0.253	4	3.7
18-Apr-02	USGS	2390	0.007	0.086	<0.015	0.42	0.248	31	10																	3100	0.013	0.041	0.019	0.33	0.233	8	6.3
22-Apr-02	DEQ									1770	0.011	0.048	0.02	0.33	0.23	10			0.014	0.048	0.026	0.28	0.268	10									
9-May-02	USGS	1270	0.004 E	0.053	<0.015	0.45	0.128	12	5																	3490	<0.007	0.042	<0.015	0.31	0.083	10	7.9

Table C-1. Continued.

Date	Sampling agency	Tilden Bridge - SR-1 Flow (cfs)	Dissolved ortho-phosphorus as P (mg/L)	Total phosphorus as P (mg/L)	Total ammonia as N (mg/L)	Total Kjeldahl nitrogen as N (mg/L)	Total NO_2+NO_3 as N (mg/L)	TSS/ SSC[A] (mg/L)	Tur-bidity (NTU)	Blackfoot steel bridge - SR-2 Flow (cfs)	Dissolved ortho-phosphorus as P (mg/L)	Total phosphorus as P (mg/L)	Total ammonia as N (mg/L)	Total Kjeldahl nitrogen as N (mg/L)	Total NO_2+NO_3 as N (mg/L)	TSS/ SSC[A] (mg/L)	Tur-bidity (NTU)
14-May-02	DEQ									1170	<0.005	0.047	0.02	0.53	<0.005	14	
23-May-02	USGS	3270	<0.007	0.096	<0.015	0.57	0.125	79	22								
27-May-02	DEQ									2480	0.007	0.043	0.01	0.4	0.042	12	
6-Jun-02	USGS	2740	<0.007	0.048	<0.015	0.46	0.088	25	6.8								
12-Jun-02	DEQ									2250	0.01	0.029	0.026	0.2	<0.005	4.4	
20-Jun-02	USGS	2420	<0.007	0.042	<0.015	0.44	0.037	20	4.3								
26-Jun-02	DEQ									1930	<0.005	0.023	0.032	0.3	<0.005	6.4	3.21
3-Jul-02	USGS	1080	0.007	0.024	0.015	0.23	0.088	6	4.6								
17-Jul-02	DEQ									2490	0.007	0.025	0.024	0.44	0.014	8	
18-Jul-02	USGS	2240	<0.007	0.034	<0.015	0.34	0.058	17	13								
31-Jul-02	DEQ									4730	0.006	0.026	0.011	0.23	0.022	6	
1-Aug-02	USGS	4290	<0.007	0.029	<0.015	0.2	0.036	28	4.5								
14-Aug-02	DEQ									3100	<0.005	0.021	0.006	0.22	<0.005	4.4	
21-Aug-02	USGS	2650	<0.007	0.024	<0.015	0.18	0.044	6	2.9								
4-Sep-02	USGS	5130	<0.007	0.029	<0.015	0.24	0.023	33	5.3								
5-Sep-02	DEQ									5980	<0.005	0.029	0.025	0.21	0.021	8.4	
18-Sep-02	USGS	3500	<0.007	0.022	<0.015	0.17	0.034	6	3								
19-Sep-02	DEQ									3600	<0.005	0.019	0.015	0.18	0.036	3.2	
9-Oct-02	DEQ	1560	0.006	0.02	0.015	0.17	0.033	<1.0		1500	0.007	0.017	0.031	0.23	<0.005	<1.0	
31-Oct-02	DEQ	1890	0.005	0.009	0.018	0.22	0.036	1.6		2150	<0.005	0.008	0.011	0.22	0.037	1.6	
14-Nov-02	DEQ	2030	<0.005	0.017	<0.005	0.14	0.049	1.6		2260	<0.005	0.013	0.27	0.12	0.093	1.6	
4-Dec-02	DEQ	1980	0.006	0.012	0.021	0.16	0.079	1.2		2130	0.006	0.02	0.007	0.21	0.163	4	
15-Jan-03	DEQ	1900	0.006	0.021	0.008	0.18	0.3	4		2050	0.007	0.02	0.005	0.14	0.302	4	
12-Feb-03	DEQ	1840	0.008	0.022	0.08	0.19	0.253	10		2020	0.008	0.027	<0.005	0.2	0.28	5.6	
18-Mar-03	DEQ	2070	0.014	0.066	0.026	0.4	0.258	21		2200	0.008	0.056	<0.005	0.3	0.293	14	
16-Apr-03	DEQ	1200	0.01	0.069	0.008	0.5	0.102	17		1360	0.013	0.064	0.007	0.45	0.062	14	
7-May-03	DEQ	2000	0.017	0.061	0.023	0.39	0.096	21		2160	0.011	0.041	0.019	0.31	0.091	13	
29-May-03	DEQ	2560	0.006	0.048	0.018	0.39	0.038	19	9	2940	0.006	0.042	0.023	0.27	0.069	18	9.26
19-Jun-03	DEQ	2930	<0.005	0.042	0.005	0.46	0.052	21	9	3500	<0.005	0.03	<0.005	0.28	0.054	12	5.74
2-Jul-03	DEQ	2600	0.005	0.032	0.009	0.27	0.027	10		3050	0.005	0.026	0.011	0.24	0.023	6.8	
30-Jul-03	DEQ	6480	0.009	0.043	0.008	0.29	0.025	18		6810	0.01	0.044	0.008	0.35	0.031	18	
Duplicate samples																	
28-Feb-01	DEQ																
7-May-01	DEQ																
2-Aug-01	DEQ																
25-Sep-01	DEQ																
29-Oct-01	DEQ																
12-Jun-02	DEQ										0.01	0.031	0.026	0.19	<0.005	7.2	
5-Sep-02	DEQ																
9-Oct-02	DEQ										0.009	0.017	0.018	0.38	<0.005	<1.0	
4-Dec-02	DEQ		0.006	0.014	0.006	0.16	0.093	1.2									
16-Apr-03	DEQ										0.013	0.061	0.016	0.43	0.061	13	
19-Jun-03	DEQ										0.005	0.033	0.007	0.27	0.055	12	6.3
2-Jul-03	DEQ										0.005	0.029	0.008	0.25	0.023	6	
30-Jul-03	DEQ										0.013	0.043	0.006	0.34	0.032	16	
Blank samples																	
28-Feb-01	DEQ		<0.005	<0.005	0.009 [2]	<0.05	<0.005	<1.0									
7-May-01	DEQ																
13-Aug-01	DEQ																
29-Oct-01	DEQ		<0.005	0.006	0.008	<0.05	0.007	<1.0									
17-Jul-02	DEQ										<0.005	<0.005	0.11	0.11	0.005	<1.0	
5-Sep-02	DEQ										<0.005	<0.005	0.02	<0.05	0.271	<1.0	
4-Dec-02	DEQ		<0.005	<0.005	<0.005	<0.05	<0.005	<1.0									
12-Feb-03	DEQ		<0.005	<0.005	<0.005	<0.05	0.005	<1.0									
7-May-03	DEQ		0.01	<0.005	<0.005	<0.05	0.051	<1									
2-Jul-03	DEQ		0.005	0.005	<0.005	<0.05	0.078	<1									

Date	Sampling agency	Firth - SR-3 Flow (cfs)	Dissolved ortho-phosphorus as P (mg/L)	Total phosphorus as P (mg/L)	Total ammonia as N (mg/L)	Total Kjeldahl nitrogen as N (mg/L)	Total NO_2+NO_3 as N (mg/L)	TSS/ SSC[A] (mg/L)	Tur-bidity (NTU)	Shelley bridge - SR-4 Flow (cfs)	Dissolved ortho-phosphorus as P (mg/L)	Total phosphorus as P (mg/L)	Total ammonia as N (mg/L)	Total Kjeldahl nitrogen as N (mg/L)	Total NO_2+NO_3 as N (mg/L)	TSS/ SSC[A] (mg/L)	Tur-bidity (NTU)
14-May-02	DEQ		<0.005	0.04	0.039	0.37	0.005	13									
23-May-02	USGS									6590	<0.007	0.039	0.009 [E]	0.25	0.173	13	9.3
27-May-02	DEQ		0.012	0.043	0.02	0.25	0.095	13									
6-Jun-02	USGS									5700	0.014	0.05	0.017	0.28	0.152	11	9.8
12-Jun-02	DEQ																
20-Jun-02	USGS									6650	<0.007	0.026	<0.015	0.19	0.111	8	4.1
26-Jun-02	DEQ		<0.005	0.024	0.028	0.23	<0.005	4.4	2.02								
3-Jul-02	USGS									4540	0.004 [E]	0.022	<0.015	0.2 [S]	0.07 [S]	5	3.7
17-Jul-02	DEQ		0.01	0.03	0.023	0.26	0.058	4.8									
18-Jul-02	USGS									5950	<0.007	0.021	<0.015	0.17	0.081	5	3.7
31-Jul-02	DEQ		0.01	0.025	0.01	0.22	0.034	7.2									
1-Aug-02	USGS									7240	0.008	0.025	0.008 [E]	0.16	0.061	6	3.8
14-Aug-02	DEQ		0.005	0.024	0.017	0.27	0.02	5.2									
21-Aug-02	USGS									5700	0.004 [E]	0.025	<0.015	0.14	0.051	4	14
4-Sep-02	USGS									7150	0.006 [E]	0.022	<0.015	0.32	0.038	6	3
5-Sep-02	DEQ		0.006	0.027	0.025	0.25	0.034	5.2									
18-Sep-02	USGS									5590	0.007	0.025	<0.015	0.14	0.061	3	5.6
19-Sep-02	DEQ		0.007	0.02	0.021	0.24	0.009	4.4									
9-Oct-02	DEQ									2310	0.02	0.032	0.021	0.2	0.096	<1.0	
31-Oct-02	DEQ		0.009	0.014	0.027	0.15	0.086	2		2640	0.017	0.022	0.045	0.13	0.158	1.6	
14-Nov-02	DEQ		0.009	0.02	<0.005	0.15	0.127	1		2540	0.018	0.032	<0.005	0.12	0.2	1.2	
4-Dec-02	DEQ		0.01	0.02	0.007	0.19	0.206	1.2		2400	0.016	0.024	0.011	0.14	0.24	<1.0	
15-Jan-03	DEQ		0.009	0.024	0.034	0.15	0.33	4.4		2370	0.013	0.024	0.049	0.21	0.335	1	
12-Feb-03	DEQ		0.012	0.096	0.021	0.37	0.334	30		2200	0.015	0.025	0.028	0.24	0.355	2.8	
18-Mar-03	DEQ		0.012	0.061	0.041	0.26	0.323	11		2560	0.02	0.058	0.062	0.31	0.33	8	
16-Apr-03	DEQ		0.025	0.069	0.005	0.41	0.097	15		2590	0.022	0.05	0.021	0.28	0.121	5.6	
7-May-03	DEQ		0.017	0.038	<0.005	0.29	0.105	11		4450	0.018	0.036	0.018	0.24	0.126	7.6	
29-May-03	DEQ		0.009	0.042	0.027	0.27	0.107	15	7.63	6730	0.013	0.04	0.044	0.19	0.123	10	7.8
19-Jun-03	DEQ		<0.005	0.029	0.018	0.25	0.08	7.2	4.27	7010	<0.005	0.026	0.025	0.21	0.111	6.4	4.98
2-Jul-03	DEQ		0.008	0.025	0.01	0.22	0.039	3.2		6400	0.011	0.03	0.015	0.23	0.068	3.2	
30-Jul-03	DEQ		0.011	0.035	0.013	0.25	0.051	10		8950	0.013	0.035	0.021	0.22	0.06	11	
Duplicate samples																	
28-Feb-01	DEQ									3000 [E]	0.019	0.039	0.089	0.16	0.268	2	
7-May-01	DEQ		<0.005	0.044	0.008	0.29	0.04	10									
2-Aug-01	DEQ		0.006	0.018	0.021	0.3	0.011	2									
25-Sep-01	DEQ		0.01	0.021	0.016	0.17	0.008	2									
29-Oct-01	DEQ										0.028	0.027	0.022	0.13	0.157	2	
12-Jun-02	DEQ																
5-Sep-02	DEQ		0.006	0.027	0.018	0.2	0.036	4									
9-Oct-02	DEQ																
4-Dec-02	DEQ																
16-Apr-03	DEQ																
19-Jun-03	DEQ																
2-Jul-03	DEQ																
30-Jul-03	DEQ																
Blank samples																	
28-Feb-01	DEQ																
7-May-01	DEQ		<0.005	0.005	0.012 [3]	<0.05	0.018 [3]	<1.0									
13-Aug-01	DEQ		<0.005	<0.005	<0.005	<0.05	0.033	<1.0									
29-Oct-01	DEQ																
17-Jul-02	DEQ																
5-Sep-02	DEQ																
4-Dec-02	DEQ																
12-Feb-03	DEQ																
7-May-03	DEQ																
2-Jul-03	DEQ																

[A]TSS=total suspended solids (DEQ analysis), SSC=suspended sediment concentration (USGS analysis)

[E]estimated

[S]most probable value

[1]dissolved ortho phosphate higher than total phosphorus most likely because of contamination

[2]because the lab assumed this sample was a blank they repeated the ammonia test and measured a similar concentration of 0.010 mg/l

[3]because the lab assumed this sample was a blank they repeated the ammonia and NO_2/NO_3 tests and measured concentrations of 0.009 mg/l and 0.016 mg/l

Table C-2. USGS Bedload sampling at Snake River near Shelley (13060000) and Blackfoot (13069500) gage sites, 2000-2002.

Date	Time	Flow (cfs)	Suspended sediment (mg/L)	Suspended sediment (tons/day)	Bedload sediment (tons/day)	Number of sampling points	Sampling location, cross section (ft from left bank)	Sampler type (code)	Sampling method (code)	Sampler bag mesh size (mm)	Sediment bedload sieve diameter, percent finer than										
											.062 mm	.125 mm	.250 mm	.500 mm	1.00 mm	2.00 mm	4.00 mm	8.00 mm	16.0 mm	32.0 mm	64.0 mm
Snake River near Shelley																					
14-Apr-00	1433	8740			0.8	20	470	1100	1000	0.25	0	0	2	63	83	93	100	100	100	100	100
14-Apr-00	1506	8740			0.3	20	470	1100	1000	0.25	0	5	15	60	80	95	100	100	100	100	100
14-Apr-00	1549	8740	24	566																	
28-Apr-00	1008	9220	16	398																	
5-May-00	1420	7730	12	250																	
19-May-00	1318	7820			0.4	20	470	1100	1000	0.25	0	0	3	76	97	100	100	100	100	100	100
19-May-00	1356	7820			0.1	20	470	1100	1000	0.25	0	0	0	40	40	60	100	100	100	100	100
19-May-00	1241	7820	10	211																	
8-Jun-00	1254	9130	12	296																	
8-Jun-00	1316	9130			0.34	20	470	1100	1000	0.25	0	0	4	67	92	100	100	100	100	100	100
8-Jun-00	1348	9130			0.1	20	470	1100	1000	0.25	0	0	0	62	88	100	100	100	100	100	100
15-Jun-00	1115	8160	2	44																	
5-Jul-00	1545	7000	5	94																	
17-Jul-00	1248	7240	5	98																	
10-Aug-00	915	4840			0.08	20	470	1100	1000	0.25	0	0	20	80	80	100	100	100	100	100	100
10-Aug-00	1000	4810			0.04	20	470	1100	1000	0.25	0	0	0	100	100	100	100	100	100	100	100
10-Aug-00	845	4890	2	26																	
29-Aug-00	1343	4370	6	71																	
14-Sep-00	1220	3520	3	29																	
29-Sep-00	1035	3580	4	39																	
6-Apr-01	1035	2870			0.04	20	462	1100	1000	0.25	0	0	33	100	100	100	100	100	100	100	100
6-Apr-01	1115	2870			0.12	20	462	1100	1000	0.25	0	12	25	62	75	88	100	100	100	100	100
6-Apr-01	945	2740	19	141																	
20-Apr-01	1400	1970	14	74																	
4-May-01	1250	3480			0.15	20	465	1100	1000	0.25	0	0	10	80	90	100	100	100	100	100	100
4-May-01	1330	3480			0.03	20	465	1100	1000	0.25	0	0	0	50	100	100	100	100	100	100	100
4-May-01	1207	3560	9	87																	
18-May-01	1252	6620	13	232																	
8-Jun-01	1450	5200			0.16	20	470	1100	1000	0.25	0	0	9	64	82	100	100	100	100	100	100
8-Jun-01	1530	5200			0.09	20	470	1100	1000	0.25	0	0	17	33	83	100	100	100	100	100	100
8-Jun-01	1410	5290	5	71																	
20-Jun-01	836	5070	4	55																	
2-Jul-01	933	5210			2.6	20	470	1100	1000	0.25	0	0	15	86	98	99	100	100	100	100	100
2-Jul-01	1000	5210			0.03	20	470	1100	1000	0.25	0	0	0	0	0	50	100	100	100	100	100
2-Jul-01	916	5210	4	56																	
16-Jul-01	1033	5210	4	56																	
2-Aug-01	1150	4150	2	22																	
10-Aug-01	830	4220	2	6.6																	
10-Sep-01	934	4320	2	23																	
21-Sep-01	1118	4340	2	23																	
4-Apr-02	1732	2090			0.02	20	398	1100	1000	0.25	24	30	38	77	91	100	100	100	100	100	100
4-Apr-02	1803	2100			0.01	20	398	1100	1000	0.25	53	55	64	78	87	100	100	100	100	100	100
9-May-02	1215	3490			0.01	20	462	1100	1000	0.25	10	15	25	83	92	100	100	100	100	100	100
9-May-02	1320	3470			0	20	462	1100	1000	0.25	31	42	56	80	88	100	100	100	100	100	100
6-Jun-02	1115	5700			0.02	20	468	1100	1000	0.25	0	0	17	58	67	83	100	100	100	100	100
6-Jun-02	1215	5730			0.46	20	468	1100	1000	0.25	0	0.3	1	12	25	70	100	100	100	100	100
1-Aug-02	1215	7240			0.04	20	470	1100	1000	0.25	0	0	7	63	83	93	100	100	100	100	100
1-Aug-02	1245	7240			0.01	20	470	1100	1000	0.25	0	0	0	33	56	89	100	100	100	100	100

Table C-2. Continued.

Date	Time	Flow (cfs)	Suspended sediment (mg/L)	Suspended sediment (tons/day)	Bedload sediment (tons/day)	Number of sampling points	Sampling location, cross section (ft from left bank)	Sampler type (code)	Sampling method (code)	Sampler bag mesh size (mm)	Sediment bedload sieve diameter, percent finer than .062 mm	.125 mm	.250 mm	.500 mm	1.00 mm	2.00 mm	4.00 mm	8.00 mm	16.0 mm	32.0 mm	64.0 mm
Snake River near Blackfoot																					
14-Apr-00	1111	7320			62	20	304	1100	1000	0.25	0	0	1	47	64	64	65	65	78	88	100
14-Apr-00	1144	7320			51	20	304	1100	1000	0.25	0	0	2	69	92	92	93	94	99	100	100
14-Apr-00	1224	7380	50	996																	
27-Apr-00	1047	7640	45	928																	
5-May-00	1045	3990	26	280																	
18-May-00	1219	4770	14	180																	
18-May-00	1304	4740			4.9	20	304	1100	1000	0.25	0	0	5	86	98	100	100	100	100	100	100
18-May-00	1340	4720			9	20	304	1100	1000	0.25	0	0	4	74	98	100	100	100	100	100	100
8-Jun-00	915	5760	18	280																	
8-Jun-00	1030	5760			8.1	20	294	1100	1000	0.25	0	0	2	79	99	100	100	100	100	100	100
8-Jun-00	1102	5760			8.5	20	294	1100	1000	0.25	0	0	3	69	98	100	100	100	100	100	100
14-Jun-00	1430	4880	13	171																	
5-Jul-00	1158	3450	15	140																	
19-Jul-00	845	4170	29	327																	
10-Aug-00	1305	2170	4	23																	
10-Aug-00	1340	2260			0.2	20	272	1100	1000	0.25	0	5	23	73	86	95	100	100	100	100	100
10-Aug-00	1415	2250			0.1	20	272	1100	1000	0.25	0	6	18	71	88	100	100	100	100	100	100
23-Aug-00	1547	2110	8	46																	
13-Sep-00	1250	1310	3	11																	
27-Sep-00	1333	2250	9	55																	
5-Apr-01	952	2120	29	166																	
5-Apr-01	1055	2220			1.3	20	270	1100	1000	0.25	6	15	32	91	99	100	100	100	100	100	100
5-Apr-01	1200	2220			2.8	20	270	1100	1000	0.25	2	5	24	84	99	100	100	100	100	100	100
20-Apr-01	1107	1260	19	65																	
4-May-01	732	1370	13	48																	
4-May-01	745	1180			0.2	20	262	1100	1000	0.25	0	0	15	88	96	100	100	100	100	100	100
4-May-01	850	1180			0.1	20	262	1100	1000	0.25	0	0	0	75	94	100	100	100	100	100	100
16-May-01	1408	1590	14	60																	
8-Jun-01	958	1830	11	54																	
8-Jun-01	920	1830			0.8	20	270	1100	1000	0.25	0	1	25	92	97	99	100	100	100	100	100
8-Jun-01	1035	1830			0.9	20	270	1100	1000	0.25	0	1	22	92	99	100	100	100	100	100	100
20-Jun-01	1211	1990	10	54																	
2-Jul-01	1245	1530	15	62																	
2-Jul-01	1300	1530			0.1	20	266	1100	1000	0.25	0	0	0	17	50	83	100	100	100	100	100
2-Jul-01	1330	1530			1.7	20	266	1100	1000	0.25	0	1	2	25	93	100	100	100	100	100	100
16-Jul-01	1308	2160	10	58																	
2-Aug-01	910	1350	5	18																	
10-Aug-01	1210	1160	3	9.4																	
7-Sep-01	1250	3830	27	279																	
20-Sep-01	1652	1880	3	15																	
4-Apr-02	1341	1880			0.07	20	270	1100	1000	0.25	2	10	31	78	89	94	96	100	100	100	100
4-Apr-02	1429	1890			0.21	20	270	1100	1000	0.25	1	2	8	90	96	99	100	100	100	100	100
9-May-02	920	1270			0.02	20	262	1100	1000	0.25	1	3	17	81	96	98	100	100	100	100	100
9-May-02	1022	1290			0.04	20	262	1000	1000	0.25	2	5	26	86	98	100	100	100	100	100	100
6-Jun-02	845	2720			0.54	20	260	1100	1000	0.25	0.2	0.5	15	92	99	100	100	100	100	100	100
6-Jun-02	945	2710			0.41	20	260	1100	1000	0.25	0	0.2	14	97	99	100	100	100	100	100	100
1-Aug-02	840	4320			8.7	20	287	1100	1000	0.25	0.1	0.4	7	73	98	100	100	100	100	100	100
1-Aug-02	915	4340			9.9	20	287	1100	1000	0.25	0	0.1	0.6	28	98	99	100	100	100	100	100

Table C-3. USGS Snake River temperature and monitoring data.

	WY2000						WY2001					
	nr Shelley			nr Blackfoot			nr Shelley			nr Blackfoot		
Date	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
1-Apr												
2-Apr												
3-Apr												
4-Apr												
5-Apr												
6-Apr										10.7	8.7	9.5
7-Apr							9.4	6.8	7.6	9.1	7.9	8.6
8-Apr							9.9	5.4	6.8	8.4	6.7	7.5
9-Apr							11.1	4.7	6.9	9.0	6.0	7.4
10-Apr							10.6	4.7	6.9	9.4	7.1	8.2
11-Apr							9.9	4.4	6.6	8.8	7.1	7.9
12-Apr							6.3	4.3	5.2	8.1	6.5	7.0
13-Apr							6.9	3.7	5.3	7.3	5.3	6.3
14-Apr							10.0	4.3	6.0	8.4	5.7	6.9
15-Apr							11.7	3.8	7.0	9.7	6.5	8.0
16-Apr							13.4	4.9	8.3	10.8	7.6	9.1
17-Apr							15.1	6.2	9.6	12.2	8.7	10.3
18-Apr							16.1	6.9	10.7	13.2	9.9	11.5
19-Apr							14.0	8.5	10.7	12.9	10.5	11.8
20-Apr							12.6	8.6	9.7	12.1	9.7	10.7
21-Apr							14.5	8.5	11.0	11.3	8.7	10.0
22-Apr							15.4	9.2	11.3	13.0	9.9	11.3
23-Apr							13.1	8.6	10.6	12.5	10.5	11.6
24-Apr							16.2	8.6	11.8	14.1	10.5	12.3
25-Apr							17.5	9.4	12.6	15.2	11.8	13.5
26-Apr							16.9	10.9	13.2	15.8	12.7	14.4
27-Apr							15.3	12.5	13.7	15.7	13.6	14.7
28-Apr				12.1	10.2	11.2	14.2	12.0	13.2	15.5	13.6	14.5
29-Apr				11.6	10.0	11.0	12.5	11.1	11.8	14.4	12.4	13.1
30-Apr	10.7	9.6	10.2	12.5	10.2	11.3	11.1	10.5	10.8	12.9	11.9	12.3
Month												
1-May	10.6	9.2	10	12.5	10.2	11.4	10.5	9.5	10.1	12.4	11.0	11.6
2-May	11.6	10.1	10.8	12.7	10.5	11.7	10.8	8.5	9.4	11.3	10.2	10.7
3-May	12.7	10.6	11.5	13.6	11.1	12.3	11.1	7.7	9.1	11.5	9.3	10.3
4-May	12.6	11.6	12.0	13.6	12.4	13.0	12.6	7.7	9.8	12.9	9.9	11.3
5-May	12.1	9.9	11.2	13.5	11.6	12.2	12.2	8.6	10.0	12.5	11.3	12.0
6-May	9.9	8.4	9.1	11.6	10.7	11.0	12.5	9.4	10.8	12.9	10.8	11.8
7-May	8.4	7.8	8.0	10.8	9.4	9.9	12.5	10.0	11.0	13.3	11.0	12.2
8-May	8.5	7.5	8.0	10.2	8.7	9.4	12.5	9.9	11.1	14.2	11.9	13.1
9-May	9.3	8.1	8.6	10.2	9.1	9.7	13.0	10.9	11.6	14.4	12.9	13.6
10-May	9.5	8.7	9.1	10.7	9.3	10	12.8	10.9	11.7	14.1	11.9	13.1
11-May	8.7	7.9	8.1	10.4	8.3	8.9	13.0	10.9	11.9	14.9	12.2	13.5
12-May	8.1	7.2	7.7	9.7	7.9	8.6	14.0	11.7	12.7	15.5	13.0	14.2
13-May	9.0	7.3	8.2	10.2	8.3	9.2	15.1	12.6	13.7	15.7	13.9	14.7
14-May	10.4	8.5	9.5	11.6	9.3	10.2	15.4	13.4	14.1	16.5	14.2	15.2
15-May	11.6	10.3	10.9	12.5	10.2	11.3	14.3	13.1	13.7	15.8	14.2	14.8
16-May	11.5	10.9	11.1	12.4	11.3	11.8	13.9	12.3	13.0	15.2	13.5	14.3
17-May	10.9	10.3	10.6	11.9	10.8	11.4	12.6	11.9	12.2	14.9	13.2	14.0
18-May	11.0	9.8	10.3	12.7	10.8	11.6	13.0	12.2	12.6	14.7	13.6	14.2
19-May	12.0	10.1	11.0	12.7	11.3	12.0	13.3	12.3	12.8	14.7	13.5	14.2
20-May	13.4	11.6	12.2	13.6	11.6	12.5	13.6	12	12.8	14.1	13.0	13.5
21-May	13.5	12.0	12.7	14.5	12.5	13.4	13.7	11.9	12.5	14.6	12.1	13.3
22-May	13.7	12.9	13.2	14.5	13.3	14.0	13.7	11.6	12.4	15.8	12.9	14.2
23-May	14.1	12.9	13.5	15.3	13.5	14.3	15.3	12.3	13.6	16.8	13.9	15.3
24-May	14.7	13.4	14.0	15.6	14.2	14.9	17.2	13.6	15.2	17.7	14.6	16.0
25-May	14.9	14.1	14.3	15.5	14.5	15.0	17.7	14.8	15.9	18.2	15.8	17.1
26-May	14.6	13.7	14.0	15.6	14.4	15.0	16.9	15.1	15.7	18.0	16.5	17.3
27-May	14.0	13.2	13.7	15.6	13.9	14.8	16.4	14.8	15.4	18.0	16.1	17.1
28-May	13.7	12.6	13.0	15.5	14.1	14.9	15.8	14.7	15.1	17.7	16.0	16.9
29-May	13.2	12.0	12.7	15.2	13.6	14.4	15.1	13.9	14.6	17.1	15.2	16.1
30-May	13.5	11.8	12.8	14.9	13.1	14.1	14.2	13.3	13.7	16.0	13.8	14.9
31-May	13.2	11.8	12.3	14.5	12.8	13.6	15.3	13.3	14.2	17.2	14.2	15.7
Month	14.9	7.2	11.1	15.6	7.9	12.1	17.7	7.7	12.7	18.2	9.3	14.1

Table C-3. Continued.

	WY2000						WY2001					
	nr Shelley			nr Blackfoot			nr Shelley			nr Blackfoot		
Date	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
1-Jun	12.7	11.2	12.0	14.2	12.1	13.1	16.2	14.0	15.1	18.9	15.0	16.8
2-Jun	13.2	11.5	12.4	14.9	12.7	13.8	16.4	15.0	15.5	17.7	16.0	16.7
3-Jun	14.1	12.6	13.4	15.5	13.1	14.3	15.0	13.1	14.2	16.3	13.9	14.9
4-Jun	14.6	13.0	13.9	16.4	13.9	15.1	13.1	10.5	11.7	13.9	12.2	12.8
5-Jun	14.6	13.4	14.1	16.4	14.4	15.5	10.9	10.2	10.5	12.9	11.3	12.1
6-Jun	15.1	13.8	14.5	16.8	14.5	15.6	12.0	10.5	11.3	14.4	11.6	13.0
7-Jun	15.7	14.1	15.0	17.2	15	16.1	14.2	12.0	13.1	16.1	13.0	14.5
8-Jun	15.5	14.6	15.1	16.9	15.3	16.2	16.1	13.7	14.9	17.7	14.6	16.0
9-Jun	14.9	13.5	14.0	16.6	14.5	15.3	17.3	15.1	16.1	18.4	15.8	17.0
10-Jun	13.5	12.6	13.0	15.2	13.8	14.4	17.3	15.4	16.3	19.2	15.8	17.5
11-Jun	13.0	12.1	12.7	15.0	13.5	14.3	17.0	15.4	16.0	18.5	16.1	17.4
12-Jun	12.9	12.4	12.6	15.0	13.5	13.9	15.6	13.4	14.8	17.4	14.1	15.8
13-Jun	13.0	12.1	12.5	14.9	12.7	13.6	13.4	11.4	12.6	14.1	12.4	12.8
14-Jun	14.4	12.3	13.2	15.3	13.3	14.3	11.4	10.5	10.9	14.7	11.6	13.1
15-Jun	15.4	14.0	14.6	15.3	14.2	14.9	13.1	10.8	12.0	14.7	12.7	13.7
16-Jun	14.9	14.1	14.5	16.1	14.2	15.1	15.0	13.1	14.2	16.3	13.0	14.5
17-Jun	14.6	13.7	14.1	16.3	14.5	15.5	16.1	15.0	15.5	16.6	15.2	16.0
18-Jun	14.9	13.5	14.2	16.6	14.7	15.6	16.2	15.0	15.4	16.8	14.9	16.0
19-Jun	14.9	14.3	14.5	16.4	15.0	15.7	16.4	14.7	15.5	17.4	15.0	16.2
20-Jun	15.1	13.7	14.1	16.1	14.5	15.4	17.2	15.0	16.1	18.9	15.8	17.2
21-Jun	14.6	13.4	14.0	16.6	14.9	15.7	18.0	15.8	16.9	19.8	16.6	18.1
22-Jun	16.2	14.6	15.4	17.4	15.2	16.2	18.6	17.0	17.7	20.6	17.4	18.9
23-Jun	17.0	15.9	16.4	18.2	16.4	17.2	19.6	17.5	18.4	21.1	18.4	19.7
24-Jun	17.8	16.2	16.7				19.8	17.8	18.6	21.5	18.5	20.0
25-Jun	18.2	16.2	17.0				18.6	17.2	17.9	20.5	17.7	19.2
26-Jun	17.8	16.3	16.9				17.7	16.5	17.2	19.5	17.4	18.1
27-Jun	18.1	16.0	16.8				18.3	16.2	17.2	20.6	16.8	18.5
28-Jun	17.8	15.9	16.6				19.6	16.5	17.9	21.3	18.0	19.6
29-Jun	18.1	16.0	16.8				20.4	17.7	18.9	22.1	18.4	20.2
30-Jun	17.8	16.3	16.8				20.9	18.5	19.6	22.8	19.0	20.8
Month	18.2	11.2	14.6				20.9	10.2	15.4	22.8	11.3	16.6
1-Jul	17.4	16.5	16.8	20.0	17.5	18.6	20.9	18.6	19.5	22.8	19.5	21.2
2-Jul	17.9	16.0	16.8	19.7	17.5	18.6	21.4	18.5	19.7	23.1	19.5	21.2
3-Jul	16.6	16.2	16.4	19.2	17.5	18.3	21.4	18.9	20.0	23.5	19.7	21.5
4-Jul	16.5	15.5	16.0	18.0	16.0	16.9	21.6	19.4	20.3	23.3	20.6	21.9
5-Jul	16.5	15.4	15.9	18.5	16.1	17.3	21.6	19.8	20.3	23.1	20.8	21.8
6-Jul	16.8	15.2	15.9	18.4	16.4	17.4	21.1	19.3	20.0	22.6	20.3	21.3
7-Jul	17.3	16.2	16.7	18.8	17.1	17.9	19.9	19.3	19.6	21.3	19.7	20.2
8-Jul	17.6	16.6	17.1	19.2	17.4	18.4	20.2	18.9	19.4	21.6	19.0	20.2
9-Jul	17.8	16.8	17.3	19.0	17.9	18.5	19.8	18.8	19.2	20.6	19.5	20.1
10-Jul	17.3	16.5	16.9	19.0	17.5	17.9	20.4	19.1	19.6	21.8	19.2	20.4
11-Jul	17.0	15.9	16.5	19.0	16.8	17.8	20.7	19.1	19.8	21.6	19.8	20.7
12-Jul	17.8	16.0	16.9	19.5	17.5	18.6	21.4	19.4	20.1	21.8	19.3	20.5
13-Jul	18.6	17.6	18.0	19.7	17.7	18.8	21.4	19.6	20.1	21.3	19.8	20.6
14-Jul	18.6	17.8	18.0	19.7	18.5	19.0	21.2	19.1	19.8	21.3	19.3	20.3
15-Jul	18.4	17.4	17.8	19.3	18.0	18.7	21.2	18.6	19.3	21.0	19.2	19.9
16-Jul	18.6	17.3	17.9	19.7	18.4	19.0	20.1	18.1	18.9	21.1	18.2	19.5
17-Jul	19.2	18.2	18.5	19.7	18.7	19.1	19.9	18.1	18.8	20.0	18.9	19.4
18-Jul	18.6	17.8	18.2	19.3	17.9	18.6	20.4	18.0	18.9	20.5	18.2	19.2
19-Jul	17.8	17.0	17.4	19.5	18.0	18.8	20.6	18.0	19.1	21.1	18.4	19.7
20-Jul	18.2	16.6	17.4	19.3	17.7	18.5	21.4	18.3	19.5	21.6	18.9	20.1
21-Jul	19.1	17.4	18.2	19.5	17.7	18.6	21.9	18.3	19.8	21.3	18.7	20.0
22-Jul	20.3	17.6	18.8				22.2	18.5	20.0	21.5	18.5	20.0
23-Jul	20.8	18.1	19.1				22.6	18.5	20.1	22.1	18.5	20.3
24-Jul	20.5	18.1	19.0				22.7	18.5	20.3	22.1	19.0	20.5
25-Jul	21.0	17.6	19.0				23.4	18.5	20.4	22.1	18.9	20.4
26-Jul	20.5	17.9	18.6				22.6	18.5	20.1	22	18.9	20.4
27-Jul	20.2	17.6	18.4				22.4	18.3	20.0	22.1	18.4	20.2
28-Jul	20.2	17.1	18.5				21.7	18.5	19.7	21.6	19.0	20.3
29-Jul	21.0	18.2	19.3	22.8	18.8	20.7	21.2	18.1	19.5	21.0	18.0	19.5
30-Jul	21.3	18.6	19.7	23.0	19.0	20.9	21.2	17.7	19.1	21.0	18.0	19.5
31-Jul	21.3	18.9	20.0	23.1	19.8	21.3	20.6	17.2	18.5	19.8	17.4	18.6
Month	21.3	15.2	17.8				23.4	17.2	19.7	23.5	17.4	20.3

Table C-3. Continued.

	WY2000						WY2001					
	nr Shelley			nr Blackfoot			nr Shelley			nr Blackfoot		
Date	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
1-Aug	21.1	19.4	20.2	23.1	20.0	21.4	21.4	16.7	18.7	21.0	17.1	19.0
2-Aug	21.5	19.4	20.1	23.1	19.8	21.3	22.1	17.5	19.5	22.0	18.2	20.0
3-Aug	20.8	19.1	19.7	22.8	19.8	20.8	20.7	18.1	19.5	20.8	18.9	19.8
4-Aug	20.7	18.7	19.4	22.8	19.5	20.9	22.7	18.8	20.4	22.1	18.7	20.3
5-Aug	20.2	18.4	19.0	21.5	19.3	20.4	22.7	18.8	20.4	22.3	19.2	20.7
6-Aug	20.3	18.1	19.0	20.5	18.8	19.7	23.4	18.9	20.8	22.6	19.5	21.0
7-Aug	20.3	18.4	19.1	20.8	18.7	19.7	23.6	19.9	21.3	22.3	20.2	21.2
8-Aug	20.2	18.4	19.1	20.5	18.7	19.6	24.3	19.9	21.7	23.0	19.8	21.4
9-Aug	21.3	18.7	19.5	21.0	19.2	20.0	22.7	20.1	21.0	22.1	20.3	20.9
10-Aug	21.8	19.1	19.9	22.0	19.5	20.5	23.2	19.3	20.8	21.8	19.0	20.4
11-Aug	21.5	18.1	19.5	21.6	17.2	19.8	22.6	19.1	20.5	21.6	19.3	20.4
12-Aug	21.7	17.3	19.0	22.0	15.8	19.1	22.7	18.6	20.3	21.6	19.2	20.4
13-Aug	21.5	17.4	19.0	21.8	17.5	19.7	22.6	19.3	20.4	22.0	19.3	20.5
14-Aug	21.5	17.1	18.9	22.3	17.1	19.6	23.6	19.1	21.0	22.1	19.3	20.7
15-Aug	20.7	17.4	18.8	21.0	17.4	19.4	22.7	19.4	20.8	21.5	19.7	20.5
16-Aug	21.7	17.3	18.9	22.0	16.4	19.3	22.7	18.6	20.4	21.8	18.9	20.3
17-Aug	21.8	17.1	18.7	21.1	17.1	19.2	22.9	18.8	20.5	22.1	19.3	20.6
18-Aug	20.7	17.6	18.6	21.6	17.2	19.4	22.2	18.9	20.2	21.5	19.5	20.5
19-Aug	20.5	17.4	18.6	20.6	17.5	19.0	21.4	18.8	19.6	20.6	18.5	19.6
20-Aug	19.2	16.8	17.7	19.5	17.2	18.3	20.1	17.8	18.8	20.0	18.2	19.1
21-Aug	19.2	16.5	17.5	18.8	16.6	17.8	21.1	17.2	18.7	19.8	17.7	18.9
22-Aug	19.9	16.2	17.8	19.8	16.9	18.2	22.1	17.3	19.3	20.3	17.4	18.9
23-Aug	21.2	17.4	18.4	19.3	17.4	18.3	21.2	17.8	19.3	20.3	18.4	19.3
24-Aug	21	17.8	19.0	21.1	17.5	19.1	22.1	17.8	19.5	20.2	18.0	19.1
25-Aug	21.8	18.1	19.6	21.1	18.4	19.7	22.2	17.3	19.4	20.5	17.7	19.0
26-Aug	21.5	18.7	19.7	21.0	18.5	19.7	22.7	17.2	19.5	21.0	18.0	19.4
27-Aug	21.2	18.1	19.2	20.8	18.0	19.4	22.2	17.7	19.5	20.6	18.4	19.5
28-Aug	20.3	17.1	18.4	20.1	17.9	18.9	22.4	18.0	19.8	20.5	18.2	19.3
29-Aug	20.7	16.3	18.0	20.1	16.9	18.6	22.7	17.8	19.9	20.6	18.2	19.4
30-Aug	19.1	17.1	17.6	19.0	17.4	18.0	21.6	17.8	19.5	20.0	18.7	19.4
31-Aug	19.2	16.3	17.3	18.2	16.1	17.2	21.9	18.3	19.6	20.3	18.2	19.2
Month	21.8	16.2	18.9	23.1	15.8	19.4	24.3	16.7	20.0	23.0	17.1	20.0
1-Sep	18.1	15.9	16.7	18.4	16.3	17.0	21.2	18.3	19.3	20.3	18.7	19.5
2-Sep	18.1	15.4	16.1	16.4	15.5	15.9	20.9	17.8	19.1	19.8	18.4	19.1
3-Sep	17.8	14.7	15.9	16.8	14.9	15.7	20.6	18.0	19.0	19.8	18.2	19.0
4-Sep	17.9	15.1	16.2	17.4	15.6	16.4	20.6	18.0	19.0	19.7	18.4	19.0
5-Sep	18.6	15.1	16.4	16.9	15.6	16.3	20.2	18.1	19.0	19.5	18.7	19.1
6-Sep	17.0	14.9	15.6	16.3	15.0	15.7	18.1	16.1	17.0	19.2	16.1	17.1
7-Sep	17.3	14.1	15.4	16.6	14.5	15.5	16.5	14.5	15.5	16.3	15.3	15.9
8-Sep	17.9	14.1	15.5	16.6	15.0	15.8	15.8	13.9	14.6	15.5	14.1	14.8
9-Sep	17.0	12.9	14.5	15.8	14.2	15.0	16.4	13.4	14.7	15.5	14.1	14.8
10-Sep				15.6	13.5	14.6	17.0	13.6	15.0	16.1	14.4	15.2
11-Sep				16.3	13.9	15.1	17.8	14.2	15.7	16.8	14.6	15.6
12-Sep				16.9	14.4	15.6	17.2	15.3	16.0	16.5	15.5	15.9
13-Sep				18.2	14.5	16.4	17.8	15.6	16.4	16.9	15.5	16.1
14-Sep				18.7	15.0	17.0	18.0	15.4	16.4	17.4	15.3	16.2
15-Sep	20.5	15.7	17.7	19.0	15.8	17.5	18.6	15.6	16.8	17.7	16.0	16.8
16-Sep	20.8	15.9	17.8	18.8	16.3	17.7	18.5	15.9	16.9	17.6	16.0	16.8
17-Sep	20.8	16.6	18.0	19.5	16.9	18.1	18.8	16.1	17.0	17.7	15.8	16.7
18-Sep	19.1	16.2	17.3	18.0	16.6	17.4	18.5	15.8	16.8	17.7	15.8	16.8
19-Sep	18.1	15.5	16.7	17.2	15.8	16.5	18.0	15.8	16.6	17.4	15.7	16.5
20-Sep	17.4	14.3	15.5	16.1	14.2	15.3	17.5	15.1	16.0	16.8	15.0	15.9
21-Sep	14.7	12.9	14.1	15.5	14.2	14.8	17.3	14.5	15.7	16.9	14.9	15.8
22-Sep	12.9	10.9	12.0	14.2	11.4	12.5	17.7	14.5	15.8	16.6	14.9	15.8
23-Sep	11.5	9.8	10.6	11.4	10.4	10.8	17.8	14.5	15.9	16.6	14.9	15.8
24-Sep	12.1	9.2	10.4	11.9	10.2	11.0	18.0	14.8	16.2	16.6	15.2	15.9
25-Sep	12.7	9.6	10.9	12.2	10.5	11.3	17.3	15.1	16.1	16.6	15.3	16.0
26-Sep	13.7	10.4	11.8	12.7	11.0	11.8	17.3	14.8	16.0	16.5	14.9	15.7
27-Sep	14.9	10.9	12.6	13.5	11.4	12.4	17.3	14.7	15.8	16.6	14.9	15.8
28-Sep	15.5	11.5	13.1	14.1	12.1	13.0	16.7	15.0	15.7	16.1	15.2	15.7
29-Sep	16.2	12.3	13.6	14.4	12.8	13.6	17.2	15.1	16	16.5	14.9	15.6
30-Sep	15.7	12.4	13.5	13.8	12.7	13.1	17.3	14.7	15.8	16.5	14.7	15.6
Month				19.5	10.2	15	21.2	13.4	16.5	20.3	14.1	16.5

Table C-4. City of Blackfoot sampling on Snake River at Blackfoot, May 2001 to September 2003 (from Discharge Monitoring Reports).

Date	Flow (cfs)	Total ortho-phosphate as P (mg/L)[1]	Total phosphorus (mg/L)[1]	Ammonia (mg/L)[1]	Nitrate+ nitrite (mg/L)[1]	Total Kjeldahl nitrogen (mg/L)[1]	Turbidity (NTU)[1]	TSS (mg/L)[1]
May-01	1470	<0.05	<0.05	0.06	0.09	0.5	6.78	13
Jun-01								
Jul-01	2910	<0.05	<0.05	<0.04	0.1	0.3	4.77	16
Aug-01								
Sep-01								
Oct-01	2370	<0.05	<0.05	<0.04	<0.04	<0.1	1.4	5
Nov-01								
Dec-01								
Jan-02								
Feb-02								
Mar-02								
Apr-02	1860	<0.05	0.09	<0.04	0.15	0.48	5.3	13
May-02								
Jun-02	2819	0.05	0.05	<0.04	0.02	0.32	6.87	10.5
Jul-02								
Aug-02								
Sep-02								
Oct-02								
Nov-02	2170	<0.05	0.05	<0.04	0.1	0.15	1.12	2
Dec-02								
Jan-03								
Feb-03								
Mar-03	1800	0.05	0.05	0.04	0.18	0.23	4.61	9
Apr-03	1500	0.05	0.05	0.04	0.02	0.21	1.27	2
May-03								
Jun-03								
Jul-03								
Aug-03	4610	<0.05	<0.05	<0.04	<0.02	0.35	4.37	9
Sep-03	2530	<0.05	<0.05	<0.04	<0.02	0.24	1.73	28

[1]TSS=total suspended solids; grab sample

Table C-5. Nutrient and sediment data from USGS sampling at Snake River near Blackfoot surface-water station (13069500).

Date	Flow (cfs)	Ammonia, filtered, (mg/L as N)		Nitrite, filtered, (mg/L as N)	Ammonia +organic nitrogen, unfiltered, (mg/L as N)	Ammonia +organic nitrogen 1/2 mdl	Nitrite+ nitrate, filtered, (mg/L as N)		Nitrite+ nitrate 1/2 mdl	Total nitrogen (mg/L)	Phosphorus, unfiltered, (mg/L)	Phosphorus 1/2 mdl	Ortho-phosphate, filtered, (mg/L as P)	Suspended sediment (mg/L)	Suspended sediment > 0.0625 mm sieve dia. (mg/L)	Suspended sediment < 0.0625 mm sieve dia. (mg/L)	Suspended sediment, sieve dia. percent < 0.0625 mm
10/22/1987	2,110						<0.1		0.05								
7/13/1988	2,570						0.12		0.12								
7/17/1989	2,970	0.018	U1		0.32	0.32	0.153	U2	0.153	0.47	<0.05	0.025	<0.001	23			73
8/14/1989	2,180	0.028	U1		0.32	0.32	0.077	U2	0.077	0.40	<0.05	0.025	0.004	11			77
9/19/1989	2,730	0.024	U1		0.29	0.29	0.067	U2	0.067	0.36	<0.05	0.025	<0.001	14			99
11/21/1989	2,400	0.02	U1		0.6	0.6	0.12		0.12	0.72	0.02	0.02	0.01	5			
1/26/1990	2,200	0.02	U1		0.4	0.4	0.37		0.37	0.77	0.04	0.04	0.02				
3/16/1990	2,010	0.01	U1		0.4	0.4	0.3		0.3	0.70	0.05	0.05	0.02	12			
5/8/1990	1,230	<0.01	U1		<0.2	0.1	0.1		0.1	0.20	0.04	0.04	<0.01	15			
7/23/1990	3,790	0.02	U1		0.3	0.3	<0.1		0.05	0.35	0.03	0.03	<0.01				
9/12/1990	2,980	0.02	U1		0.4	0.4	<0.1		0.05	0.45	<0.01	0.005	<0.01	13			
11/19/1991	3,000	0.01		0.01	<0.2	0.1	0.11		0.11	0.21	0.02	0.02	<0.01	8			
1/14/1992	1,740	0.02		<0.01	<0.2	0.1	0.32		0.32	0.42	0.06	0.06	0.01				
3/19/1992	1,650	0.01		<0.01	0.3	0.3	0.23		0.23	0.53	0.11	0.11	0.03	14			
5/13/1992	2,960	0.02		<0.01	<0.2	0.1	0.054		0.054	0.15	0.04	0.04	<0.01	20			
7/30/1992	1,300	0.03		<0.01	<0.2	0.1	0.094		0.094	0.19	<0.01	0.005	<0.01	3			
9/22/1992	1,560	<0.01		<0.01	<0.2	0.1	0.067		0.067	0.17	0.03	0.03	0.02	4			
4/12/1993	2,410	0.02		<0.01	0.5	0.5	0.27		0.27	0.77	0.04	0.04	0.03	14	4	10	71
4/26/1993	2,530	0.02		<0.01	0.2	0.2	0.13		0.13	0.33	0.02	0.02	0.01	14	2	12	82
5/10/1993	6,650	0.04		<0.01	0.4	0.4	0.28		0.28	0.68	0.11	0.11	0.03	59	11	48	81
5/24/1993	8,800	0.02		<0.01	<0.2	0.1	0.13		0.13	0.23	0.04	0.04	0.02	55	10	45	81
6/7/1993	17,100	0.04		<0.01	<0.2	0.1	0.19		0.19	0.29	0.02	0.02	0.01	75	19	56	74
6/21/1993	9,100	0.03		<0.01	<0.2	0.1	0.084		0.084	0.18	0.01	0.01	<0.01	26	11	15	57
7/12/1993	1,500	0.03		<0.01	0.2	0.2	0.088		0.088	0.29	0.03	0.03	<0.01	8	4	4	56
8/9/1993	2,840	0.02		<0.01	<0.2	0.1	0.11		0.11	0.21	0.02	0.02	<0.01	13	4	9	68
9/13/1993	1,690	0.03		<0.01	<0.2	0.1	0.45		0.45	0.55	0.01	0.01	<0.01	2	<1	2	88
10/18/1993	2,320	0.01		<0.01	<0.2	0.1	0.082		0.082	0.18	<0.01	0.005	<0.01	11			77
11/15/1993	2,810	<0.01		<0.01	<0.2	0.1	0.18		0.18	0.28	<0.01	0.005	<0.01	5			66
12/13/1993	3,340	0.01		<0.01	<0.2	0.1	0.32		0.32	0.42	<0.01	0.005	<0.01	16			70
1/10/1994	3,500	0.02		<0.01	<0.2	0.1	0.36		0.36	0.46	0.03	0.03	<0.01	14			56
2/10/1994	2,810	0.02		0.02	<0.2	0.1	0.38		0.38	0.48	0.03	0.03	0.01	13			72
3/14/1994	2,500	0.03		0.01	<0.2	0.1	0.25		0.25	0.35	0.02	0.02	0.02	13			82
4/11/1994	3,790	0.03		<0.01	<0.2	0.1	0.27		0.27	0.37	0.02	0.02	<0.01	14			69
5/26/1994	1,290	0.02		0.01	0.2	0.2	0.09		0.09	0.29	0.02	0.02	<0.01	5			89
6/17/1994	1,610	0.03		<0.01	<0.2	0.1	0.1		0.1	0.20	<0.01	0.005	0.02	4			76
6/24/1994	1,460	0.02		<0.01	0.2	0.2	0.065		0.065	0.27	<0.01	0.005	<0.01	6			71
7/18/1994	2,860	0.01		<0.01	0.3	0.3	0.051		0.051	0.35	0.04	0.04	<0.01	16			88
8/15/1994	5,760	0.02		<0.01	<0.2	0.1	<0.05		0.025	0.13	<0.01	0.005	<0.01	6			83
9/14/1994	892	0.02		<0.01	<0.2	0.1	0.13		0.13	0.23	0.01	0.01	<0.01	2			100
10/7/1994	3,220	<0.01		<0.01	<0.2	0.1	0.19		0.19	0.29	0.01	0.01	<0.01	3			48
11/7/1994	2,430	<0.01		0.01	<0.2	0.1	0.25		0.25	0.35	<0.01	0.005	<0.01	5			76
12/12/1994	2,070	<0.01		0.01	<0.2	0.1	0.35		0.35	0.45	0.02	0.02	0.02	9			86
1/17/1995	2,260	0.02		0.01	<0.2	0.1	0.36		0.36	0.46	0.03	0.03	0.01	9			71
2/21/1995	2,130	<0.01		<0.01	<0.2	0.1	0.27		0.27	0.37	<0.01	0.005	<0.01	13			89
3/21/1995	3,020	<0.01		<0.01	0.3	0.3	0.31		0.31	0.61	0.05	0.05	0.01	29			76
4/18/1995	2,710	<0.01		0.01	<0.2	0.1	0.14		0.14	0.24	<0.01	0.005	<0.01	15			94
5/10/1995	5,840	0.04		<0.01	0.5	0.5	0.2		0.2	0.70	0.07	0.07	0.02	33			92
6/1/1995	14,300	0.02		<0.01	<0.2	0.1	0.12		0.12	0.22	<0.01	0.005	0.01	35			78
6/9/1995	19,300	0.03		<0.01	<0.2	0.1	0.12		0.12	0.22	<0.01	0.005	0.01	94			67
7/6/1995	8,490	<0.01		<0.01	0.2	0.2	<0.05		0.025	0.23	<0.01	0.005	<0.01	17			78
9/5/1995	1,250	<0.01		<0.01	0.2	0.2	0.14		0.14	0.34	0.02	0.02	<0.01	4			78
10/26/1995	2,930	<0.01		0.01	0.2	0.2	0.13		0.13	0.33	0.01	0.01	<0.01	19			58
4/25/1996	13,000	<0.01		<0.01	0.2	0.2	0.18		0.18	0.38	0.05	0.05	<0.01	36			
5/29/1996	18,700	0.03		<0.01	0.3	0.3	0.15		0.15	0.45	0.07	0.07	0.01	84			
6/21/1996	16,500	0.03		<0.01	0.2	0.2	0.09		0.09	0.29	0.04	0.04	0.02	50			
7/18/1996	5,210	0.03		<0.01	<0.2	0.1	0.24		0.24	0.34	0.02	0.02	0.01	32			
8/22/1996	1,780	<0.01		<0.01	<0.2	0.1	0.26		0.26	0.36	<0.01	0.005	<0.01	8			
9/19/1996	4,900	<0.01		<0.01	<0.2	0.1	0.28		0.28	0.38	0.01	0.01	<0.01	16			
4/21/1998	8,460	0.04		<0.01	0.17	0.17	0.59		0.59	0.76	0.03	0.03	0.01	24			100
5/19/1998	17,300	0.05		0.014	0.34	0.34	0.06		0.06	0.40	0.04	0.04	0.02	64			
6/23/1998	12,500	<0.02		0.01	0.23	0.23	0.07		0.07	0.30	0.03	0.03	<0.01	26			100
7/23/1998	3,000	<0.02		<0.01	0.23	0.23	0.08		0.08	0.31	<0.01	0.005	<0.01	14			100
8/31/1998	2,530	<0.02		<0.01	0.19	0.19	0.06		0.06	0.25	<0.01	0.005	<0.01	9			100
10/20/1998	4,200	<0.02		<0.01	0.16	0.16	0.09		0.09	0.25	<0.05	0.025	<0.01	7			

<=actual value is known to be less than the value shown

U1=unfiltered samples, paired t-test for 6 filtered and unfiltered samples taken from Nov 1991 to Sep 1992 showed no significant differences (t-stat=1.94, one-tail *p* value = 0.055, two-tail p value = 0.11)

U2=unfiltered samples, paired t-test for 12 filtered and unfiltered samples taken from Nov 1989 to Sep 1992 showed no significant differences (t-stat=-0.48, one-tail *p* value = 0.32, two-tail p value = 0.64)

Table C-6. Nutrient and sediment data from USGS sampling at Snake River near Shelley surface-water station (13060000).

Date	Flow (cfs)	Ammonia, filtered, (mg/L as N)	Nitrite, filtered, (mg/L as N)	Ammonia +organic nitrogen, unfiltered, (mg/L as N)	Ammonia +organic nitrogen 1/2 mdl	Nitrite+ nitrate, filtered, (mg/L as N)	Nitrite+ nitrate 1/2 mdl	Total nitrogen (mg/L)	Phosphorus, unfiltered, (mg/L)	Phosphorus 1/2 mdl	Ortho-phosphate, filtered, (mg/L as P)	Suspended sediment (mg/L)	Suspended sediment, percent < 0.0625 mm
11/16/1990	2,830	0.04	<0.01	0.3	0.3	0.2	0.200	0.5	<0.01	0.005	0.02	3	
1/16/1991	2,920	0.16	<0.01	0.2	0.2	0.3	0.300	0.5	0.04	0.040	0.04		
3/12/1991	2,800	0.12	0.01	0.2	0.2	0.32	0.320	0.52	0.03	0.030	0.04	10	
5/15/1991	6,310	0.08	<0.01	0.6	0.6	0.21	0.210	0.81	0.06	0.060	<0.01	14	
7/10/1991	4,830	0.05	0.01	0.4	0.4	<0.05	0.025	0.45	0.03	0.030	0.02	5	
9/20/1991	3,470	0.03	0.01	0.7	0.7	0.065	0.065	0.765	0.02	0.020	<0.01	3	
11/17/1992	2,450	0.05	0.01	0.3	0.3	0.24	0.240	0.54	0.04	0.040	0.02	8	
1/19/1993	2,780	0.11	0.02	0.2	0.2	0.36	0.360	0.56	0.04	0.040	0.03		
3/22/1993	2,650	0.1	<0.01	0.2	0.2	0.39	0.390	0.59	0.04	0.040	0.04	11	
5/18/1993	11,600	0.04	<0.01	0.3	0.3	0.11	0.110	0.41	0.04	0.040	0.02	32	
7/21/1993	5,660	0.04	<0.01	0.3	0.3	0.18	0.180	0.48	0.02	0.020	<0.01		
9/29/1993	2,990	0.04	<0.01	0.2	0.2	0.22	0.220	0.42	0.02	0.020	0.02	3	
5/25/1994	4,660	0.03	0.01	<0.2	0.1	0.15	0.150	0.35	0.02	0.020	0.01	5	90
11/21/1994	2,670	0.02	<0.01	<0.2	0.1	0.26	0.260	0.46	<0.01	0.005	<0.01		
1/19/1995	2,820	0.04	<0.01	0.2	0.2	0.33	0.330	0.53	0.05	0.050	0.02		
3/27/1995	2,860	0.03	<0.01	0.2	0.2	0.35	0.350	0.55	0.02	0.020	0.02	4	97
5/19/1995	15,800	0.02	<0.01	0.3	0.3	0.11	0.110	0.41	0.04	0.040	<0.01	41	92
7/17/1995	13,300	0.03	<0.01	0.2	0.2	0.12	0.120	0.32	0.02	0.020	0.02		
9/21/1995	3,500	<0.01	0.01	2.8	2.8	0.1	0.100	2.9	0.01	0.010	<0.01	2	89

<=actual value is known to be less than the value shown

Appendix D: Point Source Information

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Table D-1. Flow and total suspended solids data from Shelley and Firth wastewater treatment plants (WWTP), January 2000 to September 2003 (from Discharge Monitoring Reports).

Date	Firth WWTP		Shelley WWTP	
	Flow (cfs)	TSS (mg/L)[1]	Flow (cfs)	TSS (mg/L)[1]
Jan-00	0.15	15.0	0.59	40.5
Feb-00	0.11	67.0	0.59	40.0
Mar-00	0.14	56.0	0.53	59.0
Apr-00	0.11	57.0	0.40	41.0
May-00	0.09	65.0	0.39	47.0
Jun-00	0.18	35.0	0.28	33.0
Jul-00	0.50	43.0	0.34	35.5
Aug-00	0.79	14.0	0.31	86.5
Sep-00	0.64	9.0	0.45	91.0
Oct-00	0.39	0.0	0.56	44.0
Nov-00	0.14	27.0	0.60	5.5
Dec-00	0.14	26.0	0.59	12.5
Jan-01	0.20	31.0	0.62	20.5
Feb-01	0.18	40.0	0.67	17.5
Mar-01	0.17	47.0	0.65	10.5
Apr-01	0.15	26.0	0.46	22.5
May-01	0.12	24.0	0.36	39.5
Jun-01	0.14	4.0	0.34	22.0
Jul-01	0.29	29.0	0.32	38.0
Aug-01	0.29	16.0	0.29	6.5
Sep-01	0.30	15.0	0.42	29.0
Oct-01	0.13	1.0	0.40	28.0
Nov-01	0.06	4.0	0.56	2.5
Dec-01	0.07	11.0	0.57	14.0
Jan-02	0.09	51.0	0.59	17.5
Feb-02	0.09	20.0	0.59	12.5
Mar-02	0.08	8.0	0.65	17.0
Apr-02	0.00	0.0	0.59	24.0
May-02	0.14	31.0	0.40	231.0
Jun-02	0.17	8.0	0.34	29.0
Jul-02	0.00	0.0	0.20	63.0
Aug-02	0.27	16.0	0.32	123.0
Sep-02	0.29	15.0	0.48	63.0
Oct-02	0.20	3.0	0.46	29.0
Nov-02	0.12	30.0	0.53	15.0
Dec-02	0.00	0.0	0.54	26.0
Jan-03	0.00	0.0	0.59	50.0
Feb-03	0.13	36.0	0.51	60.0
Mar-03	0.11	24.0	0.48	50.0
Apr-03	0.14	26.0	0.46	55.0
May-03	0.17	13.0	0.42	81.0
Jun-03	0.11	45.0		
Jul-03	0.00	0.0		
Aug-03	0.34	19.0		
Sep-03	0.16	4.0		

[1]TSS=total suspended solids; once/month grab sample

Table D-2. DEQ sampling at Firth and Shelley wastewater treatment plants (WWTP), November 2002 to July 2003.

Date	Dissolved ortho-phosphorus as P (mg/L)	Total phosphorus as P (mg/L)	Total ammonia as N (mg/L)	Total Kjeldahl nitrogen as N (mg/L)	Total NO_2+NO_3 as N (mg/L)	Total suspended solids - 105°C (mg/L)	Turbidity (NTU)
Firth WWTP							
14-Nov-02	1.92	2.24	13.6	15.6	0.036	16	
4-Dec-02							
15-Jan-03							
12-Feb-03	1.89	2.62	15.2	18	0.063	27	
18-Mar-03							
16-Apr-03	2.07	2.66	14.5	19.8	0.062	21	
7-May-03	1.28	2.43	7.46	14.5	0.325	45	
29-May-03	1.89	2.63	11	18.3	0.017	30	21.7
19-Jun-03	2.4	3.91	13.4	13.9	0.027	48	29
Shelley WWTP							
14-Nov-02	1.51	1.96	12.5	15.6	0.213	17	
4-Dec-02	1.28	1.91	11.8	15.3	0.49	21	
15-Jan-03	1.8	2.48	10.2	16.9	0.776	39	
12-Feb-03	1.76	2.61	9.25	16.1	1.19	49	
18-Mar-03	1.58	2.63	5.91	13.7	1.6	60	
16-Apr-03	2.45	3.01	6.64	12.8	0.521	23	
7-May-03	1.18	2.61	2.5	13.4	0.849	82	
29-May-03	0.143	0.872	0.026	7.28	0.027	44	27
19-Jun-03	1.07	3.38	1.81	19.2	0.058	90	35.2
2-Jul-03	1.85	5.72	4.05	21.8	0.073	91	
30-Jul-03	1.11	2.98	2.36	11.2	0.222	31	

Table D-3. Water quality data from Blackfoot Wastewater Treatment Plant, January 2000 to September 2003 (from Discharge Monitoring Reports).

Date	Flow (cfs)	Nitrate+ nitrite (mg/L)[1]	Total Kjeldahl nitrogen (mg/L)[1]	Total phosphorus (mg/L)[1]	Total ortho-phosphate as P (mg/L)[1]	Turbidity (NTU)[1]	TSS (mg/L)[2]
Jan-00	1.74						9.5
Feb-00	1.53						12.8
Mar-00	1.80						10.9
Apr-00	1.74						12.1
May-00	1.74						13.2
Jun-00	1.78						6.7
Jul-00	1.88						9.4
Aug-00	1.80						12.4
Sep-00	1.81						14.1
Oct-00	1.80						10.8
Nov-00	1.67						10.2
Dec-00	1.54						6.7
Jan-01	1.66						9.1
Feb-01	1.76						25
Mar-01	1.81	15.8	5.49	3.68	3.61	5.16	7.0
Apr-01	1.71	22.6	5.3	4.5	4.1	4.66	4.8
May-01	1.73	20.3	14.4	5.1	5.1	6.78	7.2
Jun-01	1.73	31.3	1.05	3.32	3.78	5.16	3.6
Jul-01	1.73	21.4	30.3	3.69	3.4	3.25	5.8
Aug-01	2.04	17.8	1.58	3.47	3.28	0	11.5
Sep-01	2.05	22.8	3.86	3.97	3.82	4.65	11.3
Oct-01	1.97	15.9	19.9	4.18	3.53	6.37	7.7
Nov-01	1.92	6.78	10.6	3.17	2.99	2.88	5.2
Dec-01	2.34	17.4	1.36	3.43	3	2.88	6.6
Jan-02	2.42	21.9	0.1	3.68	3.03	2.88	5.7
Feb-02	2.42	29.8	6.01	4.81		6.84	9.5
Mar-02	2.42	24.8	<0.1	3.38	3.38	2.28	4.8
Apr-02	2.42	26.6	1.89	3.91	3.28	4.66	5.5
May-02	2.02	24.7	<0.1	3.66	3.66	3.92	6.5
Jun-02	2.17	27.5	<0.1	3.87	3.75	3.09	6.0
Jul-02	2.58	22.9	1.53	3.87	3.52	3.09	7.9
Aug-02	2.58	18	2.32	4.22	4.02	7.82	12.7
Sep-02	3.12	21	0.1	5.04	3.52	8.74	9.3
Oct-02	3.30	17.4	2.47	3.46	3.4	9.66	12.2
Nov-02	3.20	9.41	1.7	4.4	3.77	20.1	19.4
Dec-02	3.10	15.5	4.45	2.83	2.7	7.57	11.9
Jan-03	3.02	16.2	3.88	0.37	0.31	5.24	7.5
Feb-03	3.05	13.9	2.55	0.49	0.2	4.81	7.5
Mar-03	3.28	15.2	4.34	6.7	6.56	13.9	8.8
Apr-03	3.44	20.4	2.76	4.01	3.82	3.35	5.9
May-03	3.80	16.1	2.48	3.22	3.13	1.15	7.2
Jun-03	4.17	13.5	1.59	4.69	4.59	1.08	7.2
Jul-03	4.25	13.6	1.93	8.08	8.07	2.5	6.1
Aug-03	4.63	9.52	2.77	6	5.36	3.47	9.0
Sep-03	4.94	6.63	3.67	2.13	2.13	6.21	5.7

[1]sampled once/month

[2]TSS=total suspended solids; monthly average, sampled twice/week

Table D-4. Simple Method pollutant load calculation for stormwater runoff from City of Blackfoot into Snake River.

Land use categories	Land use area (acres)	Percent impervious	Runoff coefficient (Rv)	Average annual precipitation (in/yr)	Fraction of average annual precipitation available for runoff	Calculated average annual storm runoff volume (ft^3/yr)	TSS[1]		Total phosphorus		Orthophosphorus		Nitrate+nitrite	
							Event mean conc.[2] (mg/L)	Annual pollutant loads (lbs)	Event mean conc.[2] (mg/L)	Annual pollutant loads (lbs)	Event mean conc.[2] (mg/L)	Annual pollutant loads (lbs)	Event mean conc.[2] (mg/L)	Annual pollutant loads (lbs)
1 Subbasin														
1 Residential--low density	21.4	20	0.23	10.0	0.90	160,903	271	2,723	0.99	10	0.78	8	0.29	3
2 Residential--medium density	102.8	30	0.32	10.0	0.90	1,074,764	271	18,189	0.99	66	0.78	52	0.29	19
3 Residential--high density	73.7	60	0.59	10.0	0.90	1,420,177	271	24,035	0.99	88	0.78	69	0.29	26
4 Commercial	252.7	90	0.86	10.0	0.90	7,099,890	271	120,158	0.99	439	0.78	346	0.29	129
4 Industrial	34.4	80	0.77	10.0	0.90	865,455	271	14,647	0.99	54	0.78	42	0.29	16
5 Public	0.0	50	0.50	10.0	0.90	0	271	0	0.99	0	0.78	0	0.29	0
6 Recreation	0.0	20	0.38	10.0	0.90	0	271	0	0.99	0	0.78	0	0.29	0
7 Transportation	0.0	80	0.77	10.0	0.90	0	271	0	0.99	0	0.78	0	0.29	0
3 Rangeland	0.0	5	0.10	10.0	0.00	0	271	0	0.99	0	0.78	0	0.29	0
4 Water	0.0	100	0.95	10.0	0.00	0	271	0	0.99	0	0.78	0	0.29	0
5 Wetland/Riparian	0.0	100	0.95	10.0	0.00	0	271	0	0.99	0	0.78	0	0.29	0
6 Barren Land	0.0	5	0.10	10.0	0.00	0	271	0	0.99	0	0.78	0	0.29	0
7 Canal	0.0	100	0.95	10.0	0.00	0	271	0	0.99	0	0.78	0	0.29	0
8 Other														
1 Junkyard	0.0	30	0.32	10.0	0.40	0	271	0	0.99	0	0.78	0	0.29	0
2 Petroleum Tanks	0.0	NA[3]	NA[3]	10.0	0.40	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]
9 Unclassified	0.0		0.05	10.0	0.40	0		0		0		0		0
Total	**485.0**					**10,621,189**		**179,752**		**657**		**517**		**192**

[1]TSS=total suspended solids

[2]conc.=concentration

[3]NA=not applicable

Table D-5. Water quality data from Aberdeen Wastewater Treatment Plant and ambient monitoring in Little Hole Draw/Hazard Creek, January 2000 to September 2003 (from Discharge Monitoring Reports.)

Date	Wastewater treatment plant effluent						Ambient monitoring (Little Hole Draw/ Hazard Creek)	
	Flow (cfs)	Ammonia (mg/L)[1]	Total Kjeldahl nitrogen (mg/L)[1]	Nitrate+ nitrite (mg/L)[1]	Total phosphorus (mg/L)[1]	TSS (mg/L)[2]	Flow (cfs)	Ammonia (mg/L)[3]
Jan-00	0.43					11		
Feb-00	0.53					9		
Mar-00	0.77					9		
Apr-00	0.71					4.5		
May-00	0.65					4.4		
Jun-00	0.74					6.5		
Jul-00	0.85					4		
Aug-00	0.68					2.4		
Sep-00	0.62					5.5		
Oct-00	1.07					16.8		
Nov-00	0.60					16		
Dec-00	0.85					13.5		
Jan-01	0.96					18.2		
Feb-01	0.87					18		
Mar-01	0.96					16.8		
Apr-01	0.88					15.5		
May-01	0.76					17.6		
Jun-01	0.63					19		
Jul-01	0.59					10.2		
Aug-01	0.51					9.2		
Sep-01	0.48					4.8		
Oct-01	0.50					9.8		
Nov-01	0.39					15		
Dec-01	0.36	4.0	2.3	4.6	1.32	5.8	0.00	
Jan-02	0.42					8.2		
Feb-02	0.39					11		
Mar-02	0.53	6.2	9.1	2	1.6	15	0.68	0.82
Apr-02	0.59					13.6		
May-02	0.71					11		
Jun-02	0.57	2.08	8.1	1.4	1.7	11.8	47.84	<0.05
Jul-02	0.60					7.6		
Aug-02	0.46					10.5		
Sep-02	0.45	<0.05	2.3	6.5	1	8	0.11	<0.05
Oct-02	0.43					7.6		
Nov-02	0.57					10.5		
Dec-02	0.76	7.1	7.5	3.74	1.4	15.2	0.00	
Jan-03	0.82					15.8		
Feb-03	0.74					12.3		
Mar-03	0.76	8.9	8.4	0.87	0.86	18	0.00	
Apr-03	0.74					18.2		
May-03	0.73					14.5		
Jun-03	0.70	8.1	7.3	2.6	1.22	12	30.02	0.05
Jul-03	0.70					10.6		
Aug-03	0.65					8		
Sep-03	0.65	3.9	1.3	8.6	1.12	9.0	8.54	<0.05

[1] once/quarter grab sample

[2] TSS=total suspended solids; monthly average, sampled weekly

[3] grab sample

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Appendix E: Tributaries, Springs, and Drains Information

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Table E-1. BOR sampling of tributaries and drainages to American Falls Reservoir, May 2001 to August 2003.

Date sampled	Replicate	Time sampled	NO_3+NO_2 (mg/L)	Ortho P (mg/L)	Total P (mg/L)	NH_3 (mg/L)	TKN (mg/L)	CO_3 (mg/L)	HCO_3 (mg/L)	TDS-180 (mg/L)	Alkalinity (mg/L)	SS (mg/L)	Lab pH (SU)	Lab EC (u S/cm)	Turbidity (NTU)	Field Temp (°C)	DO (mg/L)	Field pH (SU)	Field EC (uS/cm)	Flow (cfs)	Flow comments
Bannock Creek at Frontage Road																					
16-May-01		14:35	1.56	0.599	0.6	< 0.01	0.18	6.36	272	421	234	10	8.6	704	4	15.6	11.9	8.48	701	22.5	(Daily Avg streamflows for 10 yrs by USGS = 45.7)
30-May-01		10:30	1.45	0.345	0.37	0.02	0.28	0	289	449	237	9		744	5	12.3	13.7	8.43	748	19.5	(Daily Avg streamflows for 10 yrs by USGS = 33.8)
30-May-01	Y	10:35	1.46	0.355	0.38	< 0.01	0.3	0	289	444	237	7		744	4	12.3	13.9	8.43	742	19.5	(Daily Avg streamflows for 10 yrs by USGS = 33.8)
12-Jun-01		9:55	2.21	0.607	0.63	0.03	0.36	0	310	494	254	6		823	4	13.9	8.9	8.18	822	22	(Daily Avg streamflows for 10 yrs by USGS = 30.8)
2-Jul-01		10:40	2.6	0.747	0.83	0.06	0.36	0	307	450	252	30		752	15	18.1	8.6	8.37	763	32.4	(Daily Avg streamflows for 10 yrs by USGS = 22)
22-Aug-01		13:20	1.86	0.255	0.29	0.05	0.44	0	328	553	269	5	8.3	927	4					20.8	*Daily Avg streamflows for 10 yrs by USGS
22-Aug-01	Y	13:20	1.85	0.255	0.29	0.05	0.45	0	329	552	270	12	8.3	929	5					20.8	*Daily Avg streamflows for 10 yrs by USGS
19-Sep-01		8:50	1.36	0.268	0.32	0.02	0.24	0	316	470	259	6	8.3	820	5	11	10.1			30.2	*Daily Avg streamflows for 10 yrs by USGS
19-Sep-01	Y	8:50	1.48	0.264	0.3	0.01	0.23	0.98	316	465	261	8	8.4	817	5					30.2	*Daily Avg streamflows for 10 yrs by USGS
24-Oct-01		8:50	0.41	0.024	0.134	< 0.01	0.31	0.98	310	391	256	56	8.4	686	24	5	11.7			32.8	*Daily Avg streamflows for 10 yrs by USGS
28-Nov-01		8:40	0.41	0.019	0.094	0.02	0.27	0.49	296	392	244	48	8.4	690	17	1	17			40.3	*Daily Avg streamflows for 10 yrs by USGS
19-Dec-01		8:40	0.78	0.032	0.081	0.03	0.24	0	310	442	254	25	8	766	12	1	15			33.8	*Daily Avg streamflows for 10 yrs by USGS
16-Jan-02		12:25	0.61	0.04	0.117	0.02	NE[1]	5.39	292	409	248	92	8.5	698	24	1	12			36.1	*Daily Avg streamflows for 10 yrs by USGS
25-Feb-02		9:30	0.67	0.05	0.3	0.05	0.75	0	300	372	246	215	8.2	683	86	1				104	*Daily Avg streamflows for 10 yrs by USGS
26-Mar-02		9:35	0.47	0.086	0.8	0.1	1.99	2.94	352	511	294	778	8.4	972	148	4.4	11.6	8.45	1011	72.4	*Daily Avg streamflows for 10 yrs by USGS
2-May-02		8:30	0.64	0.044	0.168	0.02	0.42	0	285	429	234	101	8.3	730	45	8.2	11.7	8.1	764	40.9	*Daily Avg streamflows for 10 yrs by USGS
4-Jun-02		11:00	0.88	0.126	0.168	0.01	0.39	2.45	287	453	239	6	8.4	777	4					24	Estimate. (Daily Avg streamflows for 10 yrs by USGS = 33.2)
26-Jun-02		12:00	1.52	0.402	0.44	0.03	0.34	8.81	280	457	244	6	8.6	759	4					20	Estimate. (Daily Avg streamflows for 10 yrs by USGS = 22.7)
9-Jul-02		11:00	2.47	0.527	0.53	0.04	0.38	9.3	300	531	262	8	8.6	862	4					15	Estimate. (Daily Avg streamflows for 10 yrs by USGS = 18.8)
23-Jul-02		10:15	2.65	0.803	0.85	0.03	0.35	1.96	299	445	248	12	8.4	743	9	17.5	8.6	8.06	376	40	Estimate. (Daily Avg streamflows for 10 yrs by USGS = 26.4)
13-Aug-02		10:40	1.26	0.379	0.39	< 0.01	0.32	7.34	290		250	2	8.6	751	3	16.6	8.8	8.59	348	14	Estimate. (Daily Avg streamflows for 10 yrs by USGS = 22.2)
18-Sep-02		9:15	2.29	0.651	0.68	0.02	0.26	0	311		255	7	8.3	777	4	11.5	7.3	7.86	1346	44	Estimate. (Daily Avg streamflows for 10 yrs by USGS = 28.3)
8-Oct-02		15:30	1.03	0.051	0.1	0.02	0.36	7.83	306		264	24	8.6	829	12	12.68	15.27	8.54	811	12	Estimate. (Daily Avg streamflows for 10 yrs by USGS = 27.5)
5-Nov-02		13:15	0.47	0.028	0.115	0.03	0.38	0	337		276	68	8.3	750	24	2.7	11.9	8.23	425	40	Estimate. (Daily Avg streamflows for 10 yrs by USGS = 39.2)
26-Nov-02		9:30	0.41	0.032	0.091	< 0.01	0.27	0.98	319		263	47	8.4	702	17					50	Estimate. (Daily Avg streamflows for 10 yrs by USGS = 40.2)
18-Dec-02		9:30	0.47	0.039	0.2	< 0.01	0.38	0	306		251	127	8.3	675	30	1	10.9	8.21	1220	34.1	*Daily Avg streamflows for 10 yrs by USGS
Cedar Spillway																					
3-Jul-01		8:55	0.2	0.004	0.023	0.02	0.28	0	154	201	126	3		332	3	21.5	8	8.53	336		
1-Aug-01		11:00	< 0.01	< 0.003	0.02	< 0.01	0.17	8.81	124	177	116	< 1	8.7	318	< 1	17	8.9				
18-Sep-01		9:25	0.01	< 0.003	0.026	< 0.01	0.3	2.45	134	193	114	8	8.5	319	1	16	9.6				
18-Sep-01	Y	9:25	0.02	< 0.003	0.023	< 0.01	0.36	1.96	138	188	116	6	8.5	316	1						
2-May-02		11:15	< 0.01	0.004	0.068	< 0.01	0.33	5.39	125	188	111	16	8.8	299	8	11.9	12.4	8.84	309		
3-Jun-02		12:00	0.01	< 0.003	0.042	< 0.01	0.22	2.94	135	187	116	22	8.5	314	4					54	ASCC staff gage and table
27-Jun-02		16:00	< 0.01	< 0.003	0.022	0.02	0.52	7.83	132	177	121	11	8.7	311	3					35.2	ASCC staff gage and table
27-Jun-02	Y	16:00	0.01	< 0.003	0.022	0.02	0.47	8.81	129	183	120	11	8.8	311	3					35.2	ASCC staff gage and table
10-Jul-02		10:15	< 0.01	< 0.003	0.018	0.02	0.18	2.94	148	191	126	7	8.5	322	3					8.5	ASCC staff gage and table
24-Jul-02		11:10	0.02	< 0.003	0.02	< 0.01	0.18	3.92	143	187	124	4	8.7	314	2	21	8.2	8.48	159	48.4	ASCC staff gage and table
12-Aug-02		9:20	< 0.01	< 0.003	0.021	0.01	0.2	3.43	128		111	4	8.6	294	2	18	8.4	8.41	135	32.8	ASCC staff gage and table
28-Aug-02		10:30	< 0.01	< 0.003	0.013	0.02	0.15	4.9	120		107	< 1	8.8	295	1	18.2	8	8.72	254	7.8	ASCC staff gage and table
Clear Creek at Sheepskin Road																					
16-May-01		11:55	1.45	0.012	0.014	< 0.01	0.16	3.43	241	331	203	8	8.5	546	2	14.1	9.9	8.27	543	17.9	
30-May-01		12:15	1.57	0.012	0.016	0.01	0.05	0	245	330	201	3		537	< 1	15.4	11.4	8.35	527	20.8	
12-Jun-01		10:50	1.51	0.008	0.034	0.02	0.09	0	246	328	202	4		541	< 1	11.1	10.2	8.28	541	19.8	
12-Jun-01	Y	10:55	1.52	0.007	0.022	0.01	0.07	0	247	338	203	3		541	1	11.1	10.2	8.27	541	19.8	
2-Jul-01		11:35	1.73	0.008	0.016	< 0.01	0.07	0	247	313	203	2		535	1	15.9	11.6	8.42	535	17.7	
19-Sep-01		9:40	1.35	0.01	0.029	0.01	0.41	1.47	247	326	205	2	8.4	545	< 1	9	11.9				
24-Oct-01		9:30	1.6	0.011	0.052	0.01	0.28	0	256	336	210	13	8.2	552	7	7	11.5				
28-Nov-01		9:25	1.62	0.014	0.028	0.03	0.28	0	252	337	207	11	8.3	556	4	5	12.5				
28-Nov-01	Y	9:25	1.63	0.014	0.023	0.02	0.24	0	252	333	207	11	8.3	557	3						
19-Dec-01		9:30	1.63	0.016	0.076	0.06	0.88	0	253	334	207	48	8.1	555	11	6	11				
16-Jan-02		11:25	1.07	0.015	0.026	< 0.01	NE[1]	0	228	290	187	9	8.3	487	3	7	12				
25-Feb-02		10:25	1.62	0.016	0.022	0.04	0.2	0	249	326	204	5	8.2	557	1	4					
26-Mar-02		10:20	1.56	0.013	0.029	0.02	0.31	0	253	341	207	26	8.3	555	3	9.7	10.8	8.29	570		
1-May-02		14:30	1.52	0.009	0.021	0.01	0.16	3.43	241	332	203	8	8.5	539	3	13.8	13.2	8.32	560		
4-Jun-02		12:00	1.38	0.006	< 0.01	0.02	0.16	3.43	240	329	203	6	8.5	537	2					48	Estimate
26-Jun-02		13:00	1.36	0.006	0.029	0.01	0.08	5.39	232	278	199	3	8.5	526	< 1					57	Estimate
9-Jul-02		12:00	1.43	0.012	0.027	0.02	0.15	5.39	234	334	201	4	8.5	530	< 1					120	Estimate

Table E-1. Continued.

Date sampled	Replicate	Time sampled	NO_3+NO_2 (mg/L)	Ortho P (mg/L)	Total P (mg/L)	NH_3 (mg/L)	TKN (mg/L)	CO_3 (mg/L)	HCO_3 (mg/L)	TDS-180 (mg/L)	Alkalinity (mg/L)	SS (mg/L)	Lab pH (SU)	Lab EC (u S/cm)	Turbidity (NTU)	Field Temp (°C)	DO (mg/L)	Field pH (SU)	Field EC (uS/cm)	Flow (cfs)	Flow comments
Clear Creek at Sheepskin Road																					
23-Jul-02		11:20	1.46	0.007	0.039	0.02	0.1	4.41	238	321	203	2	8.5	534	< 1	14.6	11.1	8.33	269	80	Estimate
13-Aug-02		12:15	1.36	0.006	0.012	< 0.01	0.1	3.43	240		203	1	8.4	529	1	13.6	11.9	8.43	242	20	Estimate
18-Sep-02		10:30	1.48	0.008	0.018	< 0.01	0.08	1.96	245		204	1	8.4	550	< 1	10.2	9.8	8.03	950	20	Estimate
9-Oct-02		10:45	1.54	0.006	0.011	< 0.01	0.08	0	249		204	< 1	8.3	646	< 1	8.8	10.9	8.23	534	15	Estimate
29-Oct-02		10:30	1.5	0.006	0.026	0.01	0.1	0	247		203	2	8.3	549	< 1	8.6	11.3	7.77	308	17	Estimate
26-Nov-02		9:10	1.64	0.012	0.035	0.01	0.38	0	252		207	23	8.2	552	6					30	Estimate
18-Dec-02		11:15	1.6	0.014	0.077	0.03	0.52	0	252		207	38	8.2	553	10	5.9	9.2	8.11	985		No flow data
Colburn Wasteway near Sterling																					
15-May-01		13:15	0.02	0.006	0.064	0.08	0.85	1.96	226	767	189	12	8.4	1170	5	15.9	9.3	8.54	1165	3	
29-May-01		11:40	0.01	0.008	0.069	0.05	1.14	0	204	768	167	15		1153	8	18	12.7	9.03	1162	2.5	
11-Jun-01		9:55	< 0.01	0.004	0.048	0.02	0.69	0	175	523	144	12		794	6	16.2	11.6	9.05	804	4.1	
3-Jul-01		10:10	0.01	0.009	0.03	0.08	0.67	0	158	587	130	5		881	5	20.8	9.7	8.92	891	1.5	
3-Jul-01	Y	10:15	0.02	0.01	0.027	0.1	0.69	0	159	564	130	5		883	5	20.8	9.6	8.92	890	1.5	
1-Aug-01		9:40	0.18	0.073	0.155	0.92	2.46	0	208	785	171	32	8.2	1222	8	13	7.4				
24-Aug-01		9:05	3	0.028	0.053	0.12	0.32	0	292	544	239	4	8	887	2						
18-Sep-01		10:45	0.57	0.01	0.063	0.11	1.22	0	333	656	273	31	8.3	1050	4	12	3.5				
23-Oct-01		8:40	0.02	0.016	0.046	0.08	1.06	0	317	1830	260	11	8.2	2400	5	7	6.2				
27-Nov-01		10:45	0.67	0.006	0.021	0.02	0.56	3.92	287	946	242	2	8.6	1349	2	1	16				
3-Jun-02		16:00	0.84	0.004	0.036	0.01	0.68	12.7	233	548	212	10	8.8	867	6					7	Estimate
27-Jun-02		15:00	0.12	0.022	0.076	0.03	0.6	8.32	209	550	185	20	8.7	821	4					12	Estimate
10-Jul-02		9:15	0.13	0.051	0.07	0.03	0.43	0	219	481	180	2	8.1	743	2					18	Estimate
24-Jul-02		9:45	0.57	0.028	0.047	0.02	0.41	0	244	467	200	2	8.1	708	1	17.6	5.3	7.9	360	8	Estimate
12-Aug-02		10:55	1.13	0.007	0.028	0.03	0.28	0	238		195	4	8.3	559	2	15.1	7.5	8.02	299	8	Estimate
5-Nov-02		10:15	0.22	0.004	0.013	0.03	0.55	6.36	264		227	3	8.6	1204	3	1.7	14.6	8.47	684	2	Estimate
25-Nov-02		12:30	0.63	< 0.003	< 0.01	0.03	0.56	9.79	278		244	4	8.7	1327	2					2	Estimate
17-Dec-02		15:15	1.84	0.007	0.035	0.16	0.68	0	347		285	9	8.3	1372	4	1.9	12.1	7.86	2420	1.5	Estimate
15-Jan-03		10:00	1.82	0.007	0.021	0.17	0.53	0	331		271	5	8.1	1427	4	1					No flow data
10-Feb-03		10:21	2.6	< 0.003	0.022	0.08	0.5	0	354		290	5	8.1	1655	3						No flow data
1-Apr-03		11:15	0.3	0.003	0.098	0.06	1.24	4.92	357		301	23	8.5	1796	10	8.4	10.3	8.02		2	Estimate
24-Apr-03		11:10	0.18	< 0.003	0.099	0.03	0.8	0	289		237	11	8.2	1343	4	10.2	9	7.91		2	Estimate
4-Jun-03		12:30	0.02	0.003	0.036	0.01	0.67	4.43	196		168	6	8.5	797	5					5	Estimate
18-Jun-03		11:00	0.02	0.007	0.032	0.01	0.52	0	204		167	4	8.2	727	2	21.5	6.5	7.99			No flow data.
Crystal Creek																					
19-Sep-01		9:50	0.96	0.014	0.026	0.02	0.34	0	230	274	189	9	8.3	480	2	9.5	9.5				
Crystal Springs Creek below hatchery																					
16-May-01		10:40	2.13	0.014	0.075	< 0.01	0.46	1.47	257	513	213	101	8.4	848	19	12	9.8	8.03	844	90	(Daily Avg streamflows for 4 yrs in the 1980's by USGS = 46)
29-May-01		13:45	2.04	0.01	0.068	0.08	0.43	0	248	501	203	19		829	3	14.5	11.6	8.41	834	48	(Daily Avg streamflows for 4 yrs in the 1980's by USGS = 38.3)
11-Jun-01		11:30	1.98	0.008	0.042	0.09	0.43	0	257	504	211	11		823	3	15.3	11.9	8.24	830	59	(Daily Avg streamflows for 4 yrs in the 1980's by USGS = 52)
11-Jun-01	Y	11:30	1.96	0.008	0.047	0.08	0.42	0	256	503	210	13		826	3	15.3	11.6	8.32	831	59	(Daily Avg streamflows for 4 yrs in the 1980's by USGS = 52)
3-Jul-01		11:25	1.79	0.019	0.046	0.08	0.41	0	246	485	202	10		774	4	18.6	11.6	8.52	780	52	(Daily Avg streamflows for 4 yrs in the 1980's by USGS = 40.3)
2-Aug-01		10:15	1.77	0.01	0.028	0.03	0.38	7.34	231	430	202	11	8.6	722	< 1	14	14.1			43	*Daily Avg streamflows for 4 yrs in the 1980's by USGS
2-Aug-01	Y	10:15	1.75	0.01	0.025	0.02	0.32	10.3	224	426	201	10	8.6	723	< 1					43	*Daily Avg streamflows for 4 yrs in the 1980's by USGS
24-Aug-01		9:55	1.66	0.014	0.04	0.04	0.34	0	242	395	198	14	8.3	692	2					42.3	*Daily Avg streamflows for 4 yrs in the 1980's by USGS
18-Sep-01		11:50	1.47	0.015	0.046	0.03	0.36	1.47	239	405	198	6	8.4	670	1	14	12.9			51.3	*Daily Avg streamflows for 4 yrs in the 1980's by USGS
23-Oct-01		9:20	1.8	0.026	0.058	0.05	0.25	0	245	420	201	6	8.3	691	2	8	12.3			42.3	*Daily Avg streamflows for 4 yrs in the 1980's by USGS
27-Nov-01		10:00	1.84	0.032	0.065	0.04	0.25	0.98	245	445	203	5	8.4	718	2	4	14			36.7	*Daily Avg streamflows for 4 yrs in the 1980's by USGS
27-Nov-01	Y	10:00	1.85	0.034	0.065	0.03	0.22	0	279	443	229	6	8.3	718	2					36.7	*Daily Avg streamflows for 4 yrs in the 1980's by USGS
18-Dec-01		10:40	1.97	0.028	0.046	0.06	0.27	0	249	450	204	4	8.2	745	2	5	14			37.7	*Daily Avg streamflows for 4 yrs in the 1980's by USGS
16-Jan-02		10:10	2.07	0.041	0.061	0.11	NE[1]	0	256	463	210	10	8.2	782	4	4	12			38.7	*Daily Avg streamflows for 4 yrs in the 1980's by USGS
25-Feb-02		12:00	2	0.04	0.053	0.11	0.38	0	260	467	213	7	8.2	812	3	4				42.7	*Daily Avg streamflows for 4 yrs in the 1980's by USGS
26-Mar-02		14:00	2.07	0.031	0.038	0.09	0.27	0	254	479	208	5	8.2	809	1	11.4	12.1	8.16	841	38	*Daily Avg streamflows for 4 yrs in the 1980's by USGS
1-May-02		10:15	1.78	0.005	0.033	0.02	0.39	2.45	247	493	207	9	8.5	805	4	10.2	14.8	8.31	846	60	Estimate. (Daily Avg streamflows for 4 yrs in the 1980's by USGS = 34.8)
1-May-02	Y	10:15	1.78	0.005	0.036	0.02	0.39	2.45	248	486	207	7	8.5	806	3					60	Estimate. (Daily Avg streamflows for 4 yrs in the 1980's by USGS = 34.8)
3-Jun-02		15:15	1.86	0.004	0.094	0.04	0.94	8.81	225	492	199	30	8.7	808	4					52	Estimate. (Daily Avg streamflows for 4 yrs in the 1980's by USGS = 44.0)
26-Jun-02		14:30	1.67	0.018	0.042	0.1	0.36	10.3	221	469	198	5	8.6	762	1					46	Estimate. (Daily Avg streamflows for 4 yrs in the 1980's by USGS = 30.8)
9-Jul-02		14:30	1.64	0.025	0.046	0.08	0.36	10.3	219	470	197	5	8.7	728	1					50	Estimate. (Daily Avg streamflows for 4 yrs in the 1980's by USGS = 43.3)
9-Jul-02	Y	14:30	1.65	0.026	0.044	0.06	0.39	10.3	217	464	195	6	8.7	727	1					50	Estimate. (Daily Avg streamflows for 4 yrs in the 1980's by USGS = 43.3)

Table E-1. Continued.

Date sampled	Replicate	Time sampled	NO_3+NO_2 (mg/L)	Ortho P (mg/L)	Total P (mg/L)	NH_3 (mg/L)	TKN (mg/L)	CO_3 (mg/L)	HCO_3 (mg/L)	TDS-180 (mg/L)	Alkalinity (mg/L)	SS (mg/L)	Lab pH (SU)	Lab EC (*u* S/cm)	Turbidity (NTU)	Field Temp (°C)	DO (mg/L)	Field pH (SU)	Field EC (uS/cm)	Flow (cfs)	Flow comments
Crystal Springs Creek below hatchery																					
23-Jul-02		14:30	1.6	0.026	0.057	0.06	0.37	10.8	214	386	194	7	8.7	696	1	19.6	12.7	8.69	354	51	Estimate. (Daily Avg streamflows for 4 yrs in the 1980's by USGS = 35.7)
12-Aug-02		13:20	1.51	0.02	0.053	0.07	0.36	3.92	227		193	10	8.5	676	3	17.6	10.8	8.45	311	47	Estimate. (Daily Avg streamflows for 4 yrs in the 1980's by USGS = 47.3)
28-Aug-02		12:55	1.5	0.03	0.093	0.08	0.51	3.92	236		200	30	8.6	663	6	15.4	7.3	8.04	584	51	Estimate. (Daily avg streamflows for 4 yrs in the 1980's by USGS = 42.7)
17-Sep-02		13:15	1.47	0.028	0.053	0.07	0.33	0.98	238		197	10	8.4	656	2	12.6	9	8.06	117	50	Estimate. (Daily avg streamflows for 4 yrs in the 1980's by USGS = 51.7)
8-Oct-02		13:00	1.37	0.028	0.042	0.01	0.28	0	237		194	5	8.3	647	2	11.97	11.45	8.23	630	58	Estimate. (Daily avg streamflows for 4 yrs in the 1980's by USGS = 39.7)
29-Oct-02		13:40	1.48	0.026	0.043	0.06	0.28	0	229		188	5	8.3	651	2	8	13.2	8.27	361	52	Estimate. (Daily avg streamflows for 4 yrs in the 1980's by USGS = 44.0)
25-Nov-02		14:15	1.55	0.037	0.051	0.11	0.27	0	244		200	4	8.3	670	2					51	Estimate. (Daily avg streamflows for 4 yrs in the 1980's by USGS = 38.7)
18-Dec-02		14:15	1.69	0.035	0.058	0.08	0.24	0	244		200	4	8.2	689	1	5.2	10.9	8.13	1228	55	Estimate. (Daily avg streamflows for 4 yrs in the 1980's by USGS = 37.7)
15-Jan-03		11:20	1.78	0.032	0.04	0.13	0.2	0	248		203	2	8.2	734	1	7				49	Estimate. (Daily avg streamflows for 4 yrs in the 1980's by USGS = 39.7)
10-Feb-03		11:10	1.86	0.029	0.06	0.12	0.34	0	255		209	9	8.2	757	3					38	*Daily avg streamflows for 4 yrs in the 1980's by USGS
12-Mar-03		11:30	1.77	0.028	0.051	0.1	0.33	0	256		210	8	8.3	768	2	9.3	10.8	8.13		48	Estimate. (Daily avg streamflows for 4 yrs in the 1980's by USGS = 38.3)
1-Apr-03		13:00	1.59	0.018	0.041	0.07	0.35	1.48	249		207	5	8.4	760	2	11	11.7	8.13		49	Estimate. (Daily avg streamflows for 4 yrs in the 1980's by USGS = 33.7)
24-Apr-03		9:30	1.66	0.003	0.037	0.09	0.37	0	258		212	6	8.1	782	2	9.1	10.5	7.67		50	Estimate. (Daily avg streamflows for 4 yrs in the 1980's by USGS = 37.0)
12-May-03		11:50	1.55	< 0.003	0.022	0.12	0.24	3.44	241		203	3	8.5	771	1	13.4	13.4	8.3		68	Estimate. (Daily avg streamflows for 4 yrs in the 1980's by USGS = 46.8)
4-Jun-03		13:45	1.13	< 0.003	0.025	< 0.01	0.35	19.7	177		178	6	8.9	701	2					55	Estimate. (Daily avg streamflows for 4 yrs in the 1980's by USGS = 43.8)
4-Jun-03	Y		1.14	< 0.003	0.025	0.03	0.37	16.7	180		175	5	8.9	697	1					55	Estimate. (Daily avg streamflows for 4 yrs in the 1980's by USGS = 43.8)
18-Jun-03		13:10	1.03	0.004	0.02	0.04	0.56	11.8	201		185	4	8.7	693	< 1	20.8	14.2	8.79		50	Estimate. (Daily avg streamflows for 4 yrs in the 1980's by USGS = 37.8)
8-Jul-03		9:45	0.88	< 0.003	0.02	0.02	0.29	1.48	230		191	4	8.4	670	1	16.1				17	Estimate. (Daily avg streamflows for 4 yrs in the 1980's by USGS = 46.3)
Danielson Creek near mouth																					
16-May-01		9:55	0.74	0.01	0.026	< 0.01	0.18	1.47	212	349	176	8	8.4	578	3	14.1	8.9	8.23	574	42.2	(Daily Avg streamflows for 6 yrs in the 1980's by USGS = 63.2)
29-May-01		13:20	0.71	0.014	0.038	0.02	0.2	0	197	317	162	8		520	2	18	9.8	8.54	525	50.5	(Daily Avg streamflows for 6 yrs in the 1980's by USGS = 64.7)
11-Jun-01		11:00	0.55	0.007	0.027	0.02	0.2	0	190	301	156	4		499	1	16.7	11.2	8.65	501	46.9	(Daily Avg streamflows for 6 yrs in the 1980's by USGS = 67.5)
3-Jul-01		11:00	0.5	0.01	0.025	< 0.01	0.22	0	187	316	153	5		484	3	19.8	9.8	8.65	486	55.7	(Daily Avg streamflows for 6 yrs in the 1980's by USGS = 64.5)
2-Aug-01		9:40	0.47	0.008	0.017	0.01	0.2	3.92	185	281	158	6	8.5	479	< 1	16	11.2			64.8	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
24-Aug-01		9:40	0.54	0.012	0.029	0.02	0.21	0	197	282	162	6	8.3	474	< 1					64	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
24-Aug-01	Y	9:40	0.64	0.011	0.028	0.02	0.21	0	197	276	162	7	8.2	485	1					64	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
18-Sep-01		11:30	0.49	0.007	0.039	0.01	0.27	1.47	196	296	163	8	8.4	480	1	14	12.9			65.7	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
23-Oct-01		9:10	0.84	0.012	0.025	0.03	0.25	0	203	304	166	6	8.2	508	2	8	9.3			66	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
23-Oct-01	Y	9:10	0.82	0.012	0.025	0.03	0.22	0	203	305	166	4	8.3	509	2					66	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
27-Nov-01		10:10	0.94	0.012	0.026	0.03	0.16	0	206	315	169	8	8.3	526	2	3	13			56.3	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
18-Dec-01		10:50	1.1	0.021	0.044	0.13	0.34	0	216	327	177	14	8.2	546	4	4	12			54.5	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
16-Jan-02		10:00	1.17	0.024	0.041	0.07	NE[1]	0	217	317	178	8	8.2	557	4	3	13.5			53.3	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
25-Feb-02		12:15	1.11	0.025	0.036	0.07	0.27	0	218	329	179	11	8.2	568	3	3				56.3	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
26-Mar-02		14:15	1.03	0.006	0.038	0.02	0.3	0	223	339	183	16	8.3	586	3	11.5	11.1	8.38	611	52.5	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
1-May-02		9:30	0.93	0.005	0.035	0.02	0.24	0	218	350	179	8	8.3	580	4	10.8	11.6	8.15	608	59.6	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
3-Jun-02		14:45	0.62	0.014	0.04	0.03	0.32	2.45	197	318	166	10	8.5	530	3					60	Estimate. (Daily Avg streamflows for 6 yrs in the 1980's by USGS = 67.0)
26-Jun-02		14:45	0.53	0.007	0.044	0.02	0.18	9.3	164	280	150	8	8.7	469	2					65.2	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
9-Jul-02		15:00	0.49	0.013	0.018	0.02	0.28	7.83	163	292	147	7	8.7	463	2					53	Estimate. (Daily Avg streamflows for 6 yrs in the 1980's by USGS = 63.0)
23-Jul-02		14:45	0.49	0.011	0.045	0.01	0.22	7.34	174	278	155	6	8.7	467	2	20.4	11.4	8.66	236	62.5	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
12-Aug-02		13:00	0.4	0.008	0.042	0.02	0.21	5.88	172		151	6	8.6	451	1	14.2	11.3	8.58	207	69.5	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
28-Aug-02		12:40	0.44	0.011	0.023	< 0.01	0.22	2.94	188		159	6	8.5	457	1	16.6	9.4	8.35	403	51	Estimate. (Daily avg streamflows for 6 yrs in the 1980's by USGS = 64.2)
17-Sep-02		12:45	0.6	0.014	0.03	0.03	0.18	0	202		166	5	8.3	497	1	14.1	8.3	8.06	89	39	Estimate. (Daily avg streamflows for 6 yrs in the 1980's by USGS = 65.3)
8-Oct-02		13:30	0.56	0.007	0.023	0.03	0.22	1.96	188		157	8	8.5	468	2	12.97	11.73	8.47	457	67.6	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
29-Oct-02		14:15	0.79	< 0.003	0.033	0.03	0.36	0	193		158	12	8.3	493	3	8.9	11.7	8.33	276	50	Estimate. (Daily Avg streamflows for 6 yrs in the 1980's by USGS = 62.3)
25-Nov-02		13:45	0.9	0.007	0.045	0.05	0.42	0	208		171	18	8.3	510	4					40	Estimate. (Daily Avg streamflows for 6 yrs in the 1980's by USGS = 56.8)
18-Dec-02		14:45	0.95	0.02	0.041	0.06	0.16	0	204		167	9	8.2	518	2	5.3	10.4	8.2	922	36	Estimate. (Daily Avg streamflows for 6 yrs in the 1980's by USGS = 54.5)
15-Jan-03		11:00	1.04	0.018	0.034	0.09	0.16	0	209		171	9	8.1	536	2	6				53.3	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
10-Feb-03		10:55	1.05	0.013	0.045	0.07	0.25	0	213		175	15	8.2	544	4					54	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
12-Mar-03		11:00	0.93	< 0.003	0.054	0.03	0.41	0	220		180	22	8.3	555	6	8.6	10.9	8.2		53.8	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
1-Apr-03		12:45	0.94	0.007	0.049	0.01	0.32	0.98	216		179	16	8.4	553	4	10.6	10.3	8.1		52.3	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
24-Apr-03		9:45	0.76	< 0.003	0.046	0.05	0.38	0	216		177	21	8.2	542	4	10.7	9.8	7.94		58.4	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
12-May-03		11:20	0.7	< 0.003	0.036	0.03	0.2	0	204		167	22	8.3	513	3	13.1	9.9	8.14		63	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
4-Jun-03		13:30	0.48	0.005	0.032	0.02	0.27	0	197		162	8	8.3	498	3					65.5	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
18-Jun-03		12:45	0.33	0.004	0.028	< 0.01	0.23	3.44	178		152	7	8.5	472	1	20.7	10.8	8.51		66	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
8-Jul-03		10:00	0.31	0.006	0.02	0.02	0.22	1.48	175		146	5	8.4	445	2	16.7				63.7	*Daily Avg streamflows for 6 yrs in the 1980's by USGS
8-Jul-03	Y	10:00	0.32	0.004	0.022	0.02	0.22	2.46	173		146	4	8.5	445	2					63.7	*Daily Avg streamflows for 6 yrs in the 1980's by USGS

Table E-1. Continued.

Date sampled	Replicate	Time sampled	NO_3+NO_2 (mg/L)	Ortho P (mg/L)	Total P (mg/L)	NH_3 (mg/L)	TKN (mg/L)	CO_3 (mg/L)	HCO_3 (mg/L)	TDS-180 (mg/L)	Alkalinity (mg/L)	SS (mg/L)	Lab pH (SU)	Lab EC (u S/cm)	Turbidity (NTU)	Field Temp (°C)	DO (mg/L)	Field pH (SU)	Field EC (uS/cm)	Flow (cfs)	Flow comments
Little Hole Draw/Hazard Creek																					
15-May-01		11:00	0.06	0.003	0.082	0.03	0.78	0.98	163	227	135	36	8.4	385	10	15.2	8.7	8.6	379	58	*Preliminary flow from Idaho Power Gage
15-May-01	Y	11:05	0.04	0.004	0.082	0.02	0.61	1.96	161	228	135	37	8.5	382	10	15.2	8.7	8.63	378	58	*Preliminary flow from Idaho Power Gage
29-May-01		10:55	0.13	0.01	0.084	0.04	0.49	0	172	235	141	33		395	9	16.2	10.6	8.7	381	34.8	*Preliminary flow from Idaho Power Gage
11-Jun-01		9:05	0.2	0.013	0.06	0.04	0.26	0	171	240	140	14		390	5	16.3	10.5	8.45	393	24.2	*Preliminary flow from Idaho Power Gage
3-Jul-01		9:30	0.21	0.009	0.053	0.02	0.27	0	163	225	134	8		364	6	21.4	8	8.5	368	23.1	*Preliminary flow from Idaho Power Gage
1-Aug-01		10:20	0.89	0.047	0.077	0.12	0.39	0	197	302	162	7	8.2	511	1	14	8.8			7.6	*Preliminary flow from Idaho Power Gage
1-Aug-01	Y	10:20	0.92	0.048	0.076	0.12	0.42	0	199	292	163	5	8.3	511	1					7.6	*Preliminary flow from Idaho Power Gage
22-Aug-01		11:05	0.78	0.083	0.13	0.36	0.86	0	198	309	162	16	8.2	512	6					6.6	*Preliminary flow from Idaho Power Gage
18-Sep-01		10:10	0.14	0.014	0.063	0.03	0.82	0	156	217	128	11	8.3	369	2	15	10.2			27.5	*Preliminary flow from Idaho Power Gage
23-Oct-01		8:11	4.94	0.393	0.46	0.08	0.7	0	274	560	225	2	8.2	893	2	8	7.5			1.3	*Preliminary flow from Idaho Power Gage
27-Nov-01		11:15	5.86	0.444	0.54	0.05	0.44	0	278	557	228	2	8.3	892	1	2	12			1.0	*Preliminary flow from Idaho Power Gage
18-Dec-01		11:55	3.5	0.474	0.51	0.62	1.03	0	288	556	236	2	8.2	889	1	2	11.5			1.0	*Preliminary flow from Idaho Power Gage
16-Jan-02		9:10	3.98	0.425	0.49	1.88	NE[1]	0	280	544	230	5	8.1	872	4	1	11			1.0	*Preliminary flow from Idaho Power Gage
25-Feb-02		13:30	3.97	0.53	0.56	1.41	2.28	0	270	540	221	9	8.1	857	6	3				1.0	*Preliminary flow from Idaho Power Gage
26-Mar-02		15:30	3.08	0.495	0.6	2.41	3.28	0	321	618	263	10	8.3	988	5	11.8	13.2	8.33	1023	1.5	*Preliminary flow from Idaho Power Gage
2-May-02		11:42	0.04	0.005	0.117	< 0.01	0.51	2.94	130	171	112	49	8.7	306	13	12.6	12.7	8.78	316	63.0	Published flow by Idaho Power
3-Jun-02		12:45	0.09	0.014	0.055	< 0.01	0.34	5.39	133	199	118	15	8.8	328	6					46.0	Published flow by Idaho Power
27-Jun-02		15:30	0.17	0.025	0.059	0.03	0.52	15.2	140	222	140	9	9	371	6					23.0	Published flow by Idaho Power
10-Jul-02		9:45	0.14	0.05	0.064	0.05	0.28	0.98	168	223	139	4	8.4	375	2					16.0	Published flow by Idaho Power
24-Jul-02		10:25	0.07	0.038	0.067	0.01	0.31	2.45	152	188	129	8	8.5	332	2	20.6	8.8	8.41	168	40.0	Published flow by Idaho Power
24-Jul-02	Y	10:25	0.06	0.038	0.075	< 0.01	0.32	2.45	151	196	128	8	8.5	332	2	20.6	8.8	8.41	168	40.0	Published flow by Idaho Power
12-Aug-02		14:15	0.12	0.015	0.054	0.04	0.48	13.7	116		118	7	9.1	318	3	20.9	12.9	9.06	146	28	Published flow by Idaho Power
28-Aug-02		11:10	0.2	0.016	0.034	0.01	0.22	4.9	142		125	2	8.7	355	1	17.2	10.6	8.69	314	21	Published flow by Idaho Power
17-Sep-02		11:00	3.27	0.267	0.3	0.03	0.71	0	308		253	3	8.3	955	1	11.8	7.7	7.87	170	1.7	Published flow by Idaho Power
8-Oct-02		11:00	3.22	0.182	0.22	0.03	0.49	0	293		240	3	8.1	877	1	9.12	9.53	7.87	857	2	*Preliminary flow from Idaho Power Gage
5-Nov-02		9:15	4.25	0.415	0.45	0.19	1.34	0	268		220	5	8	857	3	2.4	9	7.73	486	1.28	*Preliminary flow from Idaho Power Gage
25-Nov-02		11:00	4.22	0.258	0.27	0.29	0.54	0	289		237	4	8.2	870	< 1					1.82	*Preliminary flow from Idaho Power Gage
17-Dec-02		14:30	2.74	0.727	0.82	0.45	5.4	0	294		241	5	7.9	913	3	5.1	8.4	7.45	1626	3.39	*Preliminary flow from Idaho Power Gage
15-Jan-03		9:30	5.2	0.433	0.49	0.82	3	0	297		244	3	7.9	921	2	4				5.51	*Preliminary flow from Idaho Power Gage
10-Feb-03		9:45	3.7	0.267	0.35	2.54	2.7	0	299		245	8	8	905	3	3				7.06	*Preliminary flow from Idaho Power Gage
12-Mar-03		9:00	2.21	0.63	0.78	2.77	5.36	0	345		283	14	7.8	475	7	6	7.4	7.46		3.35	*Preliminary flow from Idaho Power Gage
1-Apr-03		10:45	2.81	0.301	0.37	2.2	2.2	0	301		247	7	8.2	913	3	8.6	8.1	7.87		1.01	*Preliminary flow from Idaho Power Gage
24-Apr-03		12:30	0.02	< 0.003	0.04	< 0.01	0.36	3.44	139		120	12	8.6	345	4	11.5	10.6	8.52		47.7	*Preliminary flow from Idaho Power Gage
12-May-03		9:30	0.02	< 0.003	0.038	< 0.01	0.33	2.46	132		112	11	8.5	310	4	11.8	9.8	8.1			
4-Jun-03		11:30	0.08	0.01	0.036	0.01	0.27	3.44	137		118	7	8.6	312	3						
18-Jun-03		10:14	0.17	0.034	0.055	0.01	0.24	0	166		136	3	8.3	371	2	19.4	8.6	8.07			
7-Jul-03		15:20	0.12	0.038	0.069	0.02	0.31	5.9	143		127	4	8.7	328	2	23.2	10.7	8.26			
McTucker Creek near ponds																					
11-Jun-01		12:25	2.9	0.038	0.05	< 0.01	0.12	0	272	498	223	< 1		815	< 1	11.8	11.7	7.64	836	17	
3-Jul-01		12:10	0.93	0.008	0.028	0.02	0.26	0	200	298	164	7		494	4	19.3	10.6	8.42	494		
2-Aug-01		10:45	0.86	0.006	0.013	0.02	0.37	2.45	199	297	167	5	8.4	508	< 1	16	12.5				
24-Aug-01		10:25	0.77	0.004	0.023	0.02	0.22	0	190	254	156	7	8.2	463	2						
18-Sep-01		12:10	0.73	0.006	0.031	0.02	0.3	1.47	191	277	159	6	8.4	471	1	15	12.3				
23-Oct-01		9:35	0.98	0.014	0.027	0.01	0.17	0	209	309	171	4	8.3	521	2	8	12.5				
27-Nov-01		9:40	1.06	0.019	0.024	< 0.01	0.15	0	202	307	166	3	8.3	511	1	3	12.5				
18-Dec-01		10:30	1.22	0.016	0.028	0.03	0.16	0	207	314	170	3	8.2	534	1	3	14				
16-Jan-02		10:20	1.29	0.025	0.034	0.02	NE[1]	0	207	311	170	4	8.2	536	2	3	12.5				
25-Feb-02		11:30	1.22	0.029	0.036	0.03	0.17	0	202	294	166	8	8.2	520	2	3					
25-Feb-02	Y	11:30	1.22	0.029	0.038	0.02	0.2	0	203	254	166	8	8.2	522	2						
26-Mar-02		13:25	1.06	0.016	0.031	0.01	0.2	0	200	296	164	11	8.3	501	2	8.6	13.2	8.36	530		
1-May-02		10:45	1.25	0.007	0.041	0.02	0.37	0	204	325	167	11	8.3	542	4	10.8	12.9	8.05	588	140	
4-Jun-02		14:15	0.47	< 0.003	0.04	< 0.01	0.32	6.36	155	242	138	20	8.7	407	5					300	Estimate
26-Jun-02		14:00	0.76	0.004	0.026	0.02	0.2	2.45	184	281	155	6	8.4	467	3					220	Estimate
9-Jul-02		13:45	0.83	0.007	0.039	0.04	0.22	3.43	187	303	159	7	8.5	478	2					270	Estimate
23-Jul-02		13:15	0.41	< 0.003	0.061	< 0.01	0.29	1.96	167	216	140	21	8.4	383	4	19.4	9.2	8.34	198		No flow data. Unsafe conditions to measure Q
13-Aug-02		13:15	0.44	0.004	0.026	< 0.01	0.24	1.96	168		141	6	8.4	399	2	18.3	10.5	8.51	189	200	Estimate
18-Sep-02		11:30	0.48	0.005	0.038	0.01	0.18	1.47	169		141	4	8.3	413	2	13	8.8	8.11	720		No flow data. Unsafe conditions to measure Q

Table E-1. Continued.

Date sampled	Replicate	Time sampled	NO_3+NO_2 (mg/L)	Ortho P (mg/L)	Total P (mg/L)	NH_3 (mg/L)	TKN (mg/L)	CO_3 (mg/L)	HCO_3 (mg/L)	TDS-180 (mg/L)	Alkalinity (mg/L)	SS (mg/L)	Lab pH (SU)	Lab EC (u S/cm)	Turbidity (NTU)	Field Temp (°C)	DO (mg/L)	Field pH (SU)	Field EC (uS/cm)	Flow (cfs)	Flow comments
McTucker Creek near ponds																					
9-Oct-02		13:15	1.06	0.015	0.035	0.02	0.2	0	213		175	2	8.3	540	1	11.7	11.5	8.29	514	160	Estimate
29-Oct-02		13:00	1.11	0.016	0.026	< 0.01	0.14	0	210		172	2	8.3	553	< 1	8	12.4	8.16	300	130	Estimate
29-Oct-02	Y	13:00	1.11	0.016	0.029	< 0.01	0.16	0	217		178	2	8.3	554	< 1					130	Estimate
25-Nov-02		15:00	0.95	0.011	0.019	< 0.01	0.1	1.47	197		164	4	8.4	505	1					120	Estimate
25-Nov-02	Y	15:00	0.93	0.012	0.022	0.01	0.12	1.96	197		165	4	8.5	505	1					121	Estimate
18-Dec-02		13:45	1.09	0.016	0.035	0.01	0.13	0	202		166	2	8.2	516	< 1	4.9	11	8.25	914		No flow data.
15-Jan-03		12:00	1.13	0.012	0.021	0.04	0.08	0	201		165	4	8.2	519	1	5					No flow data
10-Feb-03		11:30	1.42	0.013	0.037	0.02	0.16	0	218		179	4	8.2	576	1						No flow data
12-Mar-03		12:00	1.2	0.015	0.04	0.02	0.25	0	212		174	10	8.3	550	2	8.7	12	8.2		280	Estimate
1-Apr-03		13:45	1.13	0.023	0.049	0.02	0.26	1.48	205		171	11	8.4	524	3	9.6	11.3	8.11		200	Estimate
24-Apr-03		9:00	1.25	0.01	0.039	0.03	0.29	0	215		176	11	8	559	2	9.7	8.8	7.42		140	Estimate
12-May-03		13:00	1.19	< 0.003	0.047	0.03	0.21	0	211		173	5	8.3	554	2	13.6	13.2	8.2		270	Estimate
4-Jun-03		14:45	0.53	< 0.003	0.034	0.01	0.32	2.95	168		143	18	8.5	415	5						No flow data. Unsafe conditions to measure Q
18-Jun-03		13:45	0.43	< 0.003	0.045	0.02	0.3	0.98	178		148	18	8.4	422	4	19.4	10.3	8.42			No flow data.
8-Jul-03		9:00	0.56	< 0.003	0.02	0.01	0.21	0	183		150	6	8.3	432	2	17.3	7.7	6.5		300	Estimate
Mokins Creek																					
29-May-01		12:45	0.15	0.026	0.2	0.05	0.75	0	236	395	194	102		632	19	17.4	9.3	8.42	561	2.9	
Portneuf River																					
16-May-01		13:40	2.18	1.163	1.22	< 0.01	0.2	0.98	281	407	232	7	8.4	677	3	15.3	8.9	7.57	663		
30-May-01		11:20	2.47	1.356	1.36	0.19	0.39	0	294	413	241	8		675	2	14.3	9.6	7.64	665		
Schlitz Drain																					
15-May-01		9:20	0.01	0.003	0.056	< 0.01	0.3	0.98	157	224	130	27	8.4	371	9	14.7	7.8	8.6	369	6.7	
29-May-01		9:40	< 0.01	0.004	0.042	0.01	0.27	0	160	217	131	15		364	6	15.7	8.9	8.56	362	7.1	
Seagull Bay tributary at Frontage Road																					
30-May-01		9:40	0.28	0.038	0.131	0.03	0.33	0	199	312	163	54		533	17	10.8	10.6	8.28	531	3.4	
12-Jun-01		9:10	0.12	0.042	0.101	0.05	0.59	0	197	291	162	nfirmed by rerun		500	28	14.3	8.3	8.29	499	8.7	
2-Jul-01		10:05	0.18	0.068	0.164	0.03	0.39	0	202	286	166	56		464	18	19.3	8.8	8.55	476	6.1	
1-Aug-01		12:35	0.68	0.174	0.24	0.04	0.65	5.88	214	434	185	18	8.5	729	4	20	12.5				
22-Aug-01		12:35	0.47	0.149	0.193	0.08	0.66	0	220	375	180	14	8.2	603	12						
19-Sep-01		11:45	0.22	0.029	0.18	0.04	0.68	2.45	183	260	154	62	8.4	452	36	15	9.5				
2-May-02		10:30	0.13	0.03	0.98	0.08	1.38	4.41	205	271	175	1337	8.5	459	260	9.4	13	8.48	474	20	Estimate
4-Jun-02		10:00	0.01	0.051	0.106	< 0.01	0.36	1.96	188	260	157	58	8.4	455	18					6	Estimate
27-Jun-02		13:00	0.04	0.066	0.149	0.03	0.42	7.83	175	261	157	27	8.7	446	12					4	Estimate
9-Jul-02		10:15	0.29	0.109	0.22	0.04	0.5	2.94	196	320	166	71	8.5	521	32					1	Estimate
13-Aug-02		9:50	0.12	0.203	0.26	0.09	0.88	1.96	200		167	13	8.4	452	10	16.4	9.4	8.47	210	2	Estimate
13-Aug-02	Y	9:50	0.12	0.195	0.25	0.12	0.9	1.96	198		166	14	8.4	451	11					2	Estimate
17-Sep-02		9:40	0.71	0.024	0.087	0.05	0.42	3.43	170		145	26	8.5	467	9	15.6	8	8.28	81	6	Estimate
12-May-03		14:45	< 0.01	< 0.003	0.125	0.03	0.5	4.43	188		162	52	8.6	451	24	17.7	8.8	8.39		2	Estimate
4-Jun-03		10:45	0.02	0.051	0.089	0.02	0.32	0	200		164	10	8.3	469	7					0.5	Estimate
Spring Creek at Sheepskin Road																					
16-May-01		12:40	0.97	0.013	0.031	< 0.01	0.14	2.45	224	291	188	24	8.5	480	4	12.7	10.2	8.28	476	346	from USGS web history
30-May-01		12:40	1	0.013	0.027	< 0.01	0.1	0	228	293	187	12		477	2	12.7	12.2	8.39	475	341	from USGS web history
12-Jun-01		11:20	0.99	0.007	0.027	0.11	0.11	0	230	287	189	8		480	2	11	10	8.24	484	319	from USGS web history
2-Jul-01		12:05	1.08	0.008	0.024	< 0.01	0.09	0	228	286	187	4		466	2	13.6	11.1	8.41	471	327	from USGS web history
24-Oct-01		9:50	1.04	0.013	0.044	0.01	0.27	0	232	294	190	4	8.2	480	2	8	11			335	from USGS web history
24-Oct-01	Y	9:50	1.04	0.013	0.051	0.01	0.22	0	233	294	191	6	8.2	486	2					335	from USGS web history
28-Nov-01		9:40	1.06	0.012	0.018	< 0.01	0.1	0	234	294	192	4	8.2	488	2	6	12			348	from USGS web history
19-Dec-01		9:40	1.06	0.017	0.038	0.02	0.5	0	232	296	190	9	8.1	492	3	8	10.5			351	from USGS web history
16-Jan-02		11:30	1.63	0.016	0.031	0.03	NE[1]	2.45	294	335	245	10	8.4	551	2	5	12			342	from USGS web history
25-Feb-02		10:30	0.99	0.011	0.02	0.01	0.16	0	234	288	192	10	8.3	494	2	4				308	from USGS web history
26-Mar-02		10:40	1	0.013	0.024	< 0.01	0.24	1.96	230	285	192	21	8.4	487	3	9.8	11.1	8.33	507	326	from USGS web history
26-Mar-02	Y	10:40	1	0.013	0.024	< 0.01	0.2	2.45	229	293	192	21	8.4	488	3					326	from USGS web history
1-May-02		14:00	0.89	0.005	0.012	< 0.01	0.13	3.43	218	288	184	8	8.5	409	3	11	16.8	8.51	482	311	from USGS web history
4-Jun-02		12:30	0.84	0.005	0.014	< 0.01	0.12	4.9	218	291	187	7	8.6	475	2					301	from USGS web history
26-Jun-02		13:30	0.84	0.008	0.024	0.01	0.09	2.94	220	280	185	5	8.4	466	1					283	from USGS web history
9-Jul-02		12:30	0.93	0.01	0.022	0.02	0.08	2.94	223	299	188	7	8.5	473	< 1					272	from USGS web history
23-Jul-02		12:00	0.94	0.007	0.022	< 0.01	0.08	2.45	224	280	188	2	8.4	472	< 1	13.1	11.2	8.28	239	274	from USGS web history

Table E-1. Continued.

Date sampled	Replicate	Time sampled	NO_3+NO_2 (mg/L)	Ortho P (mg/L)	Total P (mg/L)	NH_3 (mg/L)	TKN (mg/L)	CO_3 (mg/L)	HCO_3 (mg/L)	TDS-180 (mg/L)	Alkalinity (mg/L)	SS (mg/L)	Lab pH (SU)	Lab EC (u S/cm)	Turbidity (NTU)	Field Temp (°C)	DO (mg/L)	Field pH (SU)	Field EC (uS/cm)	Flow (cfs)	Flow comments
Spring Creek at Sheepskin Road																					
13-Aug-02		12:40	0.84	0.006	0.014	< 0.01	0.11	0	227		186	5	8.3	467	1	12.4	11.2	8.29	216	287	from USGS web history
17-Sep-02		14:30	0.9	0.005	0.027	0.01	0.11	4.41	217		185	4	8.5	472	1	11.2	12.3	8.41	84	302	from USGS web history
9-Oct-02		11:15	0.93	0.009	0.017	0.02	0.12	0	229		188	5	8.3	476	1	9.7	11.1	8.29	466	315	from USGS web history
29-Oct-02		11:20	1	0.008	0.021	0.01	0.1	0.49	226		186	6	8.4	478	2	9.4	11.2	8.16	269	313	from USGS web history
26-Nov-02		8:45	1.04	0.012	0.022	< 0.01	0.12	0	233		191	10	8.1	486	3					306	from USGS web history
18-Dec-02		11:40	1.04	0.013	0.036	0.01	0.08	0	229		188	8	8.3	482	2	7.5	9.5	8.17	860	310	from USGS web history
Spring Hollow																					
15-May-01		8:50	0.01	0.003	0.078	< 0.01	0.59	1.47	156	218	130	38	8.4	372	10	15.3	8.2	8.7	367		
29-May-01		8:50	0.01	0.004	0.038	0.01	0.25	0	157	207	129	18		358	6	16.3	8.4	8.55	361	1.6	
Sterling Wasteway																					
16-May-01		9:05	1.63	0.019	0.053	< 0.01	0.34	2.45	266	401	222	13	8.5	647	6	11.6	11.1	8.28	634	2.8	
16-May-01	Y	9:10	1.66	0.02	0.06	< 0.01	0.35	3.43	262	407	221	12	8.4	644	6	11.6	11.1	8.3	634	2.8	
29-May-01		12:15	0.69	0.019	0.075	0.03	0.42	0	249	359	204	22		578	8	16.6	12.4	8.62	579	6.6	
11-Jun-01		10:20	1.27	0.006	0.042	< 0.01	0.34	0	270	384	221	7		611	3	14.5	14.8	8.72	611	2.1	
3-Jul-01		10:35	0.58	0.015	0.049	0.03	0.45	0	255	369	209	11		567	6	18.4	10	8.47	569	7	
2-Aug-01		9:00	0.7	0.008	0.031	0.02	0.28	3.43	266	346	224	8	8.5	591	1	14	11.5				
24-Aug-01		9:20	0.38	0.008	0.03	0.02	0.33	0	252	334	207	10	8.2	541	3						
18-Sep-01		11:05	1.03	0.008	0.053	0.05	0.48	2.94	255	357	214	12	8.5	580	4	13	12.5				
23-Oct-01		8:50	1.23	0.025	0.103	0.11	0.43	0	273	372	224	30	8.3	595	17	6	12.2				
27-Nov-01		10:30	1.51	0.036	0.118	0.08	0.38	1.47	277	391	230	26	8.4	630	11	1	14				
16-Jan-02		9:40	1.71	0.045	0.144	0.16	NE[1]	0	283	377	232	103	8.3	646	36	0	13.5				
16-Jan-02	Y	9:40	1.71	0.045	0.156	0.15	NE[1]	0	287	292	235	108	8.3	646	36						
25-Feb-02		12:30	1.42	0.083	0.39	1.36	3.72	0	320	496	262	159	8.1	819	64	3					
26-Mar-02		14:49	1.64	0.058	0.146	0.15	0.6	0	299	464	245	65	8.3	754	24	15	9.7	8.29	787		
1-May-02		9:00	1.54	0.016	0.038	< 0.01	0.36	0	283	402	232	14	8.3	648	6	6.2	14.9	8.23	675	5	Published flow by Idaho Power
3-Jun-02		14:15	1.64	0.006	0.04	0.02	0.53	15.2	241	418	223	14	9.9	668	4					1.9	Published flow by Idaho Power
26-Jun-02		15:15	0.23	0.011	0.051	0.05	0.4	7.83	229	335	201	15	8.7	541	3					13	Published flow by Idaho Power
10-Jul-02		9:00	1.24	0.013	0.035	0.02	0.45	0	291	405	239	12	8.3	654	4					1.1	Published flow by Idaho Power
23-Jul-02		15:30	1.11	0.01	0.032	0.02	0.44	24	206	386	209	4	9.1	593	2	24.7	11.7	8.97	302	0.86	Published flow by Idaho Power
12-Aug-02		11:15	0.11	0.006	0.034	0.03	0.38	7.34	228		199	6	8.6	512	2	16.6	10.5	8.57	235	14	Published flow by Idaho Power
28-Aug-02		13:25	1.24	0.009	0.026	< 0.01	0.3	11.8	271		242	4	8.7	674	1	18	10	8.56	596	2	Published flow by Idaho Power
18-Sep-02		12:40	0.95	0.006	0.022	0.01	0.23	6.85	258		223	3	8.6	594	2	12.7	11.5	8.34	1029	3.5	Published flow by Idaho Power
8-Oct-02		11:45	0.9	0.018	0.042	0.06	0.35	0	262		215	8	8.3	575	4	10.15	11.15	8.18	558	9.84	*Preliminary flow from Idaho Power Gage
5-Nov-02		11:00	1.31	0.033	0.083	0.12	0.47	0	266		218	34	8.3	599	13	3.4	12.5	8.25	337	5.77	*Preliminary flow from Idaho Power Gage
25-Nov-02		12:50	1.38	0.027	0.083	0.06	0.34	4.41	263		223	35	8.6	621	9					5.4	*Preliminary flow from Idaho Power Gage
17-Dec-02		16:00	1.24	0.033	0.117	0.09	0.42	1.47	256		212	55	8.4	616	14	3.6	11.8	8.25	1101	5.99	*Preliminary flow from Idaho Power Gage
15-Jan-03		10:30	1.37	0.028	0.07	0.12	0.36	0	271		222	45	8.2	674	12	4				5.34	*Preliminary flow from Idaho Power Gage
10-Feb-03		10:37	1.46	0.032	0.133	0.19	1.32	0	296		243	197	8.2	631	65					4.86	*Preliminary flow from Idaho Power Gage
12-Mar-03		10:15	1.52	0.04	0.28	0.26	1.52	0	299		245	198	8.2	651	66	7.8	10.3	8.02		5.66	*Preliminary flow from Idaho Power Gage
1-Apr-03		11:45	1.36	0.033	0.121	0.07	0.64	3.94	273		230	52	8.5	626	19	8.6	10.9	8.07		5.32	*Preliminary flow from Idaho Power Gage
24-Apr-03		10:30	1.07	< 0.003	0.094	0.06	0.62	0	258		212	26	8.2	590	8	8.8	11.2	8		6.83	*Preliminary flow from Idaho Power Gage
12-May-03		10:30	1.8	< 0.003	0.034	0.01	0.27	0	298		244	6	8.3	692	2	9.9	14.4	8.27			
4-Jun-03		13:00	0.53	< 0.003	0.029	0.02	0.43	10.3	208		188	11	8.8	528	3						
18-Jun-03		11:30	0.32	0.004	0.041	0.04	0.55	1.48	239		198	15	8.4	545	3	19.6	10	8.26			
7-Jul-03		16:10	0.73	0.012	0.043	0.05	0.43	21.2	207		205	8	9	551	4	23.8	13.6	8.45			
Sunbeam Creek at Frontage Road																					
30-May-01		8:50	0.2	0.015	0.37	0.02	0.83	0	227	296	186	332		496	99	9.8	9.9	8.31	504	6.2	
12-Jun-01		8:25	0.18	0.038	1.08	0.07	1.22	0	233	285	191	onfirmed by rerun		470	155	13.8	8.4	8.28	474	7.2	
2-Jul-01		9:15	0.07	0.02	0.085	< 0.01	0.24	0	220	303	180	31		502	17	19.6	8.9	8.51	511	3.7	
2-Jul-01	Y	9:15	0.08	0.02	0.086	< 0.01	0.26	0	220	306	180	31		507	17	19.6	8.9	8.51	511	3.7	
1-Aug-01		12:05	0.04	0.051	0.18	0.02	0.32	13.2	179	282	169	106	8.6	472	9	18	8.9				
22-Aug-01		12:00	0.15	0.059	0.35	0.09	0.79	1.47	216	305	180	222	8.4	490	73						
19-Sep-01		8:30	0.07	0.031	0.24	0.05	0.7	0.98	210	295	174	133	8.4	489	68	10.5	10				
24-Oct-01		8:20	< 0.01	0.022	0.18	< 0.01	0.52	0.98	254	350	210	81	8.4	591	49	2	13.5				
2-May-02		10:00	0.01	0.014	0.107	< 0.01	0.3	2.45	201	305	169	57	8.4	515	34	9	13.5	8.35	535	1.5	Estimate
4-Jun-02		9:30	0.05	0.035	0.22	0.01	0.65	3.43	208	287	176	98	8.5	491	54					4	Estimate
27-Jun-02		12:00	0.42	0.076	0.2	0.11	0.92	7.34	189	270	167	57	8.7	460	32					7	Estimate
9-Jul-02		9:45	0.45	0.109	0.3	0.08	0.98	1.47	194	299	162	87	8.4	469	72					5	Estimate

Table E-1. Continued.

Date sampled	Replicate	Time sampled	NO_3+NO_2 (mg/L)	Ortho P (mg/L)	Total P (mg/L)	NH_3 (mg/L)	TKN (mg/L)	CO_3 (mg/L)	HCO_3 (mg/L)	TDS-180 (mg/L)	Alkalinity (mg/L)	SS (mg/L)	Lab pH (SU)	Lab EC (u S/cm)	Turbidity (NTU)	Field Temp (°C)	DO (mg/L)	Field pH (SU)	Field EC (uS/cm)	Flow (cfs)	Flow comments
Sunbeam Creek at Frontage Road																					
24-Jul-02		8:00	0.63	0.074	0.32	0.02	1.8	0.98	223	279	185	126	8.4	485	90	19.7	6.7	8.28	245	10	Estimate
13-Aug-02		9:15	0.27	0.079	0.146	0.1	0.52	0	214		175	17	8.2	466	21	15.9	7.7	8.25	216	4	Estimate
28-Aug-02		9:45	0.35	0.071	0.28	0.11	0.33	2.45	223		187	103	8.5	478	76	14.5	6.8	8.01	425	3	Estimate
17-Sep-02		9:15	0.12	0.035	0.088	0.04	0.3	1.96	211		176	70	8.4	483	49	14.3	8.2	8.05	88	2	Estimate
9-Oct-02		9:15	0.05	0.025	0.33	0.03	0.9	2.45	241		202	150	8.4	542	102	5.7	10.6	8.45	528	1	Estimate
12-May-03		15:15	< 0.01	0.007	0.094	0.02	0.27	9.35	192		173	45	8.7	500	26	18.3	9.9	8.61		1	Estimate
4-Jun-03		10:00	0.02	0.041	0.122	0.04	0.42	0	206		169	48	8.3	480	18					4	Estimate
18-Jun-03		9:04	0.17	0.012	0.072	< 0.01	0.5	0.98	204		169	27	8.4	491	10	16.9	8.3	7.95		10	Estimate
7-Jul-03		14:45	1.36	0.081	0.163	0.78	2.72	16.7	169		166	16	9	470	23	23.3	13.9	8.5		1	Estimate
Tarter Waste																					
15-May-01		10:20	0.01	0.003	0.035	< 0.01	0.31	0.98	160	229	133	8	8.4	375	5	14.5	8.4	8.5	375	3.2	
29-May-01		10:10	< 0.01	0.003	0.03	0.01	0.27	0	159	215	130	9		364	5	15.9	10.3	8.67	364	4.1	
29-May-01	Y	10:15	< 0.01	0.003	0.036	0.02	0.26	0	159	216	130	9		363	5	15.9	10.3	8.66	364	4.1	
Snake River at Tilden Bridge																					
27-Nov-01		9:10	0.17	0.008	0.016	< 0.01	0.3	1.47	147	211	123	2	8.4	343	1	1					

[1]NE=not entered

Table E-2. Sampling data from streams, caves, and wetlands on north and west sides of American Falls Reservoir, 1997-2000.

			Duplicate sample number			Suspended sediment (mg/L)			PO_4 as P (mg/L)			NO_3+NO_2 as N (mg/L)			Flow
Waterbody	Type	Sample date	0	1	2	0	1	2	0	1	2	0	1	2	(L/sec)
Firth River Bridge	canal	19-Jun-97		2247	2248		82.49	77.68		0.01	-0.01		0.09	0.06	
Firth River Bridge	canal	2-Aug-97		2287	2288		6.39	6.82		-0.03	-0.03		0.07	0.06	
People River	canal	12-Apr-97	2152			10.6			0.04			0.94			
People River	canal	21-Apr-97	2161			36.3			0			0.65			
People River	canal	8-May-97		2168	2169		331.08	373.12		-0.04	-0.02		0.31	0.36	
People River	canal	26-May-97		2216	2217		59.2	20.64		0.02	0.02		0.19	0.19	
People River	canal	11-Jun-97		2245	2246		86.98	93.82		0.02	0.03		0.24	0.18	
People River	canal	29-Aug-97		2331	2332		2.58	2.83		0	-0.01		0.04	0.03	
People River	canal	29-Sep-97		2376	2377		4.3	4.64		0.07	0.05		0.09	0.08	
H Canal	canal	13-May-97		2176	2177		17.4	17.04		-0.04	-0.04		0.03	0.02	
H Canal	canal	2-Jun-97		2208	2214		43.92	44.08		-0.01	0.01		0.19	0.2	
H Canal	canal	7-Sep-97		2341	2342		4.58	6.16		0.01	-0.01		0.03	0.03	
H Lake	canal	13-May-97		2180	2181		18.96	19.28		-0.01	-0.01		0.56	0.78	
H Lake	canal	2-Jun-97		2205	2215		59.96	62.04		0.06	0.02		0.24	0.24	
H Lake	canal	7-Aug-97		2305	2306		8.39	8.66		-0.02	0		0	0.01	
H Lake	canal	7-Sep-97		2343	2344		7.3	8.23		0.03	0.03		0.1	0.13	
HV	canal	2-Jun-97		2207	2212		25.64	23.88		-0.01	0		0.15	0.12	
Q1 Spill	canal	2-Jun-97		2210	2218		28.68	36.44		-0.02	-0.01		0.22	0.08	
Q1 Spill	canal	11-Aug-97		2311	2312		2.93	2.19		-0.02	0.01		0	0.01	
Q1 Spill	canal	7-Sep-97		2349	2350		1.46	1.93		-0.01	-0.01		0.02	0.02	
Q1 Spill	canal	25-Sep-97		2372	2373		2.62	3.69		0	0.01		0.04	0	
T Canal	canal	13-May-97		2172	2173		33.72	33.28		-0.05	-0.07		0.02	0.03	
T Canal	canal	2-Jun-97		2206	2213		50.16	51.56		0	0		0.21	0.2	
T Canal	canal	26-Jun-97		2251	2252		37.7	38.72		-0.02	0.01		0	0	
T Canal	canal	7-Aug-97		2307	2308		9.28	9.81		0.03	0		0	0.01	
T Canal	canal	7-Sep-97		2347	2348		4.91	5.54		0.05	0.01		0.03	0.04	
T Canal	canal	3-Oct-97		2378	2379		2.85	3.18		0	-0.01		0.03	0.03	
T Lake	canal	13-May-97		2174	2175		32	30.88		-0.06	-0.01		0.02	0.01	
T Lake	canal	2-Jun-97		2209	2211		53.36	45		0.02	0.01		0.17	0.23	
T Lake	canal	12-Jun-97		2382	2383		0	0		0.05	-0.01		0	0	
V Spill	canal	13-May-97		2178	2179		13.52	13.92		-0.05	-0.01		0.03	0.02	
V Spill	canal	7-Aug-97		2309	2310		4.35	3.67		0.03	0.01		0.02	0.01	
V Spill	canal	7-Sep-97		2345	2346		1.64	1.76		-0.02	-0.02		0.03	0.05	
T Canal	run-off	31-Dec-96	2141			2430.5			1.2			1.8			
Schritter	run-off	31-Dec-96	2142			192			0			0			
T Povey	run-off	31-Dec-96	2143			8398.5			2.2			2.77			
Rain	rain	12-Jun-97	2244			26.73			-0.08			0.19			
T Povey Rain	run-off	12-Jun-97		2249	2250		1186.9	1203.1		0.54	0.42		2.92	2.92	
Rain water-thunderstorm	rain	11-Sep-97		2351	2352		13.72	10.43		0.16	0.15		0.41	0.42	
American Game	spring	21-Apr-97	2154			1.96			0.07			3.9			
American Game	spring	2-Aug-97		2303	2304		10.23	1.82		0.18	0.19		2.92	2.92	
Big Hole at Fingal Road	spring	2-Apr-97	2147			0.56			0.07			4.59			
Big Hole at Fingal Road	spring	21-Apr-97	2157			1.36			0.1			5.26			
Christiansen Drain	spring	2-Apr-97	2151			-1.06			0.19			1.98			
Christiansen Drain	spring	2-Aug-97		2299	2300		2.07	1.79		0.03	0.09		0.25	0.25	
Cornforth Spring	spring	2-Apr-97	2150			14.63			0.2			3.52			
Crystal Springs	spring	2-Aug-97		2289	2290		4.46	4.21		0.03	-0.04		2.62	2.22	
Danielson	spring	21-Apr-97	2158			13.33			-0.01			1.16			
Danielson Creek	spring	2-Aug-97		2291	2292		10.25	7.71		0	0		0.65	0.73	
Driscoll Spring	spring	2-Apr-97	2149			4.92			0			4			
Driscoll Spring	spring	2-Aug-97		2295	2296		1.57	1.68		0.26	0.17		2.92	2.85	
Spring Hollow Highway	spring	24-Apr-97		2162	2163		74.32	71.6		0.1	0.11		20.78	22.77	
Spring Hollow Highway	spring	7-Sep-97		2335	2336		11.3	9.81		0.01	0.02		2.92	2.92	
Spring Hollow Drain	spring	7-Sep-97		2339	2340		10.8	10.72		0	0		0.03	0.01	
Spring Hollow Spring	spring	7-Sep-97		2337	2338		10.49	9.32		0.04	0.05		3	2.92	
Spring Hollow Spring	spring	24-Apr-97		2164	2165		6	5.84		0.23	0.24		27.18	24.38	
Smith	spring	21-Apr-97	2155			7.46			0.08			0.02			
Smith	spring	2-Aug-97		2301	2302		24.7	31.89		0.07	0.1		0.06	0.06	
Smith 2350W 1400S	spring	27-Mar-97	2146			8.5			0.66			2.56			
Ster West Lake	spring	21-Apr-97	2160			13.74			0.06			1.91			
Sterling West	spring	21-Apr-97	2153			2.15			0.06			4.7			
Sterling East	spring	21-Apr-97		2166	2167		16.94	20.28		0.04	0		-0.03	0.06	
Sterling South Lake	spring	2-Aug-97		2293	2294		6.46	6.93		0.02	0.27		0.43	0.42	
Yuma	spring	21-Apr-97	2159			58.48			0			2.65			
Orth	wetland	21-Apr-97	2156			21.74			0.16			-0.65			
Orth Wetland	wetland	2-Apr-97	2148			28.06			0.04			-0.27			
Orth Wetland	wetland	2-Aug-97		2297	2298		16.18	14.32		0.03	0.02		0.05	0.03	
ARS Double di	misc	21-Apr-97	2197			0			-0.09			-0.57			
ARS Raw	misc	21-Apr-97	2201			0			0.08			-0.55			
ARS RO Unit di	misc	21-Apr-97	2199			0			-0.08			-0.75			
People River	canal	5-May-98		2463	2482		47.83	46.11		0.05	0.05		0.17	0.24	
People River	canal	19-May-98		2504	2520		33.11	31.92		0.09	0.03		0.18	0.19	
People River	canal	3-Jun-98		2550	2552		30.01	31.84		0.04	0.02		0.08	0.07	
People Canal	canal	15-Jun-98		2575	2590		21.82	25.38		0.05	0.03		0.08	0.08	
People Canal	canal	30-Jun-98		2632	2637		18.58	18.79		0.05	0.05		0.03	0.03	
People River	canal	14-Jul-98		2650	2659		9.58	10.07		0.03	0.02		0.08	0.09	
People River	canal	4-Aug-98		2695	2700		5.81	5.69		0.01	0.02		0.01	0.01	
People River	canal	25-Aug-98		2719	2727		4.97	4.7		0.03	0.05		0.05	0.05	
People River	canal	14-Sep-98		2788	2790		4.74	4.39		0.06	0.04		0.16	0.14	
People's Canal	canal	5-Oct-98		2817	2822		2.59	13.16		0.23	-0.04		0.05	0.04	

Table E-2. Continued.

Waterbody	Type	Sample date	Duplicate sample number			Suspended sediment (mg/L)			PO_4 as P (mg/L)			NO_3+NO_2 (mg/L)			Flow (L/sec)
			0	1	2	0	1	2	0	1	2	0	1	2	
ASCC River Gate	canal	5-May-98		2457	2468		41.34	40.15		0.04	0.06		0.21	0.18	
ASCC River Gate	canal	19-May-98		2511	2518		33.59	36.28		0.02	0.06		0.16	0.17	
ASCC River Gate	canal	3-Jun-98		2537	2543		35.5	33.21		0.04	0.04		0.08	0.1	
ASCC River Gate	canal	15-Jun-98		2574	2588		21.58	24.09		0.07	0.03		0.08	0.11	
ASCC River Gate	canal	30-Jun-98		2630	2634		18.84	19.82		0.05	0.06		0.04	0.03	
ASCC River Gate	canal	14-Jul-98		2645	2654		9.19	9.17		0.03	0.03		0.08	0.1	
ASCC River Gate	canal	4-Aug-98		2672	2681		5.77	5.51		0.02	0.02		0.01	0.02	
ASCC River Gate	canal	25-Aug-98		2721	2726		4.82	5.04		0.04	0.05		0.06	0.04	
ASCC River Gate	canal	14-Sep-98		2783	2793		5.08	4.27		0.05	0.08		0.17	0.16	
ASCC River Gate	canal	5-Oct-98		2818	2820		3	3.28		0.15	0.11		0.07	0.07	
Radio Gauge	canal	5-May-98		2461	2467		47.68	45.95		0.02	0.05		0.16	0.16	
Radio Gauge	canal	19-May-98		2507	2513		33.81	32.72		0.07	0.05		0.16	0.16	
Radio Gauge	canal	3-Jun-98		2540	2548		37.03	35.52		0.03	0.03		0.08	0.08	
Radio Gauge	canal	15-Jun-98		2577	2585		23.1	24.52		0.04	0.03		0.07	0.08	
Radio Gauge	canal	30-Jun-98		2612	2629		17.59	18.1		0.03	0.07		0.04	0.02	
Radio Gauge	canal	14-Jul-98		2649	2658		8.78	9.35		0.03	0.03		0.05	0.08	
Radio Gauge	canal	4-Aug-98		2671	2682		6.61	10.94		0	0.01		-0.01	0.01	
Radio Gauge	canal	25-Aug-98		2716	2729		6.36	5.72		0.07	0.05		0.06	0.08	
Radio Gauge	canal	14-Sep-98		2786	2787		4.42	4.37		0.07	0.07		0.14	0.17	
Radio Gauge	canal	5-Oct-98		2802	2812		2.52	2.64		0.16	0.11		0.03	0.04	
Big Fill	canal	5-May-98		2460	2484		11.4	10.73		0.03	0.06		0.06	0.13	
Big Fill	canal	19-May-98		2505	2514		17.95	19.4		0.06	0.03		0.12	0.09	
Big Fill	canal	3-Jun-98		2545	2549		35.34	27.92		0.05	0.04		0.05	0.07	
Big Fill	canal	15-Jun-98		2576	2581		25.02	27.58		0.03	0.04		0.05	0.06	
Big Fill	canal	30-Jun-98		2617	2636		20.71	17.61		0.03	0.06		-0.01	0	
Big Fill	canal	14-Jul-98		2643	2652		15.37	11.8		0.07	0.03		0.01	0.01	
Big Fill	canal	4-Aug-98		2670	2704		11.24	9.16		-0.02	0.03		0	-0.01	
Big Fill	canal	25-Aug-98		2717	2724		2.57	2.76		0.06	0.1		-0.01	0	
Big Fill	canal	14-Sep-98		2781	2791		2.5	2.47		0.05	0.05		0.07	0.07	
Big Fill	canal	5-Oct-98		2803	2814		0.99	1.6		0.18	0.12		0	-0.01	
V Spill	canal	5-May-98		2483	2490		10.89	9.96		0.09	0.06		0.03	0.05	
V Spill	canal	19-May-98		2509	2515		20.05	19.84		0.04	0.02		0.04	0.05	
V Spill	canal	3-Jun-98		2555	2560		15.86	14.75		0.04	0.04		0.04	0.02	
V Spill	canal	15-Jun-98		2582	2587		7.48	7.58		0.03	0.04		-0.01	-0.01	
V Spill	canal	30-Jun-98		2600	2609		4.87	4.52		0.03	0.04		-0.01	-0.01	
V Spill	canal	14-Jul-98		2647	2656		2.72	1.86		0.05	0.04		-0.01	0	
V Spill	canal	4-Aug-98		2683	2691		3.58	2.83		0.01	0.04		-0.01	0	
V Spill	canal	25-Aug-98		2720	2728		1.19	1.23		0.07	0.06		0	0	
V Spill	canal	14-Sep-98		2744	2784		0.92	0.86		0.06	0.18		0	0	
V Spill	canal	5-Oct-98		2801	2806		0.84	0.56		0.18	0.08		0	-0.01	
Hazard Creek	canal	5-May-98		2491	2492		61.47	67.9		0.07	0.06		0.05	0.04	2250
Hazard Creek	canal	19-May-98		2506	2516		22.68	22.86		0.1	0.08		0.19	0.18	503
Hazard Creek	canal	3-Jun-98		2558	2563		17.1	19.5		0.09	0.07		0.11	0.13	2700
Hazard Creek	canal	15-Jun-98		2579	2591		15.58	18.84		0.09	0.05		0.02	0.02	2400
Hazard Creek	canal	30-Jun-98		2605	2606		8.92	9.89		0.09	0.12		0.07	0.07	2520
Hazard Creek	canal	14-Jul-98		2648	2657		3.24	9.06		0.13	0.14		0.45	0.35	
Hazard Creek	canal	4-Aug-98		2673	2690		24.75	62.97		0.07	0.11		0.47	0.48	4200
Hazard Creek	canal	25-Aug-98		2718	2730		163.52	155.9		0.11	0.09		0.16	0.18	2000
Hazard Creek	canal	14-Sep-98		2745	2794		8.76	6.68		0.04	0.05		0.08	0.13	1800
Hazard Creek	canal	5-Oct-98		2808	2810		9.05	9.4		0.22	0.22		0.25	0.18	1500
Wilson Spill	canal	5-May-98		2480	2486		14.45	13.3		0.06	0.07		0.08	0.01	
Wilson Spill	canal	19-May-98		2512	2519		13.04	12.33		0.06	0.02		0.07	0.06	
Wilson Spill	canal	3-Jun-98		2561	2565		27.55	26.07		0.04	0.04		0.04	0.05	
Wilson Spill	canal	15-Jun-98		2580	2586		13.99	14.07		0.06	0.02		-0.01	-0.01	
Wilson Spill	canal	30-Jun-98		2603	2610		10.27	10.61		0.04	0.06		-0.01	-0.01	
Wilson Spill	canal	14-Jul-98		2646	2655		5.68	5.8		0.06	0.02		-0.01	0	
Wilson Spill	canal	4-Aug-98		2684	2696		5.53	3.24		0.05	0.01		0	-0.01	
Wilson Spill	canal	25-Aug-98		2723	2732		1.48	1.1		0.15	0.05		0	-0.01	
Wilson Spill	canal	14-Sep-98		2782	2789		2.87	2.57		0.04	0.04		0.02	0.01	
Wilson Spill	canal	5-Oct-98		2805	2807		1.23	1.06		0.09	0.08		0	0	
Cedar Spill	canal	5-May-98		2469	2487		20.68	20.86		0.02	0.05		0.04	0.04	
Cedar Spill	canal	19-May-98		2503	2508		12.62	12.83		0.12	0.03		0.05	0.04	
Cedar Spill	canal	3-Jun-98		2553	2562		44.61	37.82		0.04	0.02		0.04	0.05	
Cedar Spill	canal	15-Jun-98		2578	2584		17.87	17.47		0.01	0.02		-0.01	0.01	
Cedar Spill	canal	30-Jun-98		2602	2608		14.54	15.58		0.01	0.03		-0.01	-0.01	
Cedar Spill	canal	14-Jul-98		2644	2653		12.18	11.84		0.04	0.02		0	0	
Cedar Spill	canal	4-Aug-98		2686	2694		6.63	6.22		0.02	0.03		0	0	
Cedar Spill	canal	25-Aug-98		2722	2731		2.58	3.06		0.04	0.1		0	-0.01	
Cedar Spill	canal	14-Sep-98		2785	2792		2.87	2.58		0.08	0.04		-0.01	0	
Cedar Spill	canal	5-Oct-98		2804	2809		2.39	2.61		0.11	0.13		-0.01	0	
Danielson	spring	5-May-98		2466	2471		42.6	16.38		0.09	0.06		1.6	1.55	
Danielson	spring	3-Jun-98		2533	2539		10.59	11.08		0.05	0.07		0.85	1.12	2400
Danielson	spring	30-Jun-98		2604	2633		18.21	13.69		0.01	0.08		0.69	0.8	240
Danielson	spring	4-Aug-98		2676	2693		5.72	5.99		0.07	0.11		0.79	0.85	2200
Danielson	spring	14-Sep-98		2755	2776		0	0		0	0		1.46	1.01	2000
Danielson	spring	18-Dec-98		2849	2851		0	0		0.1	0.06		1.89	1.34	
Crystal	spring	5-May-98		2470	2473		2.01	2.64		0.06	0.11		3.79	3.48	3750
Crystal	spring	3-Jun-98		2531	2541		1.84	2.01		0.06	0.05		3.71	4.8	4500
Crystal	spring	30-Jun-98		2613	2622		3.38	2.52		0.04	0.09		4.32	4.5	1280
Crystal	spring	4-Aug-98		2675	2679		5.75	4.74		0.08	0.09		3.55	3.67	900
Crystal	spring	14-Sep-98		2754	2777		0	0		0	0		2.01	2.19	10800

Table E-2. Continued.

Waterbody	Type	Sample date	Duplicate sample number 0	1	2	Suspended sediment (mg/L) 0	1	2	PO_4 as P (mg/L) 0	1	2	NO_3+NO_2 (mg/L) 0	1	2	Flow (L/sec)
Driscoll Spring	spring	5-May-98		2475	2489		3.4	1.81		0.15	0.21		6.61	6.28	108
Driscoll Spring	spring	3-Jun-98		2529	2551		4.82	5.2		0.16	0.09		6.06	6.41	30
Driscoll Spring	spring	30-Jun-98		2615	2621		2.8	3.19		0.15	0.1		5.03	4.27	36
Driscoll Spring	spring	4-Aug-98		2677	2680		1.81	2.46		0.53	0.09		6.17	6.36	9
Driscoll Spring	spring	14-Sep-98		2757	2775		0	0		0	0		5.29	6.58	126
Driscoll Spring	spring	9-Nov-98		2827	2841		0	0		0	0		6.64	6.67	180
Smith wetland spring	spring	5-May-98		2465	2476		21.89	19.59		0.2	0.08		0.33	0.46	30
Smith Spring	spring	3-Jun-98		2532	2542		5.57	5.93		0.04	0.07		0.03	0.03	400
Smith Spring	spring	30-Jun-98		2601	2625		8.64	8		0.1	0.11		0.04	0.04	100
Smith Spring	spring	4-Aug-98		2702	2705		4.19	4.04		0.13	0.07		0	0	270
Smith Spring	spring	14-Sep-98		2749	2751		0	0		0	0		0.03	0.02	48
Smith Spring	spring	9-Nov-98		2834	2839		0	0		0	0		1.22	0.6	18
Cornforth Spring	spring	5-May-98		2464	2481		1.64	2.02		0.12	0.13		5.58	4.5	14
Cornforth Spring	spring	3-Jun-98		2554	2559		2.33	2.85		0.31	0.28		1.86	2.19	30
Cornforth Spring	spring	30-Jun-98		2614	2624		1.81	1.27		0.22	0.28		1.41	1.7	198
Cornforth Spring	spring	4-Aug-98		2689	2706		7.58	6.52		0.16	0.16		2.53	1.96	24
Cornforth Spring	spring	14-Sep-98		2746	2750		0	0		0	0		0.18	0.19	15
Cornforth Spring	spring	9-Nov-98		2826	2828		0	0		0	0		0.81	0.82	12
Sportsman Park North Spring	spring	9-Nov-98		2832	2835		0	0		0	0		5.6	3.72	20
Poulson Spring	spring	15-Sep-98		2762	2769		0	0		0	0		9.35	3	
Poulson Spring	spring	18-Dec-98		2845	2848		0	0		0.09	0.04		1.72	2.01	
Spring Hollow Drain	spring	5-May-98		2459	2478		14.61	13.56		0.02	0.05		0.1	0.03	3
Spring Hollow Drain	spring	3-Jun-98		2557	2566		185.5	186.79		0.04	0.05		0.05	0.04	120
Spring Hollow Drain	spring	30-Jun-98		2607	2635		158.33	158.12		0.04	0.02		-0.01	-0.01	20
Spring Hollow Drain	spring	5-Aug-98		2685	2698		58.7	54.49		0.03	0.02		0	0	400
Spring Hollow Drain	spring	14-Sep-98		2748	2758		0	0		0	0		0	0	
Spring Hollow Drain	spring	5-Oct-98		2811	2815		6.12	5.89		0.14	0.17		0	-0.01	30
Spring Hollow at Spring	spring	9-Nov-98		2823	2830		0	0		0.36	0.38		47.63	41.55	16
Spring Hollow at Spring	spring	18-Dec-98		2846	2850		0	0		0.22	0.19		38.65	37.13	
Spring Hollow	spring	5-May-98		3050	2474		2479	18.93		20.38	0.06		0.07	9.35	9.64
Spring Hollow Highway 39	spring	3-Jun-98		2556	2564		18.16	18.87		0.01	0.07		5.84	6.06	
Spring Hollow Hwy 39	spring	30-Jun-98		2611	2627		6.19	7.1		0.04	0.04		4.25	4.82	
Spring Hollow Hwy 39	spring	4-Aug-98		2692	2701		25.41	27.16		0.06	0.03		6.11	6.83	
Spring Hollow Hwy 39	spring	14-Sep-98		2743	2747		502.94	505.11		0	0		6.58	5.76	180
Spring Hollow Hwy 39	spring	5-Oct-98		2813	2816		151.64	152.92		0.1	0.19		15.13	17.34	120
Spring Hollow Hwy 39	spring	9-Nov-98		2824	2831		0	0		0.31	0.29		41.55	29.68	
Sterling wetland	wetland	5-May-98		2458	2494		7.62	9.6		0.08	0.09		2.62	2.67	160
Sterling Wetlands	wetland	3-Jun-98		2535	2547		5.14	4.92		0.08	0.07		1.66	1.32	420
Sterling Wetlands	wetland	30-Jun-98		2618	2623		9.36	4.43		0.15	0.15		1.24	1.13	315
Sterling Wetlands	wetland	4-Aug-98		2669	2687		4.52	3.5		0.03	0.08		0.26	0.22	220
Sterling Wetlands	wetland	14-Sep-98		2752	2753		0	0		0	0		0.66	0.9	600
Sterling Wetland	wetland	9-Nov-98		2825	2833		0	0		0	0		1.19	1.46	780
Orth Wetland	wetland	5-May-98		2488	2493		34.58	31.02		0.14	0.08		0.1	0.07	600
Orth Wetlands	wetland	3-Jun-98		2534	2546		8.72	8		0.04	0.04		1.22	0.74	1050
Orth Wetlands	wetland	30-Jun-98		2619	2626		4.66	5.24		0.04	0.04		0.5	0.35	210
Orth Wetlands	wetland	4-Aug-98		2674	2678		41.43	50.25		0.06	0.11		0.28	0.38	150
Orth Wetlands	wetland	14-Sep-98		2756	2780		0	0		0	0		0.61	0.59	150
Orth Wetland	wetland	9-Nov-98		2838	2842		0	0		0	0		1.11	1.28	60
Christensen Wetlands	wetland	5-May-98		2462	2472		14.46	15.81		0.2	0.19		0.05	0.08	6
Christensen Wetlands	wetland	3-Jun-98		2530	2538		6.41	6.62		0.08	0.02		0.07	0.11	150
Christensen Wetlands	wetland	30-Jun-98		2616	2631		7.32	6.41		0.05	0.05		0.03	0.02	50
Christensen Wetlands	wetland	4-Aug-98		2688	2699		13.8	15.1		0.06	0.02		0	0.01	42
Christensen Wetlands	wetland	14-Sep-98		2778	2779		0	0		0	0		0.23	0.24	75
Christensen Wetlands	wetland	9-Nov-98		2837	2840		0	0		0	0		4.85	4.23	6
Deionized Water	misc	5-May-98		2477	2485		0.1	0.3		0.01	0.03		0.03	0.04	
Deionized Water	misc	19-May-98		2510	2517		0.27	0.14		0	0		0.03	0.03	
Deionized Water	misc	3-Jun-98		2536	2544		0	0.29		-0.02	-0.01		0.03	-0.01	
DI Water	misc	15-Jun-98		2583	2589		0	0		-0.01	0		-0.02	-0.02	
DI Water	misc	30-Jun-98		2620	2628		-0.27	-0.37		-0.01	-0.01		-0.01	-0.01	
DI Water	misc	14-Jul-98		2651	2660		-0.33	-0.11		0.01	0.01		-0.01	-0.01	
DI Water	misc	4-Aug-98		2697	2703		-0.27	-0.82		0	-0.02		-0.01	-0.01	
DI Water	misc	25-Aug-98		2715	2725		-0.19	-0.81		0.07	0.05		-0.01	-0.01	
DI Water	misc	14-Sep-98		2795	2796		0	0		0.04	0.02		-0.01	-0.01	
DI Water	misc	5-Oct-98		2819	2821		-0.35	-0.71		0	0		0	-0.01	
DI Water	misc	9-Nov-98		2829	2836		0	0		0	0		0	0	
DI Water	misc	18-Dec-98		2847	2852		0	0		-0.03	-0.01		0	0	
People Gate	canal	27-Apr-99		2920	2928		22.91	21.17		0.003	0.004		0.11	0.154	
People Gate	canal	20-May-99		2971	2995		23.58	23.22		0.002	0.005		0.041	0.094	
People Gate	canal	24-Jun-99		3067	3070		34	33.26		0.004	0.033		0.064	0.021	
People Gate	canal	19-Jul-99		3084	3087		5.8	6.03		0.003	0.004		0.018	0.009	
People Gate	canal	17-Aug-99		3148	3166		5.75	4.72		0.012	0.009		0.055	0.057	
People Gate	canal	20-Sep-99		3181	3188		3.4	2.76		0.003	0.002		0.017	0.028	
People Gate	canal	27-Oct-99		3257	3262		3.35	2.81		0.005	0.003		0.046	0.05	
People Gate	canal	25-Nov-99		3303	3316		2.96	3.41		0.004	0.005		0.112	0.175	
ASCC Gate	canal	27-Apr-99		2937	2938		17.95	6.61		0.003	0.004		0.241	0.137	
ASCC Gate	canal	20-May-99		2977	2980		23.23	22.71		0.003	0.004		0.113	0.1	
ASCC Gate	canal	22-Jun-99		3055	3064		30.18	30.02		0.002	0.003		0.058	0.056	
ASCC Gate	canal	19-Jul-99		3081	3086		5.72	7.07		0.002	0.003		0.021	0.025	
ASCC Gate	canal	17-Aug-99		3146	3164		5.48	4.97		0.008	0.007		0.048	0.058	
ASCC Gate	canal	20-Sep-99		3183	3184		4.65	5.95		0.004	0.002		0.016	0.024	
ASCC Gate	canal	27-Oct-99		3240	3253		3.57	4.16		0.005	0.004		0.126	0.041	
ASCC Gate	canal	25-Nov-99		3299	3318		2.27	4.91		0.005	0.007		0.147	0.177	

Table E-2. Continued.

Waterbody	Type	Sample date	Duplicate sample number			Suspended sediment (mg/L)			PO_4 as P (mg/L)			NO_3+NO_2 (mg/L)			Flow (L/sec)
			0	1	2	0	1	2	0	1	2	0	1	2	
Radio Gauge	canal	27-Apr-99		2915	2926		16.57	16.34		0.002	0.005		0.27	0.157	
Radio Gauge	canal	20-May-99		2964	2978		22.88	22.48		0.005	0.004		0.069	0.09	
Radio Gauge	canal	24-Jun-99		3063	3069		32.07	32.9		0.002	0.015		0.062	0.164	
Radio Gauge	canal	19-Jul-99		3075	3080		7.92	7.67		0.002	0.003		0.061	0.018	
Radio Gauge	canal	17-Aug-99		3138	3152		7.14	6.81		0.009	0.006		0.081	0.053	
Radio Gauge	canal	20-Sep-99		3179	3191		5.7	4.85		0.003	0.001		0.017	0.029	
Radio Gauge	canal	27-Oct-99		3247	3265		3.56	3.85		0.003	0.004		0.042	0.043	
Big Fill	canal	27-Apr-99		2925	2935		8.4	5.96		0.007	0.002		0.055	0.064	
Big Fill	canal	20-May-99		2991	2993		8.88	8.81		0.003	0.005		0.03	0.015	
Big Fill	canal	24-Jun-99		3052	3061		37.88	34.9		0.002	0.002		0.028	0.038	
Big Fill	canal	19-Jul-99		3085	3088		20.47	15		0.003	0.003		0.003	0.001	
Big Fill	canal	17-Aug-99		3155	3158		6.82	6.2		0.006	0.01		0.028	0.026	
Big Fill	canal	20-Sep-99		3180	3187		6.54	7.06		0.001	0.002		0.011	0	
Big Fill	canal	27-Oct-99		3243	3245		4.23	6.29		0.003	0.002		0	0	
V Spill	canal	27-Apr-99		2902	2908		18.02	10.39		0.003	0.004		0.303	0.101	
V Spill	canal	20-May-99		2944	2953		9.72	7.83		0.002	0.002		0	0.131	
V Spill	canal	24-Jun-99		3015	3018		10.9	9.21		0.002	0.001		0.006	0.006	
V Spill	canal	19-Jul-99		3107	3112		6.96	5.81		0.004	0.01		0.002	0.038	
V Spill	canal	17-Aug-99		3125	3129		5.4	3.88		0.006	0.006		0.01	0.01	
V Spill	canal	20-Sep-99		3216	3224		2.35	2.77		0.001	0.002		0.01	0.017	
V Spill	canal	27-Oct-99		3260	3263		3.09	2.06		0.004	0.002		0.006	0.005	
Wilson Spill	canal	27-Apr-99		2891	2904		25.47	14.41		0.002	0.003		0.097	0.131	
Wilson Spill	canal	20-May-99		2947	2957		5.44	8.13		0.003	0.003		0.007	0.01	
Wilson Spill	canal	24-Jun-99		3020	3039		12.95	14.21		0.001	0.001		0	0.004	
Wilson Spill	canal	19-Jul-99		3111	3120		7.29	8.33		0.003	0.004		0.005	0.014	
Wilson Spill	canal	17-Aug-99		3142	3151		4.27	3.24		0.006	0.006		0.031	0.027	
Wilson Spill	canal	20-Sep-99		3208	3227		3.27	3.23		0.001	0.002		0.019	0.012	
Wilson Spill	canal	27-Oct-99		3283	3289		2.69	2.81		0.002	0.002		0.002	0	
Q1 Spill	canal	27-Apr-99		2912			9.25			0.003			0.068		
Q1 Spill	canal	20-May-99		2988	2992		9.01	9.67		0.002	0.003		0.001	0	
Q1 Spill	canal	24-Jun-99		3054	3057		15.87	16.48		0.001	0.001		0.005	0.004	
Q1 Spill	canal	19-Jul-99		3074	3077		6.96	6.42		0.004	0.003		0.001	0.007	
Q1 Spill	canal	17-Aug-99		3139	3162		5.07	2.58		0.006	0.003		0.005	0.033	
Q1 Spill	canal	20-Sep-99		3201	3211		1.82	1.88		0.002	0.003		0.006	0.007	
Q1 Spill	canal	27-Oct-99		3282	3290		2.09	2.78		0.002	0.003		0	0.008	
Cedar Spill	canal	27-Apr-99		2901	2905		13.27	15.31		0.003	0.002		0.301	41.693	
Cedar Spill	canal	20-May-99		2941	2945		7.67	10.28		0.002	0		0	0	
Cedar Spill	canal	24-Jun-99		3041	3046		32.95	35.26		0.001	0.001		0.006	0.002	
Cedar Spill	canal	19-Jul-99		3092	3097		23.51	23.79		0.003	0.004		0.006	0.152	
Cedar Spill	canal	17-Aug-99		3126	3140		4.23	4.56		0.008	0.005		0.017	0	
Cedar Spill	canal	20-Sep-99		3207	3237		7.94	7.78		0.001	0.002		0.015	0.011	
Cedar Spill	canal	27-Oct-99		3274	3279		3.84	5.01		0.003	0.003		0	0	
Hazard Creek	misc	27-Apr-99		2907	2909		41.76	39.8		0.026	0.027		0.424	0.31	
Hazard Creek	misc	20-May-99		2958	2959		20.01	21.87		0.002	0.003		0.019	0.016	
Hazard Creek	misc	24-Jun-99		3022	3045		19.45	2.81		0.008	0.01		0.054	0.039	
Hazard Creek	misc	19-Jul-99		3110	3114		15.64	14.39		0.013	0.018		0.019	0.013	
Hazard Creek	misc	17-Aug-99		3124	3177		8.04	9.17		0.012	0.012		0.073	0.075	
Hazard Creek	misc	20-Sep-99		3204	3212		7.53	8.73		0.01	0.013		0.184	0.156	
Hazard Creek	misc	27-Oct-99		3254	3255		8.78	8.62		0.028	0.031		0.237	0.233	
Hazard Creek	misc	25-Nov-99		3300	3307		11.87	12.28		0.599	0.639		1.824	1.775	
Spring Hollow Drain	misc	20-May-99		2943	2950		171.33	188.2		0.003	0.003		0.001	0.109	
Spring Holow Drain	misc	24-Jun-99		3021	3036		187.38	195.06		0.002	0.003		0.003	0.001	
Spring Hollow Drain	misc	19-Jul-99		3098	3118		41.36	44.12		0.007	0.005		0.007	0.005	
Spring Hollow Drain	misc	17-Aug-99		3127	3143		30.46	36.85		0.01	0.007		0.012	0.019	
Spring Hollow Drain	misc	20-Sep-99		3203	3236		15.12	14.67		0.001	0.004		0.009	0.004	
Spring Hollow Drain	misc	27-Oct-99		3276	3280		5.47	5.01		0.003	0.003		0	0.005	
Spring Hollow Highway	spring	18-Mar-99		2864	2868								7.27	6.93	
Spring Hollow Highway	misc	27-Apr-99		2903	2910		44.26	45.57		0.008	0.005		7.619	0.115	
Spring Hollow Highway	misc	20-May-99		2949	2952		17.42	18.12		0.002	0.003		6.125	7.798	
Spring Hollow Highway	misc	24-Jun-99		3031	3033		14.87	14.2		0.002	0.001		3.313	2.669	
Spring Hollow Highway	misc	19-Jul-99		3091	3103		15.18	16.3		0.005	0.006		4.429	4.842	
Spring Hollow Highway	misc	17-Aug-99		3132	3137		548.94	556.82		0.021	0.023		6.087	5.044	
Spring Hollow Highway	misc	20-Sep-99		3217	3228		77.02	73.07		0.008	0.013		5.147	7.592	
Spring Hollow Highway	misc	27-Oct-99		3272	3275		94.61	92.79		0.009	0.009		4.306	4.555	
Spring Hollow Highway	misc	25-Nov-99		3297	3321		161.81	159.34		0.017	0.017		32.461	34.302	
Danielson	spring	27-Apr-99		2918	2921		51.35	75.64		0.002	0.002		1.106	1.117	
Danielson	spring	20-May-99		2970	2982		15.97	10.37		0.001	0.002		0.804	0.833	
Danielson Creek	spring	24-Jun-99		3032	3044		5.29	5.31		0.003	0.002		0.477	0.333	
Danielson Creek	spring	19-Jul-99		3096	3102		8.56	7.29		0.004	0.01		0.275	0.483	
Danielson Creek	spring	17-Aug-99		3160	3170		4.12	3.17		0.004	0.01		0.442	0.459	
Danielson Creek	spring	20-Sep-99		3223	3229		5.71	6.45		0.006	0.007		0.545	0.509	
Danielson Creek	spring	27-Oct-99		3256	3267		18.07	7.22		0.006	0.007		0.689	0.694	
Danielson Creek	spring	25-Nov-99		3319	3324		13.26	11.59		0.008	0.013		0.986	0.91	
Crystal Springs	spring	18-Mar-99		2859	2861								2.6	3	
Crystal	spring	27-Apr-99		2916	2924		6.09	6.09		0.002	0.007		2.63	2.411	
Crystal	spring	20-May-99		2965	2973		10.13	8.32		0.002	0		2.22	2.117	
Crystal	spring	24-Jun-99		3024	3043		6.17	5.61		0.003	0.002		2.011	1.2	
Crystal Springs	spring	19-Jul-99		3076	3072		3.58	4.19		0.004	0.003		1.147	0.738	
Crystal Springs	spring	17-Aug-99		3144	3149		7.08	7.78		0.006	0.004		1.493	1.524	
Crystal Springs	spring	20-Sep-99		3210	3230		5.14	5.9		0.003	0.006		2.099	2.229	
Crystal Springs	spring	27-Oct-99		3248	3268		4.29	4.39		0.009	0.009		1.861	1.882	
Crystal Springs	spring	25-Nov-99		3301	3312		5.86	7.02		0.009	0.008		1.818	1.557	

Table E-2. Continued.

Waterbody	Type	Sample date	Duplicate sample number 0	1	2	Suspended sediment (mg/L) 0	1	2	PO_4 as P (mg/L) 0	1	2	NO_3+NO_2 (mg/L) 0	1	2	Flow (L/sec)
Driscoll Spring	spring	18-Mar-99		2863	2875								3.83	4.67	
Driscoll	spring	27-Apr-99		2913	2914		37.02	34.23		0.005	0.006		4.196	4.115	
Driscoll	spring	20-May-99		2946	2956		22.86	18.12		0.003	0.003		2.63	3.608	
Driscoll	spring	24-Jun-99		3030	3040		12.91	17.46		0.003	0.002		2.652	4.078	
Driscoll Spring	spring	19-Jul-99		3100	3105		16.42	18.14		0.012	0.013		1.675	1.302	
Driscoll Spring	spring	17-Aug-99		3161	3169		1.71	2.05		0.007	0.014		3.072	2.831	
Driscoll Spring	spring	20-Sep-99		3202	3205		2.23	1.75		0.003	0.003		3.798	3.118	
Driscoll Spring	spring	27-Oct-99		3258	3269		12.07	1.77		0.006	0.005		3.524	3.57	
Driscoll Spring	spring	25-Nov-99		3308	3315		2.23	1.73		0.011	0.009		3.338	3.061	
Sterling Wetland	spring	18-Mar-99		2853	2865								2.83	2.93	
Cornforth Spring	spring	18-Mar-99		2866	2856								3.67	3	
Cornforth	spring	27-Apr-99		2931	2932		6.95	9.42		0.015	0.012		3.955	3.733	
Cornforth	spring	20-May-99		2955	2960		11.09	9.91		0.011	0.007		3.218	2.931	
Cornforth	spring	24-Jun-99		3023	3025		4.33	4.25		0.018	0.018		2.303	2.833	
Cornforth Spring	spring	19-Jul-99		3089	3108		5.17	2.97		0.014	0.01		2.682	1.846	
Cornforth Spring	spring	17-Aug-99		3168	3174		4.94	4.69		0.022	0.022		2.485	2.457	
Cornforth Spring	spring	20-Sep-99		3200	3214		5.37	5.57		0.054	0.047		1.632	1.62	
Cornforth Spring	spring	27-Oct-99		3252	3264		5.4	5.99		0.032	0.037		1.356	1.401	
Cornforth Spring	spring	25-Nov-99		3295	3302		3.72	3.61		0.016	0.02		1.395	1.522	
Sportsmen's Park N	spring	17-Aug-99		3133	3167		2.86	2.78		0.041	0.036		3.225	2.622	
Poulson Spring	spring	20-Sep-99		3219	3233		3569.8	2661		0.018	0.047		4.4	3.709	
Poulson Spring	spring	27-Oct-99		3277	3291		354.83	248.7		0.028	0.027		3.143	3.07	
Poulson Spring	spring	25-Nov-99		3313	3323		130.24	27.44		0.044	0.011		5.286	6.424	
Spring Hollow Spring	spring	27-Apr-99		2900	2906		4.59	0		0.057	0.048		44.351	44.422	
Spring Hollow Spring	spring	25-Nov-99		3298	3309		2.56	3.15		0.052	0.063		35.715	48.348	
Spring Hollow Spring	spring	18-Mar-99		2855	2872								20.33	35.33	
Sterling	wetland	27-Apr-99		2919	2934		56.77	61.72		0.005	0.005		2.12	2.038	
Sterling	wetland	20-May-99		2974	2979		18.72	24.59		0.002	0.005		1.533	0.772	
Sterling	wetland	24-Jun-99		3028	3047		13.13	11.81		0.007	0.008		0.631	0.387	
Sterling Wetland	wetland	19-Jul-99		3078	3093		5.9	4.87		0.01	0.011		0.742	0.533	
Sterling Wetland	wetland	17-Aug-99		3150	3172		3.29	3.21		0.009	0.008		0.503	0.533	
Sterling Wetland	wetland	20-Sep-99		3220	3234		4.99	4.14		0.003	0.006		0.928	0.106	
Sterling Wetland	wetland	27-Oct-99		3266	3270		25.52	24.91		0.025	0.021		1.371	1.195	
Sterling Wetland	wetland	25-Nov-99		3292	3296		79.46	81.14		0.018	0.013		1.823	1.701	
Orth	wetland	27-Apr-99		2922	2936		68.91	64.21		0.028	0.03		0.092	0.132	
Orth	wetland	20-May-99		2940	2948		35.25	36.75		0.006	0.006		0.225	0.203	
Orth	wetland	24-Jun-99		3017	3035		9.12	9.43		0.005	0.005		0.064	0.072	
Orth Wetland	wetland	19-Jul-99		3090	3095		3.87	2.4		0.016	0.021		0.027	0.063	
Orth Wetland	wetland	17-Aug-99		3156	3176		14.23	14.96		0.009	0.01		0.069	0.089	
Orth Wetland	wetland	20-Sep-99		3215	3238		7.17	7.97		0.003	0.005		0.215	0.009	
Orth Wetland	wetland	27-Oct-99		3244	3251		8.16	8.3		0.003	0.003		1.28	1.315	
Orth Wetland	wetland	25-Nov-99		3293	3305		65.88	68.68		0.004	0.004		1.954	1.97	
Christiansen Canal	wetland	20-May-99		2942	2961		16.17	17.04		0.003	0.003		0.302	0.382	
Christiansen	wetland	24-Jun-99		3016	3042		3.78	2.81		0.004	0.003		0.054	0.05	
Christiansen #2	wetland	19-Jul-99		3094	3113		1.74	1.84		0.009	0.013		0.016	0.012	
Christiansen #2	spring	17-Aug-99		3165	3171		1.62	1.71		0.011	0.009		0.091	0.088	
Christiansen #2	wetland	20-Sep-99		3213	3218		6.27	6.37		0.003	0.001		0.319	0.309	
Christiansen	wetland	27-Apr-99		2923	2927		121.31	118.72		0.009	0.006		0.462	0.424	
Christiansen	wetland	20-May-99		2967	2972		4.94	5.69		0.005	0.002		1.219	1.083	
Christiansen	wetland	24-Jun-99		3019	3026		5.45	8.82		0.003	0.003		0.013	0.012	
Christiansen Wetland	wetland	19-Jul-99		3109	3115		2.98	2.53		0.008	0.01		0.016	0.014	
Christiansen Wetland	wetland	17-Aug-99		3159	3163		2.93	3.8		0.007	0.009		0.033	0.033	
Christiansen Wetland	wetland	20-Sep-99		3231	3232		4.42	4.06		0.006	0.002		0.108	0.824	
Christiansen Wetland	wetland	27-Oct-99		3246	3249		55.53	53.03		0.003	0.004		0.251	0.246	
Smith	wetland	27-Apr-99		2917	2929		15.27	16.09		0.003	0.005		0.28	0.324	
Smith	wetland	20-May-99		2951	2954		8.52	9.02		0.007	0.006		0.194	0.195	
smith	wetland	24-Jun-99		3034	3037		26.03	23.59		0.005	0.006		0.018	0.004	
Smith Spring	wetland	19-Jul-99		3099	3106		38.99	5.6		0.012	0.01		0.009	0.001	
Smith	wetland	17-Aug-99		3135	3136		4.55	5.17		0.012	0.011		0.015	0.016	
Smith Spring	wetland	20-Sep-99		3225	3226		7.5	6.99		0.004	0.005		0.018	0.017	
Smith Spring	wetland	27-Oct-99		3261	3271		9.54	7.9		0.003	0.004		0.855	0.669	
Smith Spring	wetland	25-Nov-99		3294	3310		19.35	14.84		0.003	0.007		1.084	1.533	
People's River Gates	canal	19-Jun-00		3338	3365		11.41	9		0.01	0.01		0.07	0.15	
People's River Gates	canal	2-Aug-00		3378	3379		13.58	5.77		0	0.01		0.02	0.04	
People's River Gates	canal	17-Oct-00		3446	3462		2.17	2.64		0.01	0		0.11	0.13	
ASCC Gate	canal	19-Jun-00		3334	3360		11.42	9.6		0.02	0		0.07	0.09	
River Gates	canal	2-Aug-00		3391	3394		8.88	13.8		0	0		0.02	0.04	
ASCC River Gates	canal	17-Oct-00		3468	3471		2.03	2.86		0	0		0.12	0.12	
Radio Gauge	canal	19-Jun-00		3328	3332		8.2	11.21		0.01	0		0.12	0.09	
Radio Gauge	canal	17-Oct-00		3464	3470		0.81	1.61		0	0.01		0.1	0.1	
Big Fill	canal	19-Jun-00		3331	3348		19.42	15.82		0.01	0.01		0.05	0.14	
Big Fill	canal	2-Aug-00		3377	3381		9.26	9.95		0	0		0	0	
Big Fill	canal	17-Oct-00		3444	3457		1.51	-0.73		0	0.01		0.01	0.01	
V Spill	canal	19-Jun-00		3351	3373		6.26	5.48		0.01	0		0.01	0	
V Spill	canal	2-Aug-00		3395	3401		5.25	4.5		0.01	0		0	0.03	
V Spill	canal	17-Oct-00		3430	3434		0.43	1.11		0.02	0.01		0.01	0.01	
Wilson Spill	canal	19-Jun-00		3346	3367		6.05	5.46		0.01	0.01		0.01	0	
Wilson Spill	canal	2-Aug-00		3396	3409		4.98	4.7		0	0		0.01	0.01	
Wilson Spill	canal	17-Oct-00		3419	3438		7.68	1.27		0.01	0.01		0.04	0	

Table E-2. Continued.

			Duplicate sample number			Suspended sediment (mg/L)			PO_4 as P (mg/L)			NO_3+NO_2 (mg/L)			Flow
Waterbody	Type	Sample date	0	1	2	0	1	2	0	1	2	0	1	2	(L/sec)
Q1 Spill	canal	19-Jun-00		3341	3363		4.81	4.97		0.01	0		0	0	
Q1 Spill	canal	16-Jun-00		3487	3503		3.59	2.46		0.02	0.01		0.23	0.12	
Q1 Spill	canal	17-Jun-00		3491	3508		0.79	2.26		0.01	0.02		0.31	0.15	
Q1 Spill	canal	2-Aug-00		3399	3407		5.23	3.47		0.01	0.01		0.03	0	
Q1 Spill	canal	17-Oct-00		3421	3431		4.12	0.51		0.04	0.01		0.03	0.01	
Cedar Spill	canal	19-Jun-00		3339	3366		18.16	16.7		0.01	0.01		0.03	0.05	
Cedar Spill	canal	2-Aug-00		3402	3408		26.67	10.54		0	0		0.01	0	
Cedar Spill	canal	17-Oct-00		3416	3435		2.96	3.92		0.01	0.02		0.02	0.01	
Hazard Creek	misc	19-Jun-00		3336	3354		13.36	15.64		0.02	0.02		0.62	0.39	
Hazard Creek	misc	2-Aug-00		3403	3406		28.98	30.64		0.02	0.02		0.05	0.04	
Hazard Creek	misc	17-Oct-00		3418	3427		18.78	13.52		0.02	0.04		0.14	0.16	
Spring Hollow Drain	misc	19-Jun-00		3337	3345		59.42	75.38		0.12	0.09		2.39	3.06	
Spring Hollow Drain	misc	2-Aug-00		3398	3400		10.45	6.37		0.01	0.01		5.82	5.32	
Spring Hollow Drain	misc	17-Oct-00		3429	3433		10.48	12.38		0.01	0.01		0	0	
Spring Hollow Hwy	misc	2-Aug-00		3410	3411		28.02	27.75		0.01	0.02		8.43	11.21	
Spring Hollow Hwy	misc	17-Oct-00		3432	3437		714.71	697.96		0.02	0.02		8.68	8.62	
Danielson	spring	19-Jun-00		3349	3364		10.28	7		0.01	0.01		0.42	0.34	
Danielson	spring	2-Aug-00		3387	3392		11.83	7.26		0.01	0.01		0.35	0.38	
Danielson	spring	17-Oct-00		3456	3469		2.76	4.53		0	0.01		0.68	0.64	
Crystal	spring	19-Jun-00		3347	3357		9.07	7.04		0.01	0		2.07	1.38	
Crystal	spring	2-Aug-00		3389	3390		5.86	7.74		0	0.01		1.18	1.54	
Crystal	spring	17-Oct-00		3448	3467		38.96	28.52		0.01	0.02		1.79	1.91	
Driscoll	spring	19-Jun-00		3343	3350		4.66	4.28		0.01	0		3.36	3.34	
Driscoll	spring	2-Aug-00		3376	3383		21.06	27.98		0.01	0		1.17	1.5	
Driscoll	spring	17-Oct-00		3443	3451		16.39	14.14		0.01	0.01		3.06	3.42	
Cornforth	spring	19-Jun-00		3342	3359		11.92	7.46		0.03	0.02		1.97	1.49	
Cornforth	spring	2-Aug-00		3397	3405		15.69	11.6		0.01	0.01		1.94	3.05	
Cornforth	spring	17-Oct-00		3449	3466		14.12	10.69		0.11	0.09		1.31	0.93	
Sportsmens' N	spring	17-Oct-00		3447	3455		3.9	3.7		0.03	0.02		3.25	3.34	
Poulson Spring	spring	17-Oct-00		3424			6.65	0		0.01	0		0.14	0	
Spring Hollow Spring	spring	17-Oct-00		3417	3420		10.7	9.6		0.04	0.02		16.08	15.9	
Sterling	wetland	19-Jun-00		3333	3355		7.18	17.14		0.01	0.01		0.94	0.77	
Sterling	wetland	2-Aug-00		3386	3393		5.6	5.81		0.01	0.01		0.16	0.16	
Sterling	wetland	17-Oct-00		3453	3460		5.06	4.66		0.02	0.03		1.18	1.2	
Orth	wetland	17-Oct-00		3422	3426		11.09	9.43		0.02	0.02		0.64	0.67	
Christiansen Canal	wetland	17-Oct-00		3423	3439		5.22	6.1		0.03	0.02		1.09	1.2	
Christiansen	wetland	19-Jun-00		3329	3352		8.88	10.68		0.01	0.03		0.01	0.02	
Christiansen	wetland	2-Aug-00		3380	3382		4.6	3.42		0	0.01		0.02	0.02	
Christiansen	wetland	17-Oct-00		3454	3463		7.25	9.1		0.01	0.01		0.29	0.28	
Smith	wetland	19-Jun-00		3369	3374		15.37	13.78		0.01	0.01		0.1	0.15	
Smith	wetland	2-Aug-00		3384	3385		21.46	24.07		0.02	0.01		0.01	0.01	
Smith	wetland	17-Oct-00		3442	3465		2.32	3.17		0	0		0.02	0.05	
Rainwater	rain	18-Aug-00		3368	3372		13.38	12.86		0.07	0.06		1.01	1.01	
DI	misc	17-Oct-00		3452	3461		-3.3	-0.87		0.01	0.01		0	0.02	
DI	misc	19-Jun-00		3358	3371		0.47	2.21		0.01	0.01		0.01	0	
DI	misc	2-Aug-00		3388	3404		1.41	0.63		0.01	0		0	0	
DI	misc	17-Oct-00		3436	3440		-0.71	-1.5		0.04	0.01		0.01	0	
DI	misc	15-Nov-00		3498	3510		-2.19	-4.19		0.01	0.01		0	0.01	

Table E-3. Sampling data from streams, canals, and wetlands on north and west sides of American Falls Reservoir, 2001 to 2002.

Waterbody	Date	Duplicate sample number		Suspended sediment (mg/L)		NO_3+NO_2 as N (mg/L)		PO_4 as P (mg/L)		Total N (mg/L)		Total P (mg/L)	
		1	2	1	2	1	2	1	2	1	2	1	2
Snake at Idaho Falls	18-Apr-01	3517	3551	25	19	0.068	0.065	0.005	0.634	0.55	0.51	0.02	0.03
Snake at Shelley	18-Apr-01	3514	3534	30	20	0.126	0.122	0.006	0.007	1.34	1.09	0.02	0.04
Snake at People's	18-Apr-01	3512	3515	31	31	0.091	0.086	0.008	0.004	-0.3	0.1	-0.01	0.02
Snake at ASCC Gate	19-Jun-01	3558	3575	18	23	0.068	0.082	0.01	0.021	0.07	0.27	0.01	0.01
Snake at ASCC Gate	7-Aug-01	3602	3604	27	26	0.053	0.057	0.003	0.005	0.07	0.14	0.01	0.01
Snake at ASCC Gate	19-Sep-01	3605	3609	17	22	0.011	0.024	0.005	0.012	0.29	0.42	0.01	0.01
Snake at People's	17-May-02	3645	3658	20	16	0.008	0.012	0.003	0.004	0.1	0.03	0.02	0.01
Snake at ASCC Gate	14-Jun-02	3678	3687	8	8	0.014	0.016	0.002	0.002	0.22	0.12	0.06	0
Snake at ASCC Gate	9-Aug-02	3711	3718	6	5	0.021	0.026	0.004	0.006	0.06	0.25	0.02	0.03
Snake at ASCC Gate	27-Sep-02	3732	3733	2	-1						0.09		0.02
Radio Gauge	19-Jun-01	3567	3570	21	23	0.07	0.072	0.012	0.006	0.08	0.08	0.01	0.01
Radio Gauge	7-Aug-01	3590	3592	21	20	0.042	0.042	0.008	0.005	0.02	-0.06	0.01	0
Radio Gauge	19-Sep-01	3611	3626	22	14	0	0.013	0.004	0.017	-0.13	0.22	0.01	0.01
Radio Gauge	17-May-02	3642	3650	23	20	0.012	0.008	0.01	0.004	0.15	0.1	0.02	0.03
Radio Gauge	14-Jun-02	3674	3677	24	11	0.012	0.009	0.002	0.002	0.35	0.11	0.03	0.08
Radio Gauge	9-Aug-02	3698	3712	5	3	0.02	0.02	0.005	0.005	0	0.11	0.02	0.02
Big Fill	19-Jun-01	3566	3568	17	21	0.033	0.034	0.018	0.007	0.14	-0.05	0	0
Big Fill	7-Aug-01	3577	3584	16	17	0.014	0.001	0.219	0.006	-0.02	-0.07	0	0
Big Fill	19-Sep-01	3615	3632	19	14	0.011	0.003	0.02	0.008	0.11	0.04	0.01	0.01
Big Fill	17-May-02	3641	3656	16	20	0.01	0.007	0.002	0.001	0.06	0.07	0.03	0.02
Big Fill	14-Jun-02	3664	3690	11	12	0.005	0.01	0.004	0.002	0.13	0.1	0.01	0
Big Fill	9-Aug-02	3700	3706	2	2	0.014	0.007	0.003	0.001	0.06	0.09	0.02	0.02
V Spill	19-Jun-01	3572	3573	17	11	0.053	0.058	0.02	0.031	0.57	0.02	0.01	0.02
V Spill	7-Aug-01	3589	3597	17	14		0.031		0.004	-0.05	-0.04	0	0
V Spill	19-Sep-01	3619	3621	19	15		0.036	0.023	0.01	0.78	0.4	0.02	0.01
V Spill	18-May-02	3643	3659	10	8	0.028	0.007	0.003	0.002	1.14	0.84	0.02	0.02
V Spill	14-Jun-02	3665	3685	11	10	0.002	0.003	0.001	0.002	0.23	0.42	0.03	0.03
V Spill	9-Aug-02	3702	3716	0	0	0.006	0.005	0.004	0.003	-0.04	-0.02	0.01	0.01
V Spill	27-Sep-02	3745	3752							0.05	0.36	0.04	0.02
V Spill	28-Sep-02	3721	3723	2	2	0.075	0.083	0.001	0	0.03	0.01	0.01	0.02
Wilson Spill	19-Jun-01	3556	3564	13	9	0.105	0.111	0.025	0.006	4.5	0.28	0.02	0.01
Wilson Spill	7-Aug-01	3580	3588	16	14	0.133	0.141	0.15	0.16	0.14	0.11	0	0
Wilson Spill	19-Sep-01	3607	3625	16	22	0.076	0.155	0.005	0.03	0.03	0.02	0.01	0.01
Wilson Spill	18-May-02	3644	3653	10	10	0.01	0.008	0.002	0.002	0.03	0.05	0.02	0.02
Wilson Spill	14-Jun-02	3667	3668	11	10	0.001	0.002	0	-0.001	0.13	0.16	0.02	0.02
Wilson Spill	9-Aug-02	3705	3710	2	3	0.004	0.018	0.001	0.008	0.2	0	0.02	0.01
Wilson Spill	27-Sep-02	3734	3742							1.7	0.05	0.02	0.02
Wilson Spill	28-Sep-02	3726	3730	2	2	0.044	0.122	-0.001	0.001	0	0.07	0.02	0.01
Hazard at Culvert	19-Sep-01	3612	3613	47	44	0	0.001	0.006	0.017	0.34	0	0.02	0.02
Hazard at Culvert	18-May-02	3647	3652	15	15	0.007	0.011	0.002	0.003	2.82	0.36	0.03	0.02
Hazard at Culvert	14-Jun-02	3666	3673	24	24	0.007	0.005	0.001	0.004	0.18	0.09	0.03	0.02
Hazard at Culvert	9-Aug-02	3697	3709	2	2	0.052	0.057	0.002	0.006	0.13	0.11	0.02	0.02
Hazard at Culvert	28-Sep-02	3725	3731	6	5	0.065	0.049	0.001	0.002	0.26	0.17	0.02	0.02
Nash Spill	18-May-02	3640	3651	19	18	0.011	0.006	0.001	0.002	-0.01	0.06	0.03	0.02
Nash Spill	14-Jun-02	3670	3688	7	7	0.002	0.004	0.002	0.002	0.17	0.09	0.01	0.01
Nash Spill	9-Aug-02	3708	3714	2	4	0.009	0.004	0.003	0.001	0.04	0.05	0.01	0.02
Nash Spill	27-Sep-02	3741	3755							0.34	-0.01	0	0
Q1 Spill	19-Jun-01	3554	3563	31	16	0.001	0.001	0.012	0.005	0.8	-0.04	0.01	0
Q1 Spill	7-Aug-01	3591	3595	20	20	0.003	0.002	0.006	0.005	0.1	-0.04	0	0
Q1 Spill	19-Sep-01	3610	3623	18	15	0	0.016	0.007	0.009	0.04	0	0.01	0.02
Q1 Spill	18-May-02	3638	3639	12	12	0.013	0.013	0.005	0.002	0.05	0.05	0.03	0.02
Q1 Spill	14-Jun-02	3675	3691	10	9	0.005	0.004	0.002	0.004	0.06	0	0.02	0
Q1 Spill	9-Aug-02	3695	3699	-1	1	0.003	0.013	0.002	0.001	0.04	0.02	0.01	0.01
Q1 Spill	27-Sep-02	3747	3756							0.38	0.74	0.01	0.01
Q1 Spill	28-Sep-02	3727	3728	2	2	0.001	0.005	-0.001	0	0	0	0.02	0.02
Cedar Spill	19-Jun-01	3560	3569	38	31	0	0	0.007	0.005	-0.03	-0.1	0	0
Cedar Spill	7-Aug-01	3583	3585	23	15	0.021	0.002	0.006	0.005	-0.06	-0.07	0	0
Cedar Spill	19-Sep-01	3629	3630	13	10	0.067	0.008	0.01	0.009	-0.02	-0.02	0.02	0.01
Cedar Spill	18-May-02	3657	3661	19	15	0.259	0.008	0.001	0.005	0.29	0.06	0.02	0
Cedar Spill	14-Jun-02	3676	3681	9	7	0.004	0.005	0.002	0.004	0.07	0.05	0.02	0
Cedar Spill	9-Aug-02	3713	3717	2	2	0.003	0.011	0.002	0.003	-0.01	-0.01	0.02	0.01
Cedar Spill	27-Sep-02	3737	3746							2.3	0.1	0.05	0
Cedar Spill	28-Sep-02	3720	3722	2	2	-0.003	0.003	0.002	0	0	-0.01	0.01	0.02
R Spill	19-Jun-01	3555	3559	15	23	0.005	0.02	0.01	0.013	0	0	0.02	0.01
R Spill	7-Aug-01	3586	3594	16	12	0.006	0.006	0.006	0.004	-0.11	-0.04	0	0.01
R Spill	19-Sep-01	3616	3620	12	15	0	0.001	0.012	0.029	-0.06	0.06	0.01	0.01
R Spill	18-May-02	3655	3660	10	14	0.009	0.013	0.005	0.002	0.76	0.65	0.03	0.02
R Spill	14-Jun-02	3682	3686	4	5	0.006	0.008	0.005	0.003	0.04	0.11	0.02	0.01
R Spill	9-Aug-02	3694	3703	1	-1	0.009	0.015	0.002	0.005	0.01	0.03	0.02	0.02
R Spill	27-Sep-02	3754	3758							-0.09	1.08	0	0.05

Table E-3. Continued.

Waterbody	Date	Duplicate sample number		Suspended sediment (mg/L)		NO_3+NO_2 as N (mg/L)		PO_4 as P (mg/L)		Total N (mg/L)		Total P (mg/L)	
		1	2	1	2	1	2	1	2	1	2	1	2
Spring Hollow Drain	19-Jun-01	3552	3562	24	15	0.028	0.006	0.015	0.01	0.46	0.08	0.01	0.02
Spring Hollow Drain	7-Aug-01	3587	3601	22	16	0.001	0.002	0.004	0.005	0.02	-0.02	0.01	0.01
Spring Hollow Drain	19-Sep-01	3598	3617	34	36	0.001	0	0.006	0.011	0.02	0.16	0.03	0.11
Spring Hollow Drain	18-May-02	3648	3654	238	331	0.699	0.655	0.083	0.117	2.66	2.48	0.64	0.55
Spring Hollow Drain	14-Jun-02	3671	3684	11	11	-0.006	0.018	0.004	0.002	0.05	0.17	0.03	0.05
Spring Hollow Drain	9-Aug-02	3692	3701	5	4	0.012	0.029	0.004	0.005	0.21	0.19	0.03	0.02
Spring Hollow Drain	27-Sep-02	3736	3739							2.38	-0.04	0.04	0.01
Sportsman's Park	10-Sep-01					5							
Sportsman Park Springs	20-Sep-02	3778	3791			5.518	5.8	0.007	0.011				
Vollmer S Spring	10-Sep-01					4							
Vollmer N Spring	10-Sep-01					4							
Vollmer W Spiring	10-Sep-01												
Vollmer Creek	10-Sep-01												
Vollmer Springs	16-Feb-02	3636	3637	40	34	4.222	4.024	0.044	0.073	4.68	4.38	0.06	0.08
Vollmer Springs	20-Sep-02	3771	3787			2.488	1.502	0.007	0.005				
Schroeder	10-Sep-01					6							
Schroeder Springs	27-Nov-02	3772	3776			2.749	3.02	0.019	0.025				
Knudsen	10-Sep-01					10							
Knudsen Springs	24-Nov-02	3773	3781			14.819	10.324	0.029	0.017				
Spring Hollow Spring	28-Feb-01	3543	3545	2	3	41.376	40.69	0.028	0.02	44.29	45.81	0.13	0.1
Spring Hollow Spring	10-Sep-01	3624	3628	32	31	39.709	39.146	0.087	0.225	45.8	45.59	0.08	0.11
Spring Hollow Spring	16-Feb-02	3634	3635	88	84	39.682	40.227	0.057	0.058	49.35	50.6	0.09	0.09
Spring Hollow Spring	20-Sep-02	3782	3784			12.943	13.248	0.017	0.023				
Spring Hollow Spring	24-Nov-02	3775	3785			30.601	26.649	0.069	0.053				
Spring Hollow Highway	28-Feb-01	3542	3544	7	7	13.297	12.94	0.009	0.035	13.76	14.12	0.11	0.11
Spring Hollow Highway	19-Jun-01	3574	3576	443	434	6.704	7.373	0.007	0.006	6.98	6.97	0.16	0.15
Spring Hollow Highway	7-Aug-01	3582	3599	60	63	6.591	6.944	0.007	0.013	7.53	7.52	0.05	0.06
Spring Hollow Highway	19-Sep-01	3622	3631	99	118	9.953	9.862	0.022	0.032	11.27	11.3	0.15	0.15
Spring Hollow Highway	14-Jun-02	3672	3679	571	529	6.481	8.461	0.001	0.012	8.23		0.43	0.29
Spring Hollow Highway	9-Aug-02	3693	3704	10	9	8.929	9.576	0.004	0.01				
Spring Hollow Highway	27-Sep-02	3743	3753							10.96	12.3	0.02	0.02
Spring Hollow Highway	24-Nov-02	3780	3788			21.098	22.633	0.017	0.021				
Jahnke Tree	10-Sep-01					10							
Aberdeen Sewage Plant	19-Sep-01	3614	3618	32	43	4.889	5.012	1.077	0.774	9.6	10.37	1.44	1.51
Hazard at Beach Road	20-Apr-01	3538	3550	52	85	0.248	0.234	0.004	0.014	9.67	8.09	1.24	1.6
Hazard at Beach Road	19-Jun-01	3553	3557	29	17	0.085	0.089	0.429	0.053	0.92	2.88	0.14	0.12
Hazard at Beach Road	7-Aug-01	3578	3581	20	20	1.014	0.917	0.012	0.019	2.05	1.68	0.38	0.43
Hazard at Beach Road	19-Sep-01	3608	3627	27	22	0.665	0.632	0.073	0.109	1.05	1.16	0.21	0.23
Christiansen Drain	18-Apr-01	3519	3523	72	88		2.682		0.008	3.28	3.56	0.03	0.03
Christiansen sub	18-Apr-01	3527	3541	68	59	5.486	5.711	0.007	0.006	5.71	5.92	0.01	0.03
Cornforth Spring	18-Apr-01	3518	3548	47	50	3.855	3.662	0.013	0.007	4.25	3.91	0.06	0.02
Crystal	18-Apr-01	3516	3520	84	74	2.291	2.202	0.006	0.015	2.5	2.46	0.03	0.03
Crystal	18-Apr-01	3524	3536	98	82	2.88	2.931	0.007	0.002	3.1	3.16	0.03	0.05
Crystal	18-Apr-01	3513	3532	65	73	2.784	2.757	0.008	0.019	2.8	3.32	0.02	0.01
Driscoll	18-Apr-01	3539	3546	86	92	3.521	3.663	0.597	0.065	4.37	4.08	0.12	0.02
Orth	18-Apr-01	3521	3529	56	84	0.653	0.668	0.005	0.019	1.57	1.91	0.22	0.12
Smith	18-Apr-01	3528	3531	72	104	0.175	0.173	0.015	0.008	1.01	1.28	0.09	0.1
Sportsman's Artesian	18-Apr-01	3522	3537	46	22	0.138	0.143	0.021	0.005	-0.09	0.1	0.04	0.02
Sterling	18-Apr-01	3530	3533	74	73	1.739	1.801	0.022	0.006	2.13	2.83	0.07	0.06
Springfield Lake Outlet	18-Apr-01	3535	3540	59	51	0.647	0.648	0.004	0.008	1.14	1.08	0.02	0.11
Danielson	18-Apr-01	3526	3549	65	54	1.03	0.979	0.004	0.013	1.25	1.69	0.03	0.05
Spring Hollow Drain	7-Aug-01	3596	3603	30	26	0.001	0	0.006	0.004	0.03	-0.04	0.02	0.01
Deionized Water	19-Sep-01	3606	3633	0	1	0	0.005	0.005	0.008	-0.22	2.45	0	0.01
Deionized Water	24-Oct-01	3561	3565	-2	0	0.002	0.001	0.013	0.013	1.78	0.14	0	0
Deionized Water	24-Oct-01	3593	3600	0	0	0.002	0.01	0.004	0.005	-0.07	-0.1	0	0
Deionized Water	25-Oct-01	3571	3579	-1	1	0.001	0.001	0.005	0.007	0.05	1.05	0	0.01
Deionized Water	18-May-02	3646	3662	1	3	0.011	0.015	0.005	0.003	0.23	0.68	0	0.01
Deionized Water	18-May-02	3649	3663	3	-1	0.006	0.01	0.005	0.005	0.07	-0.24	0	0.03
Deionized Water	14-Jun-02	3669	3680	-1	1	-0.002	0.001	-0.001	0.002	-0.14	0.07	0	0.01
Deionized Water	14-Jun-02	3683	3689	-1	-1	0	0.001	0.003	0.001	-0.1	-0.15	0.01	0
Deionized Water	9-Aug-02	3696	3715	-1	-1	0.002	0	0.001	0	3.19	-0.18	0.06	0.01
Deionized Water	9-Aug-02	3707	3719	-1	-1	0.003	0.008	0.005	0.006	-0.21	0.73	0.01	0
Deionized Water	27-Sep-02	3740	3750							0.01	-0.09	0	0.01
Deionized Water	28-Sep-02	3724	3729	0	0	-0.002	-0.005	-0.001	0.001		0.24		0
Deionized Water	27-Nov-02	3774	3789			0.001	0	0.003	0				
Deionized Water	8-Apr-03	3765	3766			-0.002	0	0.003	0.003				
Deionized Water	27-May-03	3792	3797							0.13	-0.18	0.01	0.02
	27-May-03	3802								-0.3		0	
	2-Jun-03	3805	3806							-0.3	-0.3	-0.01	-0.01

Table E-4. Average daily flow at Sterling waste, Tarter waste, and Aberdeen waste drain, October 2001 to September 2003 (from Idaho Power data).

Date	WY 2002			WY 2003			Date	WY 2002			WY 2003		
	Sterling Waste	Tarter Waste	Aberdeen Waste Drain	Sterling Waste	Tarter Waste	Aberdeen Waste Drain		Sterling Waste	Tarter Waste	Aberdeen Waste Drain	Sterling Waste	Tarter Waste	Aberdeen Waste Drain
1-Oct			1.4	13.6	8.9	76.7	1-Dec			1.0	5.6		1.1
2-Oct			1.5	16.2	7.6	60.5	2-Dec			1.1	5.5		1.2
3-Oct			1.5	18.0	1.2	17.9	3-Dec			1.2	5.6		1.2
4-Oct			1.5	14.4	0.0	4.7	4-Dec			1.1	5.6		1.2
5-Oct			1.6	12.4		3.4	5-Dec			1.0	5.5		1.1
6-Oct			1.4	10.8		3.0	6-Dec			1.0	5.4		1.1
7-Oct			1.4	10.6		2.6	7-Dec			1.2	5.4		1.0
8-Oct			1.5	10.4		2.0	8-Dec			1.1	5.2		1.0
9-Oct			1.5	10.1		1.8	9-Dec			1.0	5.3		1.1
10-Oct			1.4	9.8		2.0	10-Dec			1.0	5.4		1.1
11-Oct			1.5	8.5		2.0	11-Dec			1.1	5.4		1.1
12-Oct			1.4	8.1		1.7	12-Dec			1.1	5.4		1.1
13-Oct			1.4	8.0		1.6	13-Dec			1.1	5.5		1.1
14-Oct			1.2	8.1		1.6	14-Dec			1.2	5.7		1.0
15-Oct			1.3	7.9		1.9	15-Dec			1.0	5.7		1.0
16-Oct			1.4	8.0		1.9	16-Dec			1.0	5.6		1.0
17-Oct			1.6	7.8		1.9	17-Dec			1.0	6.1		1.2
18-Oct			1.3	7.8		2.0	18-Dec			1.1	6.1		1.1
19-Oct			1.3	8.1		1.8	19-Dec			1.2	5.3		1.0
20-Oct			1.3	8.0		1.7	20-Dec			1.2	5.0		1.0
21-Oct			1.2	7.8		1.8	21-Dec			1.1	5.5		1.0
22-Oct			1.3	7.8		1.9	22-Dec			1.0	5.8		1.0
23-Oct			1.4	7.5		1.8	23-Dec			0.9	6.2		1.0
24-Oct			1.3	7.3		2.0	24-Dec			0.9	10.6		1.0
25-Oct			1.3	7.1		1.8	25-Dec			0.9	5.5		1.0
26-Oct			1.3	7.2		1.5	26-Dec			0.9	6.5		0.9
27-Oct			1.2	6.9		1.6	27-Dec			0.9	5.6		1.1
28-Oct			1.2	6.8		1.7	28-Dec			1.0	6.0		1.1
29-Oct			1.2	6.9		1.9	29-Dec			1.0	5.9		1.0
30-Oct			1.2	6.7		1.9	30-Dec			0.9	5.9		1.0
31-Oct			1.3	6.3		1.7	31-Dec			1.0	6.3		1.1
1-Nov			1.4	6.6		1.6	1-Jan			1.0	6.3		1.0
2-Nov			1.3	7.6		1.3	2-Jan			1.0	5.9		1.0
3-Nov			1.3	7.3		1.1	3-Jan			1.1	6.1		1.0
4-Nov			1.1	8.2		1.2	4-Jan			1.1	6.1		1.0
5-Nov			1.2	6.0		1.3	5-Jan			1.2	6.2		0.9
6-Nov			1.4	6.1		1.3	6-Jan			1.0	6.0		0.9
7-Nov			1.3	6.3		1.5	7-Jan			1.0	5.8		1.0
8-Nov			1.2	7.8		1.7	8-Jan			1.2	6.2		1.0
9-Nov			1.2	8.6		1.3	9-Jan			1.2	8.3		1.0
10-Nov			1.2	7.5		1.2	10-Jan			1.2	5.2		1.0
11-Nov			1.1	7.0		1.2	11-Jan			1.2	5.1		0.9
12-Nov			1.2	6.7		1.3	12-Jan			1.1	5.3		0.9
13-Nov			1.2	6.7		1.3	13-Jan			1.0	5.5		1.2
14-Nov			1.2	6.5		1.3	14-Jan			1.0	5.5		1.2
15-Nov			1.2	6.2		1.3	15-Jan			1.1	5.3		1.2
16-Nov			1.2	6.3		1.2	16-Jan			1.1	5.2		1.1
17-Nov			1.1	6.2		1.1	17-Jan			1.1	5.1		1.0
18-Nov			1.1	6.0		1.2	18-Jan			1.1	5.1		0.9
19-Nov			1.0	5.9		1.3	19-Jan			1.0	5.1		0.9
20-Nov			1.1	5.9		1.3	20-Jan			1.0	5.2		1.0
21-Nov			1.2	6.0		1.3	21-Jan			1.1	5.2		1.0
22-Nov			1.3	6.0		1.3	22-Jan			1.2	5.2		1.0
23-Nov			1.1	6.1		1.2	23-Jan			1.1	5.4		1.0
24-Nov			1.0	5.9		1.1	24-Jan			1.1	5.5		1.0
25-Nov			1.1	5.6		1.1	25-Jan			1.1	5.5		0.9
26-Nov			1.1	5.6		1.1	26-Jan			1.1	5.5		1.0
27-Nov			1.1	5.5		1.2	27-Jan			1.0	5.6		1.2
28-Nov			1.1	5.6		1.1	28-Jan			1.1	5.5		1.2
29-Nov			1.2	5.6		1.0	29-Jan			1.1	5.2		1.2
30-Nov			1.1	5.6		1.0	30-Jan			1.0	5.5		1.3
							31-Jan			1.0	5.5		1.2

Table E-4. Continued.

	WY 2002			WY 2003				WY 2002			WY 2003		
Date	Sterling Waste	Tarter Waste	Aberdeen Waste Drain	Sterling Waste	Tarter Waste	Aberdeen Waste Drain	Date	Sterling Waste	Tarter Waste	Aberdeen Waste Drain	Sterling Waste	Tarter Waste	Aberdeen Waste Drain
1-Feb			1.1	5.5		1.2	1-Apr			1.6	4.4		1.0
2-Feb			1.1	5.3		1.1	2-Apr			1.7	4.7		1.0
3-Feb			1.0	5.0		1.0	3-Apr	6.4	0.0	1.6	4.6		0.9
4-Feb			1.0	5.0		1.0	4-Apr	6.4	0.0	2.0	4.5		0.9
5-Feb			1.1	5.0		0.9	5-Apr	6.3	0.0	2.0	4.4		0.9
6-Feb			1.0	5.3		0.9	6-Apr	6.1	0.0	1.9	4.4		0.8
7-Feb			1.0	5.9		0.8	7-Apr	5.9	0.0	1.7	4.3		0.8
8-Feb			1.1	5.6		0.8	8-Apr	6.0	0.0	1.8	4.3		0.9
9-Feb			1.1	4.6		0.7	9-Apr	6.0	0.0	1.8	4.2		1.0
10-Feb			1.0	4.8		0.9	10-Apr	5.8	0.0	1.8	4.2		1.0
11-Feb			1.0	4.7		0.9	11-Apr	5.7	0.0	1.8	4.1		2.3
12-Feb			1.0	4.9		0.9	12-Apr	5.8	0.0	1.8	4.3		5.3
13-Feb			1.0	5.2		1.0	13-Apr	5.5	0.0	1.7	4.9		7.0
14-Feb			1.0	5.3		0.9	14-Apr	5.6	0.0	1.7	4.6		18.3
15-Feb			1.0	5.4		0.9	15-Apr	5.3	0.0	1.7	4.9		23.1
16-Feb			1.0	5.6		0.9	16-Apr	5.8	0.0	1.9	4.2		32.7
17-Feb			1.0	5.6		0.9	17-Apr	6.0	0.0	1.8	4.4		45.5
18-Feb			1.0	5.5		0.9	18-Apr	5.8	0.0	1.8	4.6		61.4
19-Feb			1.1	5.4		0.9	19-Apr	6.0	0.0	1.8	5.1		67.3
20-Feb			1.2	5.3		1.0	20-Apr	5.9	0.0	1.5	5.8		50.9
21-Feb			1.1	5.3		1.0	21-Apr	5.5	0.0	1.4	4.7	1.9	44.3
22-Feb			1.1	5.2		0.9	22-Apr	5.5	0.0	1.5	5.2	2.3	53.9
23-Feb			1.1	5.2		0.7	23-Apr	5.1	0.0	1.5	5.3	3.7	54.1
24-Feb			1.2	6.8		0.8	24-Apr	5.3	0.0	1.4	6.8	4.0	50.0
25-Feb			1.1	6.3		0.8	25-Apr	5.4	0.0	1.5	6.0	4.0	42.6
26-Feb			1.1	5.4		0.9	26-Apr	5.4	0.0	1.5	7.5	4.1	56.3
27-Feb			1.0	5.1		0.9	27-Apr	5.2	0.0	1.4	7.0	4.3	59.8
28-Feb			1.1	5.0		0.9	28-Apr	5.1	0.0	1.2	7.0	3.2	60.8
1-Mar			1.0	5.0		0.9	29-Apr	5.2	0.0	12.4	8.5	2.9	60.0
2-Mar			1.0	5.0		0.8	30-Apr	5.2	24.3	69.5	7.9	2.0	58.7
3-Mar			1.0	5.0		0.9	1-May	5.0	38.1	84.9	8.0	1.9	58.2
4-Mar			0.9	4.9		0.9	2-May	6.5	24.4	63.0	8.9	1.9	58.4
5-Mar			1.0	4.8		0.9	3-May	5.3	18.3	49.1	9.8	1.8	57.9
6-Mar			1.2	8.5		0.9	4-May	4.3	17.0	41.7	9.7	1.7	54.4
7-Mar			1.5	4.7		0.9	5-May	4.3	16.9	34.9	10.2	2.1	50.9
8-Mar			1.4	4.7		0.8	6-May	5.1	16.6	41.2	10.0	2.2	54.1
9-Mar			1.4	4.8		0.8	7-May	6.1	9.0	49.1	5.4	2.0	51.5
10-Mar			1.2	5.1		0.9	8-May	8.9	10.2	61.4	2.6	2.7	55.0
11-Mar			1.3	5.1		0.9	9-May	8.9	8.0	47.6	1.9	4.3	65.6
12-Mar			1.8	5.1		0.9	10-May	9.0	5.6	38.2	2.1	3.7	71.3
13-Mar			1.9	4.3		0.9	11-May	7.9	4.9	22.8	2.8	3.6	67.8
14-Mar			1.5	5.0		0.9	12-May	8.4	6.6	25.6	2.5	3.6	48.6
15-Mar			1.5	5.2		0.9	13-May	5.7	6.3	31.5	2.6	2.6	26.0
16-Mar			1.3	5.8		0.9	14-May	2.2	4.4	18.7	2.7	2.4	11.6
17-Mar			1.2	5.4		0.9	15-May	1.9	5.0	17.2	2.7	2.4	10.9
18-Mar			1.4	5.2		0.8	16-May	2.0	5.8	17.3	1.8	2.1	13.5
19-Mar			1.4	5.0		0.9	17-May	2.1	5.7	22.7	2.8	2.9	17.3
20-Mar			1.6	5.0		0.9	18-May	1.9	6.7	29.2	3.0	2.7	32.4
21-Mar			1.8	4.9		0.9	19-May	1.7	5.7	26.8	2.4	3.0	35.4
22-Mar			1.9	4.9		0.9	20-May	1.4	5.7	29.6	2.8	4.1	44.9
23-Mar			1.7	4.9		0.8	21-May	2.3	15.1	41.6	2.6	2.7	47.0
24-Mar			1.5	4.6		0.8	22-May	1.6	24.2	76.9	2.7	2.0	27.8
25-Mar			1.5	4.6		0.9	23-May	2.1	18.2	87.8	2.3	2.1	36.9
26-Mar			1.6	4.6		0.9	24-May	2.3	24.4	88.8	1.9	2.2	31.2
27-Mar			1.6	4.3		0.9	25-May	2.5	35.7	89.7	1.9	2.7	35.2
28-Mar			1.7	4.3		0.9	26-May	2.6	39.6	93.9	2.2	3.5	35.9
29-Mar			1.7	4.2		0.8	27-May	1.6	39.0	84.8	1.4	2.8	22.9
30-Mar			1.6	4.4		0.8	28-May	0.8	25.4	76.6	2.3	2.1	27.2
31-Mar			1.4	4.4		0.8	29-May	0.5	17.2	52.1	2.8	3.0	37.3
							30-May	0.7	13.4	38.2	2.9	3.3	35.1
							31-May	0.7	5.4	31.6	3.1	3.0	31.7

Table E-4. Continued.

Date	WY 2002			WY 2003			Date	WY 2002			WY 2003		
	Sterling Waste	Tarter Waste	Aberdeen Waste Drain	Sterling Waste	Tarter Waste	Aberdeen Waste Drain		Sterling Waste	Tarter Waste	Aberdeen Waste Drain	Sterling Waste	Tarter Waste	Aberdeen Waste Drain
1-Jun	0.6	3.3	21.2	5.9	3.2	35.2	1-Aug	3.8	1.8	24.3	3.7	1.6	45.5
2-Jun	1.7	5.8	37.7	4.6	3.6	38.6	2-Aug	3.8	1.4	19.3	4.3	2.4	42.5
3-Jun	1.9	7.9	45.9	3.5	4.2	43.1	3-Aug	3.5	1.4	22.2	5.1	2.6	51.5
4-Jun	2.5	8.8	41.9	3.7	5.3	59.4	4-Aug	3.8	1.3	33.5	5.7	5.3	56.5
5-Jun	2.4	9.6	41.6	3.9	4.6	59.9	5-Aug	12.1	1.7	34.7	4.6	3.4	47.1
6-Jun	2.6	9.4	47.5	4.1	2.5	61.2	6-Aug	11.2	1.5	23.1	4.4	1.8	47.8
7-Jun	1.6	10.0	57.7	3.7	5.0	63.8	7-Aug	11.6	2.8	16.3	4.9	1.3	51.0
8-Jun	1.3	12.8	65.3	5.7	8.0	75.0	8-Aug	12.9	3.1	11.6	4.3	1.8	42.6
9-Jun	1.9	24.8	81.9	6.9	7.7	71.5	9-Aug	13.4	3.1	15.2	4.1	2.2	48.2
10-Jun	1.3	31.6	79.9	8.4	4.4	55.0	10-Aug	16.0	2.8	24.1	7.2	2.0	53.9
11-Jun	1.3	29.3	74.7	7.0	3.3	49.0	11-Aug	15.2	2.6	35.1	11.7	3.0	45.4
12-Jun	1.7	28.7	69.4	9.0	2.6	45.0	12-Aug	14.2	2.8	27.7	10.1	2.5	43.2
13-Jun	2.2	27.5	61.6	8.2	1.8	49.1	13-Aug	11.3	1.7	22.0	10.4	1.4	34.5
14-Jun	4.0	10.3	62.5	9.1	1.7	46.6	14-Aug	9.3	0.7	21.7	10.4	1.1	32.2
15-Jun	5.2	3.8	64.4	9.9	1.9	63.5	15-Aug	9.9	1.0	22.9	10.2	1.6	28.8
16-Jun	11.9	4.3	75.5	9.3	2.1	63.6	16-Aug	8.8	0.9	36.1	10.4	1.3	12.0
17-Jun	11.7	3.9	75.5	9.3	1.9	39.1	17-Aug	8.3	1.4	38.7	10.9	0.7	4.0
18-Jun	10.5	3.3	45.8	10.7	1.8	31.2	18-Aug	8.4	1.8	45.8	10.4		2.9
19-Jun	11.7	3.9	30.5	12.7	1.2	26.1	19-Aug	2.7	2.1	48.1	8.7		2.0
20-Jun	11.7	4.9	38.1	11.3	1.3	27.1	20-Aug	1.9	2.2	27.1	5.5		2.1
21-Jun	14.6	3.8	44.8	10.4	2.1	35.5	21-Aug	1.6	2.4	14.7	4.6		2.3
22-Jun	14.6	4.3	50.5	11.5	4.8	56.2	22-Aug	1.6	2.2	14.9	3.0		2.4
23-Jun	12.7	13.0	62.8	12.5	5.8	55.9	23-Aug	1.8	2.1	30.3	3.0		2.4
24-Jun	12.6	13.2	72.7	13.1	3.9	43.8	24-Aug	2.5	1.3	26.0	4.0		2.8
25-Jun	12.2	6.4	43.9	13.4	5.4	49.6	25-Aug	2.1	0.9	34.4	3.5		3.1
26-Jun	12.6	4.3	26.4	17.7	5.2	44.0	26-Aug	2.0	1.0	33.4	3.3		2.4
27-Jun	11.8	4.3	22.6	17.1	3.9	36.5	27-Aug	2.1	0.7	27.6	2.6		2.3
28-Jun	11.6	3.3	21.4	15.8	2.6	30.3	28-Aug	2.0	0.7	20.9	2.5		2.2
29-Jun	12.0	4.5	23.1	16.5	3.5	51.1	29-Aug	1.8	1.3	33.9	2.0		2.1
30-Jun	12.9	3.8	42.2	15.3	3.9	45.1	30-Aug	1.9	1.8	39.5	2.5		2.1
1-Jul	10.0	5.1	47.3	12.0	1.2	16.9	31-Aug	2.2	2.0	40.4	1.1		2.1
2-Jul	2.3	3.1	35.4	13.1	0.9	14.5	1-Sep	2.2	1.5	49.3	1.0		2.2
3-Jul	2.8	3.8	33.3	13.5	1.0	10.2	2-Sep	2.2	1.1	31.3	0.9		2.2
4-Jul	3.3	3.9	28.2	12.7	1.7	19.0	3-Sep	2.3	0.7	6.5	0.4		2.1
5-Jul	3.5	4.5	19.0	5.0	4.7	35.1	4-Sep	2.2	0.0	4.7	1.7		2.1
6-Jul	3.2	3.6	13.8	1.7	6.1	40.4	5-Sep	0.8	0.0	4.0	0.4		2.7
7-Jul	2.8	4.2	27.4	1.7	7.7	44.6	6-Sep	1.2	0.0	3.3	0.7		3.4
8-Jul	2.7	4.3	30.7	1.8	4.1	45.2	7-Sep	1.8	0.0	2.4	1.0		3.4
9-Jul	1.1	3.5	19.3	1.6	8.5	49.2	8-Sep	2.1	0.0	2.0	1.4		2.9
10-Jul	1.1	3.1	16.0	0.9	9.7	50.2	9-Sep	0.9	0.0	2.1	1.2		2.1
11-Jul	1.0	2.6	12.0	0.6	7.7	43.1	10-Sep	1.4	0.0	2.1	1.9		4.3
12-Jul	0.7	2.5	19.2	1.9	5.2	39.7	11-Sep	1.8	0.0	2.1	1.3	2.2	33.0
13-Jul	0.9	3.1	27.4	2.0	3.1	39.8	12-Sep	1.3	0.0	2.0	1.5	2.4	15.7
14-Jul	1.7	3.0	29.4	1.9	5.1	35.3	13-Sep	1.2	0.0	1.9	1.2	0.6	16.1
15-Jul	1.3	3.2	28.7	2.2	8.1	19.5	14-Sep	0.8	0.0	1.8	1.4	0.8	36.4
16-Jul	0.5	2.9	26.1	2.6	10.2	29.3	15-Sep	4.5	0.0	1.5	1.4	1.1	29.9
17-Jul	0.7	2.5	28.5	2.6	11.3	31.0	16-Sep	4.2	0.0	1.5	1.4	1.7	33.6
18-Jul	0.8	2.0	31.1	2.6	9.8	45.5	17-Sep	3.3	0.0	1.7	1.4	4.4	47.5
19-Jul	0.5	2.7	35.4	3.2	5.3	50.9	18-Sep	3.5	0.0	1.6	1.8	17.0	60.7
20-Jul	0.6	2.2	41.6	3.4	3.7	56.7	19-Sep	5.7	0.0	2.2	2.1	10.1	31.9
21-Jul	2.0	2.1	52.6	3.6	4.2	56.8	20-Sep	6.1	0.0	19.6	2.1	1.3	4.5
22-Jul	1.4	2.3	55.0	3.8	2.7	42.4	21-Sep	6.0	0.1	68.6	1.7	0.0	3.1
23-Jul	0.9	1.3	48.8	3.0	3.1	41.3	22-Sep	5.1	0.9	69.5	1.4		2.7
24-Jul	0.7	1.4	40.2	2.9	3.6	47.0	23-Sep	5.2	0.8	62.3	1.5		3.4
25-Jul	0.8	1.7	48.2	2.9	3.5	47.3	24-Sep	5.6	0.9	52.4	1.5		2.8
26-Jul	1.7	2.8	59.6	2.9	4.6	50.3	25-Sep	6.5	1.1	52.3	1.5		2.0
27-Jul	1.9	3.3	57.3	3.0	5.8	58.7	26-Sep	11.7	1.7	50.4	1.5		2.2
28-Jul	1.8	5.4	62.7	2.8	5.0	54.4	27-Sep	13.3	1.7	60.6	1.6		2.7
29-Jul	4.1	4.5	44.3	2.3	1.7	40.8	28-Sep	13.0	2.9	67.6	1.4		1.9
30-Jul	3.7	2.7	33.0	3.0	0.9	30.9	29-Sep	12.4	4.1	71.4	1.5		2.2
31-Jul	3.8	2.5	35.9	3.8	0.8	21.4	30-Sep	12.9	3.7	78.8	1.4		2.0

Appendix F: Unit Conversion Chart

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Table F-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 (g) Cubic Feet (ft^3)	Liters (L) Cubic Meters (m^3)	1 g = 3.78 l 1 l = 0.26 g 1 ft^3 = 0.03 m^3 1 m^3 = 35.32 ft^3	3 g = 11.35 l 3 l = 0.79 g 3 ft^3 = 0.09 m^3 3 m^3 = 105.94 ft^3
Flow Rate	Cubic Feet per Second (ft^3/sec)[1]	Cubic Meters per Second (m^3/sec)	1 ft^3/sec = 0.03 m^3/sec 1 m^3/sec = ft^3/sec	3 ft^3/sec = 0.09 m^3/sec 3 m^3/sec = 105.94 ft^3/sec
Concentration	Parts per Million (ppm)	Milligrams per Liter (mg/L)	1 ppm = 1 mg/L(2)	3 ppm = 3 mg/L
Weight	Pounds (lbs)	Kilograms (kg)	1 lb = 0.45 kg 1 kg = 2.20 lbs	3 lb = 1.36 kg 3 kg = 6.61 kg
Temperature	Fahrenheit (°F)	Celsius (°C)	°C = 0.55 (F - 32) °F = (C x 1.8) + 32	3 °F = -15.95 °C 3 ° C = 37.4 °F

[1]1 ft^3/sec = 0.65 million gallons per day; 1 million gallons per day is equal to 1.55 ft^3/sec.

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

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Appendix G: Citizens' Complaints

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4709-243

IDAHO DEPARTMENT OF HEALTH AND WELFARE
DIVISION OF ENVIRONMENTAL QUALITY
COMPLAINT FORM

COMPLAINANT — Date 9/24/97

Name John Ratliff — Address —

Phone 237-8189 Around 3:00

AUTHORIZED RELEASE OF NAME [] YES [] NO WILLING TO PROVIDE TESTIMONY [] YES [] NO

COMPLAINT AGAINST: Willow Bay

Description

Complainant wants someone out to Willow Bay to test the water. Water has green moss and blue torquoise moss. Never has seen it before.

Referred to Lynn → Blaine — Program WQ — Received by Nikki

Action Taken Spoke to complainant @ 9/25/97. Moss is natural blue-green algae bloom

NAR

Investigated by — Date

Complaint received by: Telephone [] Mail [] Personal Visit []
Complaint Concerning: Industrial [] Other [X] Algae Growth
Investigation by a: Site Visit [] Discussion [X]
Time Spent: Receipt/logging ______ Investigation 12min Travel ______
Report/letter ______ Follow-up ______
TOTAL HOURS SPENT: Clerical ______ Professional 0.2
Enforcement Recommended [] Yes [] No

Figure G-1. Complaint 1.

IDAHO DEPARTMENT OF HEALTH AND WELFARE
DIVISION OF ENVIRONMENTAL QUALITY
COMPLAINT FORM

9607-48

COMPLAINANT Date July 26, 96

Name David Savage | Address 946 So. 2000 W.
Phone 328-9202 | Springfield, ID.

AUTHORIZED RELEASE OF NAME [] YES [] NO WILLING TO PROVIDE TESTIMONY [] YES [] NO

COMPLAINT AGAINST:

Description

Mr. Savage has lived in the Area Approx. 30 yrs. And has not Smelled the American Falls reservoir this bad before. It actually smells a very strongly of raw sewage. The rocks are a being stained a blue color.

Mr Savage requests DEQ to visit site and do sampling.

Mr Savage is available to show location of bluing rocks if requested.

Referred to B. Drewes | Program | Received by Natalie

Action Taken Inspected site 7/29/96 - Algae bloom

NAR

Investigated by Date

Complaint received by: Telephone [X] Mail [] Personal Visit []
Complaint Concerning: Industrial [] Other [X]
Investigation by a: Site Visit [X] Discussion []
Time Spent: Receipt/logging ____ Investigation 5 min Travel 60 min
Report/letter ____ Follow-up ____
TOTAL HOURS SPENT: Clerical ____ Professional 65 min
Enforcement Recommended [] Yes [X] No

Figure G-2. Complaint 2

Alliance for Responsible Water Policy
Shelley Allen, Chairperson
61 Cedar Hills Drive
Pocatello, Idaho 83204

1/24/05

Mike Rowe
Department of Environmental Quality
444 Hospital Way, Suite 130
Pocatello, Idaho 83201

RE: American Falls Reservoir water quality

Dear Mike,

For several years now, I have chaired a group of citizens, The Alliance for Responsible Water Policy, who are concerned with water quality, quantity, and allocation. We have spent many hours learning about water issues in general including Idaho water laws, water storage, distribution and management, and water quality and quantity issues. I also served as President of the Seagull Bay Boaters Club, a private club that operates a public marina and RV park on the American Falls Reservoir. I represent this group as a member of the American Falls Watershed Advisory Group.

I have voiced my concerns, and the complaints of the two above-mentioned groups, about water quality in the American Falls reservoir many times to you in meetings of these groups and in other public forums. The concerns with water quality are two-fold: overall concerns about water quality throughout the boating/fishing season and late summer water quality.

The first concern/complaint throughout the boating/fishing season is with the fowl smell permeating the reservoir and Seagull Bay area from the Snake River Cattle Company. At times, the stench out on the reservoir and around Seagull Bay is so bad it is nearly impossible to be outdoors. This is particularly pungent when boating or fishing in the vicinity of the cattle company or when recreating at Seagull Bay's marina and RV park. At the same time that the Bureau of Reclamation and Seagull Bay management are trying to promote more public use of this wonderful recreational facility, the stinky smell emitting from the cattle company drives people away.

The second concern/complaint is with the algae accumulation that occurs in the reservoir in the latter part of the boating/fishing/recreation season. The water becomes the consistency of thick, green scum and smells of algae. While these groups can't often boat and fish late in the summer because of water quantity, this also disrupts other recreational activity around the reservoir because the water looks and smells bad.

Please understand that these complaints are not only my own, but the complaints of the Alliance for Responsible Water Policy, the Seagull Bay Boaters Club, and the public at large.

We hope that you and the DEQ will be able to find ways to correct these water quality issues to benefit the American Falls Reservoir, water systems below the American Falls Reservoir, benefit recreation in and around the area, and expand the economy by expanding tourism in the area.

Sincerely,

Shelley Allen

Shelley Allen,
Chairperson, Alliance for Responsible Water Policy
Past President, Seagull Bay Boaters Club

Figure G-3. Complaint 3

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Appendix H: Distribution List

This is the list of people to whom the TMDL was sent.
Roy Chiappini, interested citizen
Kathy Gneiting, facilitator
Steve Howser, Aberdeen-Springfield Canal
Don Hale, Water District 1
Jerry Giesbrecht, City of American Falls
Robert Elieson, interested citizen
Robert Dial, City of Firth
Ron Harwell, City of Blackfoot
Kirk Adkins, J. R. Simplot-Aberdeen
Chuck Trost, Audubon Society
Roy Fowler, Natural Resources Conservation Service
Bruce Winegar, J. R. Simplot-Pocatello
Rick Anderson, City of Shelley
Neil and Marita Poulson, interested citizens
Jim Mende, Idaho Department of Fish and Game-Pocatello
Garth Clinger, North Bingham Soil Conservation District
Hunter Osborne, Shoshone-Bannock Tribes
Ken Estep, Power County
Shelley Allen, Seagull Bay Yacht Club
Sandra Eschief, Shoshone-Bannock Tribes
LaVerne L. Jim, Shoshone-Bannock Tribes
Tim Deeg, Aberdeen/American Falls Ground Water District
Elise Teton, Shoshone-Bannock Tribes
Jennifer Smout, Bureau of Reclamation
Alicia Lane Boyd, Bureau of Reclamation
Marti Bridges, Idaho Department of Environmental Quality
Tracy Chellis, Environmental Protection Agency
Sue Skinner, Environmental Protection Agency
Candon Tanaka, Shoshone-Bannock Tribes
Deb Mignogno, U. S. Fish and Wildlife Service
Sandi Arena, U. S. Fish and Wildlife Service
Michael Morse, U. S. Fish and Wildlife Service
Brian Hoelscher, Idaho Power Company
Alan Andersen, interested citizen
Clarice Villa, Shoshone-Bannock Tribes
Greg Weigel, interested citizen
Andy Koulermos, NewFields LLC
Craig Wampler, City of Aberdeen
Justin Krajewski, Idaho Soil Conservation Commission
Mel Vargas, Parsons

Public meetings
27 July 04, American Falls, Little Theater
28 July 04, Blackfoot, Senior Citizens' Center
29 July 04, Fort Hall, Housing Conference Room

Appendix I: Public comments

The watershed advisory group had significant involvement in the development of the original 2006 TMDL which was submitted to EPA. The original 2006 TMDL was submitted to the EPA, although DEQ rescinded the submittal in response to the Voluntary Consent Order between J.R. Simplot and IDEQ. The Shoshone-Bannock Tribes, along with DEQ updated the current TMDL to reflect changes agreed upon as a result of the consent order. The Watershed advisory group met on March 12, 2009 and agreed upon the changes to the document, it went out to public comment for 30 days on April 1, 2009. Public comment are included below.

The following are comments received from the general public, and members of either the American Falls Subbasin Watershed Advisory Group or American Falls Subbasin Coordinating Committee. Questions or comments are in **bold** with responses in regular font.

If phosphorus is the most likely limiting nutrient in American Falls reservoir, why is there a need for nitrogen load and wasteload allocations?

Granted, phosphorus is most likely the limiting nutrient to vegetative growth in the reservoir. However, there is some uncertainty on what the limiting factor is, because of this we have proposed a nitrogen target and recommended nitrogen load and wasteload allocations.

For some pollutant sources the load allocation is set at the current load estimate rather than the target load. If you have determined that, for example, a canal company has a target load of 100 pounds of total phosphorus for their return drains and the actual estimated load is only 70 pounds, shouldn't the canal company have the 100 pounds as their load allocation?

American Falls Reservoir exceeds recommended chlorophyll *a* (0.015 mg/L), because of excessive algal production. This is caused by high nutrient loading into the reservoir for which reductions in both nitrogen and phosphorus are recommended. It seems counterproductive to give a load allocation (i.e., the target load) above what is currently discharged to the reservoir when what are really needed are overall reductions in nutrient input not additions.

Allowing a nutrient source a load allocation based on a greater target load than current load has potential ramifications for trying to reduce nutrient input, especially with pollutant trading involved. Let's use a simple, and admittedly extreme, example of setting load allocations. A small reservoir has algae problems with current loading into the reservoir estimated at 310 pounds of phosphorus per year. There are three sources of pollutants – a river, a canal company, and a wastewater treatment plant (WWTP), which contribute 200, 70, and 40 pounds of phosphorus a year, respectively (see Table I-1 below).

For the first scenario (Least Load), loads are based on the lesser of current load or target load. The river is presently at its target load so its load allocation is 200 pounds of phosphorus. The canal company at an input of 70 pounds is below its target load of 100 pounds so its load allocation is the current load of 70 pounds. The WWTP is at 40 pounds and its target load is 10 pounds, which becomes its load allocation under the Least Load scenario. Total load allocation under the Least Load scenario equals 280 pounds, a reduction of 30 pounds from current loading. Effective loading (actual load to the reservoir) is 280 pounds.

For the second scenario (Target Load), all sources are given their target load: 200 pounds for the river, 100 pounds for the canal company, and 10 pounds for the WWTP. Total load allocation under the Target Load scenario is 310 pounds, a reduction of 0 pounds from current loading. Effective loading is still 280 pounds as long as the canal company maintains its current loading and does not increase to its target load.

Under the third scenario (Trade Load), the WWTP decides it would be too costly to its small population to reduce its current load, so it decides to buy 30 pounds through pollutant trading. The canal company agrees to sell its 30 pounds to the WWTP. The new load allocations become 200 pounds for the river, 70 pounds for the canal company, and 40 pounds for the WWTP. Total load allocation under the Trade Load scenario is 310 pounds, a reduction of 0 pounds from current loading. Effective loading is now 310 pounds.

Table I-1. Current, least, target, and trade loads.

	Current load	Least load	Target load	Trade load
River	200	200	200	200
Canal company	70	70	100	70
WWTP	40	10	10	40
Total	310	280	310	310

Finally, if pollutant trading is initiated in the subbasin, loads take on value. In this case, giving the canal company a load above and beyond what it currently contributes would convey a benefit to the canal company it did not deserve.

The reservoir model only considered blue-green algae. Are blue-greens the bad actors here?

Information indicates that the reservoir has two periods of high algae densities – a spring bloom of diatoms and a summer bloom of blue-green algae. Blue-green algae (primarily Aphanizomenon) represented the highest concentration of phytoplankton in the reservoir in the summer when most of the data were available. Recent spring data were non-existent, so the model concentrated on blue-green algae.

With American Falls Reservoir situated as it is and with the winds typically seen in southeast Idaho, why does the model not consider wind mixing in the reservoir?

The model has a simple representation of the hydrodynamic processes in the reservoir. The general effect of wind on vertical mixing is represented in the vertical diffusion coefficient used in the model. The coefficient used in this assessment was similar to an estimated value from the literature for this reservoir, and the model generally captures the range of vertical stratification observed in the reservoir. A more explicit, dynamic representation of wind mixing could be obtained by using a more complex model framework, such as CE-QUAL-W2. However, application of this model framework would have required bathymetry information for the reservoir, and this information was not available at the time of this assessment.

Both Bannock Creek and American Falls Reservoir are listed for sediment on the 303(d) list. The TMDL states that sediment from Bannock Creek streambanks is a problem. Why then isn't sediment from shoreline erosion in American Falls Reservoir a problem?

BURP data show that Bannock Creek is not supporting its beneficial uses. Although a direct linkage has not been made between nonsupport of cold water aquatic life and sediment, modeling in the watershed indicates sediment is elevated above what is observed in West Fork Bannock Creek, which served as a 'reference stream' for the model. No data have been discovered that would indicate sediment is impairing beneficial uses in American Falls Reservoir.

Substantial progress is expected within 10 years of the execution of the implementation plan. Development of a proper monitoring plan should allow a statistical evaluation of that progress. This is fairly optimistic.

Yes, this may be optimistic, especially the ability to statistically verify progress.

If the TMDL is solely based on critical conditions, is there a possibility that the targets may be more restrictive than natural or be unachievable?
Yes, there is a possibility that a TMDL based on critical conditions may be more restrictive than natural or be at least difficult to achieve. One of the problems in writing TMDLs for highly modified system is trying to figure out natural background levels of various constituents (e.g., sediment, nutrients, metals). If natural background levels are impossible to estimate, therefore unknown, then a TMDL could be written that is more restrictive than what occurs naturally.

A TMDL does not have to be based on critical conditions to be difficult to achieve. The purpose of the TMDL is to recommend water quality conditions necessary to support beneficial uses. Sometimes those conditions (i.e., load allocations) are very hard to meet depending on the effort and cost involved. The TMDL is concerned with the physical, chemical, and biological aspects needed to support beneficial uses. The political and economic aspects are left to other arenas.

Much of the sampling that served as a basis for the TMDL occurred during low water years. Concentrations and loads generated from drier-year data may not be indicative of years with greater water supply. There is concern then that conclusions reached in the TMDL may not adequately reflect conditions that would be seen over a longer time frame with a mixture of low, average, and high water years.

This is true. The last several years have been low water years in terms of water supply. The TMDL is based on the data we have and unfortunately does not include average or high water years.

As more data become available from higher water years, the TMDL can be revisited if the new data warrant it. DEQ monitoring will continue on Snake River and in American Falls Reservoir, but it is unknown if BOR, or other entities, will continue their monitoring.

Collecting data may penalize entities that "do the right thing", when those data are used in the TMDL to develop a load restriction. Entities that do not collect data, yet may be sources of pollutants, do not receive a load restriction, especially if they are an unknown source.

Collecting data is good as it does two things. First, better data mean a better TMDL and improves our chances of developing plans to support beneficial uses, which it is believed most of us want. Second, it protects those who collect data. Yes, there is a possibility that without data, load restrictions might be more liberal, but the reverse is also true. In many situations, it allows the entity to show that they are being good stewards of the resource. In other situations, the data provide a baseline from which the entity can show improvement.

Granted there are probably sources of pollutants, which at this time are not included in the TMDL because we are unaware of them. However, it is hoped that this public comment period would provide an opportunity for "those in the know" to make us cognizant of such situations.

Another problem that I see with the TMDL is that it does not take into account the flow of water. For example, some entity could reduce its nutrient loading of the reservoir by reducing the flow of water it discharges into the reservoir to one-third, even if the concentration of nutrients in that flow is twice as great. I am not sure that this is desirable.

Loads/wasteloads are based on flow and concentration, so reducing either would lower the load. In this case, a combination of reducing flow by ⅓ and increasing concentration by ½ would still result in a lower load. The TMDL recommends a load or wasteload allocation, but does not prescribe how an entity reduces that load. Ideally, it would be preferable to see a reduction in concentration, but the ultimate goal is to reduce total contribution of the pollutant to the receiving water, which the above scenario does.

The TMDL recommends a load allocation for Aberdeen-Springfield Canal Company. Do any of the other canal companies in southeast Idaho have TMDL requirements? There are several other companies between the Bingham-Bonneville County line and the dam, about which I know very little.

No, there are no other canal companies that have a direct load allocation similar to what is recommended for Aberdeen-Springfield Canal Company (ASCC) in southeast Idaho. No other canal company has collected the data that ASCC has, nor is there any other canal company of which we are aware that has as many drains out of the canal system. However, other regions have made allocations to canal companies (Clyde Lay, DEQ/Twin Falls, personal communication). In Portneuf River, sediment loads were assigned to canals in general.

Also in the Portneuf River, indirect loads have been placed on canal companies whose return water enters a water body that has an established TMDL. For example, Muddy Creek has a sediment TMDL, and Pretty Good Water Canal Company contributes sediment to Muddy Creek each spring when it “flushes” out its canals. The intent would be that in any implementation plan for Muddy Creek, the canal company is identified; monitoring occurs so its contribution can be quantified; an appropriate load is allocated; and a plan put in place to meet the load allocation.

There is a need to identify and monitor all sources that drain into the listed water bodies, but primarily American Falls Reservoir and Snake River. Folks need to step up and help us identify those drains, springs, etc., that need monitoring so DEQ can be in touch with the appropriate entity, if a canal drain, to work out a monitoring plan.

Flow in Snake River is increased when the Aberdeen Springfield Canal Company (ASCC) calls for water as water is released from storage upstream to fulfill their order. ASCC water also enhances flow to American Falls Reservoir when the drains are open discharging water, much of which finds its way to the reservoir, either directly or indirectly. Canal flow is also desirable as it contributes to aquifer recharge. If ASCC tries to meet their load allocation by reducing the amount of water they order (i.e., reducing flow in the concentration x flow = load equation), timing of flows in Snake River and discharge to the reservoir will most likely change as well as reduction of aquifer recharge.

Yes, if ASCC were to reduce their call for water as a way to meet their load allocation, a change in flow rates in the system would be expected. It is not known, however, whether this would be a positive or negative. Although DEQ does not have authority regarding water rights, changes in flow patterns to meet TMDLs certainly have the potential for unknown ramifications.

I did not see that we are planning to reduce the loading into the reservoir from springs, which may be significant sources of pollutants. Monitoring springs can be a real headache.

Where data from springs were available, load allocations were recommended. As mentioned in the TMDL, there is a need to identify and monitor all springs. Yes, estimating pollutant contributions from springs inundated by the reservoir, would be a real challenge.

The Aberdeen Springfield Canal Company improves water quality in American Falls Reservoir. By diverting water out of the river above Blackfoot and cleaning it up as it goes through the system, drain water is lower in pollutants (especially nitrogen) than the water would have been by continuing to the reservoir via the river.

Our data does not seem to be as clear-cut. Average concentrations of total nitrogen and total phosphorus at Nash and R spills are less than those seen at Snake River at Blackfoot (see Table I-2 below). Cedar Spill presents a slightly different picture. Total phosphorus and total nitrogen are lower than Snake River at Blackfoot (see Table I-2 below), but both phosphate and nitrate+nitrite are higher at 0.053 and 0.694 mg/L (34 sampling events), respectively (Table 2-17). (Only recently did water chemistry analysis of the spills change from sampling for phosphate and nitrate+nitrite to total phosphorus and total nitrogen.) Suspended solids are greater at all spills in comparison to the river.

Table I-2. Average concentrations of total nitrogen and total phosphorus at Nash and R spills.

Parameter	Statistic	Cedar spill	Nash spill	R spill	Snake River @ Blackfoot
Total P	Average	0.011	0.013	0.016	0.031
	Std Dev.	0.008	0.010	0.007	0.014
	Count	8	4	7	27
Total N	Average	0.179	0.094	0.196	0.316
	Std Dev.	0.417	0.067	0.296	0.11
	Count	8	4	7	27
Suspended solids	Average	86.4	9.5	10.6	8.0
	Std Dev.	414.4	8.0	6.8	5.2
	Count	34	3	6	27

We also performed paired t-tests for total phosphorus, total nitrogen, and total suspended solids concentrations from April to October collected at Snake River at Blackfoot and Firth, the two sites which bracket the ASCC diversion (Appendix C). There were no significant differences at the 95% level for total phosphorus (n = 27, degrees of freedom = 26, t statistic = -1.211, p value [two-tail test] = 0.24), total nitrogen (n = 27, degrees of freedom = 26, t statistic = 0.157, p value [two-tail test] = 0.88), or total suspended solids (n = 27, degrees of freedom = 26, t statistic = 1.82, p value [two-tail test] = 0.08)

I have concerns about the Snake River flow regimes used in the model. Both 1997 and 1999 were flood years and I wonder what the model output would be if a 'normal' flow year had been modeled. This matter needs to be seriously considered.

The department agrees that 1999 represents a high flow year and not an average year, and this was noted in the TMDL. The TMDL is based on a consideration of the results of all of EPA's model tests, which bracket the range of flow conditions in the record. There was added emphasis on higher flows (1999, 1997) in the modeling, because the model predicts higher chlorophyll *a* levels in higher flow years. Since the critical conditions are predicted to occur during higher flow years, a simulation using the 50th percentile flow year (i.e., a 'normal' year) would not change the TMDL allocations.

Ben Cope, EPA modeler, was asked to model flows from 1995, which was in the 48th percentile for all calendar year flows from 1970 to 2001 at the USGS gage site on the Snake River at Blackfoot (Ferry Butte). He encountered more error in the water budget than in other years, e.g., elevations were too high in mid-late summer. When the model was run with the shaky water balance, the water quality was better than 1997 but worse than 1999. The 60-day average chlorophyll *a* was about 0.020 mg/L.

Following the 1995 modeling attempt, 1968 calendar year flow was also modeled. Flow in 1968 was equivalent to the 47th percentile for 1970 to 2001 calendar year flows. The resulting 60-day average chlorophyll *a* concentration of 14.2 mg/L was more along the lines of other years.

Ben is doubtful that " . . . we can ascertain an "average" year, because the seasonal reservoir management (inflow versus outflow and resulting elevation) may be just as important as annual water budget. As part of my explorations, I noticed that the date at which the reservoir elevation drops below 4350 [ft] appears to line up with the model results more than annual water volumes [see Figure I-1 below]. The model may be telling us that earlier drafting would drop the residence time, lower orthophosphate levels, and starve the bloom. I would need to follow up and compare more predictions to explore this hypothesis. I think I've seen enough to say that Snake inflow is a factor but probably not a single determining factor for predicting water quality."

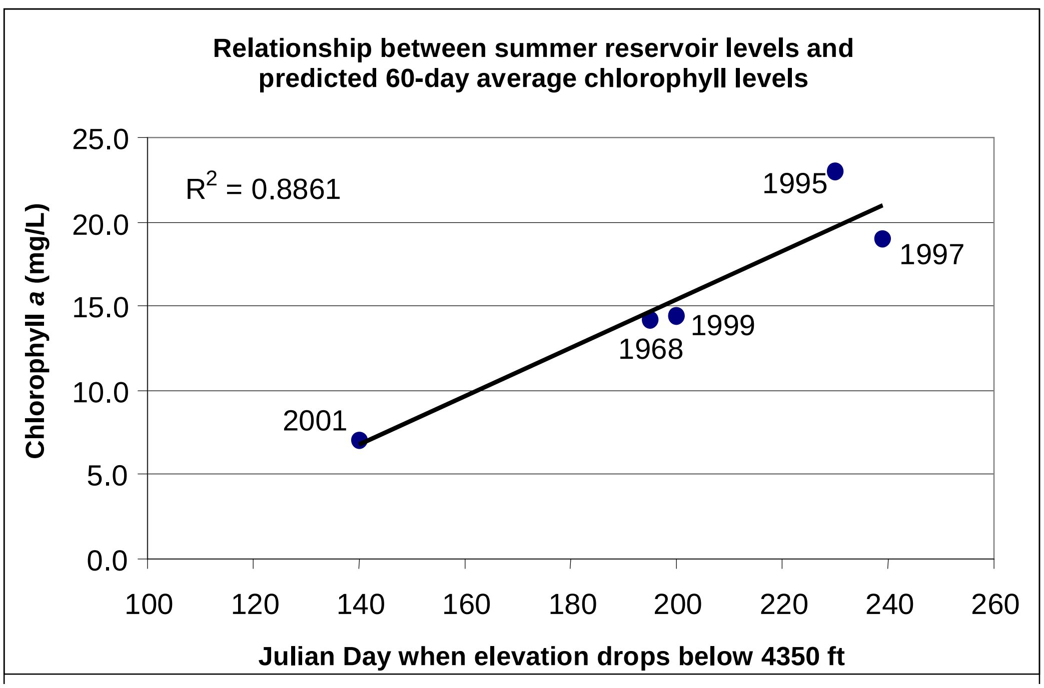

Figure I-1. Relationship between summer reservoir levels and predicted 60-day average chlorophyll levels.

Does Snake River Cattle Company have an NPDES permit, and is it a source of nutrients to the reservoir?

Yes, Snake River Cattle Company is large confined animal feeding operation (CAFO) and as such does have an NPDES. Although there is a possibility of discharging to the reservoir, Kelly

Mortensen, (livestock investigator with Idaho Department of Agriculture, personnel communication) has no knowledge of any such discharge.

There is concern for the potential contribution of pollutants from possible contamination of ground water, which is then pumped for irrigation and finds its way into, for example, the reservoir via surface water.

To develop the best TMDL possible to meet beneficial uses for southeast Idaho residents it is important to have applicable data from all pollutant sources in the subbasin. DEQ is more than willing to work with the various entities that are sources of pollutants, which contribute to loads in American Falls Subbasin. It behooves all of us to collect appropriate data so we can accurately estimate loads, prioritize areas, and begin implementing policies, programs, and/or practices to reduce loads to help meet beneficial uses. Sometimes DEQ needs help identifying those entities.

Aberdeen-Springfield Canal company is concerned that should total loads in the Reservoir increase due to unaccounted for sources, it would be faced with decreasing its already negligible loads. There was no assurance found in the document that ASCC wouldn't have to make up for sources outside of its control, or DEQ knowledge.

We believe that this concern is covered under the Reasonable Assurance section of this document. In fact, if reasonable assurance that nonpoint source reductions will be achieved is not provided, the entire pollutant load will be assigned to point sources. At this time, canal companies are not considered point sources (IDAPA 58.01.02.003.87).

In my opinion the biggest problem with the document is the lack of comprehensive data. While I realize that getting that data is a long-term process, it concerns me that we are casting allocations in stone and that modification of the TMDL will be very difficult.

There is seldom enough data. DEQ plans to continue its monitoring of Snake River and American Falls Reservoir, although the agency has neither staff time nor money to adequately sample all American Falls Subbasin water bodies. In a perfect world, all potential sources would be willing to monitor their contribution to subbasin loads. As more information becomes available, especially data contradictory to the TMDL, the TMDL can be revisited.

Finally, I would really like to see more coordination between TMDLs for the Snake and its tributaries (e.g., Portneuf and Blackfoot rivers).

We are not sure what all is envisioned in this statement. Both Portneuf and Blackfoot river TMDLs have been approved by EPA. In hindsight, it might have been better to have completed American Falls Subbasin prior to Portneuf River, but such was not the case.

There was coordination on this American Falls Subbasin TMDL and Portneuf River TMDL, but not Blackfoot River TMDL. Load allocations recommended for American Falls Reservoir helped drive changes in target concentrations in Portneuf River. These changes will be reflected in the Portneuf River TMDL when it is revisited in 2004. The Blackfoot River was not considered in this TMDL for two reasons. First, Blackfoot River enters Snake River just upstream of Ferry Butte and Tilden Bridge. Therefore, data collected at Snake River near Blackfoot (Ferry Butte) included any input from Blackfoot River. Second, lower Blackfoot River was not listed on the 303(d) list.

Improvement of Portneuf River (e.g., increased flows) and Marsh Creek (e.g., decreased sediment loading) would improve both Portneuf River and American Falls Reservoir water quality.

We agree that any improvement in water quality in the Portneuf River Subbasin would in turn improve water quality in American Falls Reservoir. The ideas suggested for the Portneuf River are better addressed in the Portneuf River Subbasin Total Maximum Daily Load plan. Ways to address sedimentation problems in Marsh Creek and other Portneuf River watersheds were addressed in the Portneuf River TMDL implementation plan. Ideas on how to increase flows were not.

Bureau of Reclamation

Please address possible implications of setting a no increase sediment TMDL for Snake River based on data collected from a limited number of drought years. How might the sediment load change seasonally and under different water conditions? What will be the process for re-evaluating and making changes to the no increase sediment TMDL?

We have been convinced that basing suspended sediment load allocations on data from the 2000-2003 time period is not an accurate reflection on the assimilative capacity of this section of the Snake River. This is especially true since there appears to be no impairment of beneficial uses by sediment in either Snake River or American Falls Reservoir. Therefore, upon evaluation of earlier (1989 to 1998) USGS data, we recommend load allocations at Ferry Butte and Shelley based on 1995 data collected by USGS. Flows in 1995 at both sites were just over the 50th percentile of all flows from 1970 to 2003. We recognize, however, that high flows such as those in 1997 would likely exceed the load allocation.

We agree that a sediment TMDL for Snake River could be improved. The first step in re-evaluating the Snake River sediment TMDL is to determine if there is impairment of beneficial uses. This involves collection of biological/physical data following the large river protocol under the Beneficial Use Reconnaissance Program and analyzing those data through the Water body Assessment Guidance. The second step is to collect more sediment data during average and above average water years. The third step is to take these data and rewrite the TMDL accordingly. DEQ will continue to monitor Snake River at the various sites for use in refining the TMDL.

City of Pocatello

City of Pocatello notes that American Falls Reservoir primary productivity “. . . appears to be phosphorus limited, which implies that reductions in nitrogen loading in the basin may not bring about water quality improvements in the impaired receiving waters [American Falls Reservoir].”

We are not totally assured that phosphorus is the only limiting nutrient to primary production in American Falls Reservoir. In addition, as pointed out in the Portneuf River TMDL, nitrogen does appear at times to be the limiting nutrient in Portneuf River. So, regardless of whether nitrogen is limiting primary production in the reservoir, there would still be a nitrogen target for the Portneuf River itself. DEQ has, and will continue to pursue funding nutrient limitation studies in American Falls reservoir, Snake River, and Portneuf River.

Application of a generic water-column target without considering the natural background condition of the river is arbitrary.

We maintain that a total phosphorus target of 0.05 mg/L is not unreasonable or arbitrary. Although there are no ‘pristine’ streams in Portneuf River Subbasin, Webb Creek serves as a DEQ reference stream. The creek was monitored by the Idaho Association of Soil Conservation Districts (IASCD) from May 1999 to April 2003. Total phosphorus averaged 0.05 mg/L (n=53, SD=0.031) with a median concentration of 0.03 mg/L.

Although other bigger river sites are affected to varying degrees by upstream human activity, average and/or median total phosphorus concentrations hover around 0.05 mg/L. Average total phosphorus concentration collected since 1993 at the USGS Portneuf River at Topaz gage (13073000) was 0.05 mg/L (n=58, SD=0.047). The median concentration was 0.038 mg/L. These values are similar to those collected on Portneuf River in Lava Hot Springs by J-U-B Engineers from November 2001 to November 2002 where mean concentration was 0.05 mg/L (n=13, SD=0.024) and median concentration was 0.045 mg/L.

Higher mean values have been found in Marsh Creek, however, well documented agricultural and livestock grazing occurs in the watershed. Marsh Creek is the major tributary to Portneuf River. Average total phosphorus concentration from 1990 to 2000 at the USGS Marsh Creek near McCammon gage (13075000) above Goodenough Creek was 0.08 mg/L (n=36, SD=0.056) and the median concentration was 0.06 mg/L. Other entities have also sampled lower Marsh Creek including IASCD below confluence with Walker Creek (mean=0.06, n=10, SD=0.049, median=0.06, sampling period=Jun-Nov 1999) and City of Pocatello further below Walker Creek (mean=0.10, n=14, SD=0.097, median=0.062, sampling period=Sep 2003-Nov 2004). Although the average value varied, the median value was consistently about 0.06 mg/L in a stream that has extensive agriculture and livestock grazing in the watershed. Therefore, DEQ considers a target of 0.05 mg/L reasonable and attainable given background conditions found in the watershed. Additionally, background phosphorus concentrations in Snake River average less than 0.05 mg/L. Given that both these inflow into American Falls, and that similar background levels are found in the Portneuf River, DEQ feels it is appropriate to limit inputs of these sources in order to improve water quality in and downstream of American Falls Reservoir.

Is the fishery appreciably worse due to aquatic growth due to phosphorus and nitrogen loading than it would be under natural conditions?

Firstly, it is difficult to define natural conditions for a reservoir. Secondly, as mentioned in the TMDL, the trout fishery potential in the reservoir is considered by Idaho Department of Fish and Game to be one of the highest in the state based on the zooplankton community. However, we don’t have sufficient data to say what, if any, effect the increased phosphorus and nitrogen loading has on the fishery. We know that increased nutrients can lead to increased phytoplankton, at least until some other factor begins to limit growth. We do not know the potential consequences to the zooplankton community, and thus the trout fishery, due to a possible reduction in the phytoplankton community from decreased nutrient loading. Thirdly, dissolved oxygen standards also may be at risk of being exceeded under certain conditions involving excessive aquatic growth and subsequent decay. Finally, there are other beneficial uses (e.g., cold water aquatic life, aesthetics), which can also be affected by excessive aquatic growth in American Falls Reservoir.

The City of Pocatello has spent $23 million dollars on upgrades at the City's Water Pollution Control Plant to improve water quality in its wastewater discharge.

We applaud the City for being proactive in their plant upgrades, and thereby improving water quality in the Portneuf River.

The City of Pocatello comments on ". . . the unfairness of targeting one set of users for the benefit of the entire watershed (including American Falls Reservoir and other downstream areas), such a limited focus inevitably will limit opportunities to improve water quality."

One of the results of the TMDL process is to identify sources of pollutant loading. That was done in both the Portneuf River and American Falls plan where load and wasteload allocations were established for both nonpoint and point sources. The City of Pocatello was not the only entity for which reductions were recommended (e.g., Inkom, Lava Hot Springs, and Aberdeen wastewater treatment plants).

The City's treatment facility upgrades were possible through loans from the State Revolving Fund loan program. This subsidized loan program is designed to improve quality of life for Idahoans. There is an expectation for those receiving these funds to use them for the betterment of the greatest number of Idaho citizens. It is not unreasonable for those downstream Idaho residents (e.g., Twin Falls, Boise) who help subsidize this fund to expect improved water quality from those facilities who receive such loans.

Through the focus of the American Falls Subbasin TMDL, the Portneuf River has been identified as the single largest contributor of phosphorus to American Falls Reservoir. Both the American Falls Subbasin and Portneuf River Subbasin TMDLs reiterate the need to work for better water quality in the Portneuf River, which will lead to better water quality in American Falls Reservoir and downstream water bodies. We do not believe this will limit opportunities to improve water quality.

The City urges IDEQ to take a holistic view of the entire Upper Snake River Basin watershed as it considers how best to improve water quality.

IDEQ agrees that taking a holistic view provides the most opportunity to benefit the entire watershed. This is why it is imperative to consider Portneuf River's contributions to the larger Snake River watershed. Pollutants exiting American Falls Reservoir ultimately end up in the lower Snake River basin, and it is important to consider their downstream effects. The DEQ is also amenable to other approaches to improve water quality, such as reducing pollutant loads via pollutant trading.

The City attached comments, which had previously been submitted in their response to the Portneuf River TMDL.

We feel the comments were adequately addressed in the Portneuf River TMDL.

The City reserves the right to legally challenge the American Falls Subbasin TMDL.

Such potential action is the City's prerogative.

The City remains committed to achieving water quality conditions that sustain beneficial uses in a cost-effective manner.

The DEQ agrees with this approach as long as such action occurs within a reasonable time frame (i.e., significant improvement measured in years not decades).

J. R. Simplot, Co.

Sampling by BOR on American Falls Reservoir from 1995 to 2000 suggests that total phosphorus and chlorophyll *a* concentrations were on average substantially lower in those years than during the drought years of 2001 to 2003 when DEQ was sampling. If additional data from more average water years were to confirm this trend, it calls into question making impairment decisions based on conditions during extreme drought conditions.

It does appear that based on limited sampling by BOR (one sampling event at one site per year) total phosphorus concentrations from 1995 to 2000 were equal to or less than levels observed during DEQ sampling from 2001 to 2003. Except for 1997 (the highest chlorophyll *a* concentration recorded), the same is true for chlorophyll *a*. We agree the TMDL would benefit from more information from average and above average water years.

Based on these data, one could surmise that all that is needed for support of beneficial uses is average to above average water years. However, during the 17 years from 1987 to 2003, only four full years (1993, 1995, 1997, and 1998) and two partial years (1996 and 1999) were not considered drought years according to the Palmer Drought Severity Index. We feel it is prudent to develop targets such that beneficial uses are supported even during lower water years.

The most recent limited pre-drought data (collected by BOR from 1995 to 2000) indicate that algae concentrations may be lower in non-drought years, which contradicts reservoir model predictions that indicate that higher flow years have higher algae and lower DO concentrations than drought years.

We would not agree that pre-drought data necessarily contradict model predictions. The third highest concentration of chlorophyll *a* recently recorded in American Falls Reservoir was 0.052 mg/L in 1997, the year of highest flow in Snake River above the reservoir. We do agree that more data are needed to validate and improve the predictive capability of the model.

Although it is mentioned in the TMDL, DEQ does not document any complaints by citizens on conditions in American Falls Reservoir.

You are correct. Documentation, albeit limited, can now be found in Appendix G and includes complaints received by DEQ in both 1996 and 1997 regarding algae blooms. We also contacted one local reservoir user as to her opinion of summer water conditions. Her response is also included in Appendix G. It should be noted that 1996 and 1997 were average to above average water years.

Are aquatic life uses in the reservoir actually impaired by nutrients?

As mentioned in the TMDL, it would appear that the salmonid population in American Falls Reservoir is not impaired by nutrients. As the reservoir has not been assessed as to support of cold water aquatic life, we do not know if this beneficial use is being impaired. We do, however, know that dissolved oxygen at certain sites falls below the 6 mg/L water quality standard. Citizen's complaints about summer algae problems would indicate that the aesthetics beneficial use of the reservoir is being impaired.

A more comprehensive biological assessment of the reservoir is needed, provided that the methods and data interpretations are specific to what is attainable in human-made reservoirs in southern Idaho. A Use Attainability Analysis (UAA) process certainly seems appropriate for the reservoir.

The reservoir is designated in our water quality standards for cold water aquatic life. Any changes to water quality standards or designated uses must go through the rule-making process and be approved by the state legislature and EPA. The goal of a UAA is to change a beneficial use of a water body from one use to another. As the reservoir provides an important trout fishery and Idaho Department of Fish and Game considers trout forage conditions in the reservoir some of the best in the state, it would be difficult to justify changing the cold water aquatic life beneficial use. Even a change from cold water aquatic life to seasonal cold water aquatic life would have no effect on the dissolved oxygen standard, and algae blooms would still be a problem from an aesthetic perspective.

The TMDL recommends the following targets: 0.015 mg/L chlorophyll *a* in the reservoir and 0.05 mg/L of total phosphorus for waters flowing into the reservoir. Neither of these targets are based on scientifically defensible cause and effect relationships between nutrient loads/concentrations and algae/DO responses in this reservoir. The Oregon chlorophyll *a* target of 0.015 mg/L is a "guidance value" that was never intended to be a hard and fast criterion.

In DEQ's opinion, total phosphorus and chlorophyll targets are appropriate for several reasons. First, the chlorophyll *a* target aligns with EPA recommendations for lakes and reservoirs in Nutrient Ecoregion III (Xeric West) as well as results from the more directly-applicable Subecoregion 12 (Snake River Basin). (Although ecoregion criteria are based on fluorometric analysis whereas American Falls Reservoir chlorophyll samples were analyzed via the spectrophotometric method the two methods are comparable [Mark Hardy, USGS, personal communication].)

The total phosphorus target of 0.05 mg/L for water inflowing into the reservoir also falls within the range of reference conditions for rivers and streams in the Xeric West Ecoregion and is slightly higher than the 25th percentile of values from Snake River Basin Subecoregion. It should also be noted, as it is in the main TMDL document, that total phosphorus levels in Snake River are consistently below the recommended phosphorus target.

Second, we agree that Oregon uses the 0.015 mg/L chlorophyll *a* target as a threshold value above which phytoplankton may be impairing beneficial uses. However, that did not deter ODEQ and IDEQ from adopting a slightly more stringent target of 0.014 mg/L for the Snake River-Hells Canyon TMDL. An internet search revealed that a chlorophyll *a* target of equal to or less than 0.015 mg/L is not uncommon. Utah chose a chlorophyll *a* target of 0.0051 mg/L for Deer Creek Reservoir (PSOMAS 2002), while Cherry Creek Reservoir in Colorado has a chlorophyll *a* standard of 0.015 mg/L (Cherry Creek Basin Water Quality Authority Web site). Kansas Department of Health and Environment (Web site) recommended summer concentrations of chlorophyll *a* at or below 0.012 mg/L in Hillsdale Lake, a reservoir in eastern Kansas.

Third, a reduction to an average summer value of 0.015 mg/L of chlorophyll *a* would mean the reservoir would still be considered in a eutrophic state (NRCS 1999). The recommended 0.015 mg/L target falls in the exact middle of the range (9-25 ug/L) of chlorophyll *a* values that identify a water body as eutrophic.

Fourth, despite its limitations, the model does predict that we can achieve the in-reservoir target for chlorophyll *a* a majority of the time if we can meet the recommended reductions in total phosphorus loads, based on the 0.05 mg/L total phosphorus target, from inflow waters.

Fifth, although often overlooked, the reservoir is designated for domestic water supply and must be protected for such a future use. Algae and algal byproducts can cause deterioration in the quality of drinking water, and can lead to taste and odor problems that are not removed through treatment (Cusimano et al. 2002). Canada's Surface Water Quality Initiative, which looked at water quality problems on prairie farms, established a chlorophyll *a* guideline for drinking water of less than 0.010 mg/L (Agriculture and Agri-Food Canada Web site). New York City chose a threshold level of 0.007 mg/L with an allowable 25% exceedance rate to protect their drinking water supply reservoirs (NYCDEP 1999).

There is evidence that the 0.025 mg/L total phosphorus target in lakes and reservoirs as recommended in the EPA's 1986 "Gold Book" is considerably lower than natural background total phosphorus concentrations in this portion of the state.

The citation for this statement is Baldwin et al. 2004, wherein the authors present data from 13 statewide monitoring wells in the lower Portneuf River area. These wells represent ambient, not natural, ground water in the state. Even so, page 11 of the report states "Mean total phosphorus concentrations ranged from 0.01 mg/L to 0.06 mg/L for east side wells and from 0.009 to 0.011 mg/L for west side wells." Compared to these values, 0.025 mg/L is not "considerably lower" than ambient background, and certainly higher than natural background.

EPA guidance on nutrient criteria are wrongly cited in the references cited.

The citation for rivers and streams has been corrected and the citations for lakes and reservoirs has been added.

Several concerns about EPA's guidance on nutrient criteria are expressed.

We believe that the EPA nutrient criteria provide a good guidance for the American Falls Subbasin TMDL. Some of the stated issues (e.g., data locations only identified as dots on large-scale maps) would be better addressed to EPA. That said, we are in agreement on several points.

We agree site-specific targets are best, but also feel that the targets selected will help move American Falls Reservoir closer to support of beneficial uses. The criteria do not make a distinction between lakes and reservoirs, and we agree that lakes are different than reservoirs and probably deserve their own criteria. We also agree that "reference conditions" for a reservoir such as American Falls Reservoir, which can fluctuate from 1.7 million ac-ft to 38,000 ac-ft over a season, are at best extremely difficult to determine.

The values for all seasons were combined and thus not reflective of the growing season. A comparison of all July and August chlorophyll concentrations in American Falls Reservoir since 1995 show that a value of 0.015 mg/L is in the 60th percentile of all values measured (n=38) and the 73rd percentile for values from the higher water years of 1995 to 2000 (n=4).

There are no reference water bodies for larger rivers in southeast Idaho and, as mentioned, it is difficult to establish "reference conditions" in reservoirs. Despite no reference lakes in the Xeric West nutrient ecoregion, we do not believe EPA's use of the 25th percentile of data from all lakes/reservoirs as a surrogate representing reference conditions is invalid as a guide for the water bodies addressed in the American Falls Subbasin TMDL.

Nitrogen data are missing for subecoregion 12 as it relates to lakes/reservoirs, but not for rivers and streams. We do not set a nitrogen target for the reservoir, but only those water bodies which flow into it.

We used the ambient nutrient criteria as guidelines for the American Falls Subbasin TMDL and feel confident in doing so. We are reminded that the goal of the TMDL is the support of beneficial uses in the various water bodies addressed in the document. The targets expressed therein are subject to change, either higher or lower, depending on data assessing the status of beneficial uses support. If beneficial uses support is achieved before attainment of the proposed target, then that target is subject to increase. The opposite is also true: should target load and wasteload allocations be met, yet beneficial uses remain impaired, further reductions in the targets would be considered.

The TMDL identifies the ground water target to be 0.025 mg/L total phosphorus.

We apologize for any misunderstanding here. We did not mean to imply that we were setting any kind of ground water target and DEQ has no intention of doing so in this TMDL. The misunderstanding may have come from Table 5-4. It was only assumed for modeling purposes that the ground water total phosphorus concentration was 0.025 mg/L, as explained in the footnote.

Rather than the approach taken in the American Falls Subbasin TMDL, a better method would be one similar to what was done in the Snake River-Hells Canyon TMDL.

As we read the Snake River-Hells Canyon TMDL, a chlorophyll *a* seasonal (May to September) target of less than 0.014 mg/L was recommended. We see the American Falls Reservoir target as similar.

The water quality model developed by EPA for the reservoir has limitations. The model prediction of higher chlorophyll and lower dissolved oxygen concentrations in typical and wet years is counter-intuitive. The model predicts the DO standard will not be achieved in the lower half of the reservoir as a result of the proposed nutrient allocations, and thus, it seems likely the standard is not being met over 80% of the reservoir as required in the standards. This further emphasizes the need for a UAA process for the reservoir.

We agree that more data might improve the predictive capabilities of the model. Bureau of Reclamation data collected in the reservoir for non-drought years does not unequivocally indicate chlorophyll *a* values are lower in typical to wet years. We again point out that one of the highest chlorophyll *a* concentrations was measured by BOR in 1997, certainly a wet year.

We are assuming that meeting the proposed nutrient reductions will result in achievement of dissolved oxygen water quality standards in the reservoir. If this proves not to be true, we may consider changes to water quality criteria at that time. As mentioned previously, even a UAA change to seasonal cold water aquatic life would not reduce the need to maintain at least 6 mg/L dissolved oxygen in the reservoir throughout the year. Any other aquatic life change would not in our opinion be remotely justifiable due to the current support in the reservoir of a salmonid fishery.

American Falls Subbasin TMDL is inconsistent with other mainstem Snake River TMDLs. Total phosphorus targets are lower than other TMDLs, and no other TMDL recommended a nitrogen target. This TMDL does not address seasonality, but proposes annual loads. The degree of rigor for the American Falls Reservoir model is not as great as that used in the Snake River-Hells Canyon TMDL.

We believe we have set reasonable targets to support beneficial uses in American Falls Reservoir, while at the same time being aware of downstream concerns. The fact that our recommended target concentrations are less than other Snake River segment targets helps alleviate concerns about meeting downstream requirements. Although there is some doubt as to whether nitrogen is a limiting nutrient in the reservoir, we decided to be conservative and recommend a target concentration. It is felt that to effect a change in American Falls Reservoir, we need to reduce loads throughout the year. This is particularly true for phosphorus which can enter the reservoir any time, adhere to bottom sediments, and release back into the water column under the right (anoxic) conditions (e.g., during the summer growing season).

The American Falls Subbasin TMDL hopes to see significant changes toward meeting its goals in 10 years as compared to Snake River-Hells Canyon which is operating under a 40-70 year time frame. Other recommendations are: formally defining American Falls Subbasin as a phased TMDL; including adaptive management language in the document; changing targets to be consistent with other TMDLs (e.g., Snake River-Hells Canyon) including a no nitrogen target; conducting a UAA; document complaints regarding recreational or aquatic life use impairments; develop defensible chlorophyll targets to protect recreation uses; monitor progress of Phase I for 10 years; formally engage a group of stakeholders to aid in this effort (e.g., review data gaps and data gathered, provide information for a UAA, provide solutions to aid water quality); and begin Phase II in year 10 to refine attainment status, uses, criteria, TMDL targets and allocations based on Phase I outcomes.

We believe we have responded to most of these suggestions in our answers to previous concerns. The time frame to see beneficial use support in American Falls Subbasin may take longer than preferred. We would hope to see some statistically significant improvement within 10 years of the start of the implementation plan. The plan itself is somewhat of a phased TMDL implementation, as recommended targets are subject to change based on status of beneficial uses support. We agree that engaging stakeholders is important if we desire to improve water quality in the subbasin. As such, we have asked the American Falls Subbasin Watershed Advisory Group to continue to work with us during the development of the implementation plan for the subbasin.

U.S. Environmental Protection Agency

Idaho Department of Environmental Quality (DEQ) developed the American Falls TMDL as a phased TMDL. While phased TMDLs are acceptable, EPA believes it is important for DEQ to acknowledge that all TMDLs must be developed to meet water quality standards. While DEQ has developed interim and final TMDL targets, EPA feels that DEQ should emphasize that the final targets are developed to meet water quality standards and implementation plans developed will be consistent with the final targets outlined in the TMDL. For example, on pages XXVII-XXIX, DEQ discusses the interim targets, but fails to discuss the final targets. Failure to completely acknowledge final targets can lead to confusion in the public and regulated communities. Any National Pollutant Discharge Elimination System (NPDES) permits that are written to comply with this TMDL will utilize the wasteload allocation based on the final targets developed.

Your concerns have been noted, clarification of the targets have been addressed on page xxx. Idaho DEQ recognizes that a phased TMDL is an approach to achieving water quality goals in a watershed. The interim total phosphorus target concentration for American Falls is 0.07 mg/L and the final target concentration is 0.05 mg/L. DEQ also acknowledges that NPDES permits are generally written with the final target concentration and not the interim wasteload allocation.

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