Pend Oreille River
Total Maximum Daily Load
for Temperature

Draft

Washington Department of Ecology
Kalispel Tribe of Indians
Idaho Department of Environmental Quality
United States Environmental Protection Agency

August 2007

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Abbreviations, Acronyms, and Symbols

§303(d)	Refers to section 303 subsection (d) of the Clean Water Act, or a list of impaired water bodies required by this section
§	Section (usually a section of federal or state rules or statutes)
AU	assessment unit
AWS	agricultural water supply
BMP	best management practice
Btu	British thermal unit
C	Celsius
CC	ceremonial and cultural use
CFR	Code of Federal Regulations (refers to citations in the federal administrative rules)
cfs	cubic feet per second
cm	centimeters
C/N	commerce/navigation
COE	Corps of Engineers
COLD	cold water
CSH	core summer habitat
CWA	Clean Water Act
DWS	domestic water supply
Ecology	Washington Department of Ecology
EPA	United States Environmental Protection Agency
F	Fahrenheit
ft	feet
GIS	Geographical Information Systems
HUC	Hydrologic Unit Code
IDAPA	Refers to citations of Idaho administrative rules
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
km	kilometer
km^2	square kilometer
LA	load allocation
LC	load capacity
m	meter
m^3	cubic meter
m^3/s	cubic meter per second
mi	mile
mi^2	square miles

MGD million gallons per day

mg/L milligrams per liter
mm millimeter

MOA Memorandum of Agreement

MOS margin of safety

MRLC multiresolution land cover

n.a. not applicable

NB natural background

NLCD National Land Cover Dataset

NPDES National Pollutant Discharge Elimination System

PCBs Polychlorinated biphenyls

PCR primary contact recreation

RM river mile

SBA subbasin assessment

SM salmonid migration

STP sewage treatment plant

SWS stock water supply

TDG total dissolved gas

TMDL total maximum daily load

U.S. United States

U.S.C. United States Code

USEPA United States Environmental Protection Agency

USFS United States Forest Service

USGS United States Geological Survey

WAG Watershed Advisory Group

WBAG *Water Body Assessment Guidance*

WDFW Washington Department of Fish and Wildlife

WH wildlife habitat

WHH wildlife habitat and hunting

WLA wasteload allocation

WWTP waste water treatment plant

Executive Summary

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

This document addresses the Pend Oreille River in the Pend Oreille River Subbasin that has been placed on Idaho's, and,Washington's §303(d) lists, as well as unlisted impairments to Washington and Kalispel tribal waters. Washington and Idaho are issuing this TMDL for state waters of the Pend Oreille River and Washington is issuing for temperature impaired tributaries in Washington waters. The states are submitting these TMDLs to United States Environmental protection Agency (EPA) for approval. The EPA is issuing this TMDL for Kalispel Tribal waters of the Pend Oreille River and impaired tributaries.

This subbasin assessment (SBA) and TMDL analysis have been developed to comply with Idaho and Washington TMDL schedules. The assessment describes the physical, biological, and cultural setting; water quality status; pollutant sources; and recent pollution control actions in the Pend Oreille River Subbasin, located in north Idaho and the northeast corner of Washington.

The first part of this document, the SBA, is an important first step in leading to the TMDL. The SBA 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 TMDL analysis quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition of meeting water quality standards.

Subbasin at a Glance

The Pend Oreille River drains the Clark Fork – Pend Oreille watershed encompassing approximately 26,000 square miles. The Clark Fork – Pend Oreille watershed spans three states, including Montana, Idaho, and Washington, as well as a portion of British Columbia, Canada, before entering the Columbia River (Council 2005). The Pend Oreille River begins at the outlet of Pend Oreille Lake in northern Idaho and flows west across the Idaho Panhandle into the northeast corner of Washington (Figure A). The Pend Oreille River flows for about 26 miles in Idaho before reaching Albeni Falls Dam just east of the border between Idaho and Washington, and then flows north for about 72 miles in Washington before entering Canada and eventually into the Columbia River. The subbasin is located in Bonner County in Idaho and Pend Oreille County in Washington.

Three large dams have been built on the Pend Oreille River. The Albeni Falls dam is located just upstream of the Washington-Idaho state line in Idaho. The two other major dams, the

Box Canyon Dam and Boundary Dam, are located on the Pend Oreille River in Washington. Box Canyon dam is just downstream of the City of Ione and Boundary Dam is about one mile upstream of the Canadian border.

The Kalispel Indian Reservation occupies about 4,600 acres along the Pend Oreille River in Washington. The Reservation lies primarily in the lowlands bordering the Pend Oreille River with the bulk of the Reservation on the river's east side.

Evaluation of available temperature data showed the temperature in the Pend Oreille River often in exceedance of Idaho's, Washington's, and the Kalispel Tribe's numeric water quality criteria for temperature, leading to the inclusion of the river on the Idaho and Washington §303(d) lists. This document addresses the §303(d) listing of the mainstem of the Pend Oreille River for a temperature impairment. Figure A also presents the locations of the listed segments along the river in Idaho and Washington. The temperature exceedances are affecting the aquatic life beneficial uses of cold water aquatic life habitat in Idaho, core summer habitat in Washington, and salmonid migration on the Kalispel Reservation.

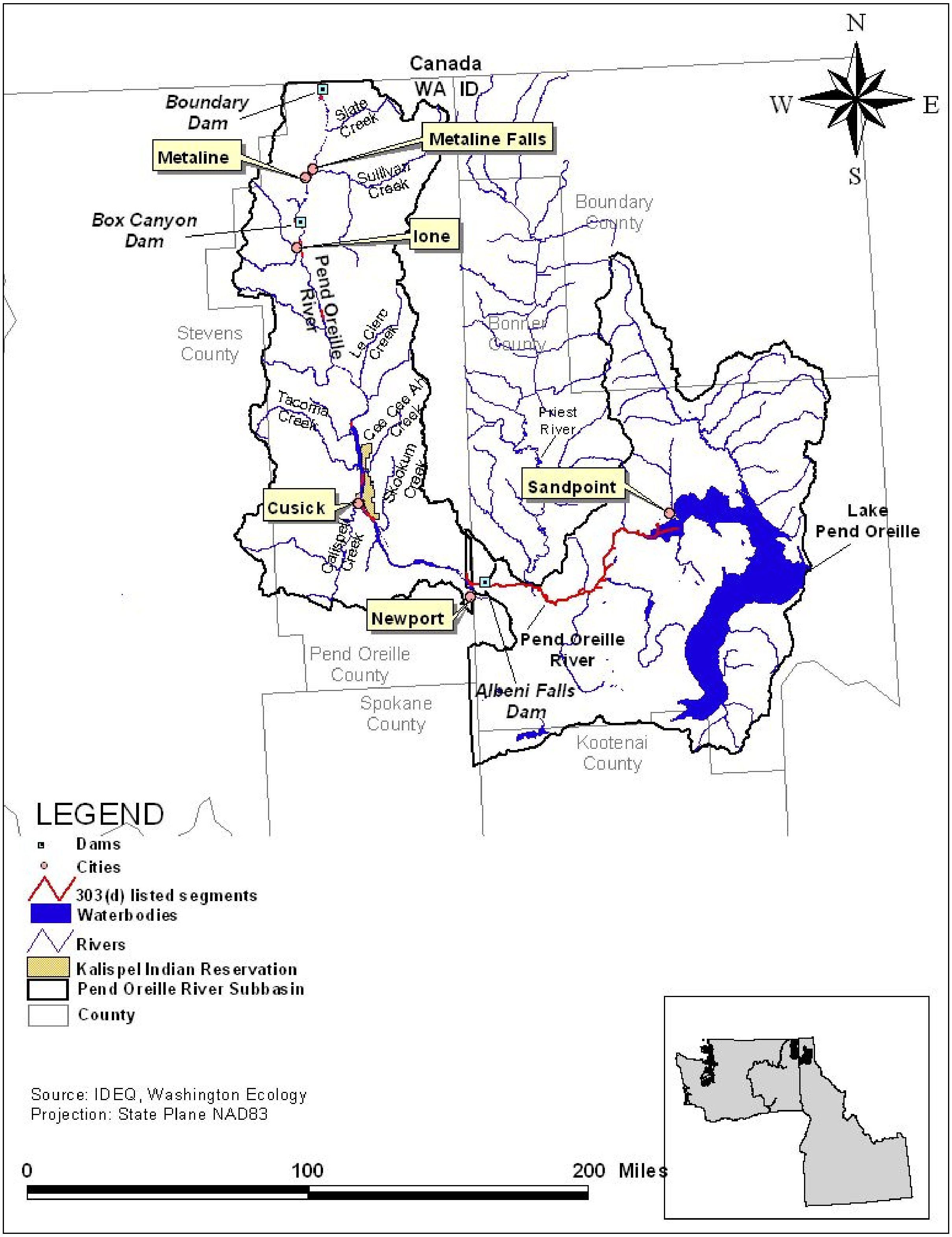

Figure A. Location of the Pend Oreille Subbasin.

Key Findings

Tables A and B present the percent heat load reduction required by the temperature TMDL for the Idaho and Washington portions of the mainstem Pend Oreille River, respectively. Table C presents the allocations for the impaired tributaries in Washington and the Kalispel Reservation. For more detail on the TMDL calculations and allocations, please see Section 5 of this report.

Table A. Load allocations for Albeni Falls Dam.

Target	Existing Temperature (ºC)	Date of Maximum Temperature Impairment	Allowable Temperature (ºC) 1	Existing Heat Load (kcal/day)	Allowable Heat Load (kcal/day)	Reduction Required
Idaho Cross Section	23.4	August 8, 2004	22.3	6.641E+11	6.329E+11	4.7%

[1] Equal to natural temperature plus allowable increase.

Table B. Existing and allowable heat loads for Pend Oreille River in Washington on the maximum dates of impairment.

Compliance Area	Date of Maximum Temperature Impairment	Location of Maximum Impairment	Existing Temperature (ºC)	Existing Heat Load (kcal/day)	Allowable Temperature (ºC)	Allowable Heat Load (kcal/day)	Reduction Needed
Box Canyon Reservoir	8/24/04	River Mile 34.6	22.22	6.651E+11	20.00	5.986E+11	10.0%
Kalispel Reservation	5/7/04	River Mile 64.2	14.41	1.100E+12	12.85	9.809E+11	10.8%
Boundary Reservoir	8/25/04	River Mile 17.7	23.15	1.065E+12	19.97	9.191E+11	13.7%
Below Boundary Dam	8/25/04	River Mile 16.8	22.78	1.048E+12	19.99	9.200E+11	12.2%

[1] Based on outflow from Box Canyon Reservoir (12,234 cfs)
[2] Based on flow at Newport (31,200 cfs)
[3] Based on flow from Boundary Reservoir (18,811 cfs)

Table C. Shade allocations for impaired tributaries to the Pend Oreille River.

Water Body	Load Allocation (Effective Shade to Achieve Criteria in %)	Increase in Shade Needed (%)	Status
Indian Creek	91	6	Impaired
Skookum Creek	90	0	Meets Criteria
NF Skookum Creek	85	5	Impaired
Calispell Creek below Smalle Ck	64	64	2004 303(d)
Cee Cee Ah Creek	77	7	Impaired
Tacoma Creek	81	11	Colville NF TMDL
Cusick Creek	82	29	Colville NF TMDL
Mill Creek	88	3	Impaired
Middle Creek	85	0	Meets Criteria
Leclerc Creek	43	8	Impaired
E Br LeClerc Creek (lower)	91	56	2004 303(d)

E Br LeClerc Creek (upper)	90	25	2004 303(d)
Ruby Creek	83	23	Colville NF TMDL
SF Lost Creek	83	13	Colville NF TMDL
Lost Creek	60	30	2004 303(d)
Little Muddy Creek	67	7	2004 303(d)
Big Muddy Creek	82	7	Colville NF TMDL
Cedar Creek	79	28	2004 303(d)
Sullivan Creek	64	39	Colville NF TMDL
Slate Creek	78	0	Colville NF TMDL
Lime Creek	97	9	Colville NF TMDL
Flume Creek	85	0	Colville NF TMDL

Introduction

This TMDL has been jointly developed by the states of Idaho and Washington and USEPA for the shared waters of the States of Idaho and Washington and the Kalispel Tribe. The TMDL processes for the two states differ. The format of this document is based primarily on the Idaho structure. However, the structure and content also meet Washington requirements. The following table shows how the Idaho and Washington TMDL document structures align.

State of Idaho	State of Washington
Acknowledgements	Acknowledgements
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2. Subbasin Assessment – Water Quality Concerns and Status	Background
3. Subbasin Assessment – Pollutant Source Inventory	Water Quality and Resource Impairments
4. Subbasin Assessment – Summary of Past and Present Pollution Control Efforts	Background
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5.2 Loading Capacity	Loading Capacity
5.3 Estimates of Existing Pollutant Loads	Technical Analysis
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1. Subbasin Assessment – Watershed Characterization

The federal Clean Water Act (CWA) requires that states restore and maintain the chemical, physical, and biological integrity of the nation's waters. States, pursuant to Section 303 of the CWA, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. Section 303(d) of the CWA establishes requirements for states to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States must periodically publish a priority list (a "303(d) list") of impaired waters. Currently this list must be published every two years. For waters identified on this list, states must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. (A TMDL also refers to the written document that contains allocations for point and nonpoint sources and also contains supporting analyses for several water bodies and/or pollutants within a given watershed.) This document addresses the the mainstem of the Pend Oreille River, which has been placed on Idaho's and Washington's §303(d) lists for temperature impairments, as well as several unlisted impairments in Washington and Kalispel Tribal waters.

For tribal waters, the authority to issue TMDLs remains with EPA until individual tribes receive specific authorization to do so, thus EPA will be issuing this TMDL for Kalispel Tribal waters.

The TMDL is a plan to improve water quality by limiting pollutant loads. Specifically, a TMDL is an estimation of the maximum pollutant amount that can be present in a water body and still allow that water body to meet water quality standards (Water quality planning and management, 40 CFR Part 130). Consequently, a TMDL is water body- and pollutant-specific. The TMDL also allocates allowable discharges of individual pollutants among the various sources discharging the pollutant.

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

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

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

The overall purpose of the SBA and TMDL is to characterize and document pollutant loads in the Pend Oreille River Subbasin. The first portion of this document, the SBA, is partitioned into four major sections: watershed characterization, water quality concerns and status, pollutant source inventory, and a summary of past and present pollution control efforts (Sections 1 – 4). This information will then be used to develop a TMDL for temperature for the Pend Oreille River Subbasin (Section 5).

1.1 Introduction

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

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

Background

The federal government, through the U.S. Environmental Protection Agency (USEPA), assumed the dominant role in defining and directing water pollution control programs across the country. The Idaho Department of Environmental Quality (IDEQ) implements the CWA in Idaho and the Department of Ecology (Ecology) implements the CWA in Washington, while the USEPA oversees Idaho and Washington and certifies the fulfillment of CWA requirements and responsibilities. The USEPA also implements the CWA on the Kalispel Indian Reservation. The Tri-State Water Quality Council (Council) originally received a grant from the USEPA to prepare a TMDL for the Idaho portion of the Pend Oreille River; however, since the river flows through the state of Washington and the Kalispel Indian Tribe as well, a Memorandum of Agreement (MOA) was signed with IDEQ, Ecology, the Kalispel Tribe, and USEPA Region 10 to prepare a joint, interstate-EPA TMDL for the main-stem of the river from Lake Pend Oreille to the Canadian border.

Section 303 of the CWA requires IDEQ and Ecology to adopt, with EPA approval, water quality standards and to review those standards every three years. The Kalispel Tribe has also established water quality standards under the Clean Water Act. Additionally, IDEQ and Ecology must monitor waters to identify those not meeting water quality standards. IDEQ and Ecolgy must establish a list of impaired waters, called the “303(d) list” that describes water bodies not meeting water quality standards. Waters identified on the §303(d) list require further analysis. For those waters not meeting standards, IDEQ and Ecology must establish a TMDL for each pollutant impairing the waters.A SBA and TMDL provide a summary of the water quality status and allowable TMDL for water bodies on the §303(d) list. The Pend Oreille River is currently listed on Idaho’s §303(d) list for temperature, sediment, and total dissolved gas (TDG) and on Washington’s §303(d) list for temperature, TDG, pH, aldrin, and total PCBs. This document addresses the temperature issues and listing only. Sediment, TDG, pH, aldrin, and total PCB TMDLs will be addressed separately.

State and Tribal Roles

Idaho, Washington, and the Kalispel Tribe have adopted 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 and/or tribe may assign or designate beneficial uses for particular water bodies to support. These beneficial uses are identified in the states' and tribes' water quality standards. Table 1 compares the beneficial uses for Idaho, Washington, and the Kalispel Indian Tribe.

Table 1. Comparison of designated beneficial uses in the Idaho, Washington, and Kalispel Tribe water quality standards.

<table>
<tr><th colspan="2">Idaho[ab]</th><th colspan="2">Washington[c]</th><th>Kalispel Indian Tribe[d]</th></tr>
<tr><td rowspan="6">Aquatic life</td><td>Cold water</td><td rowspan="6">Aquatic life</td><td>Char spawning and rearing</td><td>Brown trout spawning</td></tr>
<tr><td>Seasonal cold water</td><td>Core summer salmonid habitat</td><td>Adult salmonid migration</td></tr>
<tr><td>Warm water</td><td>Salmonid, spawning, rearing, and migration</td><td rowspan="5"></td></tr>
<tr><td>Salmonid spawning</td><td>Salmonid rearing and migration only</td></tr>
<tr><td rowspan="2">Modified</td><td>Non-anadromous interior redband trout</td></tr>
<tr><td>Indigenous warm water species</td></tr>
<tr><td rowspan="3">Contact recreation</td><td>Primary (swimming)</td><td rowspan="3">Recreational uses</td><td>Extraordinary primary contact recreation</td></tr>
<tr><td rowspan="2">Secondary (boating)</td><td>Primary contact recreation</td><td>Primary contact recreation</td></tr>
<tr><td>Secondary contact recreation</td><td rowspan="2"></td></tr>
<tr><td rowspan="4">Water supply</td><td>Domestic</td><td rowspan="4">Water supply</td><td>Domestic</td></tr>
<tr><td>Agricultural</td><td>Agricultural</td><td>Agricultural water supply</td></tr>
<tr><td rowspan="2">Industrial</td><td>Industrial</td><td rowspan="2"></td></tr>
<tr><td>Stock watering</td></tr>
<tr><td>Wildlife habitats</td><td rowspan="5"></td><td rowspan="5">Miscellaneous</td><td>Wildlife habitat</td><td>Wildlife habitat and hunting</td></tr>
<tr><td>Aesthetics</td><td>Aesthetics</td><td>Aesthetic quality</td></tr>
<tr><td>Special resource water</td><td>Harvesting</td><td>Ceremonial and cultural use</td></tr>
<tr><td rowspan="2">Outstanding resource water</td><td>Commerce and navigation</td><td rowspan="2"></td></tr>
<tr><td>Boating</td></tr>
</table>

[a]IDAPA58.01.02-110-07

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

[c]WDOE 2006
[d]Kalispel Indian Tribe 2004

Tri-State Water Quality Council's Role

This Pend Oreille temperature TMDL Report was assembled and written by Tetra Tech, Inc. under contract to the Tri-State Water Quality Council (Council), which was formed in 1993 as a result of a comprehensive study conducted by two EPA regions and the water quality agencies of Montana, Idaho, and Washington through the Federal CWA §525 (MDEQ et al. 2007). The study led to the development of the Clark Fork-Pend Oreille Watershed Management Plan. The first priority in the Plan was to convene an entity to oversee implementation of management actions identified in the Management Plan. The Council was created for this purpose.

The Council is a diverse basin-wide stakeholder group consisting of representatives from local governments, citizens, tribes, environmental organizations, business and industry, and federal, state and local agencies. The Council has been actively involved in affecting change in the basin by facilitating the development of water quality improvement plans (including this Idaho/Washington Pend Oreille River TMDL), implementing on-the-ground water quality restoration projects, monitoring water quality to assess results, building partnerships with key stakeholder groups, and coordinating the big picture aspects of basin-wide issues.

For this TMDL, the Council is responsible for the formation of relevant advisory groups as well as facilitation of stakeholder and public meetings related to development of the TMDL. Through a grant with the USEPA, the Council is responsible for preparation of the TMDL report, integrating information from Washington, Idaho and the Kalispel Tribe into one coherent document for this interstate system.

1.2 Physical and Biological Characteristics

The Pend Oreille River drains the Clark Fork – Pend Oreille watershed, which encompasses approximately 26,000 square miles (Figure 1). The Clark Fork – Pend Oreille watershed spans three states, including Montana, Idaho, and Washington, as well as a portion of British Columbia, Canada, before entering the Columbia River (Council 2005). The Pend Oreille River begins at the outlet of Pend Oreille Lake in northern Idaho and flows west across the Idaho Panhandle into the northeast corner of Washington (Figure 2). The Pend Oreille River is the only outlet from Lake Pend Oreille, Idaho's largest and deepest natural lake (MDEQ et al. 2007). The river flows for about 26 miles in Idaho before reaching Albeni Falls Dam just east of the border between Idaho and Washington (Council 2005). The river, draining an area of approximately 1,000 square miles in Washington, flows north for about 72 miles in Washington before entering Canada where it continues to flow through British Columbia and eventually into the Columbia River.

The largest tributary to the Pend Oreille River in Idaho is the Priest River. The Priest River flows out of Priest Lake, which is fed by Upper Priest Lake and the Upper Priest River. Major tributaries to the Pend Oreille River in Washington are shown in Table 2. The watershed also contains many glacially-formed lakes including Sullivan Lake and Bead Lake.

Table 2. List of Significant Tributaries evaluated in the TMDL.

Creek Name	Reservoir	Designated use	Temperature criterion	Maximum observed temperature (°C)	Lowest observed flow (cfs)	2004 §303(d) list
Indian	Box Cyn	char	12.0	14.1	2	1
Skookum	Box Cyn	spawn/rear	17.5	15.6	2.4	1
Skookum		spawn/rear	17.5			
NFSkookum		spawn/rear	17.5			
Calispell	Box Cyn	spawn/rear				
Calispell blw Smalle			17.5	30.3	20	5
Calispell abv Smalle		char	12.0			5
Cee Cee Ah	Box Cyn	spawn/rear	17.5	18.5	2	1
Tacoma	Box Cyn	spawn/rear	17.5	17.7	5.6	4A
Cusick	Box Cyn	spawn/rear	17.5			4A
Mill	Box Cyn	core summer	16.0	22.6	1.7	1
Middle	Box Cyn	spawn/rear	17.5	15.9	1.2	(1)
Leclerc	Box Cyn	core summer	16.0	18.9	8.7	1
E.B. Leclerc		char	12.0			5
Ruby	Box Cyn	spawn/rear	17.5	20.7	2.4	5
SF Lost	Box Cyn	spawn/rear	17.5	17.6	0.48	2
Lost	Box Cyn	spawn/rear	17.5	21.9	<1	5
Big Muddy	Box Cyn	spawn/rear	17.5	18.1	0.51	1
Little Muddy	Box Cyn	spawn/rear	17.5	19.0	0.21	5
Cedar	Box Cyn	core summer	16.0	20.7	1.2	5
Sullivan	Boundary	spawn/rear	17.5	19.1	45	4A
Slate	Boundary	char	12.0	15.4	5.79	1
Lime	Boundary	spawn/rear	17.5			4A
Flume	Boundary	spawn/rear	17.5	14.4	2.41	1

Three large dams have been built on the Pend Oreille River. The Albeni Falls dam is located just upstream of the Washington-Idaho state line in Idaho. The Albeni Falls Dam was built on the river in 1952 about 26 miles downstream from where the river leaves Lake Pend Oreille. Pend Oreille Lake and Pend Oreille River levels are controlled by the U.S. Army Corps of Engineers (COE) through the dam at Albeni Falls (Council 2005). The two other major dams, the Box Canyon Dam and Boundary Dam, are located on the Pend Oreille River in Washington. Box Canyon dam is just downstream of Ione and Boundary Dam is about one mile upstream of the Canadian border.

Much of the subbasin's land falls within the boundaries of the Kaniksu and Colville National Forests. In addition, the Salmo-Priest Wilderness area, part of the Colville National Forest, is located in the far northeastern corner of the Pend Oreille Subbasin in Washington.

The Kalispel Indian Reservation occupies about 4,600 acres along the Pend Oreille River in Washington with nearly 1,000 additional acres in trust. Portions of Calispell Creek, Cee Cee Ah Creek, and the Pend Oreille River are within waters of the Kalispel Indian Reservation. The Kalispel Indian Reservation lies primarily in the lowlands bordering the Pend Oreille River with the bulk of the Reservation on the River's east side. A smaller piece on the River's west side includes the confluence of Calispell Creek and the Pend Oreille River.

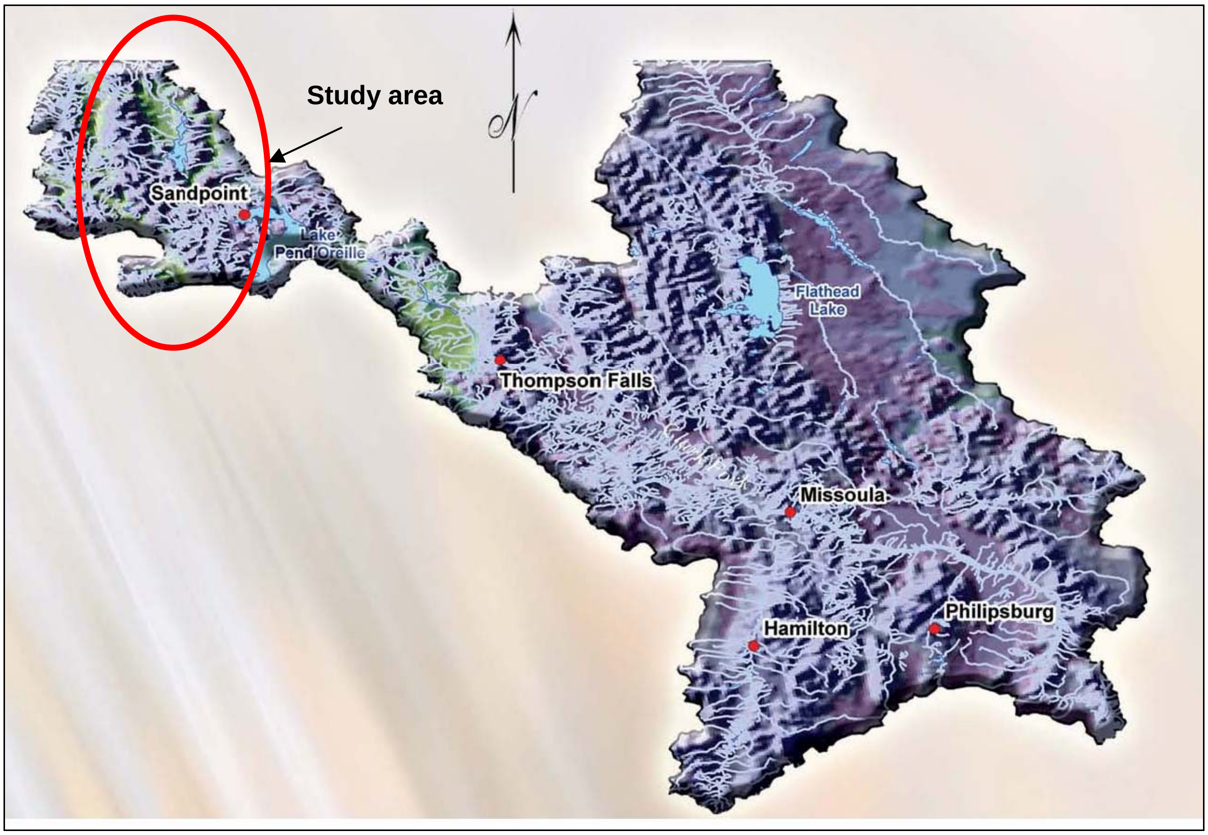

Figure 1. Entire Clark Fork – Pend Oreille River Basin.

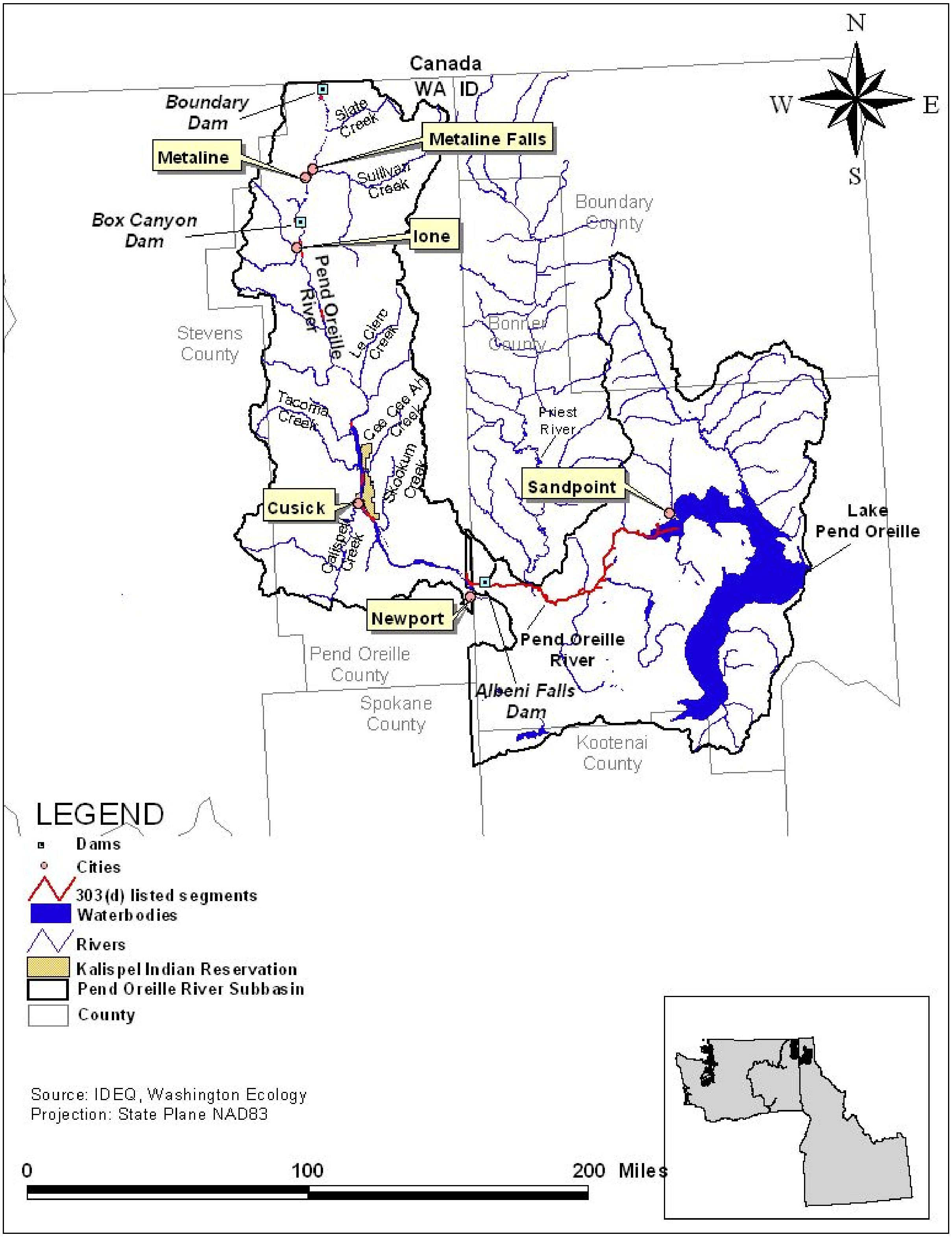

Figure 2. Location of the Pend Oreille River Subbasin.

Climate

Northern Idaho and north eastern Washington have characteristics typical of mountain/continental climates as well as those more typical of maritime climates (Entrix, Inc. 2002). Prevailing weather is from the west, bringing air masses from the Pacific with high moisture content and moderate temperatures. Since the mountain ranges are perpendicular to the prevailing weather, the air masses are forced to rise and cool, dumping moisture as rain or snow on the mountains and causing the adjacent valleys to be much drier. Summers are generally warm or hot in most valleys and much cooler in the mountains. Summers are also relatively dry. Winter storms pass over the area from November through March causing a wet winter season (IDEQ 2001). Winters are typically cold and long with a deep, continuous snowpack normally covering all but the lowest elevations from December through April (Entrix, Inc. 2002). It does snow in the lower elevations; however, the snowcover is not continuous.

Average monthly temperatures in the Idaho portion of the subbasin range from 27°F (-3°C) to 64°F (18°C) (IDEQ 2001). Based on weather data collected at climate stations located in Washington at Boundary Dam, Metaline Falls, and Newport, average monthly temperatures range from lows of - 9 to -3°C (15 to 25 °F) in the winter to highs around 15 to 21°C (60 to 70 °F) in the summer (Entrix, Inc. 2002).

Average precipitation varies greatly with latitude, elevation, and local physiography. Annual precipitation generally increases with elevation and is variable, especially at the higher elevations, with strong orographic gradients (Entrix, Inc. 2002). Average annual precipitation is 33 inches (84 cm) in Sandpoint, Idaho, located on the north end of Lake Pend Oreille, and exceeds 49 inches (125 cm) in the surrounding mountains (IDEQ 2001). Only eleven to eighteen percent of annual precipitation falls during the summer (July-August). In winter, precipitation falls mainly as snow, averaging 88 inches (224 cm) per year. Annual runoff is produced mostly by melting snow in April and May.

Depending on elevation and location, over half of the precipitation can come as winter snow with November, December and January usually being the wettest months (Entrix, Inc. 2002). In the northern portion of the Pend Oreille River Subbasin in Washington, winter snowfall ranges from about 40-80 inches and is most common during December through February. Over half of the snowpack becomes available for snowmelt-generated runoff as temperatures increase in the spring. The area is subject to midwinter and spring rain-on-snow events. Peak streamflow events result from both rain and rain-on-snow events.

Research by the Climate Impacts Group (CIG) indicates the potential for many impacts of climate change on hydrology and water resources in the Pacific Northwest (CSES 2007). Temperature models have shown the likelihood of increased temperatures in the region, which would cause more winter precipitation to fall as rain rather than snow, increasing winter streamflow. The typical winter snowline would be elevated, resulting in decreased snow covered area in the mountains and decreased total winter snowpack. Earlier snow melt would cause spring peak flows to be earlier in the year, increasing the time between snowmelt and fall rains. Increased temperatures would also lead to decreased summer streamflow, leading to more significant low flow events.

Subbasin Characteristics

The Pend Oreille River Subbasin hydrography, geology, soils, topography, land use, and fisheries are described in this section of the report.

Hydrography

The majority of the hydrography and hydrology information in this section was taken from the *Level 1 Assessment for WRIA 62* (Entrix, Inc. 2002). The Level 1 Assessment was completed as part of the Washington State Watershed Management Act (RCW 90.82) and provides a watershed characterization and identifies data gaps.

The Pend Oreille River has been strongly affected by the construction and operation of the Albeni Falls, Box Canyon, and Boundary Dams, which were built in 1952, 1955, and 1967, respectively. The river enters Washington just below Albeni Falls Dam at river mile (RM) 90.1 in Idaho and flows through two hydroelectric dams (Box Canyon at RM 34.4 and Boundary Dam at RM 17) in Washington.

- ***Albeni Falls Dam*** was the first major hydroelectric development on the Pend Oreille River. It controls the outflow from Lake Pend Oreille, determining flows for the dams downstream and providing flood control. The dam is operated by the U.S. Army Corps of Engineers. The dam regulates flow and storage on a seasonal basis, with a drawdown for flood control beginning in September and refill during spring runoff to reach a steady summer lake elevation.

- ***Box Canyon Dam***, located just north of Ione, Washington, is 55.7 miles downstream from Albeni Falls Dam. The Box Canyon Dam is owned and operated by Pend Oreille Public Utility District (PUD). It is a low head dam (about 41 feet) and impounds water to the base of Albeni Falls Dam. Box Canyon Reservoir is 56 miles long, mostly running through broad valleys, with some narrower reaches including a narrow valley (the old Box Canyon) in the final reach. Box Canyon Dam is operated as a “run-of-the-river” reservoir, with elevations held for the maximum power production available below flood control elevations. During high river flows (above 70,000 cubic feet per second [cfs]), Box Canyon operates in a “free flow” mode. Generation does not occur at these times and the dam spill gates are fully open.

    - ***Boundary Dam*** is located approximately 17 miles downstream of Box Canyon Dam, just upstream of the Canadian border. Boundary Dam is owned and operated by the City of Seattle. Construction of Boundary Dam submerged Z Canyon and Metaline Falls and created numerous backwater slough areas. Boundary Dam backs waters to the base of the Box Canyon Dam and regulates the Pend Oreille River downstream of Box Canyon. The reservoir is steep walled from above the Boundary Dam upriver to Metaline (the old Z Canyon), with water depths extending to 260 feet. At Metaline and upriver, Boundary Reservoir widens and depths range from 10 to 30 feet with localized deeper holes. Boundary Dam is operated for “load following”: the reservoir is drawn down during the day to meet peak power demands and then allowed to refill during the night. During these refill times outside of high flow conditions, flows downstream of the dam are often reduced to zero.

The flow of the Pend Oreille River is controlled by the three dams, slowing the river as it flows and affecting river temperature, sediment, gravel recruitment, and habitat. Much of the annual runoff in the Pend Oreille River Subbasin is produced by melting snow, with peak flows typically occurring from April through June. Baseflow typically occurs from August to October.

Hydrologic records for the mainstem Pend Oreille River are maintained by the United States Geological Survey (USGS) at gaging stations located at the town of Newport just below Albeni Falls Dam (USGS 12395500), below Box Canyon Dam (USGS 12396500), and at the international boundary (USGS 12398600 – data provided by the City of Seattle) (Entrix, Inc. 2002). Figure 3 shows the locations of the dams and the USGS stations.

Tributary flows have been collected by USGS intermittently on Sullivan Creek (USGS 12398000), and from other tributaries by the Kalispel Tribe and the Pend Oreille Conservations District. A list of the tributaries included in TMDL analysis is shown in Table 1.

Hydrology above Albeni Falls Dam

The Pend Oreille River from its origin at Lake Pend Oreille to the Idaho state line lies in the fourth order USGS hydrologic unit code (HUC) 17010214. The largest tributary to the Pend Oreille River is the Priest River, which drains approximately 902 square miles in USGS HUC 17010215. The Priest River Subbasin had an average daily discharge of approximately 1,470 cfs for the 2003 water year. The Pend Oreille River drains 24,200 square miles (62,678 km^2) (IDEQ 2001) before entering Washington. River flows range from 11,200 to 73,000 cfs. Albeni Falls Dam influences water levels in the lake and Pend Oreille River according to season. The lake is maintained in between 2,062 and 2,062 feet (USACOE 2007) above sea level during the summer months and the Pend Oreille River essentially becomes a shallow outlet arm of the lake. The gates are opened at Albeni Falls Dam in the fall and water is drawn down for flood storage to its winter level of 2,051 feet (USACOE 2007). The lake is maintained in its low range until the spring snowmelt again refills the lake for the summer season. The dam operation protects upstream benefical uses. Water is released for upstream flood control and when the spillway is closed during summer months Lake Pend Oreille levels support recreational and ecological uses. The mean annual flow at Newport (USGS 12395500) below Albeni Falls Dam is approximately 25,680 cfs. Peak streamflow at this gage tends to occur during April through June, which coincides with spring snowmelt.

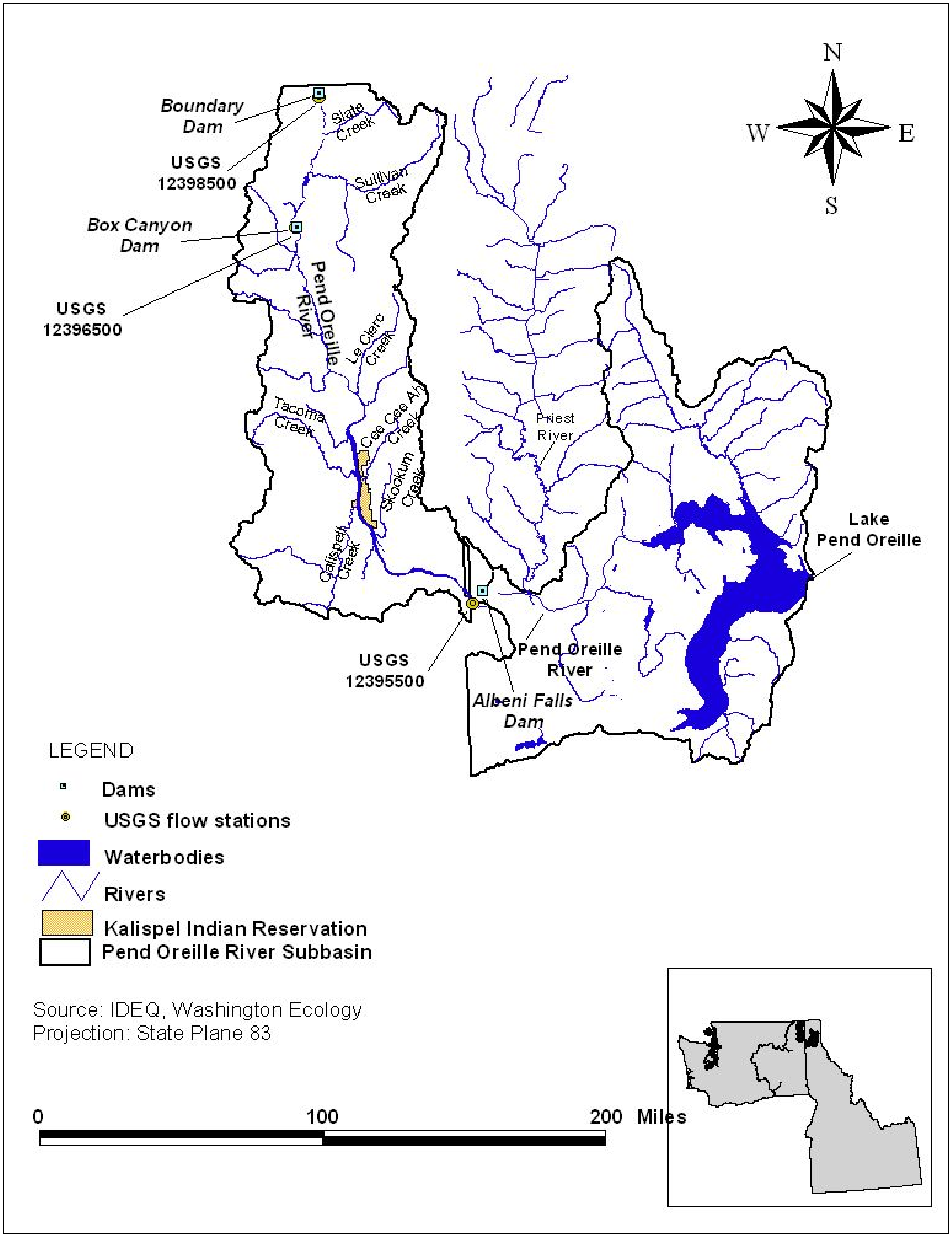

Figure 3. Location of dams and flow guaging stations.

Hydrology from Albeni Falls Dam to Box Canyon Dam

The construction of Box Canyon Dam caused the water of the Pend Oreille River to be backed up for approximately three-quarters of the length of the Pend Oreille River in Washington. Only about 8 miles (15%) of the Box Canyon reach is currently considered riverine habitat (Entrix, Inc. 2002). The backwater from the dams has a significant effect on streambank conditions, flooding potential, and erosion and sedimentation processes.

There are 22 tributary streams to the Pend Oreille River between Albeni Falls Dam and Box Canyon Dam. Most of them are small drainages for the surrounding mountain slopes and valley bottom. The largest tributary to the Pend Oreille River between the two dams is Calispell Creek with a drainage area of about 68 square miles.

Over 97 percent of Box Canyon Dam's total drainage is upriver and the river entering the Box Canyon reservoir is under regulation by Albeni Falls Dam. Because there is relatively little inflow between Albeni Falls Dam and Box Canyon Dam, the flow passing Box Canyon is essentially the same as the flow released from Albeni Falls Dam. The estimated water travel time from Albeni Falls Dam to Box Canyon Dam is between 12 and 36 hours, depending on the flow rate of the river.

The peak-measured hourly flow at the Pend Oreille River below Box Canyon Dam (USGS 12396500) for the 2004 and 2005 period was 86,100 cfs on June 9, 2005 (Breithaupt and Khangaonkar 2007). The minimum-hourly flow measured for 2004 and 2005 was 4,772 cfs on September 11, 2005. The mean annual flow of the Pend Oreille River at Box Canyon Dam is approximately 26,243 cfs. The peak flows occur during late spring and early summer, which is typical for rivers influenced by snowmelt runoff. The minimum flows occur during late summer and early fall. On a daily basis, the flows downstream of Box Canyon Dam vary only slightly reflecting the run-of-the-river hydroelectric operation of Box Canyon Dam.

Hydrology from Box Canyon Dam to Boundary Dam

Boundary Dam uses a peaking mode operation for power generation with no flow releases at night. The large daily variation of flows provides evidence that Boundary Dam uses peaking mode operation (Breithaupt and Khangaonkar 2007). Mean annual flow at Boundary Dam is approximately 26,990 cfs. Peak streamflow for 2006 was 89,900 cfs on May 21, coinciding with spring snowmelt. For more details on hydrology characteristics in the Boundary Dam portion of the river, see Section 2.5.1 of Breithaupt and Khangaonkar (2007).

The largest tributary to the Pend Oreille River in Washington is Sullivan Creek with a drainage area of 122 square miles, which enters the river downstream of Box Canyon Dam (Entrix, Inc. 2002). The Sullivan Creek watershed delivers 18 percent of the flow gained by the Pend Oreille River in Washington, but only represents 1 to 1½ percent of the flow in the river. Sullivan Creek's average annual flow is 125.9 cfs above Outlet Creek and 251.1 cfs at Metaline Falls. As measured at a point near Metaline Falls, the monthly average flows are sharply higher in May and June (685.9 cfs and 764.9 cfs, respectively) than during the rest of the year. Minimum flows occur in both January and February (81.4 cfs and 73.5 cfs, respectively) and August and September (91.1 cfs and 85.4 cfs, respectively). The monthly mean minimum and maximum flows at Metaline Falls are 40.8 cfs and 1,590 cfs; and the corresponding instantaneous records are 27 cfs and 4,020 cfs.

Geology and Soils

Idaho

The geology of northern Idaho and the Pend Oreille Subbasin is complex with parent materials comprised of igneous, sedimentary, and metamorphic rocks ranging in age from Precambrian to present time (Savage 1965 as cited in Council 2005). The geology of the Pend Oreille River in Idaho can essentially be broken into two broad categories—sedimentary deposits of more recent times and igneous/metamorphic parent materials.

The geology near the outlet of Lake Pend Oreille is comprised primarily of Pleistocene outwash deposits of gravel and sand on both sides of the river. Repeated advances and recessions of glacial ice during the early and late Wisconsin periods from about 70,000 to 90,000 years ago and 10,000 to 20,000 years ago, respectively, are responsible for the current morphology of the watershed. Smaller amounts of glacial till and unsorted glacial debris associated with a terminal moraine of the Cocolalla sublobe are found on the south side of the Pend Oreille River near the outlet of Lake Pend Oreille. Geologic evidence suggests that during the Pleistocene the current channel of the Pend Oreille River was completely covered by glacial ice (Savage 1965 as cited in Council 2005).

A few miles downstream from the outlet of Lake Pend Oreille are prominent ridges of Cretaceous granite and metamorphic intrusive rock, which make up portions of the riverbank and bottom. These outcrops represent a small part of the much larger Kaniksu Batholith. Still further downstream on both sides of the Pend Oreille River are substantial outcrops of coarsegrained schist and gneiss believed to be of Precambrian age. These rocks are the oldest in the region and represent Pre-Belt Series rocks, which dominate much of eastern Idaho and Western Montana.

Approaching the border of Idaho and Washington the geology is again made up of Pleistocene glacial outwash gravel and sand with some minor outcrops of Precambrian metamorphosed rock and Cretaceous granite to the north. Along the entire river channel are the most recent Quaternary alluvial deposits. The two largest outcrops of Quaternary alluvial material on the north side of the river are found near the outlets of the Priest River and Riley Creek. The two largest outcrops of Quaternary alluvial material on the south side of the River are a few miles below the outlet of Lake Pend Oreille and about midway downstream towards the border of Idaho and Washington.

Soils in the floodplain are poorly drained to excessively drained on alluvial fans, terraces, and dunes. Upslope of the river, the terrain is rolling to very steep with rock outcrops, and very well drained soils (IDEQ 2001).

Washington

All geology and soils information for Washington were taken form Entrix, Inc. (2002). Soils in the Washington portion of the Pend Oreille Subbasin vary widely in texture, drainage and other characteristics. Generally they are moderately deep and well drained. They were formed from weathered granitic rock, shale, phyllite, igneous rock, quartzite, and glacial till material. The residuum and till are mixed with or mantled by volcanic ash and loess.

The subbasin is underlain by granite rocks associated with the Kaniksu Batholith and metasediments associated with the Belt Series. The quartzite-based Belt rocks weather into a broad range of size classes. These are significantly more stable and resilient on hill slopes and in stream channels than the uniform coarse weathered granitic sands of the intrusive batholiths. The bedrock is typically covered with glacial till, which consists of unsorted and unstratified materials from glacial ice movement. The till is composed of material derived from rocks that were transported and deposited by the continental ice sheet. The till derived from Belt rocks is usually medium textured with a moderate amount of rock fragments, while the granitic till is usually sandier and has a more variable amount of rock fragments. The top portion of the glacial till is loose and permeable while the lower part can be dense and impermeable. The dense layer can restrict water movement and root penetration. Deposits of outwash and alluvium are found in valley bottoms and were deposited by streams. Glacial-fluvial deposits are located on slopes and valley bottoms where ice lobes caused water to pond. Lacustrine sediments from glacial lakes are usually found at elevations below 2,600 feet, but also can be found at higher elevations. These deposits typically have a silty to sandy texture with few rock fragments.

Most of the glacial material has been covered with a layer of volcanic ash 0.5–1.5 feet thick. The ash derives from Cascade volcanoes, primarily Mount Mazama. It is usually a silt loam with little gravel or cobble and normally has a high infiltration rate and high permeability. The ash has a high water and nutrient holding capacity and is excellent for tree growth.

Pend Oreille County Comprehensive Plan categorizes the soils in the Washington portion of the subbasin into three local regions: the Selkirk Mountains, Pend Oreille River Valley, and Southern Pend Oreille County.

- ***Selkirk Mountains:*** Soils on the slopes of the Selkirk Mountains tend to be fine-textured and only moderately (20 to 40 inches) deep, such as Belzar silt loam. Concave slopes sometimes hold deeper soils, such as Ahren loam. The terrace and floodplain soils of the river valley tend to be deeper, and some are coarser-textured. They may also have a seasonally high water table.
- ***Pend Oreille River Valley:*** The ancient lakebeds of the Pend Oreille River Valley are made up of fine-textured sediments (clay, silt, and fine sand). A fringe of glacial till occurs in the valley, often forming a transition between the mountains and the lake deposits. South of Usk, this till is part of a terminal moraine from the most recent glaciation. The gently sloping Newbell silt loam is associated with the glacial till on the valley edge, while soils such as the Anglen and Martella silt loams are found on terraces that mark the gradual retreat of the glacier. Soils of the valley floor include the Blueslide silt loam, Cusick silty clay loam, and Kegel loam. These soils formed in lakebed sediments, and are deep, fine-textured, and wet.
- ***Southern Pend Oreille County:*** Low mountains, level glacial floodplains, and lakes characterize this landscape unit. The low mountains of Southern Pend Oreille County include both intrusive rocks and metamorphic rocks similar to those found further north. Glacial floodplains surround the mountains. Massive floods that poured through the area when glacial Lake Missoula repeatedly breached a 2,000-foot ice dam in northern Idaho left these relatively level deposits of sand and gravel. Soils on slopes, such as the Mobate-Rock outcrop complex, tend to be shallow. Their texture varies with the underlying rock, but wind-borne loess and volcanic ash have given many Pend Oreille County soils fine-textured upper horizons. Deep, highly permeable soils such as the Kaniksu and Orwig sandy loams developed on the glacial floodplains.

Topography

In general, the Pend Oreille River Subbasin's topography consists of river-bottom flatlands in a long and narrow trough between the forested, mountainous terrain of the Selkirk Mountains and Okanagan Highlands (MDEQ et al. 2007). The following topography information for the Idaho portion of the Pend Oreille River Subbasin was taken from IDEQ (2001) and topography information for the Washington portion of the Pend Oreille River Subbasin was taken from Entix, Inc. (2002).

Idaho

The Pend Oreille subbasin is separated from the Priest River subbasin by a north-south running ridge (Selkirks) that varies in elevation from 7,300 feet (2200m) in the north to 3,600 feet (1,100 m) in the south. To the northeast and separating the Pend Oreille-Clark Fork basins from the Koontai River Basin, the southwest facing Cabinet Mountains are less than 6600 feet (2,000m) in elevation.

The ridges to the southeast of the lake that separate the Pend Oreille – Clark Fork basins from the Coeur d'Alene River Basin face north and west. They are generally less than 5,000 feet (1,500m) in elevation, although Packsaddle Mountain on the southeast side of the lake reaches an elevation of 6,400 feet (1,951m). The Hoodoo and Cocolalla valleys are separated from the Rathdrum Prairie and the Spokane River Basin to the south by a gentle arched plain reaching an elevation of approximately 2,500 feet (760m). Between Hoodoo Creek and Cocolalla Creek, and between Cocolalla Creek and Pend Oreille Lake are several mountains ranging in elevation from 4,100 feet (1,250m) to 5,000 ft (1,500m). On the west side of Hoodoo Creek is Hoodoo Mountain at 5,000 feet (1,500m) associated with a north-south running ridge separating the basin from Washington drainages. The northern tip of this ridge drains north into the Pend Oreille River.

Washington

Glacially modified foothills and mountains with deep, narrow valleys characterize the central and northern portions of the Washington portion of the subbasin. Extensive outwash and glaciolacustrine terraces characterize the southern portion. Mountains on both sides of the river form the Pend Oreille River valley. The sides of the Pend Oreille valley are gently sloping to steep slopes composed of glacial drift, residuum and colluvium, and rock outcrops. To the west of the Pend Oreille River lies the Selkirk Mountain range, characterized by many deep narrow valleys and steep slopes.

Elevations in the subbasin range from 1,700 feet (at Boundary Dam) to more than 7,300 feet above mean sea level. In the northeasternmost corner of Washington, from Metaline to the Canadian border, the heavily forested mountains become progressively higher and more rugged. The highest northern mountain in the Washington portion is Gypsy Peak at 7,309 feet above sea level and to the south, South Baldy Mountain at 5,961 feet. Intervening glaciated valleys range in elevation from 2,000 to 2,400 feet and the area is dotted with abundant lakes derived form the melting of glacial ice.

The Pend Oreille River forms a deeply incised channel from Metaline Falls north to its junction in Canada with the Columbia River. Two well-developed terraces are present along portions of the Pend Oreille River at approximately 2,100 and 2,575 feet in elevation. In the southern portions of the subbasin, expanses of flat agricultural land can be found along the

Pend Oreille River. In the Cusick area, the river flows adjacent to an extensive floodplain, some of which is now hydrologically disconnected by dikes and pumps.

Land Use

Idaho

The description of the land use along the Pend Oreille River provided in this section is based on a Geographical Information System (GIS) coverage of the National Land Cover Dataset (NLCD). The NLCD was a joint effort of the USGS and the USEPA as part of the Multi-Resolution Land Characteristics (MRLC) consortium, a multiagency consortium developed to acquire satellite-based remotely sensed data for their environmental monitoring programs. The 1992 NLDC was derived from the early to mid-1990s Landsat Thematic Mapper satellite data.

The NLCD includes 21 land use classifications that were grouped into the following broader Categories (Council 2005):

- Open water
- Developed
- Barren
- Forested
- Shrubland
- Other vegetated (grassland)
- Pasture and cropland
- Transitional
- Wetlands

Land use surrounding the Pend Oreille River is a primarily forested with concentrated areas of development and agriculture. Agriculture on the lowland plains includes grain crops, hay, pasture, and livestock (IDEQ 2001). Urban development areas include the cities of Sandpoint, Dover, and Laclede, all located on the north side of the river. However, development along both sides of the river is increasing rapidly. Riparian vegetation adjacent to the river is limited to those areas that have either not been developed or where the river bank is bedrock (Council 2005). Vegetation patterns in the subbasin have also been largely influenced by wildfire (IDEQ 2001). The riparian and floodplain areas in the watershed were originally covered by old growth stands of western red cedar, while various vegetation species and stages of succession dominated the upland areas. Early settlement of the watershed brought forest clearing, agriculture, logging, hydroelectric developments, mining, railroads, and urbanization. The present vegetation coverage is a result of all of these factors as well as natural and human-caused fires.

Washington

The northern portion of the Pend Oreille River is in the western hemlock vegetation zone (Entrix, Inc. 2002). The southern portion of the subbasin is in the ponderosa pine vegetation zone. Potential natural vegetation includes western white pine, lodgepole pine, ponderosa pine, western red cedar, Douglas fir, wheatgrass, fescue, and needlegrass. Approximately 37 acres of pure aspen stands occur adjacent to the Box Canyon Reservoir shoreline. Current and historical land management activities compounded by extensive wildfires in the 1930s have reduced mature forests in the watershed.

Nearly all of the original forests between the major roads east and west of the Pend Oreille River are believed to have been logged or burned at least once, or permanently cleared for agriculture or residential development (Entrix, Inc. 2002). About 46 percent of the watershed is currently in open fields (pasture, hayfields, row crops, and fallow land), and only about 38 percent is now forested. Twelve percent of the land area can be classified as urban or developed; large portions of the remaining forests contain scattered residential developments or have been platted for development.

The Washington portion of the subbasin includes aspen stands, which are defined as Priority Habitats by Washington Department of Fish and Wildlife (WDFW). Quaking aspen (*Populus tremuloides*) occurs sporadically throughout eastern Washington, with the tallest groves typically found in riparian areas and other moist sites.

Figure 4 presents the land use coverage in the Pend Oreille River Subbasin.

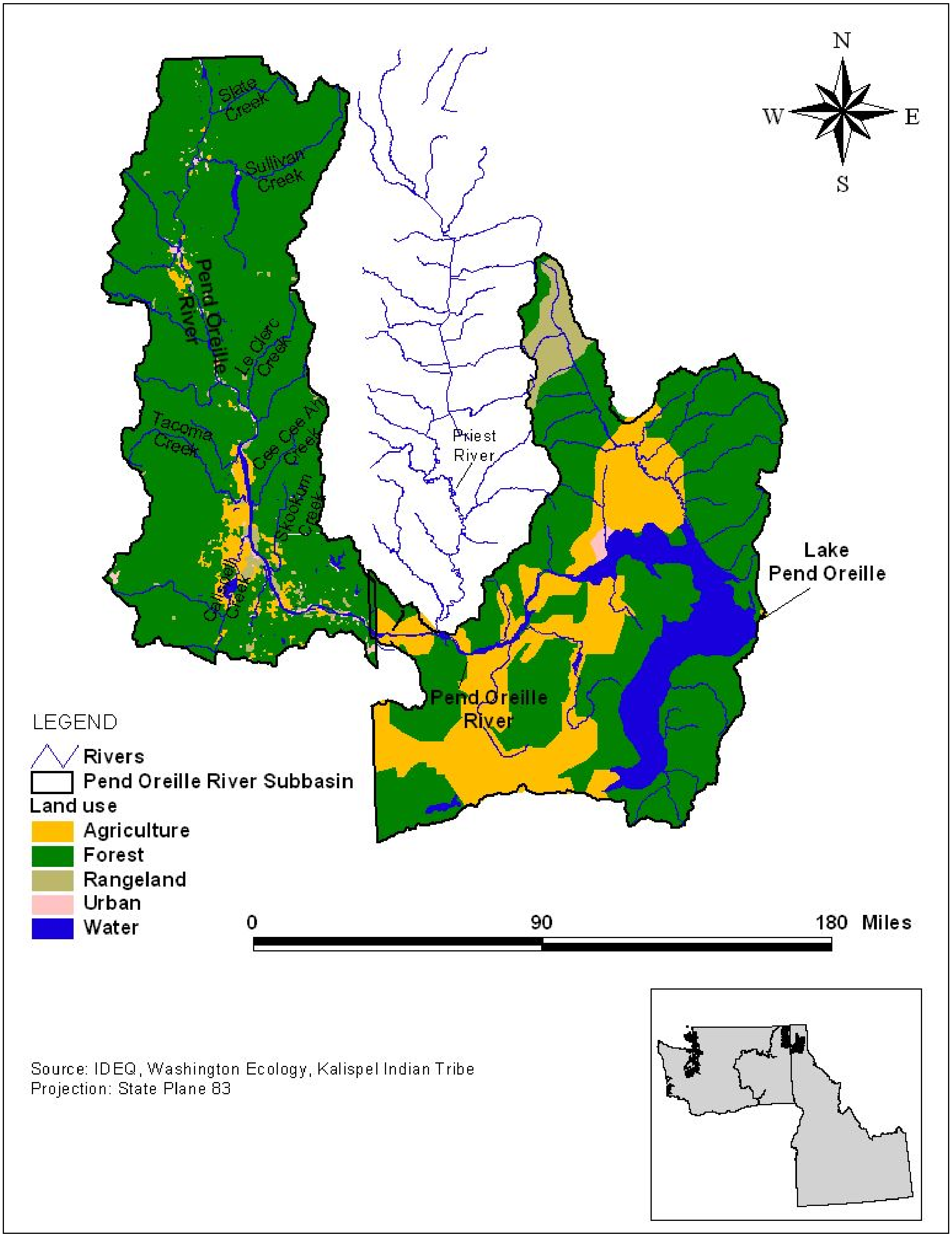

Figure 4. Land use in the Pend Oreille Subbasin.

Fisheries

Historical overharvest, land use practices such as logging, farming, residential development, roads, and the construction of hydrolelectric dams in the watershed have taken a toll on the fisheries in the Pend Oreille River Subbasin (IDFG and Sport Fish Restoration 2003). Following the construction of the Albeni Falls, Box Canyon, and Boundary dams, the Pend Oreille River changed from a free-flowing system that predominately supported native cold water salmonids, to a slower moving system that supports primarily non-native species. Before the construction of the dams, the river produced a large number of trout, including currently threatened Bull Trout stocks. Cold water springs and creeks provided refuge during the warm summer months. The dams now inhibit migratory movements of salmonids (Entrix, Inc. 2002).

Westslope cutthroat trout, bull trout, pygmy whitefish, and mountain whitefish are the salmonids native to the Pend Oreille River drainage (IDFG and Sport Fish Restoration 2003). The Pend Oreille River is currently a mixed (i.e., warm and coldwater) fishery including rainbow, brown, and cutthroat trout; largemouth and smallmouth bass; black crappie; yellow perch; bluegill; pumpkinseed; and bullhead (IDFG and Sport Fish Restoration 2003). Non-native fish are abundant in the watershed, including yellow perch, largemouth bass, pumpkinseed, brook trout, brown trout, and rainbow trout (Entrix, Inc. 2002).

The current annual winter drawdown by the Albeni Falls Dam inhibits the establishment of a viable sport fishery in the Pend Oreille River. Impoundment of the river has created a warm water reservoir from June through September and a cold flowing river from October through May. Artificially high water has also eliminated the natural vegetative cover along the shoreline, causing severe erosion and additional impacts to fish habitat. Habitat conditions are not suitable for the establishment of either a trout or warmwater sport fishery. Salmonids use the river seasonally, but brown trout are the only species found (in low abundance) year round. The Pend Oreille River below the Albeni Falls Dam supports a productive warmwater fishery (IDFG and Sport Fish Restoration 2003).

Shallow sloughs at the confluence of tributaries and the Pend Oreille River provide potential spawning areas for warm water species such as largemouth bass, pumpkinseed, and yellow perch. Trout species are more abundant in the tributaries than in the main stem of the river (Entrix, Inc. 2002).

Bull trout, a federally listed threatened species, are occasionally captured in Boundary and Box Canyon reservoirs. The fish most likely originate from Lake Pend Oreille, where a self-sustaining population exists. Surveys conducted to assess bull trout populations in the Boundary Reservoir found no bull trout in any tributaries to this portion of the Pend Oreille River (Entrix, Inc. 2002). Brook trout currently inhabit many tributary streams formerly utilized for spawning and rearing by native cutthroat and bull trout (IDFG and Sport Fish Restoration 2003). Bull trout waters in the Pend Oreille Subbasin have been identified as Pend Oreille Lake and its tributaries, the Clark Fork River and its tributaries, Priest Lake and its tributaries, Upper Priest Lake and its tributaries, and Priest River and its tributaries. The Pend Oreille River itself has not been identified as Bull trout waters (IDFG and Sport Fish Restoration 2003).

Subwatershed Characteristics

The following information describes the subwatershed characteristics for the main stem of Pend Oreille River and its Washington and Kalispel tributaries, since these are the §303(d) listed segments in the subbasin being addressed by this TMDL study.

The Pend Oreille River begins at the outlet of Lake Pend Oreille and drains 24,200 square miles (62,678 km^2). Flows range from 11,200 to 73,000 cfs in Idaho. The subbasin's topography consists of river-bottom flatlands in a long and narrow trough between the Selkirk Mountains and the Okanagan Highlands. Soils in the floodplain are poorly drained to excessively drained on alluvial fans, terraces, and dunes. Upslope of the river, the terrain is rolling to very steep with rock outcrops, and very well drained soils (IDEQ 2001).

Albeni Falls, Box Canyon, and Boundary dams significantly influence water levels in the river. During the summer months, the dams hold the lake level artificially high, and the Pend Oreille River, downstream of its mouth essentially becomes a shallow outlet arm of Pend Oreille Lake. During the fall the dam gates are opened and water level is drawn down for flood control storage. Presence of the dams has altered the river substrate, which historically was deep holes and runs with cobble and gravel. When the dam was constructed, riparian vegetation was cleared to prevent excessive debris from entering the water during flow changes. This increased erosion and deposition of silt in gravel bars (IDEQ 2001).

Most of the water in the Pend Oreille River originates upstream in the Rocky Mountains. Streamflow in local tributaries is replenished by rainfall and snowmelt (Dames & Moore, Inc. et al. 1995). Irrigated agriculture and domestic use account for most of the out-of-stream use of water. The heaviest period of irrigation occurs during summer months. Other uses of water include stockwater, fish rearing, recreation and power production (Dames & Moore, Inc. et al. 1995).

Land use in the subbasin has not changed significantly for several decades. The main agricultural areas are located along the river corridor. Agricultural land uses include fruit orchards, cultivated crops, and livestock grazing. Irrigation can require significant amounts of water seasonally or during the dry summer months. The town of Newport, located along the Pend Oreille River at the Idaho border, is the major developed area in the watershed. The remainder of the watershed is primarily federally managed forest, which is typically located in the upland areas and is used primarily for timber and livestock production (Dames & Moore, Inc. et al. 1995).

Stream Characteristics

Pend Oreille River

The Albeni Falls, Box Canyon and Boundary dams and an extensive levying system have altered the Pend Oreille River's natural flow, influencing channel morphology and changing areas of natural scour and deposition (Entrix, Inc. 2002). As aforementioned, the Albeni Falls Dam significantly influences water levels in the Pend Oreille River. The dam holds the water level in the lake artificially high in the summer, making the Pend Oreille River essentially a shallow outlet arm of Lake Pend Oreille. The gates are opened in the fall and water level is drawn down for flood control (IDEQ 2001).

The portion of the river between Albeni Falls Dam and Box Canyon Dam is typically 1,600 to 2,300 feet wide from RM 60 to RM 90.3, and 700 to 1,000 feet wide from RM 34.5 to RM 60 (Entrix, Inc. 2002). The river has deepened, ranging from 9 to 40 feet, and silts and sands with some cobbles now dominate the substrate. Riverbank vegetation is mostly grasses and hardwoods. Approximately 53 percent of the Box Canyon reservoir is bordered by wooded habitat, including hardwoods (Entrix, Inc. 2002). The river's shoreline has a gentle to moderate slope consisting of mostly fine sediments (<4 mm) with about 10 percent consisting of boulder and rip rap. The river has an average depth of 23.3 feet (7.1 m), a maximum depth of 159 feet (48.5 m), and an average width of 2,300 feet (700 m) (IDEQ 2001).

The predominance of south-flowing drainages and the progressively higher mountainous areas to the north of the subbasin indicate that the Pend Oreille River once flowed in the opposite direction (Entrix, Inc. 2002). The Pend Oreille River once flowed due west from Pend Oreille Lake into the Spokane River drainage on its way to the Columbia River. The river was fed from the higher topographic areas of Washington to the north. During the last glaciation, catastrophic volumes of water were repeatedly released during a series of glacial outburst floods. In eastern Washington, these floods forced the Pend Oreille River to the north, scouring and incising through the Box Canyon and Boundary areas to join the Salmo River before entering the Columbia River.

The resultant topography of the northeastern corner of Washington is fairly rugged, with mountainous areas reaching 7,300 feet in elevation and the intervening glaciated valleys ranging in elevation from 2,000 to 2,400 feet. The area is heavily forested and dotted with abundant lakes derived from the melting glacial ice. Tributary streams are steep, fast-flowing and v-shaped at the headwaters (Entrix, Inc. 2002).

Glacial lake sediments deposited during the Pleistocene glaciation cover many of the rocks in the subbasin and the Pend Oreille River forms a deeply incised channel from Metaline Falls north to its junction in Canada with the Columbia River (Entrix, Inc. 2002). Two well-developed terraces are located along the Pend Oreille River at 2,100 and 2,575 feet in elevation. In the central Washington portion of the subbasin, the glacial, lacustrine and alluvial materials form low-lying areas. Numerous terraces are evident, often with steep edges.

In the southern portion of the Pend Oreille River Subbasin, the river flows slowly as it travels over low-gradient terrain and is fed by streams that have gentler gradients and lower headwater elevations.

Tributaries

Information regarding the stream characteristics of the Washington tributaries addressed in this TMDL report was summarized from Entrix, Inc. (2002). For more detail, see Section 2.2 of *Level 1 Assessment WRIA 62* (Entrix, Inc. 2002).

Portions of Sullivan creek have been straightened, although historically, the stream was probably a pool:riffle channel. The head waters of Sullivan Creek are wide glacial scour features. Sullivan Creek below North Fork Sullivan Creek is generally a steep, bedrock dominated channel and is deeply confined and entrenched as it cuts through a rock canyon. As the stream flows downstream, the channel becomes flat and dominated by boulder and cobble. The stream channel currently lacks pools and has developed a planer form most likely as a result of removing woody debris and channel straightening.

Cee Cee Ah Creek is approximately 9.5 miles long and the drainage basin ranges in elevation from 2,040 to 5,370 feet. The headwaters of the creek begin as intermittent streams that have steep gradients. The lower portions of the creek flow over a low gradient. Cee Cee Ah Creek lacks in-stream cover and has a low number of primary pools. The creek's confluence with the Pend Oreille River is a large, slow-moving, open water area caused by the river's backwater.

LeClerc Creek's channel pattern, width, and location have not changed much since the 1950s. Tributaries flow from steep gradients to form the North Branch LeClerc Creek. The stream banks of LeClerc Creek are unstable and cause pools and backwaters to form. At the confluence with the Pend Oreille River, LeClerc Creek forms a small sandy delta.

Calispell Creek is approximately 7 miles long. Streamflow modifications have occurred because of dams, dikes, and diversions placed on the stream for irrigation purposes. The only riparian vegetation is grasses and some cattails. The stream banks are generally flat and gradual.

Skookum Creek is approximately 8 miles long. Stream elevation ranges from approximately 5,800 feet at the headwaters to 2,040 feet at the mouth. The headwaters of Skookum Creek are in ponds in a broad, flat-bottomed valley. The ponds flow into a wide shallow stream channel. Riffles are the dominant stream characteristic about 1 mile downstream from the headwaters. At about 5 miles downstream, Skookum Creek enters the Pend Oreille River valley floodplains where the gradient is very flat and marshy.

1.3 Cultural Characteristics

Land ownership, land use, and cultural aspects of the Pend Oreille River Subbasin are discussed below.

<u>Land Use</u>

Historically, land uses in the Pend Oreille Subbasin in both Idaho and Washington have consisted of agriculture, mining, and timber. However, these land uses are transitioning to rural residential and recreational development, especially along or in the vicinity of the river (MDEQ et al. 2007). The Pend Oreille River Subbasin in Washington is mostly rural with large areas of forest, mountains, valleys, and open pastures (Entrix, Inc. 2002). Homes and ranches are widely dispersed. Current land use in Pend Oreille County includes public lands, private forest, agriculture, rural residential, and industrial areas. Industrial development has mainly been related to mining (especially from Metaline Falls northward) and to timber (including lumber mills and the Ponderay Newsprint pulp mill).

Forest cover is more fragmented in southern Pend Oreille County. There are large blocks of agricultural land and many rural home sites. Subdivisions are scattered among the crop and forest lands, and development reaches urban densities where cabins line the shores of lakes in the subbasin.

Land use surrounding the Pend Oreille River in Idaho is a primarily forested with concentrated areas of development and agriculture. Agriculture on the lowland plains includes grain crops, hay, pasture, and livestock (IDEQ 2001). Urban development areas include the cities of Sandpoint, Dover, and Laclede, all located on the north side of the river. However, development along both sides of the river is increasing rapidly. Riparian vegetation adjacent to the river is limited to those areas that have either not been developed or where the river bank is bedrock (Council 2005). Vegetation patterns in the subbasin have also been largely influenced by wildfire (IDEQ 2001). The riparian and floodplain areas in the watershed were originally covered by old growth stands of western red cedar, while various vegetation species and stages of succession dominated the upland areas. Early settlement of the watershed brought forest clearing, agriculture, logging, hydroelectric developments, mining, railroads, and urbanization. The present vegetation coverage is a result of all of these factors as well as natural and human-caused fires.

Kalispel Indian Reservation lands are located along approximately 10 miles of the east side of the Pend Oreille River. The 4,550-acre Reservation has isolated residential development, grazing, some timber harvesting, hay production, and sites for collection of the camas plant. North of the Reservation, are lands known as the Flying Goose Ranch. In 1992, the Bonneville Power Administration purchased the Flying Goose Ranch for transfer to the Tribe as mitigation for the loss of land from the construction and operation of the Albeni Falls Dam. A 10-year restoration plan is being implemented by the Tribe to reproduce lost riparian forests and wetlands, and enhance existing uplands. A small section of Reservation land is located on the west side of the river just north of Cusick. This area consists of approximately 160 acres and is occupied by a small industrial development.

Forest Land

The Washington portion of the Pend Oreille River Subbasin is dominated by forest cover. Approximately 93 percent of the area in Washington is forested (Entrix, Inc. 2002). Other forest lands in the Pend Oreille River Subbasin area are largely owned by corporations.

The forested area in Washington is dominated by the Coleville National Forest. The Colville National Forest is approximately 5,500 square kilometers and is located in northeast Washington (WDOE 2005). The forest is located in Pend Oreille, Stevens, and Ferry counties. Communities immediately adjacent to the forest include Colville, Chewelah, Kettle Falls, Republic, Newport, Ione, and Metaline Falls. Borders to the forest include Canada to the north, Okanogan National Forest to the west, Idaho and the Idaho Panhandle National Forests to the east, and Colville Confederated Tribal lands along a southern portion of the forest.

In addition to forestry, cattle grazing and recreation are additional uses of the forest. There are currently about 7,000 head of cattle that graze on the Colville Forest annually in 45 permitted grazing areas. Hunting, camping, picnicking, and fishing are popular recreational activities. Recreational use of the forest also includes motorcycle trails, snowmobile trails, lakes with boat launches, interpretive trails, fishing derbies, and scenic drives (WDOE 2005).

The Idaho portion of the Pend Oreille River Subbasin is also dominated by forest cover (58 percent). Much of this forested land in Idaho is owned by the USFS and private owners, with small portions owned by the state and the U.S. Bureau of Land Management.

Agriculture

Agricultural land use in the Washington portion of the Subbasin is estimated to be 4 percent of land cover and rangeland is about 2 percent. Most Pend Oreille County farms are small, part time operations. Only 28 of 205 farms had more than 500 acres in 1992 (Entrix, Inc. 2002).

Agriculture in the watershed consists primarily of livestock grazing (mostly cattle, some horses, and bison on the Kalispel Reservation) and hay production (Entrix, Inc. 2002). The largest areas of agricultural lands are in the southern portions of the watershed, where expanses of flat agricultural lands are found along the river. Agriculture on these lowland plains includes grain crops, hay, pasture, and livestock (MDEQ et al. 2007).

Most of the agricultural land in the Washington area originated from 160-acre plots that were homesteaded at the turn of the century. A few privately owned farms occur in the Box Canyon watershed and are operated primarily for hay and beef cattle. Farmers also lease some United States Forest Service (USFS) managed lands for use as summer pasture (Entrix, Inc. 2002).

Agriculture is about 26 percent of the land use cover in the Idaho portion of the Pend Oreille River Subbasin and rangeland is approximately 3 percent of the area. According to the 2002 Census of Agriculture, there are 743 farms in Bonner County, Idaho and the average farm size is 122 acres.

Land Development and Urbanization

Urban land use comprises 1 percent of Pend Oreille County. Small farms, shoreline subdivisions, and small towns occupy the lake terraces along the Pend Oreille River valley. The City of Newport, located on the Washington-Idaho border in the southeast corner of the Washington portion of the subbasin, is the largest urban area in the Washington portion of the subbasin, with approximately 2,000 residents. Other small towns located in the Pend Oreille River valley in Washington are Dalkena, Usk, Cusick, Tiger, Ione, Metaline, and Metaline Falls. These all have populations of less then 1,000. The Kalispel Indian Reservation is located along the river (Entrix, Inc. 2002).

Numerous residential developments and public recreation and public access sites are located along the Pend Oreille River. Residential, recreation, and retirement-home development along the Box Canyon reservoir has increased in recent years. Forest, agricultural, and open lands along the river are being replaced by the growth of residential subdivisions. Many residential homes and second/retirement home subdivisions occur along the Pend Oreille River (Entrix, Inc. 2002).

Urban land use makes up less than 1 percent of the Pend Oreille River Subbasin in Idaho and is mainly concentrated around the City of Sanpoint on the shores of Lake Pend Oreille.

Recreation

The Pend Oreille River Subbasin has many recreation attractions that draw people to this area. Hiking and mountain biking are popular. Exploring mines and mineral collecting is another unique recreational attraction. The beautiful and diverse scenery also draws visitors to the area. Berry-picking, firewood-gathering, hunting, fishing, boating, water skiing, camping, and bird watching are other common activities in the subbasin. Vacation homes along the river are becoming more common and with that, an increase in water-based recreational activities. Snowmobiling is the primary winter recreational activity.

See Figure 4 for a map of the land use distribution in the Pend Oreille River Subbasin.

Land Ownership, Cultural Features, and Population

In Idaho, the main stem of the Pend Oreille River flows through Bonner County (MDEQ et al. 2007). In Washington the river flows through Pend Oreille County, a sparsely settled rural region in the northeast corner of the state (see Figure 1).

Much of the subbasin in Idaho is privately owned with a concentration of homes along the river (MDEQ et al. 2007). Approximately 67 percent of the land in Washington is publicly owned and managed by state and federal government agencies (Federal, 63.4 percent; State, 3.5 percent). Most of the remaining 33 percent is in private ownership, while 0.6 percent is tribal land (MDEQ et al. 2007, Entrix, Inc. 2002). These public lands are located primarily in the headwaters and upland areas. Private land ownership is concentrated in the valley bottoms, along river and lake shorelines.

The largest city in the basin is Sandpoint, Idaho, located on the shores of Lake Pend Oreille, with a population of 6,835 (US Census Bureau 2000). Other towns along the river in Idaho include Dover (population 342) and Priest River (population 1,800) (MDEQ et al. 2007). The largest city in Washington is Newport, which has a population of 1,965. The next largest town, Ione, has about 475 residents (MDEQ et al. 2007). The 2000 census counts 206 residents of the Kalispel Indian Reservation, of which 180 are Native American (MDEQ et al. 2007).

According to the 2000 census, the population in Pend Oreille County is 11,732. This represents a growth rate of about two percent from 1995 (Entrix, Inc. 2002). It is estimated that approximately 25 percent of the county’s permanent resident population lives in the Little Spokane drainage, south of the Pend Oreille River Subbasin. Therefore, the total subbasin population is estimated to be approximately 8,000.

Pend Oreille County experienced a higher rate of population growth than usual in the 1990s, but this growth has since slowed (Entrix, Inc. 2002). In general, southern portions of the county (often south of the Pend Oreille Subbasin border), exhibited greater rates of population growth while areas further north (in the subbasin) have had slower population growth. The population of Pend Oreille County is expected to increase to 16,666 by the year 2025(OFM 2002).

History and Economics

Historically, Bonner County had a resource-based economy, producing timber, agricultural products, and mined minerals. However, this resource-based sector has been replaced by a growing services, retirement, and recreation based economy (IDEQ 2001).

Local, state, and federal government jobs account for approximately 30 percent of employment in the Pend Oreille River Subbasin in Washington, with the remaining 70 percent split between retail, manufacturing, and service jobs (MDEQ et al. 2007). Economic activity in the Washington portion of the subbasin is predominantly timber harvesting and recreation, supplemented with grazing, mining, and heavy industry (Entrix, Inc. 2002). Crop and pasture land support about 6 percent of the Pend Oreille County economy (Entrix, Inc. 2002).

2. Subbasin Assessment – Water Quality Concerns and Status

This section identifies the water quality limited segments of the Pend Oreille River addressed in this report, the applicable water quality standards for these segments, existing water quality data, and data gaps.

2.1 Water Quality Limited Assessment Units Occurring in the Pend Oreille River Subbasin

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

Idaho: About Assessment Units and Watershed Administrative Units

Assessment Units (AUs) now define all the waters of the state of Idaho. These units and the methodology used to describe them can be found in the WBAGII (Grafe et al. 2002).

AUs are groups of similar streams that have similar land use practices, ownership, or land management. Stream order, however, is the main basis for determining AUs—although ownership and land use can change significantly, the AU remains the same.

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

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

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

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

Listed Waters

Idaho

The entire length of the Pend Oreille River in Idaho is included on Idaho's §303(d) list for temperature impairments (Table 3). Refer to Figure 1 for the locations of the listed segments.

Table 3. §303(d) temperature impairments in Idaho included in this TMDL.

Water body name	Assessment unit ID number	Idaho 2002 §303(d) boundaries
Pend Oreille River	ID17010214PN002_02*	Pend Oreille Lake to Priest River
Pend Oreille River	ID17010214PN002_03*	Pend Oreille Lake to Priest River
Pend Oreille River	ID17010214PN002_08	Pend Oreille Lake to Priest River
Pend Oreille River	ID17010214PN001_02*	Priest River to Albeni Falls Dam
Pend Oreille River	ID17010214PN001_08	Priest River to Albeni Falls Dam

*Not addressed in this TMDL

Washington

Several segments of the mainstem Pend Oreille River and six tributaries of the Pend Oreille River in Washington are on the 2004 §303(d) list for temperature impairments (Table 4). Refer to Figure 1 for the locations of the listed segments.

Table 4. §303(d) segments for temperature impairments in the Pend Oreille River Subbasin in Washingtonincluded in this TMDL.

Water body name	1996 listing	2002/2004 listing ID	Water course number	Water body ID	Township	Range	Section
Pend Oreille River	Yes	43539	DS54SI	WA-62-1010	40N	43E	03
Pend Oreille River	Yes	42515	DS54SI	WA-62-1020	40N	43E	10
Pend Oreille River	Yes	11452	DS54SI	WA-62-1010	39N	43E	21
Pend Oreille River	Yes	41513	DS54SI	WA-62-1020	38N	43E	19
Pend Oreille River	Yes	42512	DS54SI	WA-62-1010	38N	43E	20
Pend Oreille River	Yes	8617	DS54SI	WA-62-1020	31N	46E	07
Cedar (Ione) Creek	Yes	38212	AS86PH	WA-62-3310	38N	43E	31
Leclerc Creek, E.B.	No	21710	CG54YF	WA-62-2300	35N	44E	17
Leclerc Creek, E.B.	No	21711	CG54YF	WA-62-2300	36N	44E	33
Little Muddy Creek	No	21725	ZE63VQ	WA-62-3200	37N	43E	06
Lost Creek	Yes	21717	EK49EK	WA-62-1960	36N	43E	22

In addition to the §303(d) listed water bodies included in Table 4, there are several Washington and Kalispel Tribe water bodies that are included in this TMDL study that are impaired, but not included on the §303(d) list. There are some water bodies in the Pend Oreille River Subbasin that had data collected after the deadline for submission for the 2004 §303(d) list that showed streams to be impaired. These "impaired" water bodies will either be on the next Washington or Kalispel Tribe §303(d) list or the TMDLs will be approved first and the water bodies will be included in the category of the §303(d) list "addressed by TMDL" (category 4a). Table 5 lists the "impaired" Washington and Kalispel Tribe water bodies that are included in this TMDL study, but were not included on Washington's or the Tribe's 2004 §303(d) lists.

Table 5. Impaired tributaries to the Pend Oreille River.

Water Body	Washington or Kalispel Tribe Water Body
Indian Creek	Washington
Skookum Creek	Washington
NF Skookum Creek	Washington
Calispell Creek below Smalle Ck	Washington and Kalispel Tribe[1]
Cee Cee Ah Creek	Washington and Kalispel Tribe[1]
Tacoma Creek	Washington
Cusick Creek	Washington
Mill Creek	Washington
Middle Creek	Washington
Leclerc Creek	Washington
Ruby Creek	Washington
SF Lost Creek	Washington
Big Muddy Creek	Washington
Sullivan Creek	Washington
Slate Creek	Washington
Lime Creek	Washington
Flume Creek	Washington

[1]Shared waters of Kalispel Tribe and State of Washington. All other tributaries are State only.

2.2 Applicable Water Quality Standards

Idaho, Washington, and Kasipel Indian Tribe water quality standards consist of two components: (1) designated and existing uses and (2) narrative or numeric water quality criteria necessary to support those uses. Furthermore, water quality standards serve the purpose of protecting public health, enhancing the quality of water, and protecting aquatic resources. The water quality standards for the Pend Oreille River Subbasin are discussed below.

Beneficial Uses

Idaho

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) gives a more detailed description of beneficial use identification for use assessment purposes. The beneficial uses in the Idaho portion of the Pend Oreille River are cold water (COLD), primary contact recreation (PCR), and domestic water supply (DWS) (IDAPA 58.01.02.07).

Idaho Existing Uses

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

Idaho Designated Uses

Designated uses under the CWA are "those uses specified in water quality standards for each water body or segment, whether or not they are being attained." Designated uses are simply uses officially recognized by the state. In Idaho these include uses such as aquatic life support, recreation in and on the water, domestic water supply, and agricultural uses. Water quality must be sufficiently maintained to meet the most sensitive use. Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life or salmonid spawning. Designated uses are specifically listed for water bodies in Idaho in tables in the Idaho water quality standards (see IDAPA 58.01.02.003.27 and .02.109-.02.160 in addition to citations for existing uses).

Idaho Presumed Uses

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

Washington

The following beneficial uses are identified in Washington's water quality standards (WDOE 2006) for the Pend Oreille River (from the Canadian border to the Idaho border) and its tributaries:

- Primary contact recreation; domestic, industrial, agricultural, and stock water; salmonid spawning, rearing, and migration; wildlife habitat; harvesting; commerce/navigation; boating; and aesthetics.
- The following tributaries of the Pend Oreille River are designated for char spawning and rearing:
    - Calispell Creek from Smalle Creek upstream;
    - Cedar Creek from latitude 48.7500 longitude -117.4349 to (including tributaries) to headwaters; Indian Creek from mouth to headwaters;
    - Le Clerc Creek, East Branch, and West Branch Le Clerc Creek: all waters (including tributaries) above the junction;
    - Slate Creek from mouth to headwaters (including tributaries);
    - Sullivan Creek above junction with Harvey Creek (including tributaries) to headwaters; and
    - Tacoma Creek, South Fork, and tributaries.
- The following tributaries of the Pend Oreille River are designated for core summer salmonid habitat:
    - Cedar Creek from mouth to latitude 48.7500 longitude -117.4349 (including tributaries);
    - Le Clerc Creek from mouth to junction with West Branch le Clerc Creek (including tributaries); and
    - Mill Creek from mouth to headwaters (including tributaries).

Kalispel Indian Tribe

Water quality in water bodies on the Kalispel Indian Reservation shall be managed to protect the recognized beneficial uses identified in the water quality standards (Kalispel Indian Tribe 2004). The beneficial uses may be revised in the future to include additional beneficial uses as long as the existing uses are protected. At the boundary between two waters of different classifications, the water quality standards for the more stringent shall prevail. The designated beneficial uses for the Pend Oreille River, Cee Cee Ah Creek, and Calispell Creek in the Kalispel Indian Reservation are adult salmonid migration, primary contact recreation, agricultural water supply, wildlife habitat and hunting, ceremonial and cultural use, and aesthetic quality (Kalispel Indian Tribe 2004). Cee Cee Ah Creek is also designated for Brown Trout Spawning.

Table 6 presents the beneficial uses for Idaho, Washington, and the Kalispel Indian Tribe for the Pend Oreille River.

Table 6. Designated beneficial uses in the Pend Oreille River Subbasin.

State/Tribe	Water body	Beneficial uses
Idaho	Pend Oreille River	COLD, PCR, DWS
Washington	Pend Oreille River	SRM, PCR, DWS, AWS, SWS, WH, Harvesting, C/N, Boating, Aesthetics
	Calispell Creek	CSR, SRM, PCR, DWS, AWS, SWS, WH, Harvesting, C/N, Boating, Aesthetics
	Cedar Creek	CSR, CSH, SRM, PCR, DWS, AWS, SWS, WH, Harvesting, C/N, Boating, Aesthetics
	Le Clerc Creek, East Branch Le Clerc Creek, West Branch Le Clerc Creek	CSR, CSH [Le Clerc Creek from mouth to junction with W. Branch (including tributaries) only], SRM, PCR, DWS, AWS, SWS, WH, Harvesting, C/N, Boating, Aesthetics
	Slate Creek	CSR, SRM, PCR, DWS, AWS, SWS, WH, Harvesting, C/N, Boating, Aesthetics
	Sullivan Creek	CSR, SRM, PCR, DWS, AWS, SWS, WH, Harvesting, C/N, Boating, Aesthetics
	Tacoma Creek, South Fork Tacoma Creek	CSR, SRM, PCR, DWS, AWS, SWS, WH, Harvesting, C/N, Boating, Aesthetics
	Mill Creek	CSH, SRM, PCR, DWS, AWS, SWS, WH, Harvesting, C/N, Boating, Aesthetics
Kalispel Indian Tribe	Pend Oreille River	SM, PCR, AWS, WHH, CC, Aesthetic quality
	Cee Cee Ah Creek	SM, PCR, AWS, WHH, CC, Aesthetic quality
	Calispell Creek	SM, PCR, AWS, WHH, CC, Aesthetic quality, BTS

COLD – cold water; PCR – primary contact recreation; DWS – domestic water supply; SRM – salmonid spawning, rearing, and migration; AWS – agricultural water supply; SWS – stock water supply; WH – wildlife habitat; C/N – commerce/navigation; CSR – char spawning and rearing; CSH – core summer habitat; SM – salmonid migration; WHH – Wildlife habitat and hunting; CC – ceremonial and cultural use; BTS – brown trout spawning.

Criteria to Support Beneficial Uses

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

IDEQ's procedure to determine whether a water body fully supports designated and existing beneficial uses is outlined in IDAPA 58.01.02.053. The procedure relies heavily upon biological parameters and is presented in detail in the Water Body Assessment Guidance (Grafe et al. 2002). This guidance requires the use of the most complete data available to make beneficial use support status determinations. Figure 5 provides an outline of the stream assessment process in Idaho for determining support status of the beneficial uses of cold water aquatic life, salmonid spawning, and contact recreation.

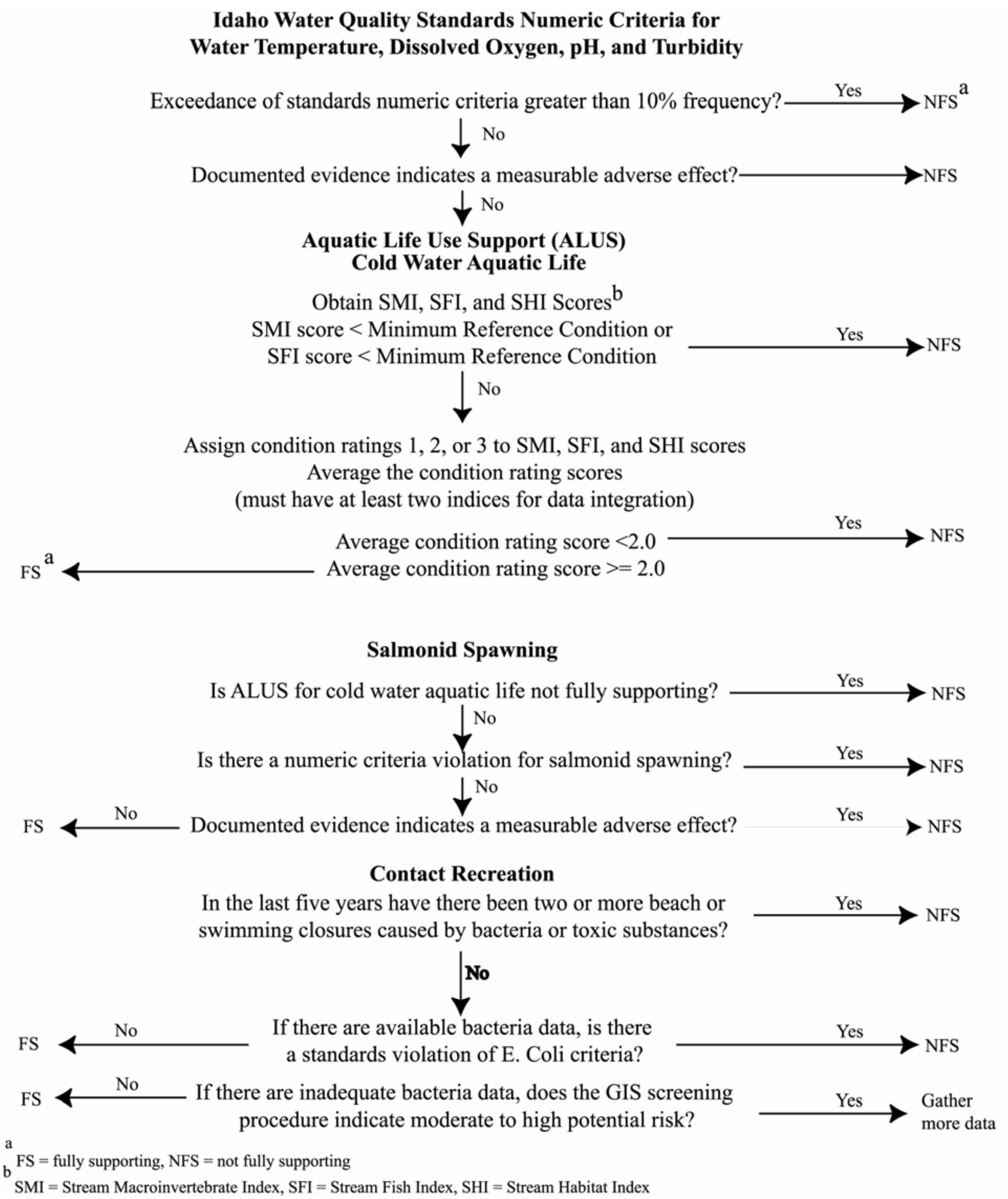

Figure 5. Determination Steps and Criteria for Determining Support Status of Beneficial Uses in Wadeable Streams in Idaho: *Water Body Assessment Guidance*, Second Addition (Grafe *et al*. 2002)

In July 2003, Ecology made significant revisions to Washington's surface water quality standards (Chapter 173-201A WAC). These changes included eliminating the classification system the state used for decades to designate uses for protection by water quality criteria (e.g., temperature, dissolved oxygen, turbidity, bacteria). Ecology also revised the numeric temperature criteria assigned to waters to protect specific types of aquatic life uses (e.g., native char, trout and salmon spawning and rearing, warm water fish habitat).

Ecology submitted the revised water quality standards regulation to the U.S. EPA for federal approval. EPA was not satisfied that Ecology's 2003 standards met the requirements of the federal Clean Water Act and the federal Endangered Species Act (ESA). Their main concerns were over the temperature criteria applied to waters that support endangered fish species (e.g., bull trout, salmon, and steelhead). As a consequence, EPA formally disapproved portions of the revised standards.

Ecology agreed to initiate state rule revision proceedings that will consider making the changes EPA has highlighted as necessary. The result of the corrective state rulemaking will be that a number of streams and stream segments would receive more stringent temperature and dissolved oxygen criteria.

The state expects to conclude its corrective rulemaking proceedings in October 2006, and have approved state standards in 2007. The temperature TMDLs for Pend Oreille Subbasin waterbodies in Washington addressed in this TMDL report have been developed to meet the proposed temperature water quality criteria for Washington. Note that the Pend Oreille River has a special condition for temperature (see tables below).

Tables 7, 8, and 9 include the temperature criteria used in this TMDL for Idaho, Washington, and the Kalispel Tribe, respectively.

Table 7. Temperature criteria supportive of designated beneficial uses in Idaho water quality standards.

Beneficial Use	Water quality criteria	Source
Cold water aquatic life	22°C or less daily maximum; 19°C or less daily average[a]	Idaho Water Quality Standards: IDAPA 58.01.02.250
Natural background conditions	200.09. Natural Background Conditions as Criteria. When natural background conditions exceed any applicable water quality criteria set forth in Sections 210, 250, 251, 252, or 253, the applicable water quality criteria shall not apply; instead, there shall be no lowering of water quality from natural background conditions. Provided, however, that temperature may be increased above natural background conditions when allowed under Section 401: e. If temperature criteria for the designated aquatic life use are exceeded in the receiving waters upstream of the discharge due to natural background conditions, then Subsections 401.01.c. and 401.01.d. do not apply and instead wastewater must not raise the receiving water temperatures by more than three tenths (0.3) degrees C.	Idaho Water Quality Standards: IDAPA 58.01.02.200.09

[a]Temperature Exemption for Idaho - Exceeding the temperature criteria will not be considered a water quality standard violation when the air temperature exceeds the ninetieth percentile of the seven-day average daily maximum air temperature calculated in yearly series over the historic record measured at the nearest weather reporting station.

Table 8. Temperature criteria supportive of designated beneficial uses in Washington water quality standards.

<table>
<tr><th></th><th>Beneficial Use</th><th>Water quality criteria</th><th>Source</th></tr>
<tr><td>Site-specific Temperature Criterion for the mainstem Pend Oreille River[ab]</td><td>Applies to all beneficial uses</td><td>Temperature shall not exceed a 1-DMax of 20°C due to human activities. When natural conditions exceed a 1-DMax of 20°C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C; nor shall such temperature increases, at any time, exceed t = 34/(T + 9).</td><td rowspan="4">Washington Water Quality Standards: Washington Administrative Code (WAC) 173-201A</td></tr>
<tr><td rowspan="3">Temperature Criterion for the Pend Oreille River tributaries[bc]</td><td>Char Spawning and Rearing</td><td>12°C (53.6°F)</td></tr>
<tr><td>Core Summer Salmonid Habitat</td><td>16°C (60.8°F)</td></tr>
<tr><td>Salmonid Spawning, Rearing, and Migration</td><td>17.5°C (63.5°F)</td></tr>
<tr><td rowspan="2">General Criteria</td><td colspan="3">When a water body's temperature is warmer than the criteria in Table 200 (1)(c) (or within 0.3°C (0.54°F) of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the 7-DADMax temperature of that water body to increase more than 0.3°C (0.54°F).</td></tr>
<tr><td colspan="3">When the background condition of the water is cooler than the criteria, the allowable rate of warming up to, but not exceeding, the numeric criteria from human actions is restricted as follows: Incremental temperature increases resulting from the combined effect of all nonpoint source activities in the water body must not, at any time, exceed 2.8°C (5.04°F).</td></tr>
</table>

[a]"1-DMax" or "1-day maximum temperature" is the highest water temperature reached on any given day. This measure can be obtained using calibrated maximum/minimum thermometers or continuous monitoring probes having sampling intervals of thirty minutes or less.
[b]"Natural conditions" or "natural background levels" means surface water quality that was present before any human-caused pollution. When estimating natural conditions in the headwaters of a disturbed watershed it may be necessary to use the less disturbed conditions of a neighboring or similar watershed as a reference condition. (See also WAC 173-201A-260(1).
[c]The highest 7-day average of the daily maximum temperatures (7-DADMax).

Table 9. Temperature criteria supportive of designated beneficial uses in Kalispel Tribe water quality standards.

Beneficial Use	Water quality criteria	Source
Adult salmonid migration	Temperature shall not exceed 18°C as a moving 7-day average of the daily maximum temperatures with no single daily maximum temperature greater than 20.5°C. When natural background conditions prevent the attainment of the numeric temperature criteria, human-caused conditions and activities considered cumulatively can increase temperature levels by only an additional 0.3°C.	Kalispel Tribe (2004)
Brown trout spawning	These criteria apply between October 1 and March 1. Temperature shall not exceed 9°C as a moving 7-day average of the daily maximum temperatures with no single daily maximum temperature greater than 13°C. When natural background conditions prevent the attainment of the numeric temperature criteria, human-caused conditions and activities considered cumulatively can increase temperature levels by only an additional 0.3°C.	

2.3 Pollutant/Beneficial Use Support Status Relationships

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

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

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

2.4 Summary and Analysis of Existing Water Quality Data

This section presents a summary of available data presented in *Idaho Pend Oreille River Model: Model Development and Calibration* (PSU 2006a), *Pend Oreille River, Box Canyon Model: Model Development and Calibration* (PSU 2006b), and *Modeling of the Pend Oreille River, Boundary Hydroelectric Project CE-QUAL-W2 Model Calibration Report* (Breithaupt and Khangaonkar 2007) for the Pend Oreille River in Idaho, the Pend Oreille River in Washington above Box Canyon Dam, and the Pend Oreille River in Washington above Boundary Dam, respectively. See each of these reports for greater detail on the available water quality data (Appendices A, B, and C).

Data Quality

Washington's *Water Quality Data Act* (WQDA), codified in RCW 90.48.570 through 90.48.590, requires that Ecology develop and implement a policy that describes the Quality Assurance (QA) measures, guidance, regulations, and existing policies that help ensure the credibility of data and other information used in agency actions based on the quality of state surface waters. Ecology's Credible Data Policy requires that Ecology use credible data for the development of all TMDLs.

This TMDL has relied on temperature data collected by Department of Ecology as well as by the Army Corps of Engineers, Pend Oreille PUD, Kalispel Tribe, Pend Oreille Conservation District, Seattle City Light, and the U.S. Forest Service. These data were all collected following acceptable data quality procedures, and the quality of the data has been reviewed and confirmed as part of TMDL development. Ecology's data quality procedures are described in Appendix D. Citations for the reports with descriptions of data quality procedures are provided in the References section.

The credible data policy also requires that computer modeling used in TMDL development be based on credible data and a description provided in the TMDL report of how the model framework was selected and applied to the TMDL study, including the calibration process. This information has been presented in the three model calibration reports that are cited in the References (PSU 2006a, PSU 2006b, and Breithaupt and Khangaonkar 2007).

Flow Characteristics/Hydrodynamics

Idaho

The flow characteristics for the Pend Oreille River were previously discussed in the Hydrography portion of Section 1.2 of this report. Also see the Boundary Conditions section of *Idaho Pend Oreille River Model: Model Development and Calibration* (PSU 2006a) and the Boundary Conditions section of *Pend Oreille River, Box Canyon Model: Model Development and Calibration* (PSU 2006b) for more detail on the flow and hydrodynamics of the Pend Oreille River. The locations and the extent of the hydrodynamic and flow data for the Idaho portion and Box Canyon Reservoir portion of the river are presented in Appendix A of PSU (2006a) and PSU (2006b), respectively.

Washington

Water-surface elevations were measured at three locations in the Boundary Reservoir portion of the Pend Oreille River for 2004 and 2005: the USGS gauge downstream of Box Canyon Dam, Boundary Dam, and Boundary Dam tailrace **(**Breithaupt and Khangaonkar 2007).

The water levels downstream of Box Canyon Dam were near the full-pool elevation, which is 1,990 feet (606.55 m) **(**Breithaupt and Khangaonkar 2007); however, during the high flow periods of May, June, and July, water levels were greater than the full-pool elevation. Daily variations in water level are primarily due to the peaking-mode operation of Boundary Dam.

The minimum water level measured during 2004 and 2005 was about 1,970 feet (600.46 m) **(**Breithaupt and Khangaonkar 2007). The daily range was 20 feet (6.10 m), except during the summer-recreation season in which variations are restricted to 10 feet (3.05 m) to allow user access **(**Breithaupt and Khangaonkar 2007). Downstream of Boundary Dam there is considerable daily variation in water level because of releases from the dam. See Section 2.5.2 in Breithaupt and Khangaonkar (2007) for more detail on hydrodynamic and flow characteristics of the Boundary Reservoir.

Continuous tributary flows have been measured by the Kalispel Tribe at the locations listed in Table 10. Spot tributary flow measurements have been collected by the Pend Oreille Conservations District and the U.S. Forest Service. Low flows on the significant tributaries are shown in Table 2.

Table 10. Kalispel Tribe Flow Monitoring Locations.

Site Acronym	Watershed	Stream Name	Period of Record	Elevation (feet)	Catchment Area (acres)
SFC1	Calispell	S.F. Calispel	2001-current	2,039	42,646
WIN1	Calispell	Winchester Creek	2001-current	2,070	10,046
CCA1	CCA	Cee Cee Ah Creek	2001-current	2,060	12,364
CCA1a	CCA	Cee Cee Ah Creek	2004-current	2,340	
DAV1	Davis	Davis Creek	2005-current	2,060	
IND1	Indian	Indian Creek	2001-current	2,160	2,851
LEC1	Leclerc	Leclerc Creek	2001-current	2,035	58,058
MID1	Middle	Middle Creek	2001-current	2,120	6,847
NFS1	Skookum	N.F. Skookum Creek	2001-current	2,190	9,985
SKO1	Skookum	Skookum Creek	2001-current	2,200	2,010
TAC1a	Tacoma	Tacoma Creek	2004-current	2,120	
SKO2	Skookum	Skookum Creek		2,063	16,560

Water Column Data

Idaho

There are 9 temperature monitoring sites in Lake Pend Oreille and the Idaho portion of the Pend Oreille River, with vertical, time series, or grab sample data collected by IDEQ, Tetra Tech, Inc., the US Navy, the City of Sandpoint, and the US Army Corps of Engineers in 2004 and 2005. Table 2 in *Idaho Pend Oreille River Model: Model Development and Calibration* (PSU 2006a) lists the site names, descriptions and the types of data available at each site and Figure 12 in PSU (2006a) presents the locations of the monitoring stations.

The vertical profile data from the monitoring stations in Lake Pend Oreille indicate that there is thermal stratification in the lake in the middle of the summer (PSU 2006a). Time series temperature data taken at different depths in the Pend Oreille River show that there is still slight thermal stratification present in the river 1.5 km downstream from the lake. See Figures 13 through 20 in *Idaho Pend Oreille River Model: Model Development and Calibration* (PSU 2006a) for time series and vertical profile plots of the temperature data for the Pend Oreille River. Appendix A in *Idaho Pend Oreille River Model: Model Development and Calibration* (PSU 2006a) presents the extent of the available water quality data for the Pend Oreille River in Idaho. Figure 6 presents an example of continuous temperature data at various depths in the Pend Oreille River in 2005.

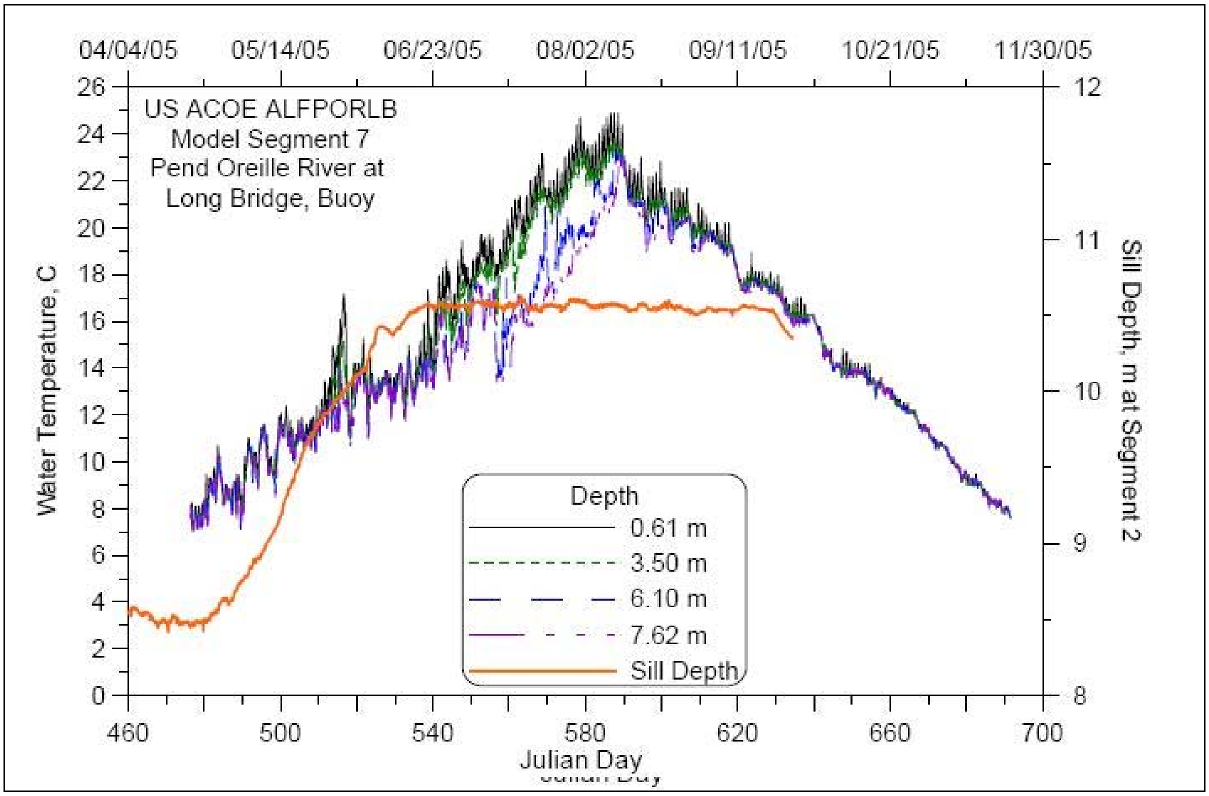

Figure 6. Continuous temperature data at various depths in the Pend Oreille River (2005) (Source: PSU 2006a).

Washington

Based on temperature data collected by Ecology in 2004 along the entire length of the Pend Oreille River, the temperature of the water exceeded the criteria for most of July and August. See Appendix A of this document for the results of the 2004 water quality monitoring study. The Quality Assurance Project Plan – Pend Oreille River Temperature Total Maximum Daily Load Technical Study (Pickett 2004) contain a review of historical data. The temperature modeling reports for the Pend Oreille River also include summaries of temperature data and are discussed below.

Figure 7 presents the locations of the temperature monitoring sites for the Box Canyon portion of the Pend Oreille River. Time series data were collected by Ecology, ACOE, and Foster Wheeler. The vertical profile temperature data were all collected by Ecology. Figure 8 presents the outflow temperature data for 2004 from Albeni Falls Dam (inflow to the Box Canyon reach).

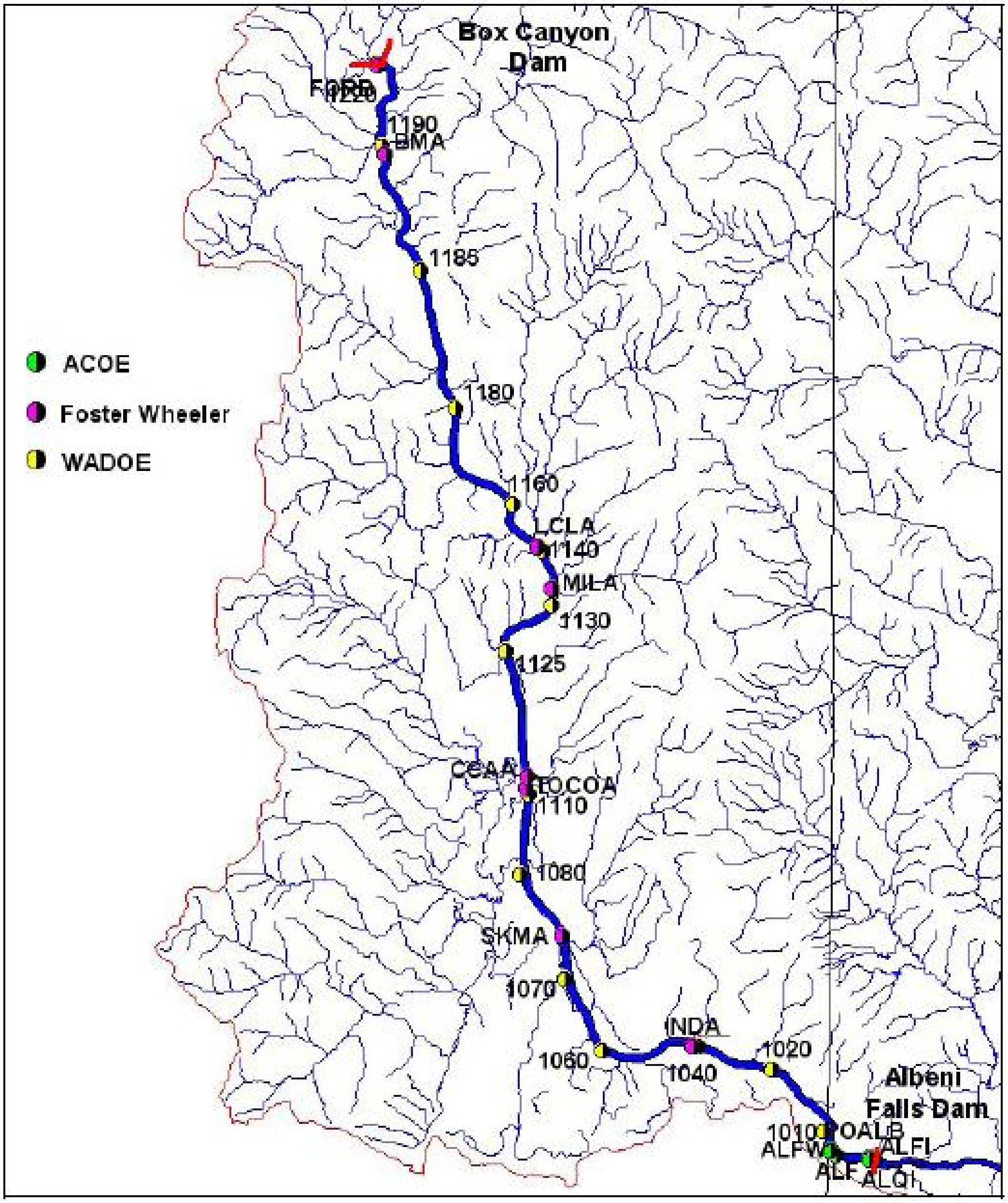

Figure 7. Location of water quality monitoring stations for Box Canyon portion of the Pend Oreille River (source: PSU 2006b).

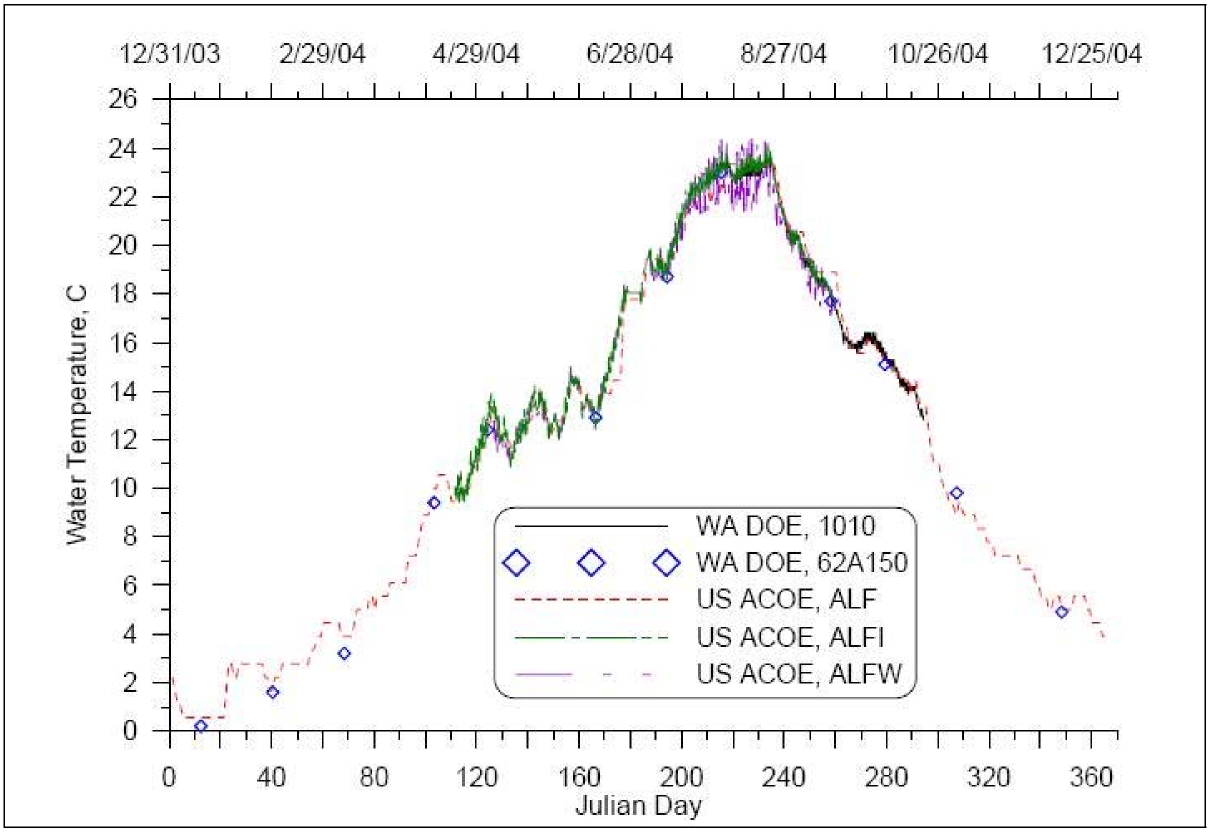

Figure 8. Temperature at the outflow of Albeni Falls Dam for 2004 (Source: PSU 2006b).

Temperature measurements in the Boundary Dam portion of the Pend Oreille River consist of time series and vertical profiles taken at several monitoring stations along the Pend Oreille River in the Boundary Reservoir reach **(**Breithaupt and Khangaonkar 2007). The time series data give the temperatures over a long time period at one location and one depth. The vertical profile data provide a snapshot of temperatures at one location but at many depths.

Time Series – Boundary Dam

Temperature measurements were collected from July 2004 through December 2005 in the Boundary Dam portion of the Pend Oreille River **(**Breithaupt and Khangaonkar 2007). There was little thermal stratification present and surface and deep temperatures were similar. Figure 9 shows the locations of the temperature monitoring locations and Table 11 presents the annual maximum temperature and daily temperature ranges from the time series data.

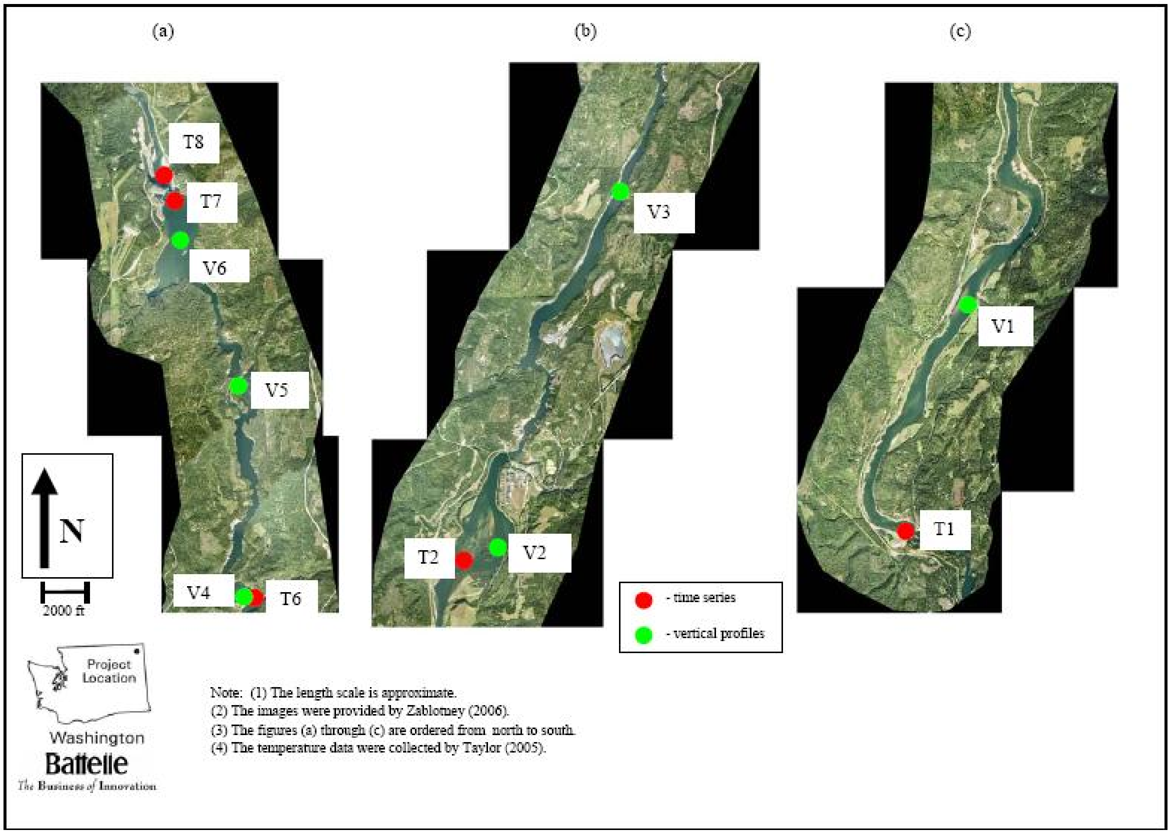

Figure 9. Locations of temperature monitoring locations in the Boundary Dam portion of the Pend Oreille River (source: Breithaupt and Khangaonkar 2007).

Table 11. Annual maximum temperature from the measured temperature time series and daily temperature ranges (source: Breithaupt and Khangaonkar 2007).

Station (Depth)	Annual 1-DMAX Temperatures (°C)		Daily Temperature Range (°C)[a]			
	2004	2005	July 1 – Sept 30, 2004 (JD 183-274)		July 1 – Sept 30, 2005 (JD 548-639)	
			Maximum	Mean	Maximum	Mean
Box Canyon Dam Tailrace	24.46	23.85	0.89	0.35	1.75	0.28
T2a (1 m)	24.73	b	1.06	0.59	1.13	0.61
T2b (3.2 m)	24.61	b	0.99	0.55	0.89	0.52
T2c (5.4 m)	24.70	b	0.99	0.52	0.82	0.48
T2d (7.6 m)	24.68	b	0.99	0.51	0.77	0.48
T2e (9.8 m)	24.58	b	0.99	0.51	0.77	0.48
T6a (1 m)	24.70	b	0.89	0.48	1.71	0.71
T6b (11 m)	24.58	b	0.82	0.43	1.50	0.42
T6c (21 m)	24.48	b	0.82	0.43	1.50	0.41
T6d (31 m)	24.56	b	0.85	0.45	1.46	0.41
T7a (5 m)	24.68	24.77	1.71	0.49	3.19	0.64
T7b (11 m)	24.46	23.83	1.50	0.31	2.32	0.30
T7c (17 m)	24.18	23.76	0.91	0.29	1.29	0.26
T7d (23 m)	24.12	23.69	0.78	0.28	1.29	0.26
T7e (29 m)	24.12	b	0.74	0.27	c	c
Boundary Dam Tailrace	24.32	23.79	0.71	0.28	1.40	0.28

(a) The daily range of temperature is the difference between the maximum and minimum temperatures at the depth for the day.
(b) There are data missing from the time series for 2005, and so the available data do not necessarily include the maximum for the year.
(c) No data were available to compute the mean daily temperature range.

The annual maximum temperatures in Boundary Reservoir were nearly 25°C **(**Breithaupt and Khangaonkar 2007). However, the maximum temperatures entering Boundary Reservoir from Box Canyon Dam were already near 25°C **(**Breithaupt and Khangaonkar 2007). The maximum temperatures did not increase from upstream to downstream and actually appear to drop slightly.

The tailrace temperatures downstream of Box Canyon and Boundary Dams show little daily variation in temperature, with the largest mean daily variation being 0.35°C in the Box Canyon Dam tailrace **(**Breithaupt and Khangaonkar 2007). The maximum daily ranges seen were larger in 2005 than in 2004 in both Box Canyon Dam and Boundary Dam tailraces. The relatively high maximum ranges show that there were periods during the summer 2005 when significant surface heating occurred in both reservoirs. Even with the relatively high level of heating seen in summer 2005, the annual daily maximum temperature was about 0.5°C less than in 2004 for both the Box Canyon Dam and Boundary Dam tailraces. For the Box Canyon Dam tailrace, the annual maximum of the daily maximum temperature for 2004 was 24.46°C, and for Boundary Dam tailrace, it was 24.32°C, while for 2005 these values were 23.85°C and 23.79°C **(**Breithaupt and Khangaonkar 2007), suggesting that the system was cooling slightly.

At station T2 the temperature data cover the period from mid-July 2004 through November 2004 and August 2005 into November 2005 (Figure 10). The mean daily range of temperatures at station T2 in 2004 and 2005 was larger (approximately 0.6°C) than for the Box Canyon tailrace (0.3°C) entering Boundary Reservoir. The same was true for the maximum daily temperature range in 2004, but not in 2005, suggesting the maximum ranges are short term fluctuations. The temperature ranges decreased with depth, indicating the surface layers were subject to limited surface heat exchange. The largest measured temperature occurred in 2004 with a daily maximum temperature of 24.73°C near the surface.

At station T6 the temperature data covered the period from mid-July 2004 through November 2004, mid-May 2005 through mid-June 2005, and August 2005 into November 2005 (Figure 11). The daily ranges of temperature at station T6 in 2004 were smaller than at station T2, but, in 2005, they were larger. The maximum temperature in 2004 was 24.43°C.

The temperature measurements for Station T7 began in mid-July 2004 and ended in mid-November 2005 (Figure 12). Station T7 had the largest maximum temperature ranges as compared with the upstream stations (T2 and T6). The maximum range was 1.71°C in 2004 and 3.19°C in 2005, indicating that some surface heating occurred. However, the mean temperature ranges were either the same as or smaller than the upstream station T6. The maximum temperature measured for 2004 was 24.68°C and for 2005 it was 24.77°C.

At all the Boundary Reservoir stations where time series temperature data were collected (T2, T6, and T7), the maximum temperatures and temperature ranges decreased with depth. This is expected and reflects the occurrence of a small amount of heat exchange at the surface.

See Section 2.6.1 of Breithaupt and Khangaonkar (2007) for more detail on times series temperature data.

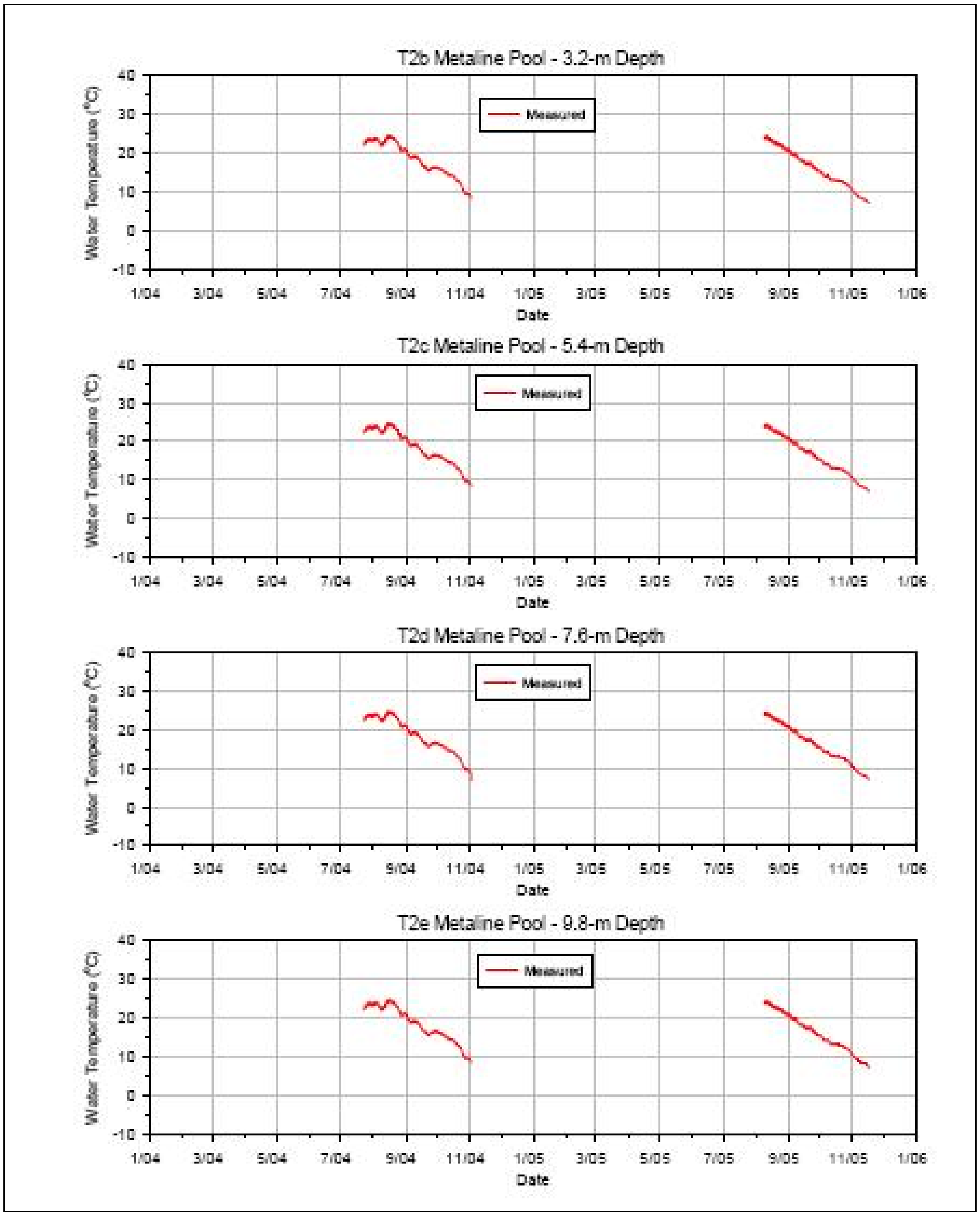

Figure 10. Time series temperature data at station T2 (Source: Breithaupt and Khangaonkar 2007).

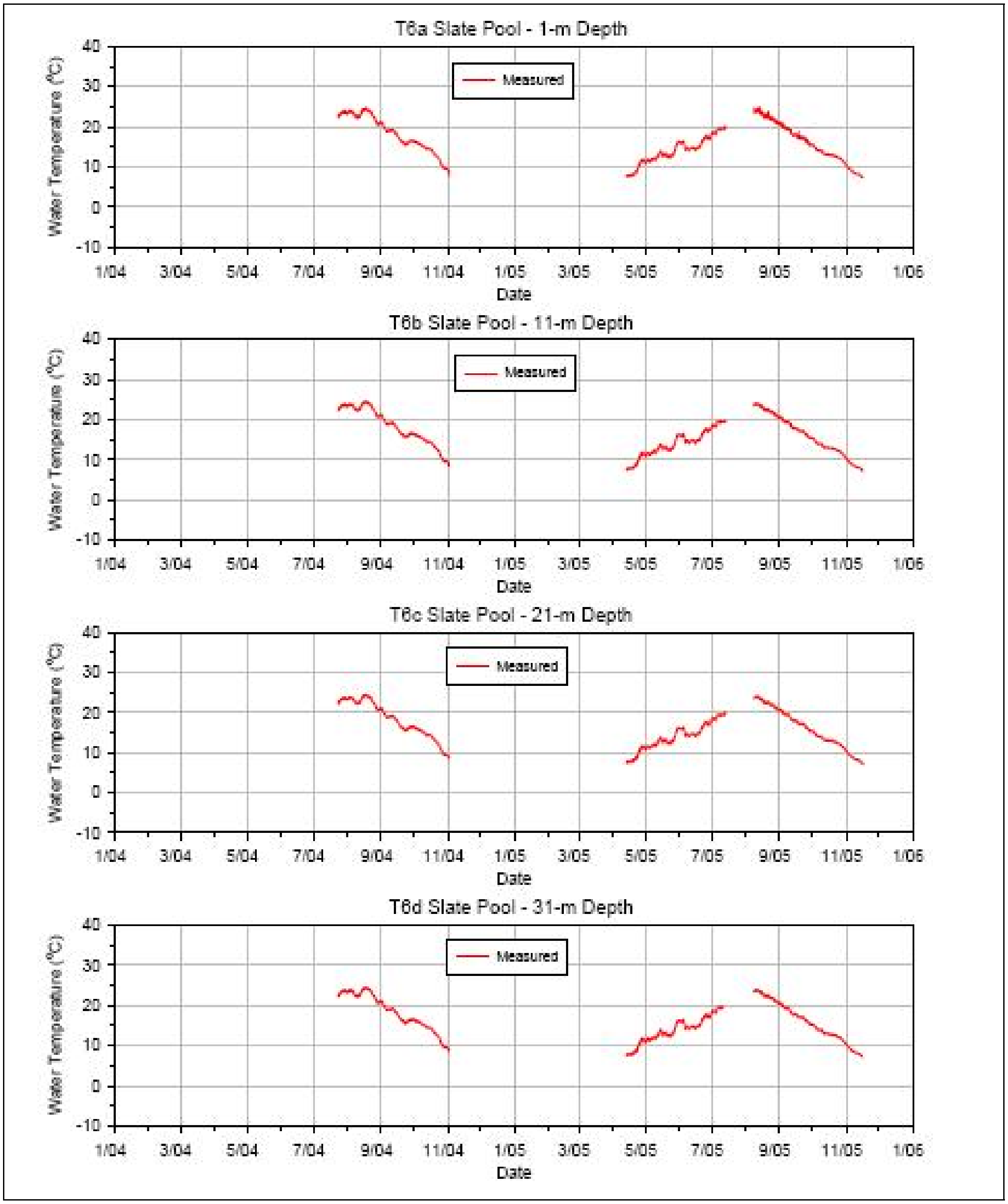

Figure 11. Time series temperature data at station T6 (Source: Breithaupt and Khangaonkar 2007).

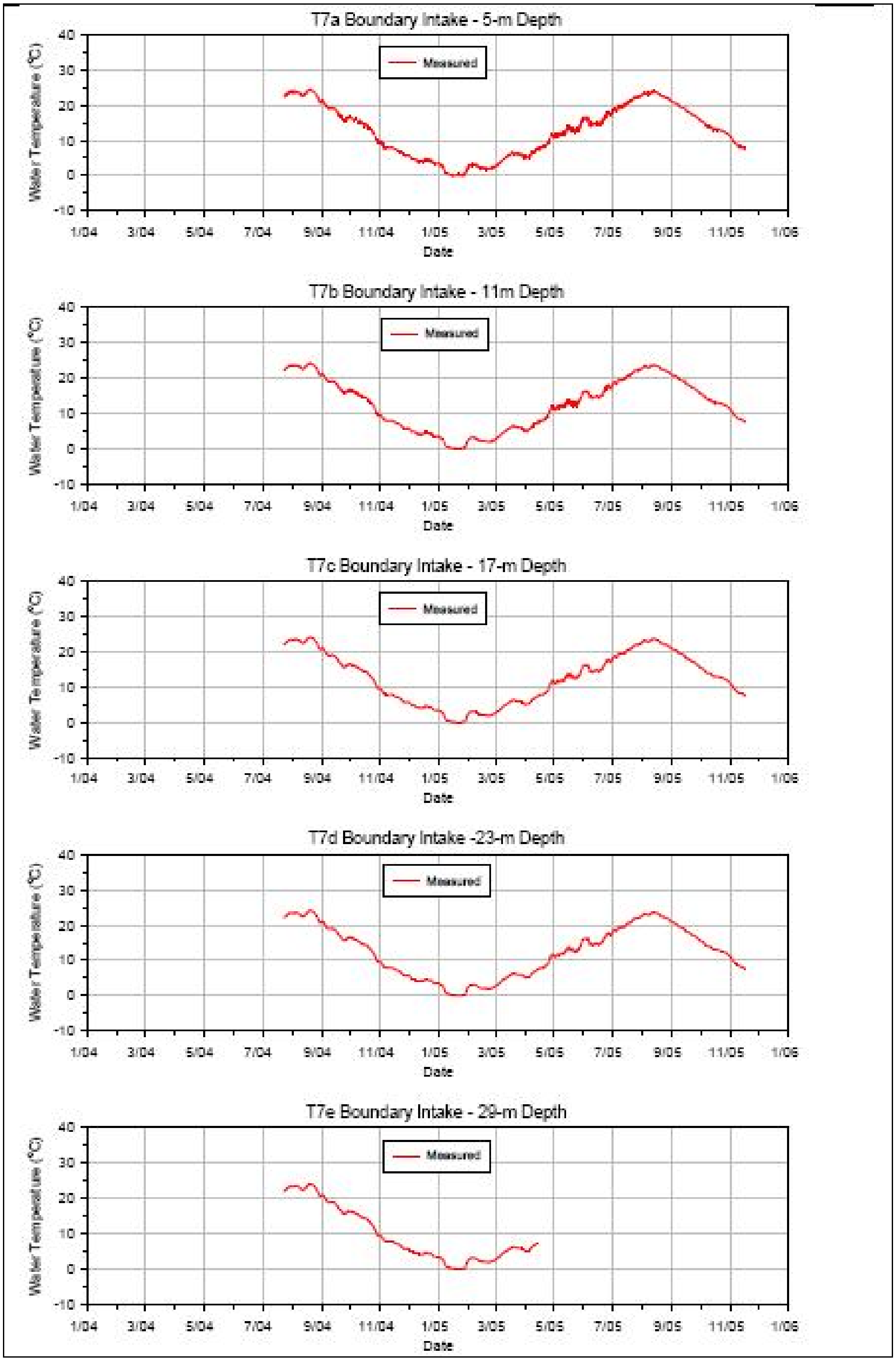

Figure 12. Time series temperature data at station T7 (Source: Breithaupt and Khangaonkar 2007).

Vertical Profiles – Boundary Dam

Vertical profile temperature data were collected in 2004 and 2005 at six monitoring locations in Boundary Reservoir (stations V1, V2, V3, V4, V5, and V6) (Breithaupt and Khangaonkar 2007). See Figure 9 for the locations of the vertical profile temperature monitoring locations.

The vertical temperature profiles were taken on five days in 2004 and four days in 2005. The temperature profiles show little variation with depth, which indicates that Boundary Reservoir was well mixed at the time. There were some slight increases in surface temperature during the mid to late summer at many of the stations, but the degree of stratification was minimal and would not be expected to reduce vertical mixing. The largest temperature variations with depth were seen at Boundary Reservoir (station V6) on August 17, 2004 with a surface temperature of 24.24°C and a bottom temperature of 22.45°C, and on August 1, 2005 with a surface temperature of 23.32°C and a bottom temperature of 22.23°C. These variations were likely transient given the generally well mixed nature of Boundary Reservoir. In general, the vertical temperature variations in the vertical profiles are less than 1°C. Figures 13 through 18 present the vertical profile data for the Boundary Dam portion of the Pend Oreille River. See Section 2.6.2 of Breithaupt and Khangaonkar (2007) for more detail on vertical profile temperature data in Boundary Reservoir.

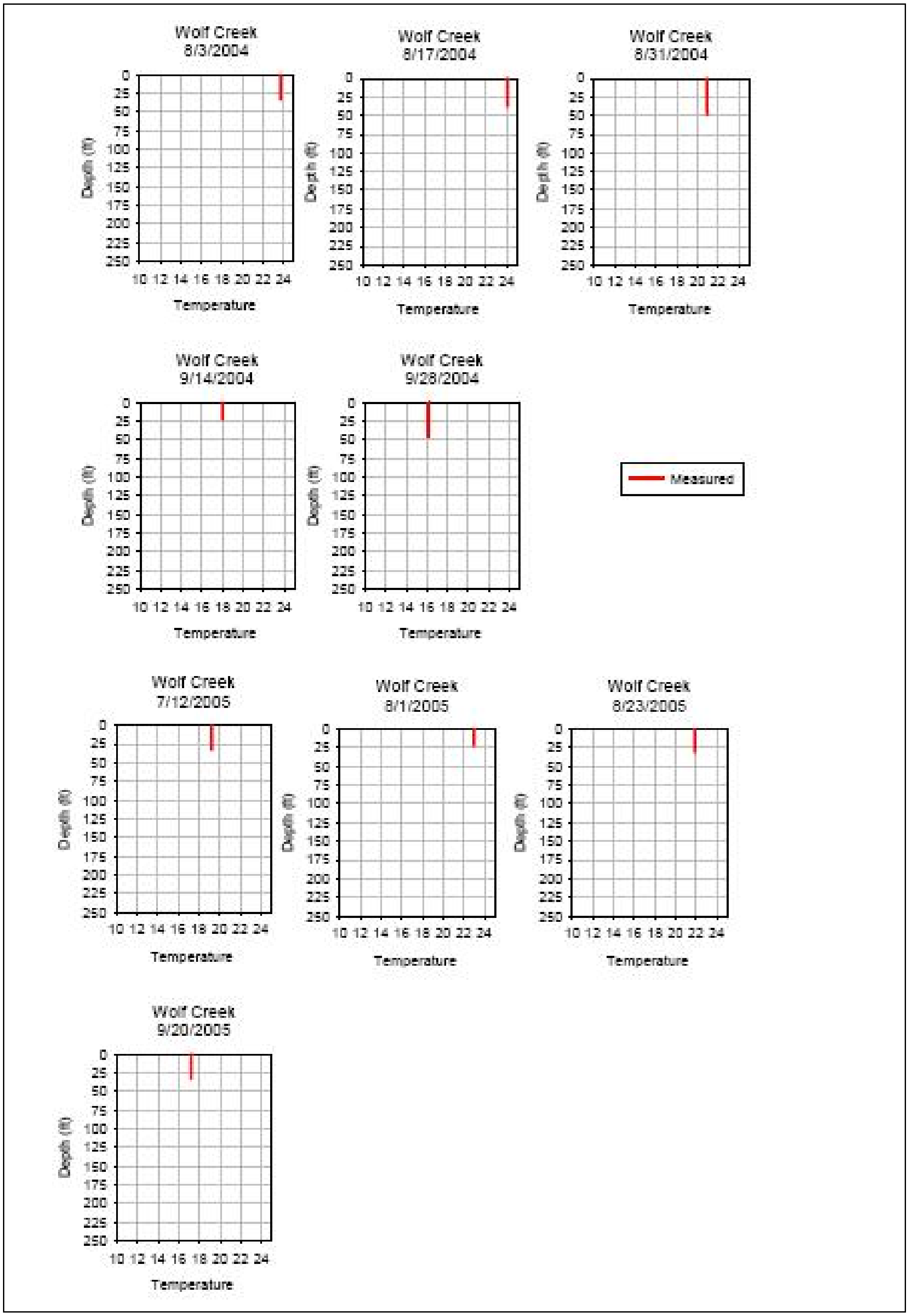

Figure 13. Vertical temperature data at station V1 (Source: Breithaupt and Khangaonkar 2007).

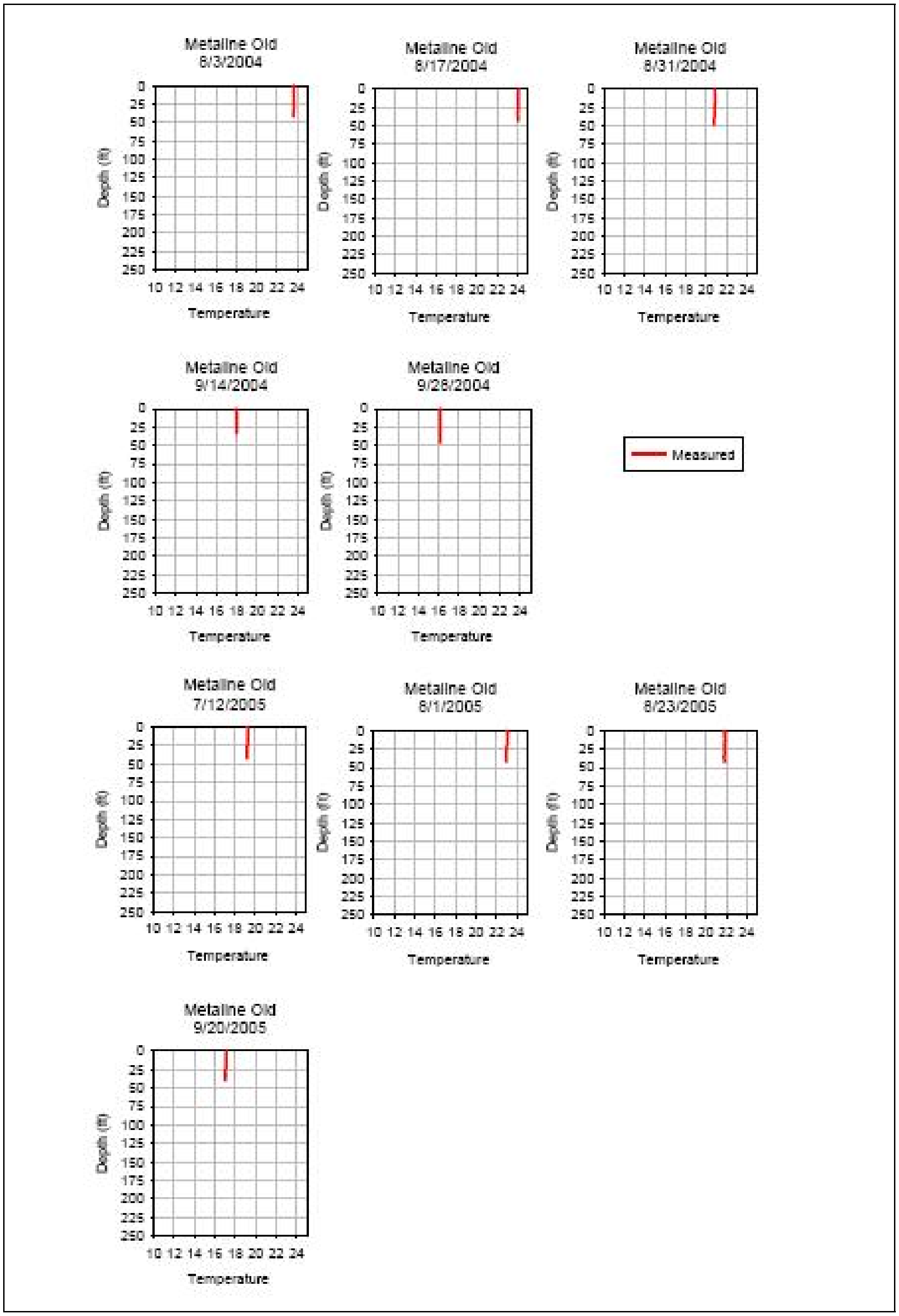

Figure 14. Vertical temperature data at station V2 (Source: Breithaupt and Khangaonkar 2007).

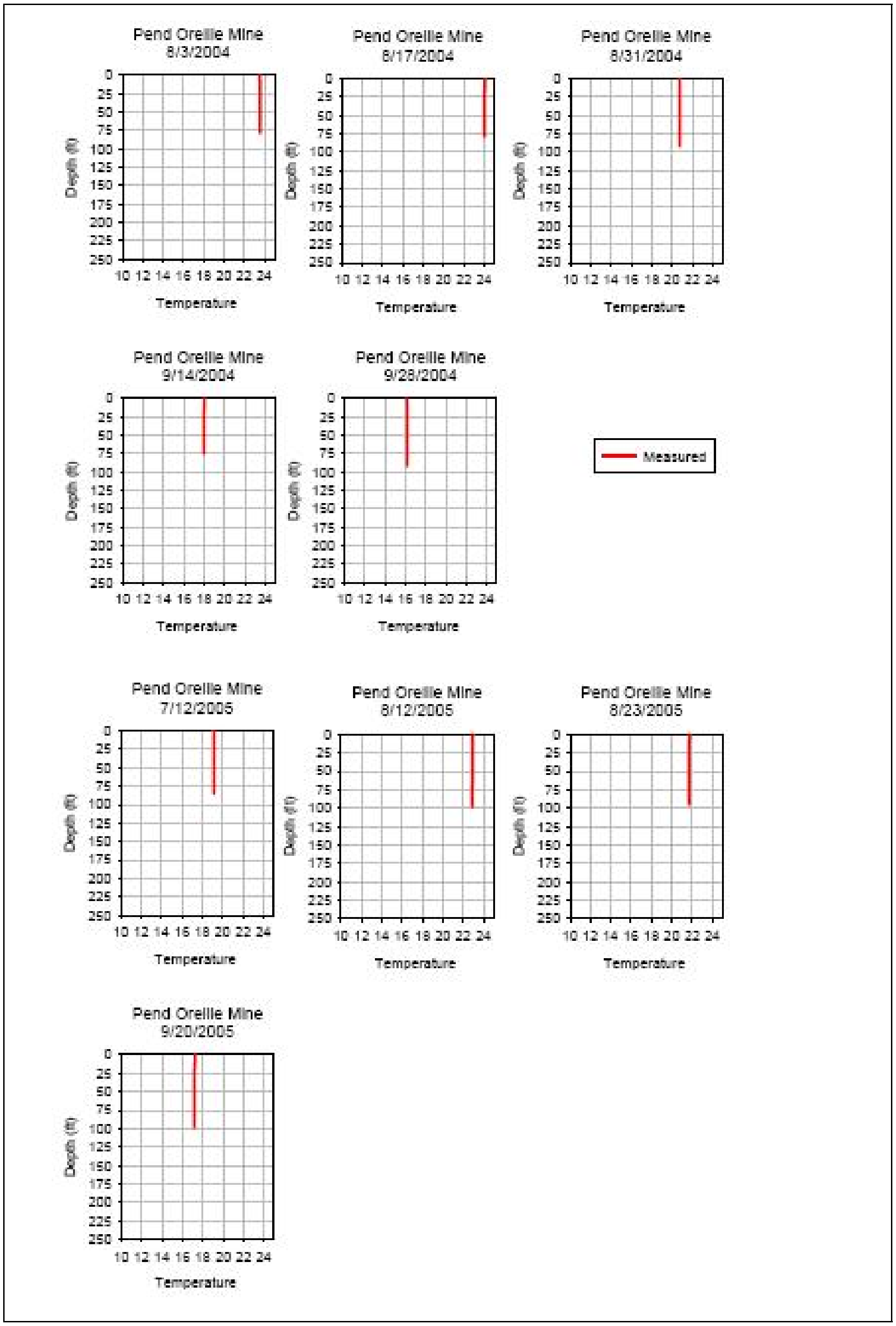

Figure 15. Vertical temperature data at station V3 (Source: Breithaupt and Khangaonkar 2007).

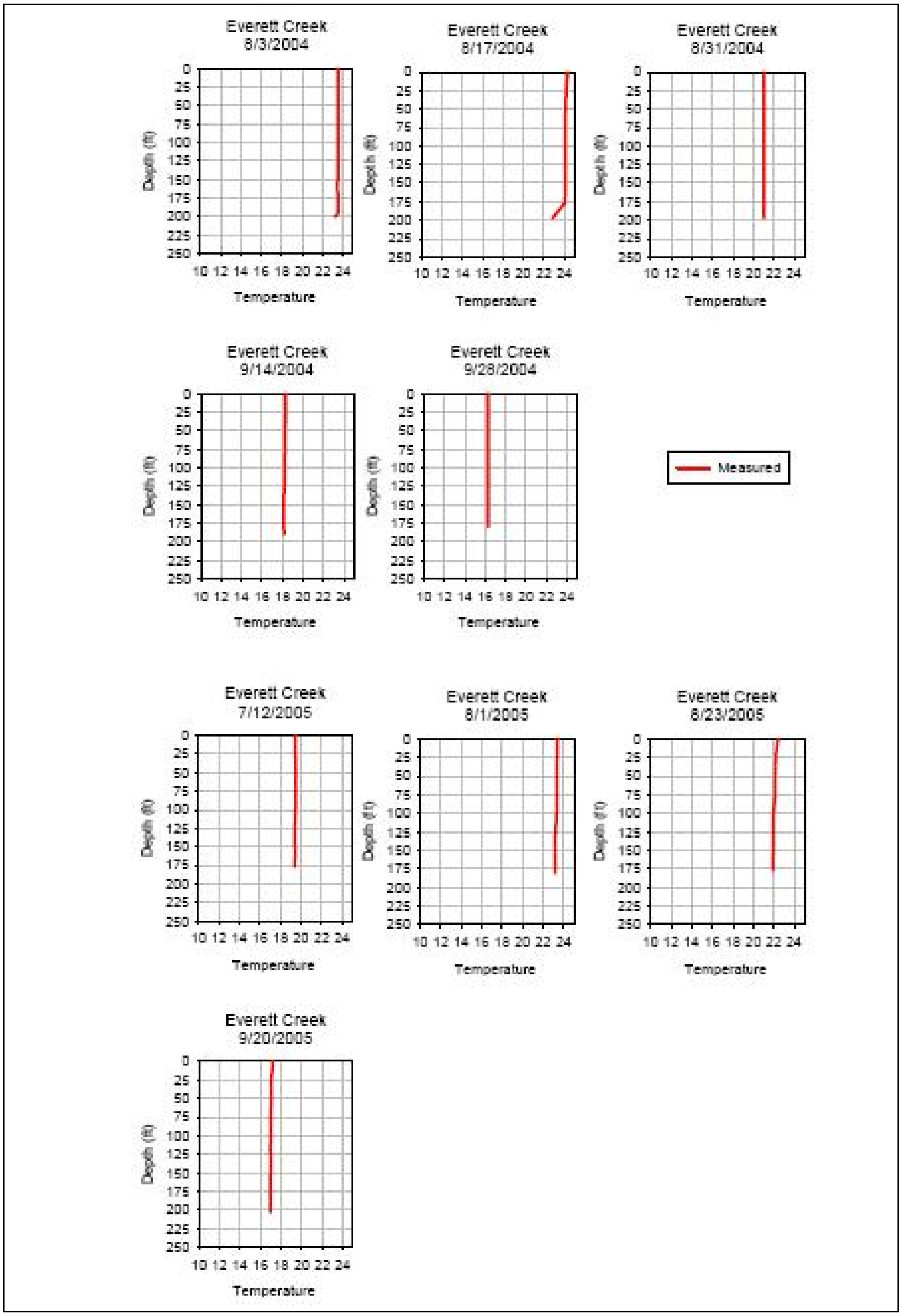

Figure 16. Vertical temperature data at station V4 (Source: Breithaupt and Khangaonkar 2007).

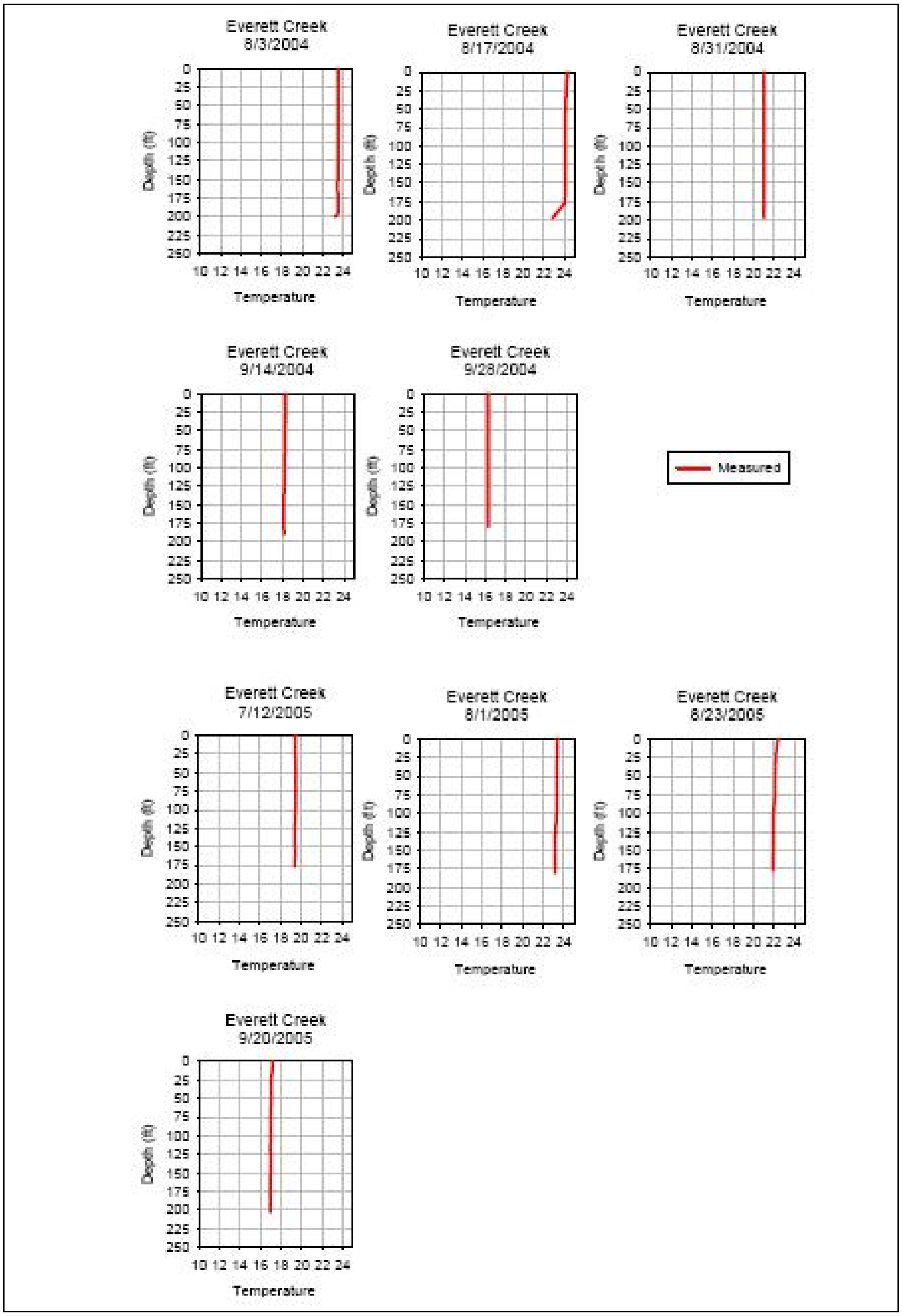

Figure 17. Vertical temperature data at station V5 (Source: Breithaupt and Khangaonkar 2007).

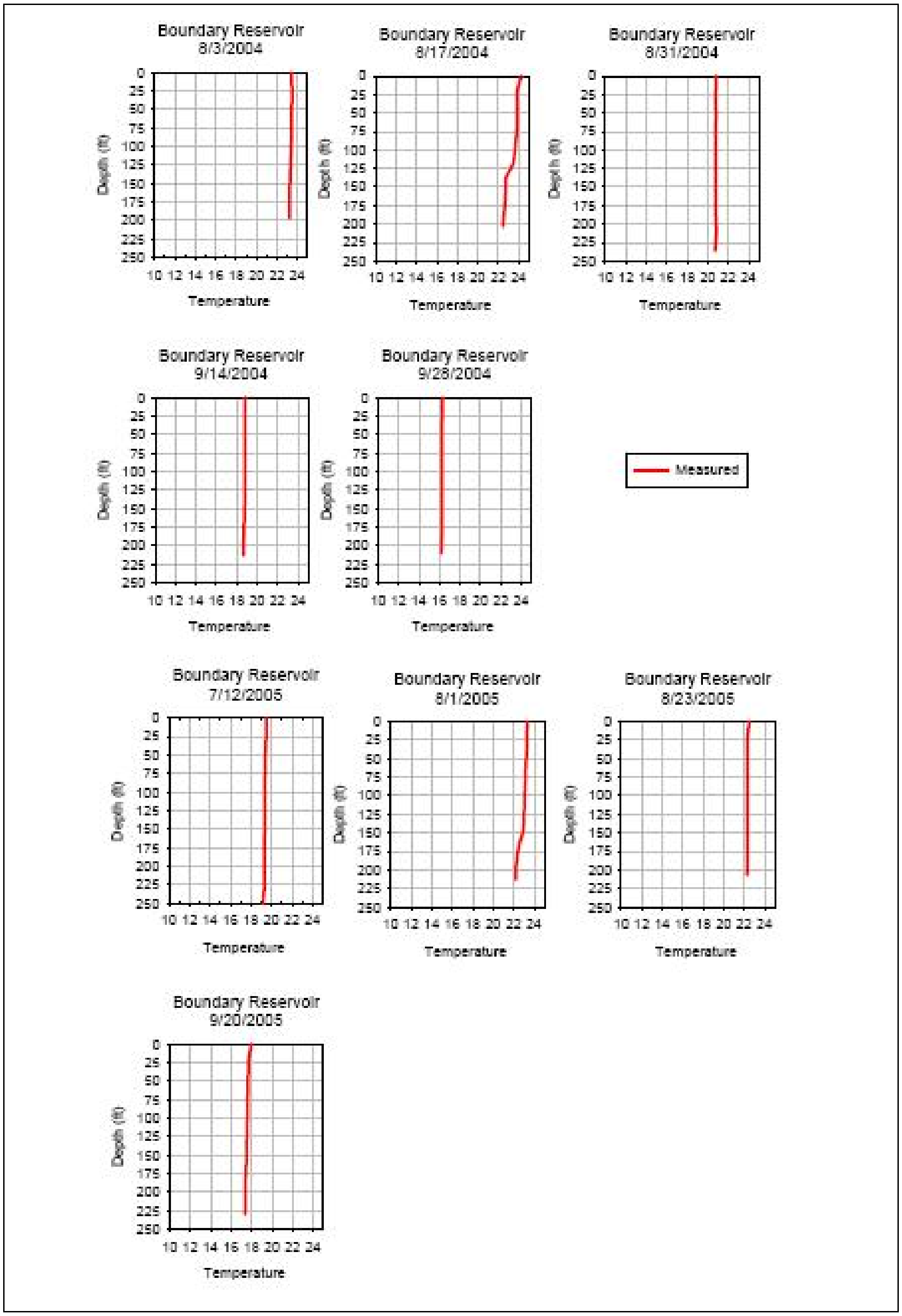

Figure 18. Vertical temperature data at station V6 (Source: Breithaupt and Khangaonkar 2007).

Tributary Temperatures

Continous tributary temperature monitoring in Washington during the study period was conducted by the Kalispell Tribe. Spot temperature monitoring data were also collected by the Pend Oreille Conservation District. Tributaries within National Forest boundaries have been monitored continuously by the USFS, and these tributaries were evaluated as part of the Colville National Forest TMDL (WDOE 2005). Maximum temperatures observed in the tributaries evaluated in this study are shown in Table 1.

Status of Beneficial Uses

Temperature data for the Pend Oreille River in Idaho, Washington, and the Kalispel Reservation indicate that the temperature criteria for the water body are being exceeded and, therefore, beneficial uses of the river are not currently being met.

2.5 Data Gaps

The identification of data gaps helps to provides an estimation of the amount of error involved in the analyses, and helps to provide guidance for future data collection necessary to analyze the condition of the water body over time.

Idaho

An improvement that could be made in data collection includes continuous temperature monitoring in the Pend Oreille River. There are currently little continuous water quality data available in the study area to evaluate diurnal dynamics of temperature (PSU 2006a).

Washington

A limitation to this study is temperature in critical bull trout habitat. The TMDL analysis has focused on a model of river conditions that are averaged across the channel and within the model segments. The model scale and dimensions chosen do not allow for an evaluation of thermal refugia along the banks of the river and mouths of tributaries, and the potential loss of refugia from human activities.

Studies suggest that groundwater inflows may also be locally signficicant, and the location of thermal refugia supported by groundwater inflows and the potential reduction or absence of groundwater inflow from human activities are additional data gaps.

3. Subbasin Assessment–Pollutant Source Inventory

This section summarizes the point and nonpoint sources of pollution in the Pend Oreille River Subbasin.

3.1 Sources of Pollutants of Concern

The primary nonpoint sources of pollution in the Pend Oreille River Subbasin are hydroelectric dams and loss of riparian shade due to forestry, grazing, and industrial and residential development. The loss of riparian shade is mainly an issue on some of the tributaries in Washington, not along the main stem of the Pend Oreille River.

Point sources in the subbasin that have permit limits for temperature, include 8 wastewater treatment plants (WWTPs) or sewage treatment plants (STPs), one paper mill, and one mine. All 10 of these point sources are discussed below.

Point Sources

Idaho

There are three point sources located in the Idaho portion of the Pend Oreille River Subbasin and included in the temperature TMDL (Figure 19). All three are WWTPs and include the City of Sandpoint WWTP, City of Dover WWTP, and City of Priest River WWTP. Table 12 presents information for each of the facilities. Note that during the hot time of year the WWTPs generally discharge water that's cooler than the current ambient conditions (PSU 2006a and 2006b).

Table 12. Point sources discharges in the Idaho portion of the Pend Oreille River Subbasin.

Facility name	NPDES permit number	Average discharge (mgd)
City of Sandpoint WWTP	ID0020842	1.5
City of Dover WWTP	ID0027693	.02
City of Priest River WWTP	ID0020800	.25

Washington

There are three point sources in the Box Canyon portion of the Pend Oreille River Subbasin (Figure 19). Theses facilities include two municipal discharges, the City of Newport WWTP and the City of Ione STP, and one industrial discharge, Ponderay Newsprint Company.

The City of Newport treats wastewater with an oxidation ditch (PSU 2006b). The City of Ione treats its wastewater with an aerated stablization lagoon. Discharge to the river from the lagoons is intermittent, and the lagoons are open to the sun. Ponderay Newsprint is a pulp mill that treats wastewater with an oxidation ditch and clarifier system.

There are four point sources that discharge to the Boundary Reservoir (Figure 19). These include Selkirk High School, Town of Metaline STP, Town of Metaline Falls STP, and the Pend Oreille Mine (Teck Cominco). The flows from the four point sources are very small (less than 1 cfs [0.03 m^3/s]) and are an insignificant portion of the total flow of the Pend Oreille River (<0.1%) (Breithaupt and Khangaonkar 2007).

Table 13 presents information for each of the three facilities in the Box Canyon Reservoir portion of the subbasin and Table 14 presents information for the four facilities in the Boundary Reservoir portion.

Table 13. Point sources discharges in the Box Canyon (Washington) portion of the Pend Oreille River Subbasin.

Facility name	NPDES permit number	Average discharge* (mgd)
City of Newport WWTP	WA0022322	1
City of Ione STP	WA0045373	0.336
Ponderay Newsprint Company	WA0045268	3.744

*Average design flow from EPA's PCS database

Table 14. Average discharges for NPDES facilities in the Boundary Reservoir (Washington) portion of the Pend Oreille River Subbasin.

Facility name	NPDES permit number	Average discharge (cfs)*
Selkirk High School	WA0044938	0.004
Town of Metaline STP	WA0020699	0.042
Town of Metaline Falls STP	WA0021156	0.019
Teck Cominco-Pend Oreille Mine	WA0001317	0.82

*Source: Breithaupt and Khangaonkar (2007)

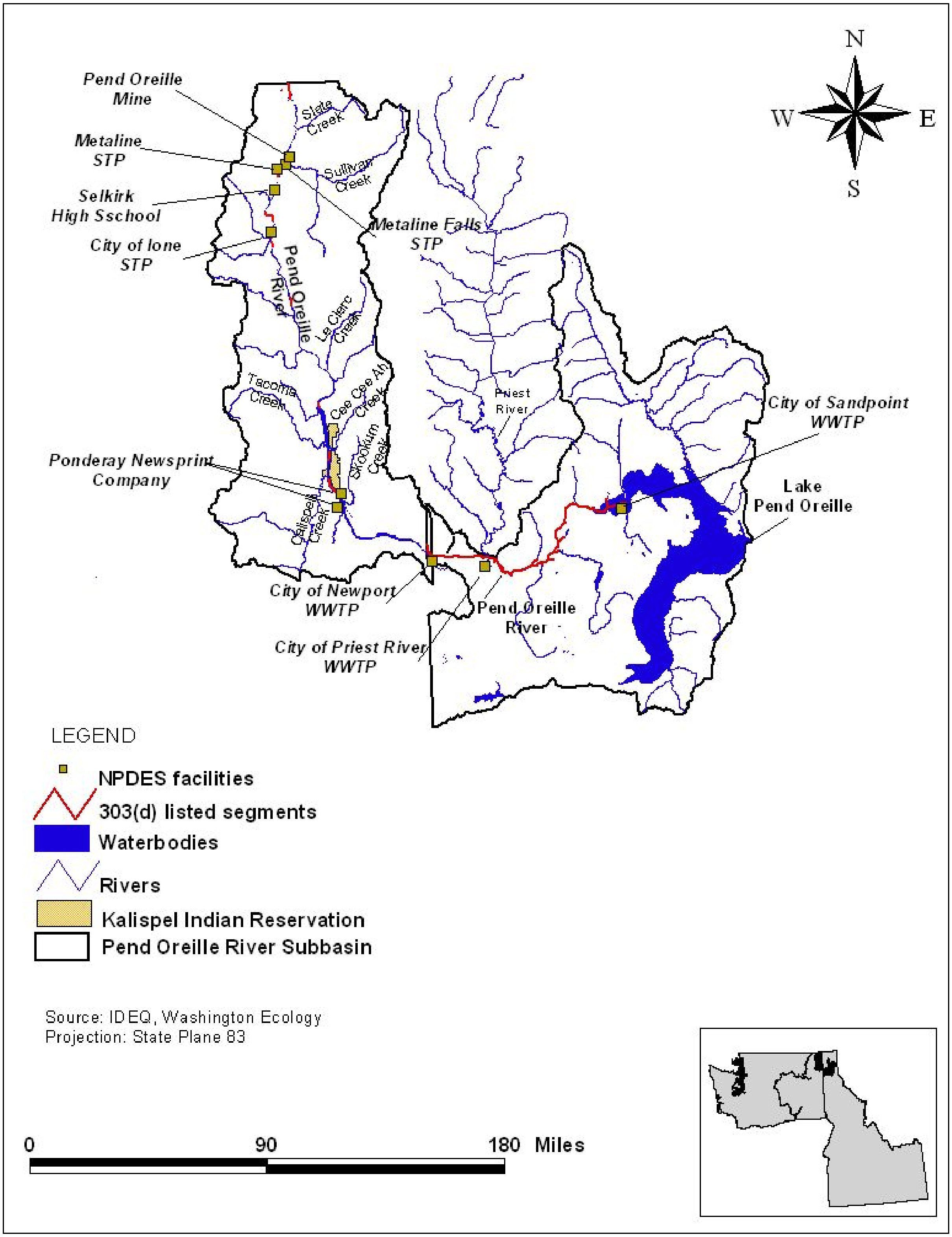

Figure 19. Location of point source in the Pend Oreille River Subbasin

Nonpoint Sources and Dams

As a consequence of channel straightening, dams, diking, and loss of riparian vegetation, water in the Pend Oreille River Subbasin is exposed to heat for longer periods so that water temperatures increase (Entrix, Inc. 2002).

Dams are a form of channel modification that resembles a nonpoint source. However, the Courts have determined the characterization of dams as point sources for which NPDES permits will not be issued for certain parameters. The current policies of the state of Washington and EPA are to not issue NPDES permits for dams other than for sanitary sewage.

Since the construction of dams, changes in water temperature, as well as stream channel characteristics, water quality, and sediment loads in the Pend Oreille River have impacted habitat-forming processes and productivity of key fish stocks (Entrix, Inc. 2002).

Temperature is an important factor in determining abundance and distribution of salmonids and spiny ray fish. Salmonids typically prefer colder water temperatures while spiny ray fish (e.g., largemouth bass) prefer warmer waters. Fish with a wider spectrum of tolerance have a broader range of habitat open to them (Entrix, Inc. 2002).

Dams change the natural flow conditions and temperature regimes (Entrix, Inc. 2002). Water temperatures in the lower Pend Oreille River are generally above 20˚C from May through October. Surface water releases from Albeni Falls Dam frequently exceed Washington's 20˚C temperature criterion from July through September and reduced velocity below Box Canyon Dam inhibits cooling. Therefore, cold-water habitat is scarce in the Pend Oreille River during the summer months.

Loss of Riparian Vegetation

The loss of riparian vegetation in the Pend Oreille River Subbasin is a result of land use practices such as forestry and livestock grazing.

Forest management activities often result in the removal of riparian vegetation, which can reduce the shaded area of a stream, leading to increased water temperatures (Entrix, Inc. 2002; WDOE 2006a). As stream temperature rises, the dissolved oxygen level in the water decreases, which can lead to inhibited growth and disrupted metabolism in cold water fish species such as salmonids. Historic timber harvesting practices and the construction of roads near streams have led to temperature increases in the Pend Oreille River Subbasin (Entrix, Inc. 2002).

In addition to forest roads, increased urbanization along the river and the associated roads can increase water temperature by causing the removal of shading vegetation (Entrix, Inc. 2002).

Improper grazing can also reduce streamside vegetation, thereby resulting in increased water temperature (Entrix, Inc. 2002). This occurs when livestock are allowed access to the streambanks for grazing.

Two impacts of shading may be affecting temperatures in the Pend Oreille River: loss of riparian shade on the mainstem, and loss of shade on tributaries that increase tributary water temperatures. Some of the tributaries have already been addressed by the Colville National

Forest TMDL, but the portions of the major tributaries downstream of the National Forest have been addressed in this TMDL.

3.2 Data Gaps

The identification of data gaps helps to provides an estimation of the amount of error involved in the analyses, and helps to provide guidance for future data collection necessary to analyze the condition of the water body over time.

Point Sources

Temperature and flow monitoring and reporting is currently not required in NPDES permits for all dischargers in Washington. To ensure compliance with allocations, monitoring for these parameters should be included in future permits.

Nonpoint Sources

Shade information for the main stem and tributaries is limited. As implementation of shade restoration is planned and implemented, additional more detailed field shade assessment would be helpful.

Calispell Creek is a unique system that is currently the subject of a separate study. Data gaps for that subwatershed are being addressed through that process. See *Development and Application of the QUAL2Kw Modeling System to Simulate Temperature in Lower Calispell Creek* (Tetra Tech, Inc. 2007) for details.

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

The major sources of pollutants in the Pend Oreille River are hydropower dams, mining, timber harvest, residential development, industrial development and discharge, historical fires, loss of riparian habitat, agriculture, livestock, and roads (IDEQ 2001).

There are many citizens and agencies that have worked together over the years to protect or restore water quality in the Pend Oreille River Subbasin. Some of the groups that have contributed to this effort include:

- Tri-State Water Quality Council
- Alliance for the Wild Rockies
- Public Lands Council
- Trout Unlimited
- Cabinet Resource Group
- Idaho River United
- Pend Oreille River Homeowners Association
- Sewer Districts
- Stream Segments of Concern Local Working Committees
- Pend Oreille Conservation District
- Kalispel Tribe
- U.S. Forest Service

For information on past and ongoing pollution control efforts in the watershed, refer to the Colville National Forest TMDL (Ecology 2005), the Pend Oreille PUD FERC relicensing and 401 certification documentation (Pend Oreille PUD 2000), and the WRIA 62 planning process documents (Entrix, Inc. 2002; Golder Associates 2005a, Golder Associates 2005b, Golder Associates 2006).

5. Total Maximum Daily Loads

A TMDL prescribes an upper limit on discharge of a pollutant from all sources to assure water quality standards are met. The TMDL is defined relative to the loading capacity (LC): the greatest amount of loading that a water body can receive without violating water quality standards. The TMDL allocates this loading capacity among the various sources of the pollutant. Pollutant sources fall into two broad classes: point sources, which receive several individual or an aggregate wasteload allocation (WLA); and nonpoint sources, each of which receives a load allocation (LA). Natural background (NB), when present, is considered part of the LA, but is often broken out on its own because it represents a part of the load not subject to control. Because of uncertainties regarding quantification of loads and the relation of specific loads to attainment of water quality standards, the rules regarding TMDLs (Water quality planning and management, 40 CFR Part 130) require a margin of safety (MOS) be a part of the TMDL.

Practically, the margin of safety is a reduction in the load capacity that is available for allocation to pollutant sources. The natural background load is also effectively a reduction in the load capacity available for allocation to human-made pollutant sources. This is summarized in the following equation:

$$\mathbf{LC = MOS + NB + LA + WLA = TMDL}$$

Here, the loading capacity or TMDL is broken down into its components: the margin of safety and natural background, if quantified, and the allocation among pollutant sources.

An important step in a loading analysis is the quantification of current pollutant loads by source. This allows the specification of load reductions as percentages from current conditions. The load capacity is typically based on critical conditions – the conditions when water quality standards are most likely to be violated. If protective under critical conditions, a TMDL will be more than protective under other conditions.

A load is fundamentally a quantity of a pollutant discharged over some period of time, and is the product of concentration and flow. Due to the diverse nature of various pollutants, and the difficulty of strictly dealing with loads, the federal rules allow for “other appropriate measures” to be used when necessary. These 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. For temperature TMDLs, the ‘concentration’ measure is temperature, while load can be expressed in thermal units such as calories.

Despite the flexibility allowed in the federal rules, a recent court decision in the D.C. Circuit Court of Appeals (Friends of the Earth, Inc. vs. EPA et al., No. 05-5015, 2006) requires that all TMDLs include expressions of the TMDL, WLAs and LAs in terms of daily loads.

5.1 Modeling Tools for the Pend Oreille River TMDL

Water quality models using CE-QUAL-W2 have been developed for three sections of the Pend Oreille River to support TMDL development and allocations for temperature and heat load. The CE-QUAL-W2 model is a two-dimensional, laterally averaged, hydrodynamic water quality model. Basic eutrophication processes are simulated such as temperature-nutrient-algae-dissolved oxygen-organic matter and sediment relationships, although for this TMDL only flow and temperature were simulated. Since the model assumes lateral homogeneity, it is typically suited for relatively long and narrow waterbodies exhibiting longitudinal and vertical water quality gradients. The US Army Corps of Engineers Waterways Experiment Station (WES) Environmental Laboratory developed the original models with recent enhancements by Portland State University and Scott Wells.

The modeling tools cover the following sections of the Pend Oreille River:

1. Idaho Section - Long Bridge at Lake Pend Oreille to the Albeni Falls Dam (The Idaho Model)

The Idaho Model was calibrated to observed data for most of 2004 and 2005 (21 months). The average absolute mean errors (AME) for vertical profile and continuous data were 0.37^{o}C and 0.51^{o}C, respectively. Absolute mean error describes the magnitude of the difference between the model and observed data in the units of the variable. It is considered a measure of model precision (how close are the data to the mean). Mean errors (ME) for the model, a measure of model accuracy or bias (point to point comparisons), were 0.18^{o}C and 0.26^{o}C, for continuous and profile data, respectively.

2. Kalispel Tribe and Washington Section - Albeni Falls Dam to the Box Canyon Dam (The Box Canyon Model)

The Box Canyon model, previously calibrated for 1997 and 1998, was revised and recalibrated to 2004 observed data. The average AME for continuous temperature data for all three years was 0.33^{o}C. Mean error was -0.05^{o}C.

3. Washington Section- Box Canyon Dam to the International Border (The Boundary Model).

The Boundary model was calibrated to observed data for 2004 and 2005. The AME and ME for continuous time series data were 0.28^{o}C and -0.16^{o}C, respectively. These error statistics were slightly lower for maximum daily temperature and vertical profile data. Consultants for Seattle City Light developed the calibrated model and a second scenario for calibrated conditions with Boundary dam removed. Ecology developed the additional TMDL scenarios.

Reports describing model development, calibration, and scenarios are available under the following titles:

- Annear, R., C. Berger, and S. Wells (PSU). 2006a. Idaho Pend Oreille River Model: Model Development and Calibration. Technical Report EWR-02-06, Department of Civil and Environmental Engineering, Portland State University, Portland, OR.
- Annear, R., C. Berger, and S. Wells (PSU). 2006b. Pend Oreille River, Box Canyon Model: Model Development and Calibration. Technical Report EWR-04-06, Department of Civil and Environmental Engineering, Portland State University, Portland, OR.
- Annear, R., C. Berger, and S. Wells (PSU). 2007a. Idaho Pend Oreille River Model: Model Scenario Simulations. Technical Report EWR-01-07. Department of Civil and Environmental Engineering, Portland State University, Portland, OR.

- Annear, R., C. Berger, and S. Wells (PSU). 2007b.Pend Oreille River, Box Canyon Model: Model Scenario Simulations. Technical Report EWR-03-07. Department of Civil and Environmental Engineering, Portland State University, Portland, OR.
- Breithaupt, S.A. and T. Khangaonkar. 2007. Temperature Modeling of the Pend Oreille River, Boundary Hydroelectric Project: CE-QUAL-W2 Model Calibration Report. Prepared for Seattle City Light by Battelle – Pacific Northwest Division, Richland Washington.

5.2 In-stream Water Quality Targets for TMDL

The TMDL and LC are based on the applicable water quality standards associated with the designated beneficial uses of the water body. These standards contain a variety of numeric criteria, which constitute the in-stream targets for the TMDL.

Heat load to the Pend Oreille River resulting from direct solar isolation on the river and its tributaries, the impact of mainstem dams, and direct point source discharges was evaluated through an assessment of measured temperature data with support from modeling analyses. Load and wasteload allocations were based on temperature and associated heat load at specified flows necessary to meet the in-stream targets.

Idaho

All reaches of the Idaho portion of Pend Oreille River are designated for the cold water aquatic life beneficial use in Idaho's Water Quality Standards (IDAPA 58.01.02). Waters designated for cold water aquatic life are not to vary from the following characteristics due to human activities:

- water temperatures of 22^{o}C or
- less with a maximum daily average of no greater than 19^{o}C (IDAPA 16.01.01.250.02.c).

The goal of the temperature TMDLs is to achieve applicable temperature criteria and restore all of the temperature-impaired water bodies (listed or not) to "full support of designated beneficial uses" (Idaho Code 39.3611, 3615). Idaho must also insure that water quality of Pend Oreille River meets the state of Washington standards (discussed below) at the state line since the river flows across the state line into Washington.

Idaho water quality standards also include provisions (IDAPA 58.01.02.200.09 and IDAPA 58.01.02.401.03.a.v) that address circumstances where natural temperature conditions exceed existing criteria, as follows:

> "**Natural Background Conditions as Criteria**. When natural background conditions exceed any applicable water quality criteria set forth in Sections 210, 250, 251, 252, or 253, the applicable water quality criteria shall not apply; instead, there shall be no lowering of water quality from natural background conditions. Provided, however, that temperature may be increased above natural background conditions when allowed under Section 401."

> "If temperature criteria for the designated aquatic life use are exceeded in the receiving waters upstream of the discharge due to natural background conditions, then

Subsections 401.03.a.iii. and 401.03.a.iv. do not apply and instead wastewater must not raise the receiving water temperatures by more than three tenths (0.3) degrees C."

Note: Subsections 401.03.a.iii. and 401.03.a.iv. state the following: "If the water is designated for warm water aquatic life, the induced variation is more than plus two (+2) degrees C. (3-15-02); If the water is designated for cold water aquatic life, seasonal cold water aquatic life, or salmonid spawning, the induced variation is more than plus one (+1) degree C."

Washington and the Kalispel Tribe

Two sets of standards apply in the Pend Oreille River downstream of the Idaho-Washington border, both of which must be met in shared waters: Washington standards for State waters and Kalispel Tribe standards in Tribal waters.

The Washington standards are designed for the protection of salmon spawning, rearing and migration. Site specific criteria for temperature on the mainstem Pend Oreille River are:

- Shall not exceed a 1-day maximum of 20ºC due to human activities; and
- When natural conditions exceed a 1-day maximum of 20ºC, no temperature increase will be allowed which will raise the receiving waters temperature by more than 0.3 ºC; and
- Nor shall such temperature (t) increases, at any time, exceed t=34/(T+9), where T is natural temperature.

The tributaries to the Pend Oreille River must meet different standards depending on the beneficial uses designated for them. The standards are based on 7-day average of the daily maximums:

- Char spawning and rearing: 12ºC
- Core summer salmonid habitat: 16ºC
- Salmon spawning rearing and migration: 17.5ºC
- If natural conditions are greater than the criteria, no increase above 0.3ºC

For Kalispel Tribe waters, the standards for the Pend Oreille River and Calispell Creek are based on protection of adult salmonid migration. The temperature shall not exceed 18°C as a moving 7-day average of the daily maximum temperatures. In addition no single daily maximum temperature shall be greater than 20.5°C. When natural background conditions prevent the attainment of the numeric temperature criteria, human-caused conditions and activities considered cumulatively can increase temperature levels by an additional 0.3°C. For Cee Cee Ah Creek, in addition to the natural conditions clause, temperature shall not exceed 9°C as a moving 7-day average of the daily maximum temperatures and no single daily maximum temperature greater than 13°C.

All natural condition temperatures are based on results of the model runs. The natural scenario includes river simulation without dams or NPDES point sources, with tributary inputs at current quality and at natural temperatures, and with main stem shade conditions based on potential natural vegetation (PNV) and topographic features (Leinenbach 2007a, c, d).

Tributaries were modeled with rTemp, a simple model that predicts a time-series of water temperatures in response to heat fluxes determined by meteorological data, groundwater inflow, and other forcing functions (see http://www.ecy.wa.gov/programs/eap/models.html). Current conditions were calibrated to measured temperatures using shade estimates from stream surveys and GIS canopy coverages (Leinenbach 2007b). Shade was then reduced to PNV levels to develop temperature time series for the natural scenario (Leinenbach 2007e). Load allocations were determined by setting shade to levels that allowed each tributary to meet the standards for that stream.

Design Conditions/Critical Period

The temperature criteria apply to all waters in the states of Idaho and Washington and in Kalispel Tribal waters year around. Although criteria are also exceeded at other times of the year, the critical time period for water temperature has been determined to be May through early June and mid-July through September when air and water temperatures are at their peak, or when the river is most sensitive to temperature increases from human activities, and the maximum exceedances of criteria occur. The TMDL focuses on achieving temperature targets for these months, and in particular focuses on maximum exceedances of the temperature criteria. If the temperature standards are attained during these months, particularly during the dates of maximum impairment, it is expected that temperature criteria will be met throughout the rest of the year.

Guidance from EPA indicates that it is appropriate for temperature criteria to focus on the summer maximum conditions to protect the coldwater beneficial uses that occur then (USEPA 2003). Generally, improving river conditions to reduce summer maximum temperatures will also reduce temperatures throughout the summer and in the late spring and early fall (i.e., shift the seasonal temperature profile downward).

Experience with modeling temperature in impoundments has shown that median flow and air temperature conditions may be critical, because they may be more sensitive to increases in temperature from human activities. The years with lowest flows and highest air temperatures may also be critical, although natural conditions may also be warm under these climatic and hydrologic conditions. The years 2003 and 2004 were evaluated for their relationship to critical conditions, and it was determined that 2003 represented a low flow, high temperature year, and 2004 represented and median conditions year. Therefore the development of a synthetic critical conditions scenarios is unnecessary for this TMDL.

Compliance Monitoring Points

Idaho

In the Idaho portion of the Pend Oreille River, IDEQ has selected 13 compliance areas to evaluate whether the temperature criteria are being met. These specific points include water temperature at the surface, bottom, and volume weighted portions of pools at 10 km and 35 km downstream of Railroad Bridge. The 10 km and 35 km pools were selected because they are relatively deep and are expected to be representative of the first and last third of the river, respectively. Daily maximum and daily average temperatures are evaluated for each.

Additional compliance areas, based on continuous data, were selected and include 1) the outflow from Albeni Falls Dam, 2) surface and volume-weighted longitudinal profiles, and 3) a longitudinal cross-section of the river. For the longitudinal evaluations, extreme weather days of August 8 and 16, 2004 were chosen. August 16th was one of the hottest days of 2004 and August 8th represented a hot part of the year with maximum hypolimnetic entrainment from Lake Pend Oreille.

Based on an evaluation of compliance using the existing condition model results, IDEQ has established three water quality targets or compliance points that should be considered when developing allocations. These targets have been prioritized for the development of implementation actions. The targets were selected by IDEQ based on water temperature exceeding Idaho numeric criteria and estimated natural conditions.

The first implementation priority is the “Idaho Cross Section” target. It represents a cross section of the Pend Oreille River on a day of the year (August 8) when maximum entrainment of Pend Oreille Lake’s hypolimnion is occurring. This target is based on the findings at compliance area 13 (Table 8), and is directly related to beneficial use impairment.

The second implementation priority is the “Idaho Bottom 35 km” target, representing a point of maximum increase in bottom water temperatures. This target is second priority because IDEQ has less confidence in the absolute reduction amount needed and a clear link to beneficial use protection is missing.

The third implementation priority is the “Washington State Line” target. This target is third priority because it is based on meeting numeric criteria rather than the attainment of beneficial uses. IDEQ is expected to meet Washington water quality standards at the Idaho/Washington border. This target has been developed by the WDOE, and is based on Washington water quality standards.

Washington and Kalispel Tribe

The mainstem Pend Oreille River from the Washington state line to the International Boundary has been divided into four compliance sections:

1. Box Canyon Reservoir – Waters of Washington State from the Idaho state line to the Kalispel Reservation, and downstream from the Kalispel Reservation to Box Canyon Dam,
2. Kalispel Reservation – Shared Tribal and State waters described by model segments 116 through 171 (RM 72.1 to 63.7),
3. Boundary Reservoir – Below Box Canyon dam to the Boundary Reservoir Dam
4. Below Boundary Dam – Boundary Dam to the international border

5.3 Loading Capacity

Loading capacity is the amount of heat a water body can receive and still meet water quality standards. The heat loading capacity must ensure that standards are met regardless of seasonal variation and foreseeable increases in future loads. In this TMDL, loading capacity is expressed as a head load in kilocalories per day (kcal/day).

The heat load needed to achieve the temperature criteria during the critical time of the year is used as the loading capacity for all water bodies. The heat loading, in kcal/day, needed to achieve temperature criteria in each water body can be derived as follows:

$$HL = Q \times \frac{28.3169 L}{ft3} \times \frac{1kg}{1L} \times \frac{86{,}400 \sec}{day} \times \frac{1kcal}{kg / 1^{o} C} \times T = \frac{kcal}{day} \quad (1)$$

Where

HL = Heat Load (kcal/d)

Q = Discharge (cfs)

T = Temperature (^{o}C)

* A kilocalorie (kcal) is the energy needed to increase the temperature of 1 kg (or 1 L) of water by 1^{o}C.

Idaho

For the state of Idaho, the loading capacity can be calculated using Equation 1 above based on both maximum temperature (22^{o}C) and daily average (19^{o}C) for any point (and associated flow) along the Pend Oreille River in Idaho (Table 15) except when the natural temperature is above these levels. In this case, the natural temperature plus 0.3 ^{o}C is used in the equation.

Table 15. Summary comparisons of modeling results to Idaho water quality standards.

No.	Compliance area	Temperature evaluation classification	Reference figure [1]	Numeric criterion[2]	Status
1	10 km downstream of the Railroad Bridge – Surface	Average	Figure 2	19ºC	Meets Standards
2	10 km downstream of the Railroad Bridge - Bottom	Average	Figure 4	19ºC	Meets Standards
3	10 km downstream of the Railroad Bridge – Volume-Weighted	Average	Figure 5	19ºC	Meets Standards
4	35 km downstream of the Railroad Bridge - Surface	Average	Figure 6	19ºC	Meets Standards
5	35 km downstream of the Railroad Bridge - Bottom	Average	Figure 7	19ºC	*Does Not Meet Standards*
6	35 km downstream of the Railroad Bridge – Volume-Weighted	Average	Figure 8	19ºC	Meets Standards
7	Albeni Falls Dam Outflow	Continuous	Figure 9	22ºC	Meets Standards
8	10 km downstream of the Railroad Bridge - Surface	Maximum	Figures 10 and 11	22ºC	Meets Standards
9	35 km downstream of the Railroad Bridge - Surface	Maximum	Figures 12 and 13	22ºC	Meets Standards
10	Longitudinal - Surface	Continuous	Figure 14	22ºC	Meets Standards
11	Longitudinal –Volume-Weighted	Continuous	Figure 15	22ºC	Meets Standards
12	Pend Oreille Cross Section (Aug 16)	Continuous	Figures 16 and 18	22ºC	Meets Standards
13	Pend Oreille Cross Section (Aug 8)	Continuous	Figures 19 and 21	22ºC	*Does Not Meet Standards*

[1]References figures in Annear et al. 2007a.

[2] Once temperature has exceeded numeric criterion, the compliance area is compared to natural temperatures according to Water Quality Standards, Natural Conditions Statement (IDAPA 58.01.02.053.05)".

Washington

Figure 20 presents the loading capacity (in temperature units) for the State of Washington and Kalispel Tribe for the Pend Oreille between Albeni Falls Dam and Box Canyon Dam. The plots show the difference between existing and natural conditions compared to the increase allowed by applicable standards. The dates selected are those where the maximum exeedences of the criteria were observed for the state of Washington waters (August 24, 2004) and Kalispel Tribe waters (May 7, 2004). For the section of the Pend Oreille River below Box Canyon Dam to the International Border, the loading capacity is presented in Figure 21 for the date of maximum impairment (August 24, 2004). The heat loading capacity of the Pend Oreille River in kilocalories can be calculated with Equation 1 using the flow on the associated date at each segment of the river. Load capacity for Pend Oreille tributaries are provided as percent shade in Table 16.

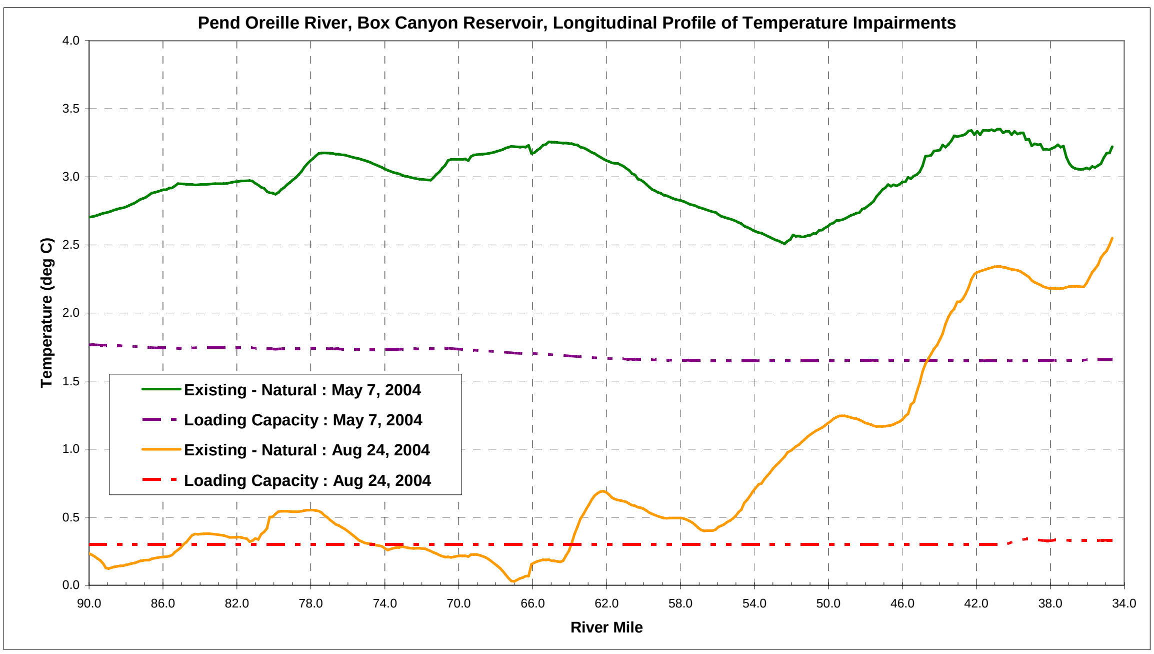

Figure 20. Longitudinal profile of temperature impairments above the Box Canyon Reservoir on May 7 and August 24, 2004.

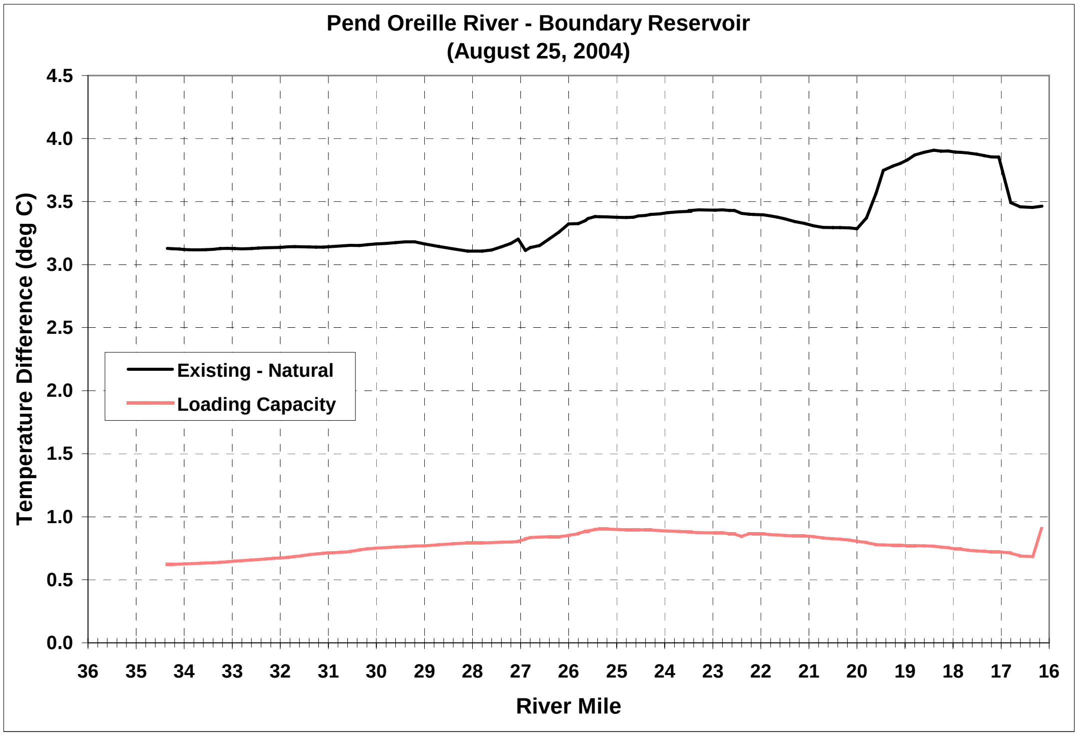

Figure 21. Longitudinal profile of temperature impairments above Boundary Reservoir dam on August 25, 2004.

Table 16. Load capacity as percent shade for impaired tributaries to the Pend Oreille River.

Water Body	Existing Effective Shade (%)	Load Capacity (Site Potential Effective Shade in %)
Indian Creek	85	91
Skookum Creek	90	94
NF Skookum Creek	80	97
Calispell Creek below Smalle Ck[1]	0	81
Cee Cee Ah Creek[1]	70	96
Tacoma Creek	70	87
Cusick Creek	53	96
Mill Creek	85	96
Middle Creek	85	97
Leclerc Creek	35	78
E Br LeClerc Creek (lower)	35	91
E Br LeClerc Creek (upper)	65	90
Ruby Creek	60	89
SF Lost Creek	70	94
Lost Creek	30	71
Little Muddy Creek	60	93
Big Muddy Creek	75	93
Cedar Creek	51	79
Sullivan Creek	25	64
Slate Creek	78	78
Lime Creek	88	97
Flume Creek	85	85

[1]Shared waters of Kalispel Tribe and State of Washington. All other tributaries are State only.

5.4 Estimates of Existing Pollutant Loads

Idaho

Modeling results for 2004 represent a typical above normal temperature year and are used to evaluate existing loads. An estimate of existing heat load can be calculated at each modeled segment of the river by multiplying the streamflow up to that segment by the temperature using Equation 1.

Figure 22 shows the daily maximum temperature 10 km downstream from the Long Bridge for the natural conditions scenario and existing conditions (Annear et al. 2007a). Natural conditions are simulations of current conditions with: Albeni Falls Dam removed, wastewater discharges eliminated, tributary stream temperatures at cool background conditions (below temperature criteria), and Pend Oreille River bank shading density at 50 percent. Fifty percent shade density was chosen in order to be consistent; a sensitivity analysis was performed that demonstrated that Pend Oreille River bank shade density had no cumulative effect on Pend Oreille River water temperatures.

Based on a comparison of the existing and natural condition model scenarios, existing temperatures exceed the natural criterion at all three Idaho compliance areas discussed in Section 5.2. At the “Idaho Cross Section” target area, since natural conditions are higher than 22ºC, the loading capacity is 0.3ºC above natural temperature. The “Idaho cross section” target requires water temperatures to be between 0.1ºC and 0.4ºC cooler than current conditions in the reach between 27 km and 39 km.

The second compliance area is the "Idaho Bottom 35 km" target. The temperature criterion of 19 ºC is exceeded from late June to early September (~ June 27 to September 6), with existing conditions exceeding the natural temperatures during most of the period. To meet the natural criterion, water temperatures at the "Idaho bottom 35 km" target area should be between 0.1ºC and 1.5ºC cooler than current conditions.

The third implementation priority is the "Washington State Line" target. The "Washington State Line" target is based on a 1.49ºC reduction in temperature on May 1 at the state line. This target is based on the portion of Washington's standard that states: nor shall such temperature (t) increases, at *any time*, exceed t=34/(T+9), where T is natural temperature.

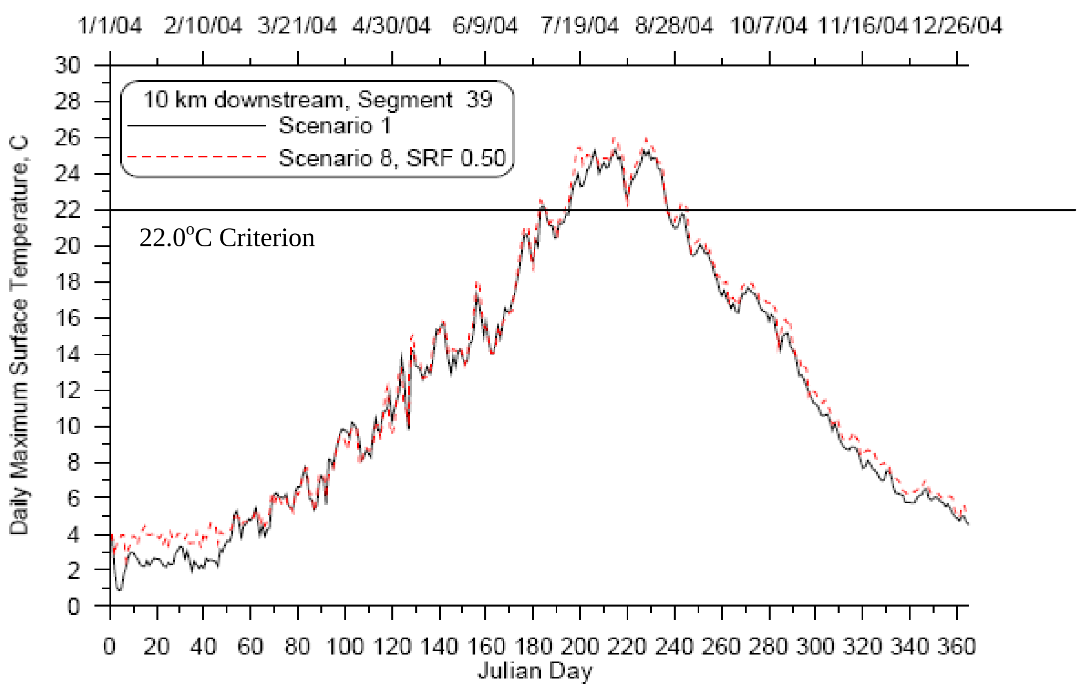

Figure 22. Daily maximum surface temperature time series at 10 km downstream from Lake Pend Oreille for the Natural Conditions (8) and Existing Conditions (1) Scenarios, 2004. Figure from Annear *et al*., 2007a.

The existing loads at each of these compliance areas on the date of maximum impairment is calculated with Equation 1 and summarized in Table 17.

Table 17. Summary of Idaho water quality impairments and existing heat loads.

Target	Implementation priority	Location of affected area	Date of maximum impairment [1]	Existing temperature (°C)	Stream flow (cfs)	Existing heat load (kcal/day)
Idaho cross section	1	Idaho portion of Pend Oreille River	August 8, 2004	23.4	11,600[2]	6.641E+11
Idaho bottom 35 km	2	35 km downstream from railroad bridge	August 1, 2004	22.5	12,160[3]	6.694E+11
Washington state line	3	Idaho and Washington state line	May 1, 2004	13.09[4]	20,000[2]	6.410E+11

[1] Based on difference between natural temperature plus 0.3 degree and existing.
[2] Stream flow at Newport (USGS data).
[3] Assumed to be 95% of the Newport drainage area.
[4] Based on Box Canyon model, segment 15 (97.3% of the impairment is due to upstream sources)

Washington and Kalispel Tribe

Figures 23 and 24 show existing conditions for segments of the Pend Oreille River near Tiger and above Boundary Dam. Existing conditions are plotted as the existing temperature minus the natural background temperature and compared with the loading capacity within that segment. For the Box Canyon model, the graph indicates that existing conditions are higher than loading capacity during portions of spring and summer in 2004 and during late summer, early fall of 2005. At Boundary Dam, existing conditions are elevated above loading capacity from late spring to early fall for 2004, with fewer exceedances during 2005. The existing heat loads, based on dates of maximum impairment for sections of the Pend Oreille River, were calculated using Equation 1 and are provided in Table 18. Existing capacity, presented as effective shade, for tributaries to the Pend Oreille River is shown in 16.

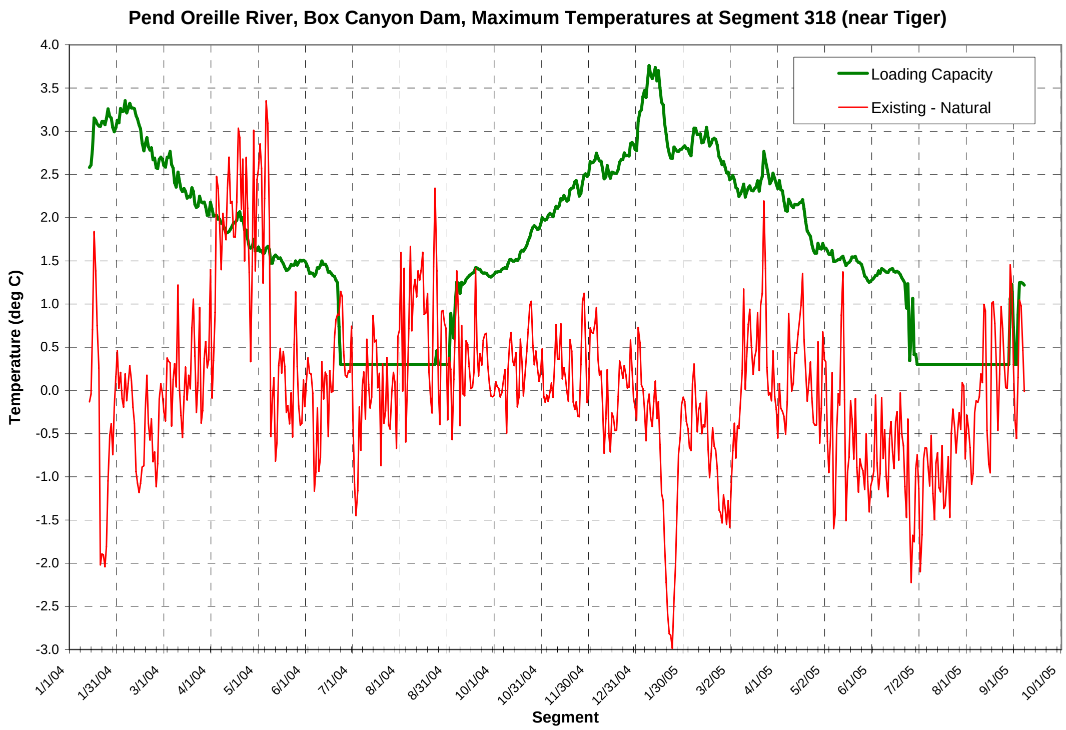

Figure 23. Temperature above natural and loading capacity above Box Canyon Dam at Segment 318 for 2004.

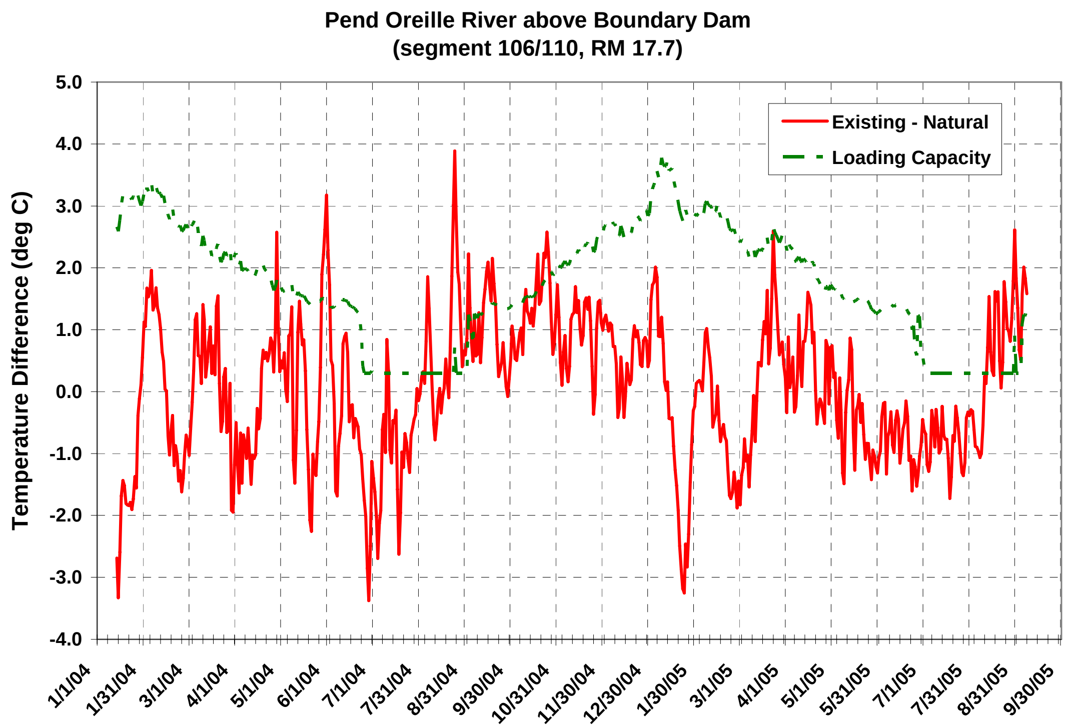

Figure 24. Time series of existing temperature above natural compared to the loading capacity above Boundary Dam at model segments 10 for 2004.

Table18. Existing heat load for the Pend Oreille River in Washington and Kalispel waters on dates of maximum impairment.

Segment	Date of maximum impairment	Existing temperature (ºC)	Stream flow (cfs)	Existing heat load (kcal/day)
Box Canyon Reservoir	8/24/04	22.22	12,234[1]	6.651E+11
Kalispel Reservation	5/7/04	14.41	31,200[2]	1.100E+12
Boundary Reservoir	8/25/04	23.15	18,811[3]	1.065E+12
Below Boundary Dam	8/25/04	22.78	18.811[3]	1.048E+12

[1]Based on outflow from Box Canyon Reservoir; [2]Based on flow at Newport; [3]Based on flow from Boundary Reservoir

5.5 Allocations

Allowable heat loads to the Pend Oreille River must be allocated to sources that contribute to temperature impairment. Nonpoint sources such as the main stem dams, main stem vegetation, and tributaries are given load allocations in contrast to waste load allocations assigned to direct, point source discharges. The load and wasteload allocations needed to meet the applicable water quality standards will be based on the temperature and associated heat load at specified flows necessary to meet the in-stream targets.

Both load and wasteload allocations are given in units, kcal/day. In addition, shade allocations are provided for individual tributaries as part of this TMDL. For nonpoint sources, the allocations for each source are presented for the date of maximum temperature impairment for each applicable compliance area in the river.

An important premise of this allocation procedure is that the allocations and associated targets for the specific compliance areas on the days of greatest impairment correspond to heat load reductions necessary to also meet targets during other times of the year and under different flow conditions. Daily loads on other days of the year can be calculated with Equation 1 in Section 5.3 using the associated streamflow for location of interest.

Idaho

Load Allocations

The nine tributaries that discharge directly into Pend Oreille River within Idaho (Hornsby Creek, Carr Creek, Alder Creek, Priest River, Strong Creek and four small unnamed tributaries) at current discharge amounts and current temperatures have no significant, cumulative effect on the Pend Oreille River temperatures, as modeled (see Figures 33 through 43 in Annear et al. 2007a). Likewise, a sensitivity analysis of bank shading along the Pend Oreille River demonstrated that bank shade has no significant effect on Pend Oreille River temperatures (see Figure 56 in Annear et al. 2007a). Therefore, IDEQ has chosen not to assign load reductions to these sources.

The vast majority of differences in temperatures, from natural conditions to existing conditions, in the Idaho portion of the Pend Oreille River can be accounted for due to the operation of Albeni Falls Dam (see Figures 44 through 55 in Annear et al. 2007a). Accordingly, Table 14 provides the load allocation for Albeni Falls Dam.

The existing and allowable temperatures for the Idaho Cross Section target in Table 19 is derived from model scenario simulations using the Idaho Pend Oreille River model (Annear et al. 2007a). Data for the Idaho Cross Section were taken from Figures 19, 20, and 59 in the referenced document.

Since the Idaho Cross Section represents the primary implementation priority for the Pend Oreille River in the state of Idaho, a load allocation has been developed for this compliance target. The allocation will be implemented along with continued temperature monitoring to determine whether further controls are needed to meet the temperature criteria at other compliance areas (e.g., Idaho Bottom 35 km and Washington State Line). The approaches designed to implement this load allocation and meet heat load allocations in the Washington and Kalispel portions of the Pend Oreille River will be addressed in the implementation plan for this TMDL.

Table 19. Load allocation for Albeni Falls Dam.

Target	Existing Temperature (ºC)	Date of Maximum Temperature Impairment	Allowable Temperature (ºC) 1	Existing Heat Load (kcal/day)	Allowable Heat Load (kcal/day)	Reduction Required
Idaho Cross Section	23.4	August 8, 2004	22.3	6.641E+11	6.329E+11	4.7%

[1] Equal to natural temperature plus allowable increase.

Waste Load Allocations

At current capacities and current effluent temperatures, the three wastewater treatment facilities on the Idaho portion of the Pend Oreille River do not have a significant effect on in-stream temperature. The permitted design flow and temperature limits for the three facilities are presented in Table 20.

Table 20. Permit limits for NPDES discharges to the Idaho portion of Pend Oreille River.

NPDES facility	Maximum allowable discharge temperature	Discharge volume (permitted design flow)
City of Sandpoint WWTP	20.0 ºC	3.0 MGD
City of Dover WWTP	20.0 ºC	0.5 MGD
City of Priest River WWTP	20.0 ºC	0.25 MGD

Wasteload allocations have been developed to memorialize appropriate operating conditions and to plan for future growth. The allocations (Table 21) are based on monthly average temperatures (Table 22) for each point source multiplied by the current permitted flow. Future growth is planned for by allocating a reserve capacity, an increase in discharge volume by approximately 7 percent. Future growth must meet or exceed targets set by current permitted sources performance. The heat load is calculated with the formula below:

$$HL = Q \times \frac{3.7854L}{gal} \times \frac{1kg}{1L} \times \frac{1kcal}{kg/1oC} \times T = \frac{kcal}{day} \qquad (2)$$

Where

HL = Heat Load (kcal/d)

Q = Discharge (gallons per day)

T = Temperature (^oC)

Table 21. Heat load allocations for each NPDES permitted source by month (millon kcal/day).

Facility	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
City of Sandpoint WWTP	102.2	90.8	102.2	113.6	159.0	181.7	215.8	227.1	204.4	181.7	147.6	113.6
City of Dover WWTP	18.9	18.9	18.9	22.7	26.5	32.2	37.9	37.9	34.1	30.3	26.5	22.7
City of Priest River WWTP	8.5	9.5	10.4	11.4	14.2	16.1	18.9	18.9	18.0	15.1	13.2	11.4
Reserve for Future Growth	9.2	8.2	9.2	10.2	14.3	16.4	19.4	20.4	18.4	16.4	13.3	10.2

Table 22. Target temperatures for each NPDES permitted source by month (^oC).

Facility	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
City of Sandpoint WWTP	9.0	8.0	9.0	10.0	14.0	16.0	19.0	20.0	18.0	16.0	13.0	10.0
City of Dover WWTP	10.0	10.0	10.0	12.0	14.0	17.0	20.0	20.0	18.0	16.0	14.0	12.0
City of Priest River WWTP	9.0	10.0	11.0	12.0	15.0	17.0	20.0	20.0	19.0	16.0	14.0	12.0
Reserve for future growth	9.0	8.0	9.0	10.0	14.0	16.0	19.0	20.0	18.0	16.0	13.0	10.0

IDEQ will allocate the reserve heat load to applicants for NPDES permits on a first come-first serve basis. IDEQ will track the status of the reserve load, and ensure that no more than what is identified in the TMDL has been allocated in NPDES permits.

Washington and Kalispel Tribe

The existing and allowable loads for each of the identified compliance areas along the Pend Oreille River have been calculated based on the day of maximum temperature impairment. The daily maximum is determined from the model results within each of the compliance sections of the river. Daily maximum is based on the maximum temperature per segment over the water column and the maximum temperature per day. The allowable temperature is based on the water quality targets (see Section 5.2) applicable to the specific compliance areas that have been identified. These results are provided in Table 23.

Since the heat load depends on stream flow, the allowable load for any day of the year can be determined by using the allowable temperature and the stream flow for that day, along with Equation 1. The targets below are set based on maximum impairment with the assumption that measures to reduce temperature at these times of the year will result in the river meeting standards during non-critical times as well.

Table 23. Existing and allowable heat loads for Pend Oreille River in Washington on the maximum dates of impairment.

Compliance Area	Date of Maximum Temperature Impairment	Location of Maximum Impairment	Existing Temperature (ºC)	Existing Heat Load (kcal/day)	Allowable Temperature (ºC)	Allowable Heat Load (kcal/day)	Reduction Needed
Box Canyon Reservoir	8/24/04	River Mile 34.6	22.22	6.651E+11	20.00	5.986E+11	10.0%
Kalispel Reservation	5/7/04	River Mile 64.2	14.41	1.100E+12	12.85	9.809E+11	10.8%
Boundary Reservoir	8/25/04	River Mile 17.7	23.15	1.065E+12	19.97	9.191E+11	13.7%
Below Boundary Dam	8/25/04	River Mile 16.8	22.78	1.048E+12	19.99	9.200E+11	12.2%

[1] Based on outflow from Box Canyon Reservoir (12,234 cfs)
[2] Based on flow at Newport (31,200 cfs)
[3] Based on flow from Boundary Reservoir (18,811 cfs)

Load Allocations

The modeling tools were used to run scenarios that can be used to understand the contributions of various sources including mainstem dams, tributary loading, the effect of mainstem riparian vegetation, and NPDES point sources. The relative contribution of sources to temperature impairment in the Pend Oreille River is demonstrated in Figures 25 and 26. During 2004, above the Box Canyon Dam, the dam and “upstream conditions” are the predominant source of the impairments, which occur mostly in May through August. The primary source of “upstream conditions” is the Albeni Falls Dam. Mainstem vegetation, tributaries, and point sources contribute to impairments by small amounts. The pattern is similar above the Boundary Dam (Figure 26).

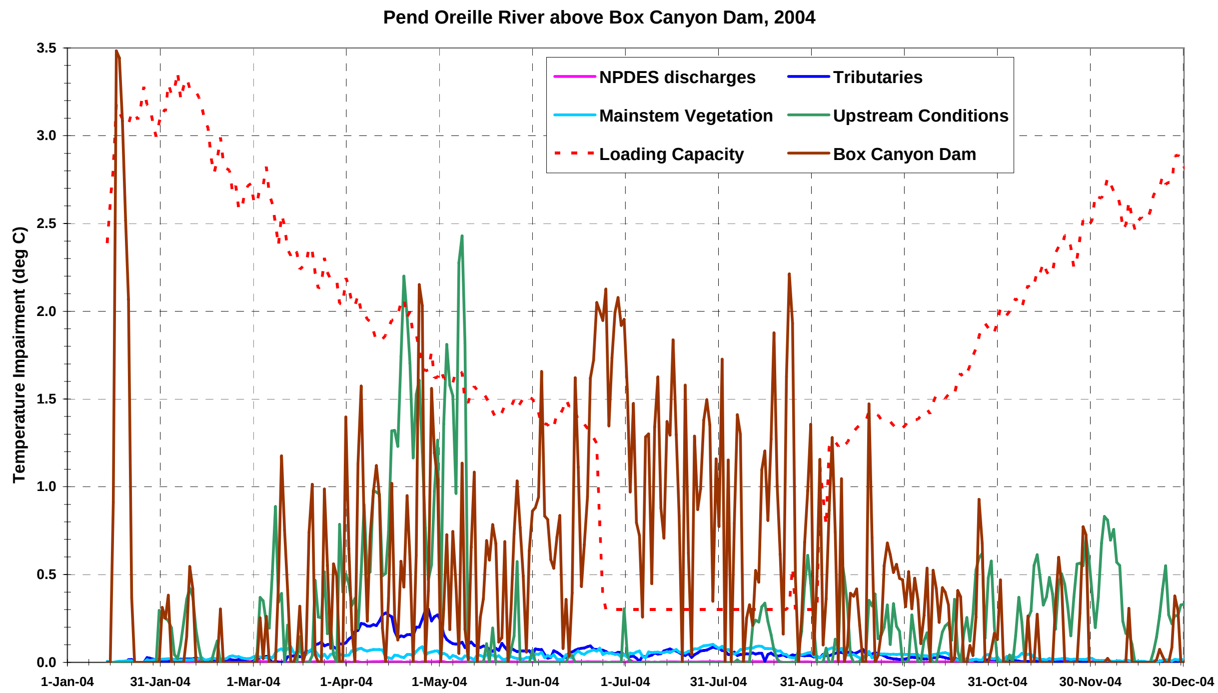

Figure 25. Influence of individual sources on temperature above Box Canyon Dam (2004).

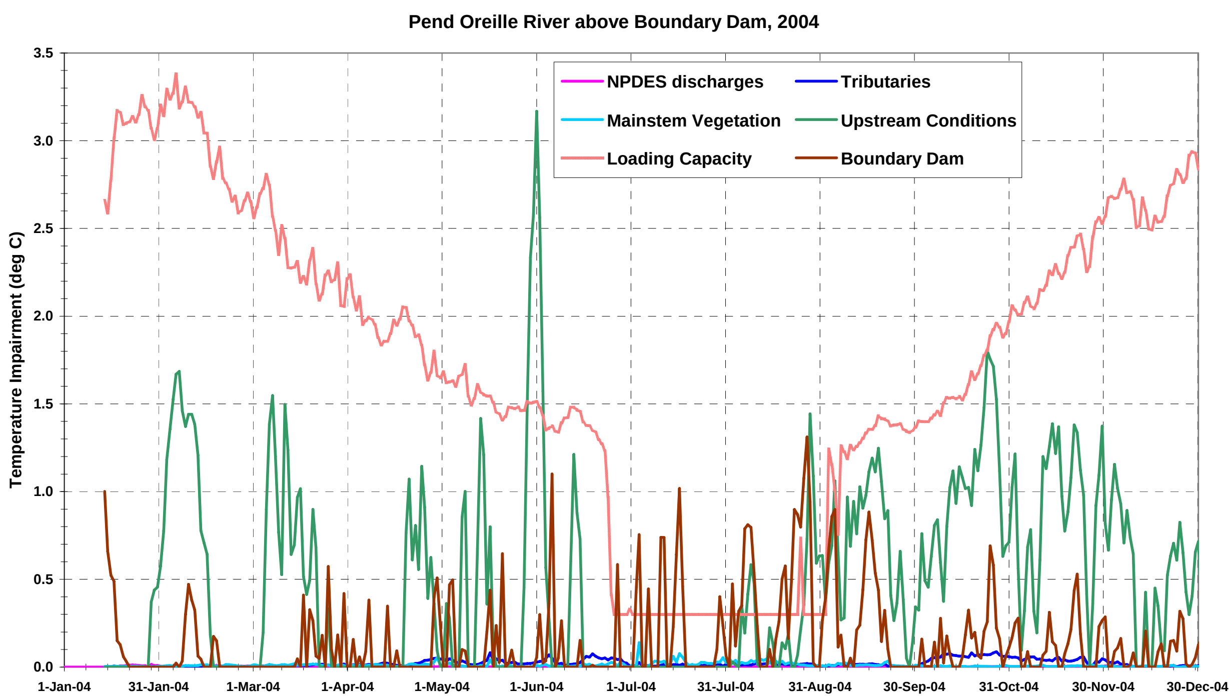

Figure 26. Influence of individual sources on temperature above Boundary Dam (2004).

The next step in the TMDL development process is to allocate loads to the various sources contributing to the temperature balance within the Pend Oreille River. The allocations for mainstem riparian vegetation and tributary loading are presented in terms of shade requirements and heat load. Heat load allocations are also provided for the mainstem dams, point sources, and upstream sources.

For the maximum days of impairment within the four compliance areas,each source can be determined (Table 24) based on the results of the modeling scenarios. The mainstem dams, including their contribution to upstream sources, are the largest contributor to heat loading and temperature impairment for all four compliance areas (Table 25). Existing (Table 25) and allowable (Table 26) heat loads have been calculated along with the respective reductions needed to meet in-stream water quality targets (Table 27). Point sources contribute an insignificant amount to temperature impairment and heat loading; therefore WLAs are kept at existing loads.

Table 24. Source contribution to temperatures above the criteria for days of maximum impairment.

	Box Canyon Reservoir	Kalispel Reservation	Boundary Reservoir	Below Boundary Dam
Date of maximum existing	8/24/04	5/7/04	8/25/04	8/25/04
River mile location of maximum (model segment)	34.6 (358)	64.2 (168)	17.7 (106)	16.8 (113)
NPDES	0%	0%	0%	0%
Tributaries	1%	17%	2%	1%
Mainstem vegetation	1%	1%	1%	1%
Dam[1]	97%	65%	77%	20%
Upstream sources[2]	0%	17%	20%	78%

[1] Box Canyon Dam for Box Canyon Reservoir and Kalispel Reservation; Boundary Dam for Boundary Reservoir and Below Boundary Dam

[2] The predominant upstream source is the Albeni Falls Dam for the Box Canyon model segments and the Box Canyon Dam for Boundary model segments.

Table 25. Existing heat loads (kcal/day) by nonpoint sources for Pend Oreille River in Washington.

	Box Canyon Reservoir	Kalispel Reservation	Boundary Reservoir	Below Boundary Dam
Date of maximum existing	8/24/04	5/7/04	8/28/04	8/28/04
River mile location of maximum (model segment)	34.6 (358)	64.2 (168)	17.7 (106)	16.8 (113)
Tributaries	6.65E+09	1.87E+11	2.13E+10	1.05E+10
Mainstem vegetation	6.65E+09	1.10E+10	1.07E+10	1.05E+10
Dam	6.45E+11	7.15E+11	8.20E+11	2.10E+11
Upstream sources	0.00E+00	1.87E+11	2.13E+11	8.17E+11

Table 26. Allowable heat loads (kcal/day) by nonpoint sources for Pend Oreille River in Washington.

	Box Canyon Reservoir	Kalispel Reservation	Boundary Reservoir	Below Boundary Dam
Date of Maximum Existing:	8/24/04	5/7/04	8/28/04	8/28/04
River Mile Location of Maximum (Model Segment)	34.6 (358)	64.2 (168)	17.7 (106)	16.8 (113)
Tributaries	5.99E+09	1.67E+11	1.84E+10	9.20E+09
Mainstem Vegetation	5.99E+09	9.81E+09	9.19E+09	9.20E+09
Dam	5.81E+11	6.38E+11	7.08E+11	1.84E+11
Upstream Sources	0.00E+00	1.67E+11	1.84E+11	7.18E+11

Table 27. Load allocations as heat load reductions needed to meet the temperature criteria for the State of Washington and Kalispel Tribe.

	Box Canyon Reservoir	Kalispel Reservation	Boundary Reservoir	Below Boundary Dam
Date of maximum existing:	8/24/04	5/7/04	8/28/04	8/28/04
River mile location of maximum (model segment)	34.6 (358)	64.2 (168)	17.7 (106)	16.8 (113)
Tributaries	10%	11%	14%	12%
Mainstem vegetation	10%	11%	14%	12%
Dam	10%	11%	14%	12%
Upstream sources	0%	11%	14%	12%

Load allocation targets for mainstem riparian vegetation along the Pend Oreille River have been developed based on percent canopy cover and average tree height. Figures 24 and 25 provide summaries of shade and tree height deficits for the Boundary and Box Canyon models. The shade targets are aimed at restoring a riparian buffer of mature trees that approach PNV (potential natural vegetation) conditions.

Figures 27 and 28 show both main stem riparian shade impairments and temperature impairments for each segment by river mile. Shade impairments are expressed as the deficit between PNV and current conditions for the right and left banks, in terms of average tree height in feet or in terms of percent canopy cover. Temperature impairments are shown both by the maximum DO deficit caused by shade impairment and by the number of days when impairment was found from shade deficits. There is no obvious relationship; however, the data patterns suggest that shade impairments upstream produce impairments farther downstream.

Targets have also been determined for all identified major tributaries: 18 tributaries to the Box Canyon reservoir and 4 tributaries to the Boundary reservoir. The targets are based on percent effective shade (Table 28)necessary for the tributary to meet water quality standards for individual tributaries. Some tributaries meet standards under existing conditions, while some have allocations already set under the Colville National Forest TMDL, and some will have targets to address current §303(d) listings and impairments. Note that in Table 28, “2004 §303(d)” status is any water body listed as impaired (category 5) on Washington's 2004 §303(d) list. If data collected in the Pend Oreille River Subbasin after the deadline for submission for that list shows a stream to be impaired it is just called "impaired". These “impaired” water bodies will either be on the next Washington §303(d) list or the TMDLs will be approved first and the water bodies will be included in the category of the §303(d) list "addressed by TMDL" (category 4a). Washington’s §303(d) list does not include tribal waters, so those waters are also listed as "impaired" if they are found not to attain tribal water quality standards.

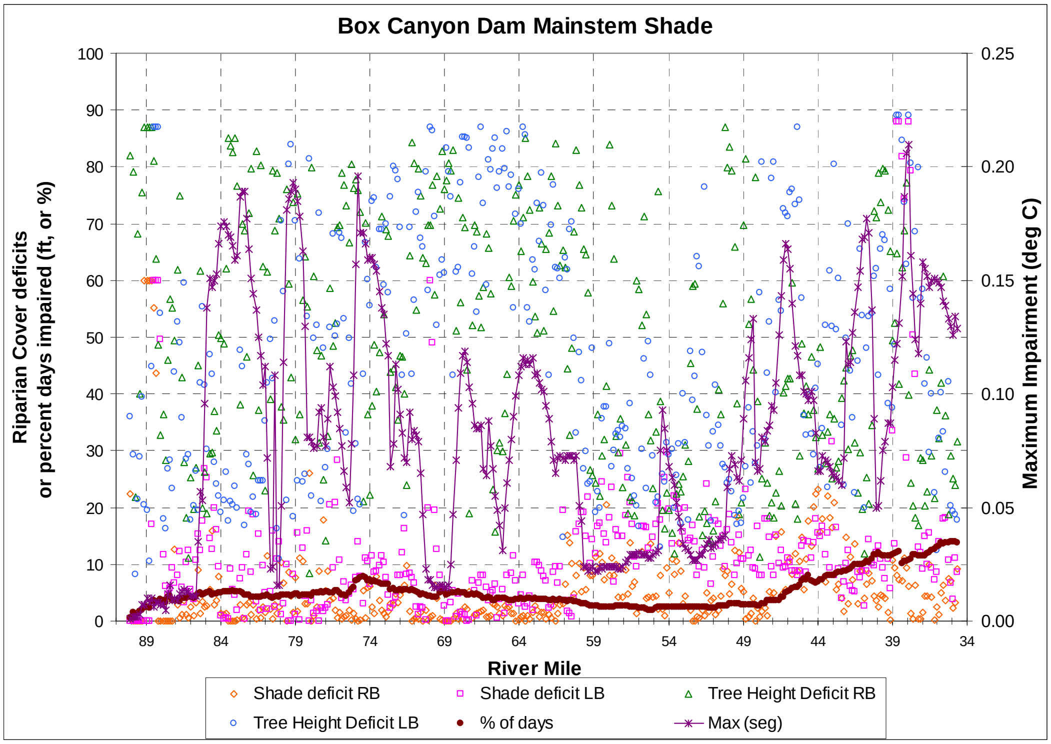

Figure 27. Riparian shade and tree height deficits for the Pend Oreille upstream of Boundary Dam.

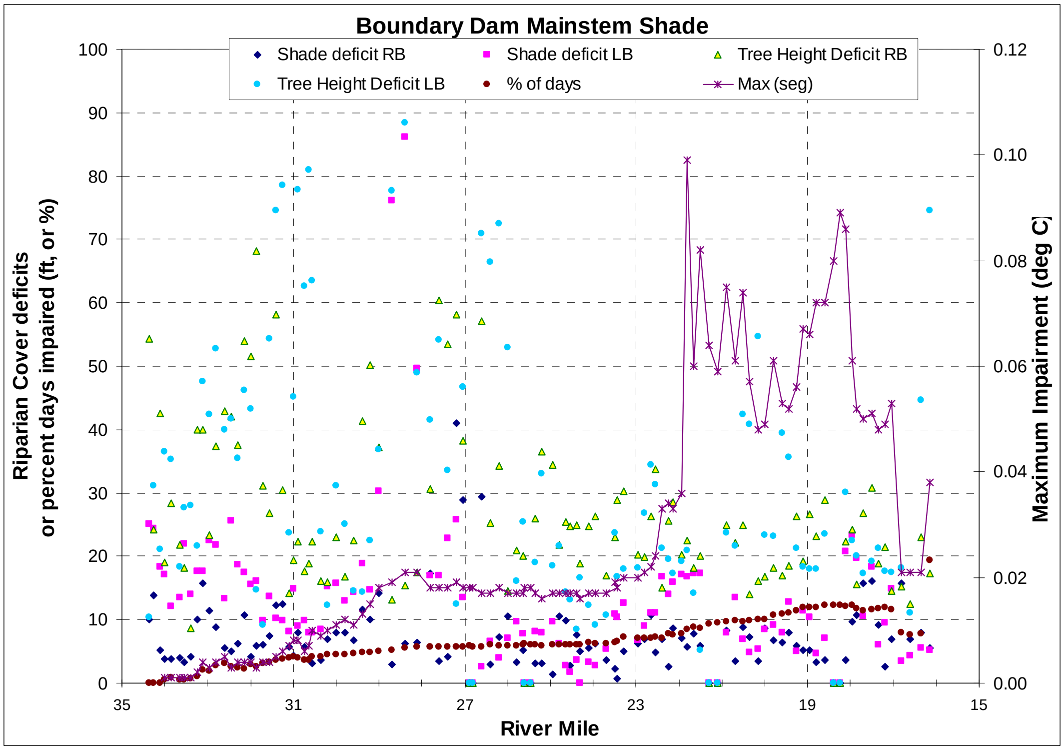

Figure 28. Riparian shade and tree height deficits for the Pend Oreille upstream of Box Canyon Dam.

Table 28. Shade allocations for impaired tributaries to the Pend Oreille River.

Water Body	Load Allocation (Effective Shade to Achieve Criteria in %)	Increase in Shade Needed (%)	Status
Indian Creek	91	6	Impaired
Skookum Creek	90	0	Meets Criteria
NF Skookum Creek	85	5	Impaired
Calispell Creek below Smalle Ck[1]	64	64	2004 303(d)
Cee Cee Ah Creek[1]	77	7	Impaired
Tacoma Creek	81	11	Colville NF TMDL
Cusick Creek	82	29	Colville NF TMDL
Mill Creek	88	3	Impaired
Middle Creek	85	0	Meets Criteria
Leclerc Creek	43	8	Impaired
E Br LeClerc Creek (lower)	91	56	2004 303(d)
E Br LeClerc Creek (upper)	90	25	2004 303(d)
Ruby Creek	83	23	Colville NF TMDL
SF Lost Creek	83	13	Colville NF TMDL
Lost Creek	60	30	2004 303(d)
Little Muddy Creek	67	7	2004 303(d)
Big Muddy Creek	82	7	Colville NF TMDL
Cedar Creek	79	28	2004 303(d)
Sullivan Creek	64	39	Colville NF TMDL

Slate Creek	78	0	Colville NF TMDL
Lime Creek	97	9	Colville NF TMDL
Flume Creek	85	0	Colville NF TMDL

[1]Shared waters of Kalispel Tribe and State of Washington. All other tributaries are State only.

Waste Load Allocations

The point sources are a minor contributor to the heat load and no reductions are required. However, WLAs are assigned to protect against future increases.

Allocations for existing dischargers in the State of Washington are based on current discharge temperatures and flows (Table 29) and are provided in Table 30. Reserve allocation for future growth will be provided equal to 30 percent of the existing load from municipal discharges (increase based on 2025 population projections), with 5 percent applied to Kalispel reservation waters and 25 percent applied to State of Washington waters (roughly proportional to length of river in Tribal waters).

There are no point source discharges to waters of the Kalispel Reservation or the Pend Oreille River tributaries, therefore no wasteload allocations given for these waters.

Table 29. Allocation flow and temperature for individual dischargers to the Pend Oreille River, Washington.

	Jan - Mar		Apr - Jun		July - Sept		Oct - Dec	
Facility	Flow (m^3/s)	Temp (ºC)	Flow (m^3/s)	Temp (ºC)	Flow (m^3/s)	Temp (ºC)	Flow (m^3/s)	Temp (ºC)
Newport WWTP	0.022	10.6	0.022	20.4	0.022	25.2	0.022	19.0
Ponderay Newsprint Company	0.252	32.2	0.252	32.2	0.252	32.2	0.252	32.2
Ione WWTP	0.021	10.6	0.021	23.8	0.021	25.2	0.021	19.0
Selkirk School District #70	0.00022	8.5	0.00022	17.5	0.00022	20.9	0.00022	16.6
Metaline WWTP	0.0076	8.5	0.0076	17.5	0.0076	20.9	0.0076	16.6
Metaline Falls WWTP	0.0206	11.6	0.0206	30.5	0.0206	25.2	0.0206	19.0
Pend Oreille Mine (Teck Cominco)	0.063	21.4	0.063	21.4	0.063	21.4	0.063	21.4

Table 30. Heat load allocations (million kcal/day) by season for individual dischargers to the Pend Oreille River, Washington.

Facility	Jan - Mar	Apr - Jun	July - Sept	Oct - Dec
Newport WWTP	20.1	38.5	47.6	35.9
Ponderay Newsprint Company	701.1	701.1	701.1	701.1
Ione WWTP	19.2	43.2	45.6	34.4
Selkirk School District #70	0.2	0.3	0.4	0.3
Metaline WWTP	5.6	11.5	13.7	10.9
Metaline Falls WWTP	20.5	54.2	44.8	33.7
Pend Oreille Mine (Teck Cominco)	116.7	116.7	116.7	116.7
Future Reserve - Washington	220.8	241.4	242.5	233.2
Future Reserve - Kalispel Tribe	44.2	48.3	48.5	46.6

Margin of Safety

This TMDL incorporates an implicit margin of safety through conservative model assumptions and standard interpretation.

The two model years under consideration, 2004 and 2005, have been evaluated for flow and weather conditions and represent a hot weather/low flow year, and a median year. Compliance under the conditions represented by these two years will ensure compliance in other years of differing weather and hydrology. Further, compliance was evaluated for over 600 individual dates during those two years and for all segments in the model, with a detailed analysis to determine critical locations for compliance. This ensures that compliance with the TMDL allocations will ensure compliance in all locations.

In the case of Washington and the Kalispel Tribe, the resulting TMDL allocations are based on the maximum temperature in the water column, which ensures compliance at all locations in the water column. For Idaho, daily average and daily maximum temperatures in the surface, bottom, and full water column were evaluated for the purposes of determining compliance with the applicable standards and calculating the TMDL allocations.

Seasonal Variation

Seasonal variation has been accounted for in this TMDL in two ways. First, the models used to determine the TMDL and allocate to sources is based on multiple seasons of data. Second, critical conditions of temperature have been identified generally as the late spring and late summer through early fall periods. Management measures implemented to meet the temperature criteria during these periods are also expected to allow the river to meet criteria during other periods.

Reasonable Assurance

The TMDL analysis has shown that the three dams on the Pend Oreille River are the principal cause of impairment, and all other sources combined (NPDES, mainstem shade, and tributaries) would not cause impairment alone. The two dams in Washington are regulated under existing FERC licenses and Section 401 certifications issued by WDOE, providing enforceable mechanisms to control heat load from these sources. The federal Albeni Falls Dam is not FERC-licensed; however federal facilities have legal obligations to comply with federal laws including provisions of approved TMDLs.

Background

Separate allocations have not been explicitly allocated to background contributions to heat load. However, the natural background temperature is used as a basis for the analysis of impairment.

Reserve

A *de minimus* reserve capacity for the Pend Oreille River has been allocated for point sources only. No reserve capacity is allocated to nonpoint sources or to the main stem dams.

5.6 Implementation Strategies

This Implementation Strategy is intended to describe the framework for how to improve water quality. It describes the roles and authorities of cleanup partners (i.e., those organizations with jurisdiction, authority, or direct responsibility for cleanup) and the programs or other means through which they will address these water quality issues.

Washington

Following USEPA approval of this TMDL, interested and responsible parties will work together to develop a *Water Quality Implementation Plan*. That plan will describe and prioritize specific actions planned to improve water quality and achieve water quality standards.

IDEQ, Ecology, and the Kalispel Tribe recognize that implementation strategies for TMDLs may need to be modified if monitoring shows that the TMDL goals are not being met or significant progress is not being made toward achieving the goals.

What Needs to be Done?

The implementation plan will be developed jointly through a collaborative process involving the Pend Oreille River WAG, landowners, land managers, and responsible resource agencies. Contents of the implementation plan are expected to include:

- A description of how targets are to be attained
- An identification of BMPs and BMP locations
- An identification of existing efforts that will help achieve TMDL goals
- An implementation schedule with milestones based on restoration priorities.
- Provisions to seek funding sources and sponsoring agencies.

Consistent with the Forests and Fish agreement, implementation of the load allocations established in this TMDL for private and state forestlands will be accomplished via implementation of the revised forest practices regulations. The effectiveness of the Forests and Fish rules will be measured through the adaptive management process and monitoring of streams in the watershed. If shade is not moving on a path toward the TMDL load allocation by 2009, Ecology will suggest changes to the Forest Practices Board.

Washington State Department of Natural Resources (DNR) is encouraged to condition forest practices to prohibit any further reduction of stream shade and not waive or modify any shade requirements for timber harvesting activities on state and private lands. New forest practices rules for roads also apply. These include new road construction standards, as well as new standards and a schedule for upgrading existing roads. Under the new rules, roads must provide for better control of road-related sediments, provide better streambank stability protection, and meet current best management practices. DNR is also responsible for oversight of these activities.

Who Needs to Participate?

The responsible parties expected to play a role in implementing this TMDL include: the Pend Oreille WAG, IDEQ, Ecology, NRCS, USEPA, U.S. Fish and Wildlife Service, Kalispel

Indian Tribe, counties, local highway districts, municipalities, industries, and local landowners.

Generally, IDEQ is the designated lead management agency responsible for TMDL implementation and will make efforts to address past, present, and future pollution problems in an attempt to link them to watershed characteristics and management practices designed to improve water quality and restore the beneficial uses of the water body.

Idaho Code states that "designated agencies" are responsible for implementing the implementation plan (IDEQ accessed 2007). Designated agencies include the following:

- Idaho Department of Lands (timber harvest, oil and gas exploration and development, and mining issues)
- Soil Conservation Commission (grazing and agriculture issues)
- Idaho Department of Transportation (public road issues)
- Idaho Department of Agriculture (aquaculture issues)
- DEQ (all other issues)

The U.S. Forest Service and the Bureau of Land Management, through governmental MOA, also serve as designated agencies on the federal lands they manage. Ultimately, however, it is the on-the-ground land managers, landowners, and citizens who are responsible for implementation.

Reasonable Assurances

Idaho

Operation of the Albeni Falls Dam greatly affects the aquatic resources upstream in Lake Pend Oreille. Much work has been done to date by Idaho and others to optimize Albeni Falls Dam operations to the benefit of upstream beneficial uses. IDEQ will assist ACOE in evaluation of any future dam operations changes. IDEQ will make sure that future operation improvements include TMDL allocation objectives. IDEQ expects ACOE to continue participation in actions that offset impairments and improve Idaho beneficial uses. IDEQ will assist ACOE in evaluating the effectiveness of these offsets in attaining the allocation target presented in this TMDL.

EPA is responsible for NPDES permits in Idaho and future NPDES permits shall include the WLAs outlined in this TMDL. IDEQ is responsible for providing water quality certification for these NPDES permits. IDEQ will not provide water quality certification for future Pend Oreille River NPDES permits that have not included compliance with loads allocated in this or future TMDLs.

Washington

When establishing a TMDL, reductions of a particular pollutant are allocated among the pollutant sources (both point and nonpoint sources) in the water body – for the Pend Oreille temperature TMDL, both point and nonpoint sources exist. TMDLs (and related Action Plans) must show “reasonable assurance” that these sources will be reduced to their allocated amount. Education, outreach, technical and financial assistance, permit administration, and enforcement will all be used to ensure that the goals of this water clean up plan are met.

Ecology believes that the following activities are already supporting this TMDL and add to the assurance that water temperature will meet conditions provided by Washington and Idaho water quality standards. This assumes that the activities described below are continued and maintained.

The goal of the Pend Oreille River *Water Quality Improvement Plan* for temperature is for the waters of the basin to meet the state's water quality standards. There is considerable interest and local involvement toward resolving the water quality problems in the Pend Oreille River. Numerous organizations and agencies are already engaged in stream restoration and source correction actions that will help resolve the temperature problem. The following rationale helps provide reasonable assurance that the Pend Oreille River nonpoint source TMDL goals will be met by the target date.

Ongoing BMP Projects

Washington

Table 31 presents ongoing BMP projects related to the temperature impairment in the Washington portion of the Pend Oreille River Subbasin as of 2000 (Entrix 2001).

Table 31. Ongoing BMP projects in the Pend Oreille River Subbasin (Washington; as of 2000)

Responsible party	Subject	Project location/name/description
DNR	Watershed analysis	LeClerc Creek Watershed Analysis
	Road maintenance and abandonment	Stimson Lumber Company Road Maintenance and Abandonment Plans, LeClerc WAU Middle Creek WAU, and Skookum WAU
		Crown Pacific Road Maintenance and Abandonment Plans, LeClerc WAU, Box Canyon WAU, and Skookum Creek
		Arden Tree Farms Road Maintenance and Abandonment Plans, Box Canyon WAU
		State Lands Road Maintenance and Abandonment plans, Winchester WAU and Tacoma Creek
		Small Landowner Road Maintenance and Abandonment Plans, 62 individual plans
Seattle City Light	Water Quality Monitoring	Funding for joint Kalispel/WDFW Fisheries, WQS 2000/2001
		Stimson Lumber Temperature and Sediment Monitoring in LeClerc Creek Watershed and Tri-State Water Quality Council Nutrient and Metal Monitoring at Newport
Kalispel Natural Resources Department	Fish Population Study and Stream Habitat Study	Box Canyon Reach Fish Population Study and East Fork Small Stream Habitat Surveys
	Shoreline Stabilization	Flying Goose Ranch and Mainstream Shoreline Stabilization
	Wetland and Riparian Enhancement	Wetland and Riparian Enhancement on Reservation and Browns
	Water Quality	Cee Cee Ah and Skookum Creek Water Quality Sampling
		Indian and Cedar Creek Water Quality Sampling
		Calispell and Half Moon Creek Water Quality Sampling
		West and East Branch LeClerc Creek Water Quality Sampling
		Mill and Ruby Creek Water Quality Sampling

Source: Entrix 2001

While Ecology is authorized under Chapter 90.48 RCW to impose strict requirements or issue enforcement actions to achieve compliance with state water quality standards, it is the goal of all participants in the Pend Oreille River TMDL process to achieve clean water through voluntary control actions.

Ecology will consider and issue notices of noncompliance in accordance with the Regulatory Reform Act in situations where the cause or contribution of cause of noncompliance with load allocations can be established.

There is currently a Detailed Implementation Plan (DIP), developed by the local watershed planning unit, for the Pend Oreille River watershed. The DIP was completed in the first year of Phase IV implementation, in accordance with the Watershed Planning Act, Chapter 90.82 Revised Code of Washington (RCW). The purpose of the DIP is to guide implementation of the Washington Resource Inventory Area (WRIA) 62 Watershed Management Plan actions (Golder Associates 2006). The DIP document identifies completed and ongoing implementation activities in the Washington portion of the Pend Oreille River watershed.

Monitoring

Washington

Finding sources, showing that BMPs are working, and verifying that the plan is being implemented is the intent of the monitoring effort.

For that purpose, the Pend Oreille Public Utilities District (PUD) monitors water quality on a monthly basis upstream and downstream of Box Canyon Dam by instantaneous grab samples (Entrix 2001). There is an objective of documenting baseline conditions to describe water quality immediately above and below Box Canyon Dam relative to current operation as well as to supplement existing baseline water quality data for the entire reservoir. Shore-based sampling occurs once a month.

Monitoring and assessment programs are conducted by the Kalispel Tribe, Natural Resources Department for on-reservation waters and by the Washington State Department of Ecology for waters bordering the reservation (Wingert and Gross 2006). The Tribe also monitors waters off the reservation including about two dozen tributaries along the Pend Oreille River in Washington. The Department of Ecology currently monitors two sites monthly on the Pend Oreille River. The Pend Oreille Conservation District monitors surface waters on a project basis. The Tri-State Water Quality Council monitors waters throughout the Clark Fork/Pend Oreille system. This group monitors primarily nutrients, nuisance algae, and metals and primarily in the Montana portion of the drainage. The Tribe contracts limnological studies of lakes in the lower Pend Oreille annually.

The Department of Ecology analyzes surface water of the Pend Oreille River for temperature and other constituents. This sampling occurs monthly at Newport, on the Idaho/Washington border, and Metaline Falls, near the Washington/Canadian border.

Compliance monitoring will be needed when water quality standards are believed to be achieved.

Entities with enforcement authority will be responsible for following up on any enforcement actions. Stormwater permittees will be responsible for meeting the requirements of their permits. Those conducting restoration projects or installing BMPs will be responsible for monitoring plant survival rates and maintenance of improvements, structures and fencing.

The *Water Quality Implementation Plan* will describe the coordinated monitoring strategy. The long-term effectiveness of TMDL implementation activities can be assessed by monitoring the Pend Oreille River temperatures at target sites. If implementation activities are adequate, the daily mean temperatures at the target site should equal the TMDL target. Individual years may exceed those temperatures because of natural variation.

Short term monitoring for compliance with WLAs will be accomplished through effluent monitoring by the point sources. For individual dams, one option for short term monitoring is to evaluate the temperature difference between successive dams. The TMDL includes curves showing the temperature differences for existing conditions and for the conditions of the implemented TMDL. Effectiveness of TMDL implementation within individual impoundments can be determined by comparison of actual temperature differences between dams to the TMDL curves.

A temperature monitoring plan including clear, well defined objectives and a quality assurance/quality control component should be developed as part of the TMDL implementation plan. The objectives of the plan should include characterization of point source effluent temperature, and of daily average temperature at target sites and in critical fish habitat and fish holding facilities in and around the dams.

Kalispel Indian Tribe

The Kalispel Tribe's Natural Resources Department, Water Quality Program collects water quality data at 60 sites in the Pend Oreille Subbasin. Two of these sites are on reservation waters. Each of these sites has continuous temperature monitoring and 15 of these sites have continuous flow monitoring. Nutrients are sampled monthly at two of the sites except during periods of high runoff when they are sampled every other week. Metals are sampled at one site on the same schedule as nutrients.A Quality Assurance Project Plan covering sampling activities is on file with the EPA.

Adaptive Management

The *Water Quality Implementation Plan* will identify interim targets. These targets will be described in terms of concentrations and/or loads, as well as in terms of implemented cleanup actions. Partners will work together to monitor progress toward these goals, evaluate successes, obstacles, and changing needs, and make adjustments to the cleanup strategy as needed.

It is ultimately WDOE and IDEQ's responsibility to assure that cleanup is being actively pursued and water standards are achieved. If the TMDL targets are not met, but the water quality standards are, then this TMDL has been satisfied.

Adaptive management is required when results from water quality monitoring show that load allocations and/or interim targets in this TMDL are not being met. An adaptive management strategy will also be used if the load allocations and/or targets are met, but the Pend Oreille River still does not meet temperature water quality standards. Effectiveness monitoring will be conducted after the implementation plan is finalized.

If implementation activities are not producing expected or required results, Ecology and/or IDEQ may choose to conduct additional studies to identify the significant sources of heat input to the river system. If the causes can be determined, implementation of additional BMPs, educational efforts, or a combination of these will likely be taken. However, if some unforeseen event affects the landscape, such as a wildfire, the timelines to meet the load allocations in this TMDL may need some modification.

Potential Funding Sources

Centennial Clean Water Funds, Section 319 Funds, and State Revolving Funds are the primary funding sources for TMDL implementation. In addition, there is a variety of other state and federal programs available that may provide funds - CREP, Salmon Recovery, Watershed Planning Act, and the Public Works Trust Fund are examples.

The source of funding for BMPs can be dependent on the landowner. Projects on federal lands are typically funded through the agency that manages those lands. Projects conducted on private or state lands may be funded through a variety of funding mechanisms, including Section 319 grants administered by IDEQ. These are grants established under Section 319 of the Clean Water Act to support nonpoint source pollution management activities.

Next Steps

Once the TMDL has been approved by EPA, a *Water Quality Implementation Plan* must be developed within one year. Ecology works with local people to create this plan, choosing the combination of possible solutions they think will be most effective in their watershed. Elements of this plan include: who will commit to do what, how will we figure out whether it worked, what if it doesn't work, and potential funding sources.

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GIS Coverages

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Glossary

305(b)

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

§303(d)

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

Alluvium

Unconsolidated recent stream deposition.

Ambient

General conditions in the environment (Armantrout 1998). In the context of water quality, ambient waters are those representative of general conditions, not associated with episodic perturbations or specific disturbances such as a wastewater outfall (USEPA 1996).

Anadromous

Fish, such as salmon and sea-run trout, that live part or the majority of their lives in the saltwater but return to fresh water to spawn.

Anthropogenic

Relating to, or resulting from, the influence of human beings on nature.

Anti-Degradation

Refers to the U.S. Environmental Protection Agency’s interpretation of the Clean Water Act goal that states and tribes maintain, as well as restore, water quality. This applies to waters that meet or are of higher water quality than required by state standards. State rules provide that the quality of those high quality waters may be lowered only to allow important social or economic development and only after adequate public participation (IDAPA 58.01.02.051). In all cases, the existing beneficial uses must be maintained. State rules further define lowered water quality to be 1) a measurable change, 2) a change adverse to a use, and 3) a change in a pollutant relevant to the water's uses (IDAPA 58.01.02.003.61).

Aquatic
Occurring, growing, or living in water.

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

Assimilative Capacity
The ability to process or dissipate pollutants without ill effect to beneficial uses.

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.

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

Best Management Practices (BMPs)
Structural, nonstructural, and managerial techniques that are effective and practical means to control nonpoint source pollutants.

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.

Colluvium
Material transported to a site by gravity. **Community**
A group of interacting organisms living together in a given place.

Cretaceous
The final period of the Mesozoic era (after the Jurassic and before the Tertiary period of the Cenozoic era), thought to have covered the span of time between 135 and 65 million years ago.

Criteria

In the context of water quality, numeric or descriptive factors taken into account in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels, and to limit the number of violations per year. The U.S. Environmental Protection Agency develops criteria guidance; states establish criteria.

Cubic Feet per Second

A unit of measure for the rate of flow or discharge of water. One cubic foot per second is the rate of flow of a stream with a cross-section of one square foot flowing at a mean velocity of one foot per second. At a steady rate, once cubic foot per second is equal to 448.8 gallons per minute and 10,984 acre-feet per day.

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).

Erosion

The wearing away of areas of the earth's surface by water, wind, ice, and other forces.

Exceedance

A violation (according to IDEQ, Ecology, and Kalispel Tribe 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).

Flow

See *Discharge*.

Fully Supporting

In compliance with water quality standards and within the range of biological reference conditions for all designated and exiting beneficial uses as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).

Fully Supporting Cold Water

Reliable data indicate functioning, sustainable cold water biological assemblages (e.g., fish, macroinvertebrates, or algae), none of which have been modified significantly beyond the natural range of reference conditions.

Fully Supporting but Threatened

An intermediate assessment category describing water bodies that fully support beneficial uses, but have a declining trend in water quality conditions, which if not addressed, will lead to a "not fully supporting" status.

Geographical Information Systems (GIS)

A georeferenced database.

Gradient

The slope of the land, water, or streambed surface.

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 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.

Instantaneous	A condition or measurement at a moment (instant) in time.
Interstate Waters	Waters that flow across or form part of state or international boundaries, including boundaries with Native American nations.
Load Allocation (LA)	A portion of a water body's load capacity for a given pollutant that is given to a particular nonpoint source (by class, type, or geographic area).
Load(ing)	The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. Loading is the product of flow (discharge) and concentration.
Load(ing) Capacity (LC)	A determination of how much pollutant a water body can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, and a margin of safety, it becomes a total maximum daily load.
Loam	Refers to a soil with a texture resulting from a relative balance of sand, silt, and clay. This balance imparts many desirable characteristics for agricultural use.
Loess	A uniform wind-blown deposit of silty material. Silty soils are among the most highly erodible.
Margin of Safety (MOS)	An implicit or explicit portion of a water body's loading capacity set aside to allow the uncertainly about the relationship between the pollutant loads and the quality of the receiving water body. This is a required component of a total maximum daily load (TMDL) and is often incorporated into conservative assumptions used to develop the TMDL (generally within the calculations and/or models). The MOS is not allocated to any sources of pollution.
Mean	Describes the central tendency of a set of numbers. The arithmetic mean (calculated by adding all items in a list, then dividing by the number of items) is the statistic most familiar to most people.

Metric

1) A discrete measure of something, such as an ecological indicator (e.g., number of distinct taxon). 2) The metric system of measurement.

Milligrams per Liter (mg/L)

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

Million Gallons per Day (MGD)

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

Monitoring

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

Mouth

The location where flowing water enters into a larger water body.

National Pollution Discharge Elimination System (NPDES)

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

Natural Condition

The condition that exists with little or no anthropogenic influence.

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.

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.

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.

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.

Reach
A stream section with fairly homogenous physical characteristics.

Resident
A term that describes fish that do not migrate.

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

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

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

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

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.

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.

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

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

Subwatershed

A smaller watershed area delineated within a larger watershed, often for purposes of describing and managing localized conditions. Also proposed for adoption as the formal name for 6^{th} field hydrologic units.

Surface 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.

Total Maximum Daily Load (TMDL)

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

Tributary

A stream feeding into a larger stream or lake.

Wasteload Allocation (WLA)

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

Water Body

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

Water Column

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

Water Pollution

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

Water Quality

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

Water Quality Criteria

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

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

Water Quality Modeling

The prediction of the response of some characteristics of lake or stream water based on mathematical relations of input variables such as climate, stream flow, and inflow water quality.

Water Quality Standards

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

Watershed

1) All the land which contributes runoff to a common point in a drainage network, or to a lake outlet. Watersheds are infinitely nested, and any large watershed is composed of smaller "subwatersheds." 2) The whole geographic region which contributes water to a point of interest in a water body.

Wetland

An area that is at least some of the time saturated by surface or ground water so as to support with vegetation adapted to saturated soil conditions. Examples include swamps, bogs, fens, and marshes.

Appendix E. Unit Conversion Chart

Table A-1. Metric - English unit conversions.

	English Units	Metric Units	To Convert	Example
Distance	Miles (mi)	Kilometers (km)	1 mi = 1.61 km 1 km = 0.62 mi	3 mi = 4.83 km 3 km = 1.86 mi
Length	Inches (in) Feet (ft)	Centimeters (cm) Meters (m)	1 in = 2.54 cm 1 cm = 0.39 in 1 ft = 0.30 m 1 m = 3.28 ft	3 in = 7.62 cm 3 cm = 1.18 in 3 ft = 0.91 m 3 m = 9.84 ft
Area	Acres (ac) Square Feet (ft^2) Square Miles (mi^2)	Hectares (ha) Square Meters (m^2) Square Kilometers (km^2)	1 ac = 0.40 ha 1 ha = 2.47 ac 1 ft^2 = 0.09 m^2 1 m^2 = 10.76 ft^2 1 mi^2 = 2.59 km^2 1 km^2 = 0.39 mi^2	3 ac = 1.20 ha 3 ha = 7.41 ac 3 ft^2 = 0.28 m^2 3 m^2 = 32.29 ft^2 3 mi^2 = 7.77 km^2 3 km^2 = 1.16 mi^2
Volume	Gallons (gal) Cubic Feet (ft^3)	Liters (L) Cubic Meters (m^3)	1 gal = 3.78 L 1 L= 0.26 gal 1 ft^3 = 0.03 m^3 1 m^3 = 35.32 ft^3	3 gal = 11.35 L 3 L = 0.79 gal 3 ft^3 = 0.09 m^3 3 m^3 = 105.94 ft^3
Flow Rate	Cubic Feet per Second (cfs)[a]	Cubic Meters per Second (m^3/sec)	1 cfs = 0.03 m^3/sec 1 m^3/sec = 35.31cfs	3 ft^3/sec = 0.09 m^3/sec 3 m^3/sec = 105.94 ft^3/sec
Concentration	Parts per Million (ppm)	Milligrams per Liter (mg/L)	1 ppm = 1 mg/L[b]	3 ppm = 3 mg/L
Weight	Pounds (lbs)	Kilograms (kg)	1 lb = 0.45 kg 1 kg = 2.20 lbs	3 lb = 1.36 kg 3 kg = 6.61 lb
Temperature	Fahrenheit (°F)	Celsius (°C)	°C = 0.55 (F - 32) °F = (C x 1.8) + 32	3 °F = -15.95 °C 3 °C = 37.4 °F

[a] 1 cfs = 0.65 million gallons per day; 1 million gallons per day is equal to 1.55 cfs.
[b] The ratio of 1 ppm = 1 mg/L is approximate and is only accurate for water.

Appendix F. Distribution List

[To be added]

Appendix G. Public Comments

[To be added]