

PUBLIC UTILITY DISTRICT NO. 1 *of* CHELAN COUNTY
P.O. Box 1231, Wenatchee, WA 98807-1231 • 327 N. Wenatchee Ave., Wenatchee, WA 98801
(509) 663-8121 • Toll free 1-888-663-8121 • www.chelanpud.org

April 30, 2013

VIA ELECTRONIC MAILING

Honorable Kimberly D. Bose, Secretary, and
Nathaniel J. Davis, Sr., Deputy Secretary
FEDERAL ENERGY REGULATORY COMMISSION
888 First Street, NE
Washington, DC 20426

Re: **Lake Chelan Hydroelectric Project No. 637**
Article 405 – 2012 Annual Flow and Water Temperature Report, associated Water Quality Assessment Report, and Request to Change Annual Reporting Date to April 30.

Dear Secretary Bose and Deputy Secretary Davis:

On March 5, 2013, the Federal Energy Regulatory Commission (Commission) issued a letter order granting extension of time pursuant to Article 405 and the Water Quality Certificate Condition V.A.(iii) for the Lake Chelan Hydroelectric Project (Project). The Commission granted the Public Utility District No. 1 of Chelan County, Washington (Chelan PUD) to file the above-referenced report by the extended deadline of April 30, 2013.

Chelan PUD hereby files the 2012 Annual Flow and Water Temperature Report and associated Water Quality Assessment Report. Additionally, since this is the second year in a row that weather has delayed retrieval of the monitoring devices, Chelan PUD respectfully requests to change the reporting date for the annual report to April 30 of each year. This will permit safe retrieval of the devices.

On March 25, 2013, a final draft of this report was provided to the resource agencies, Tribes and non-governmental organizations specified for 30-day review, which ended April 25.[1] Please refer to Appendix D for the consultation documentation.

[1] *See* http://www.chelanpud.org/departments/licensingCompliance/LC_implementation/corres/40392.pdf

Please contact me or Steve Hays at (509) 661-4181 of my office regarding any questions or comments regarding this request.

Sincerely,

Michelle Smith
Licensing and Compliance Manager
michelle.smith@chelanpud.org
(509) 661-4180

cc: Erich Gaedeke, FERC Portland Regional Office
Pat Irle, Washington Department of Ecology
Chelan River Fish Forum

Enclosure: 2012 Annual Flow and Water Temperature Report and associated Water Quality Assessment Report

LAKE CHELAN ANNUAL FLOW AND WATER TEMPERATURE REPORT 2012

LICENSE ARTICLES 405 & 408

Final

LAKE CHELAN HYDROELECTRIC PROJECT
FERC Project No. 637

April 30, 2013

Public Utility District No. 1 of Chelan County
Wenatchee, Washington

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Chelan PUD received a new license (License) from the Federal Energy Regulatory Commission (FERC) on November 6, 2006, authorizing Chelan PUD to operate the Lake Chelan dam and powerhouse for a period of 50 years. The License conditions require that Chelan PUD provide minimum flows to the Chelan River and monitor those flows and water temperatures at various locations. The License required the construction of a Low Level Outlet at Chelan Dam, a Reach 4 habitat channel and spawning areas in the tailrace, and operations to protect aquatic life through flow ramping rates and powerhouse operations. The License also requires that Chelan PUD file an Annual Flow and Temperature Report with the FERC documenting compliance with these License requirements.

Minimum flows to the Chelan River of 80 cfs and 320 cfs were provided in accordance with the schedules described in License documents. Additional flow was provided from the Pump Station to the Reach 4 habitat channel for salmon and steelhead spawning during their respective spawning periods (October 15 – November 30 and March 15 – May 15). There was one deviation below minimum flow requirements in 2012 due to a control system malfunction. Corrective measures were taken to prevent further occurrences. The FERC determined that the deviation did not constitute a violation of Article 405 of the license.

Chelan PUD implemented operating criteria for compliance with the two inches per hour ramping rates that were refined in 2011 and managed flow releases using those operating criteria in conjunction with onsite monitoring of actual water level changes. The refined criteria performed well during the adjustments of spill flows that occurred from late May – early August and when ramping down from flows provided for whitewater boating in September. One additional refinement was made, based on observation, and implemented in 2012.

Powerhouse operations for Chinook redd protection were studied to determine the maximum time period that powerhouse outages could last while still maintaining adequate oxygen levels in Chinook salmon redds. There were a number of partial day outages scheduled from January 1 – 31 and February 24 – March 9 to test the intragravel oxygen response in Chinook redds and to conserve water to maintain lake levels. The powerhouse generally ran continuously with both units in operation from February 1 – 24 and March 10 – 25. From March 26 through April 22, except for brief periods for removal of dissolved oxygen study equipment (3/26-28), at least one powerhouse unit at minimum generation (approximately 800 cfs) was kept in operation to maintain oxygen levels in Chinook salmon redds. The studies had demonstrated that minimum generation levels were sufficient to maintain oxygen levels. On April 9 the accumulated temperature units for emergence of Chinook salmon fry had been reached for the final Chinook spawning activity observed the previous November. The powerhouse was taken out of operation from April 23 – May 1 in order to refill to meet the May 1 minimum target elevation for Lake Chelan.

During the spawning period for steelhead, the powerhouse operated at minimum generation until April 22, was not operated again until May 1, then resumed intermittent operation through the rest of May. Steelhead spawning was observed in the Reach 4 habitat channel in 2012 between late March and mid May, with 7 redds in the habitat channel and canal outlet pool. No steelhead redds were observed in the tailrace.

During the Chinook spawning period in 2012, powerhouse daily average flows were maintained above 2000 cfs from October 1 –December 15, with the exception of a few hours with flows between 1000 - 2000 cfs. A total count of 426 Chinook redds were estimated to have been deposited in the Chelan River Reach 4 (139), tailrace (231), and downstream in the Chelan/Columbia River confluence and Columbia River (56). Powerhouse flows were generally above 2,000 cfs from December 16 – 31, with the exception of daytime flows at minimum generation (about 800 cfs) from December 16 – 20 for installation of oxygen monitoring equipment in Chinook redds and cylindrical egg tubes with Chinook eggs for egg-emergence survival studies. A single period of less than two-hours with no powerhouse flow was needed on December 19 for egg tube installation.

Water temperatures were monitored at seven locations in the Chelan River and tailrace. There were a few days from late July through September when water temperatures released from the Low Level Outlet appear to have been slightly cooler than the average water temperature arriving at Chelan Dam from the outlet of Lake Chelan. Water temperatures demonstrated small increases during transit from the upper end of Reach 1 to the end of Reach 3 during March – August, but cooling from September – December Water temperatures neither increased nor decreased during transit through the Reach 4 habitat channel. The peak daily average water temperatures measured from upstream to downstream locations were 23.1 °C at the Low Level Outlet, 22.4 °C at the bottom of Reach 4, and 23.4 °C in the tailrace. The highest hourly temperatures recorded at these locations were 23.6 °C, 24.9 °C and 24.2 °C, respectively. The highest 7-DADMax temperatures recorded were 22.9 °C at the top of Reach 1, 24.4 °C at the end of Reach 3 and 24.6 °C at the bottom of Reach 4.

Water quality measurements in the Reach 4 Habitat Channel during 2-3 days in August and October met the criteria for dissolved oxygen, pH and turbidity. There was no monitoring of total dissolved gas below the Chelan Dam spillway in 2012.

SECTION 1: INTRODUCTION

The Lake Chelan Hydroelectric Project (Project) is owned and operated by the Public Utility District No. 1 of Chelan County (Chelan PUD). The Federal Energy Regulatory Commission (FERC) license for operation of this project, issued on November 6, 2006, authorizes Chelan PUD to operate the Lake Chelan dam and powerhouse for a period of 50 years. As part of the normal operation of the Project, Chelan PUD withdraws water from Lake Chelan for power generation and discharges that water through the powerhouse into an excavated tailrace, which leads to the confluence of the Chelan River and the Columbia River. Flows released from the Chelan Dam follow the natural channel of the Chelan River, joining with the powerhouse tailrace flows and discharging to the Columbia River. As a requirement of the new License, minimum flows were established for the Chelan River and that flow was initiated on October 14, 2009.

Chelan PUD filed an Operations Compliance Monitoring Plan (OCMP), as required in License Article 405, which describes how Chelan PUD operates to meet: (1) the instream flows, ramping rates, and tailrace flows as set forth in Article 7 of the Lake Chelan Settlement Agreement and Chapter 7 of the Comprehensive Plan attached to the Settlement Agreement; (2) and the lake levels as set forth in Article 8 of the Settlement Agreement and Chapter 8 of the Comprehensive Plan. The OCMP includes the specifics of flow measurement techniques, electronic flow data posting, quarterly and annual reporting requirements, and an implementation schedule.

Chelan PUD filed a Threatened and Endangered Species Protection Plan (TESPP), as required in License Article 408, which describes: (1) how Chelan PUD implemented provisions for timely development of a system to release water at the Lake Chelan Dam or pump water from the project powerhouse tailrace to the Chelan River, and subsequent operation of that system to continuously maintain flows equal to or greater than the flows required for Chelan River Reach 4; and (2) methods and schedules for monitoring of flows in the project tailrace and in Reach 4 of the Chelan River and annual reporting of the monitoring results, as set forth in Article 7 of the Lake Chelan Settlement Agreement and Chapter 7 of the Comprehensive Plan attached to the Settlement Agreement, and (3) methods for timely determination of the need to take actions to improve water quality characteristics adversely affecting anadromous fish, and identification and implementation of appropriate actions.

The OCMP and TESPP were submitted to FERC on May 4, 2007 and FERC issued an order approving the TESPP on November 28, 2007 and an order modifying and approving the OCMP on November 30, 2007. Both the OCMP and TESPP require the recording and reporting of flows in the Chelan River, as related to meeting minimum flow requirements, protection of fish habitat and protection of salmon and steelhead eggs incubating in the tailrace. The FERC order approving the OCMP requires that Chelan PUD shall file an Annual Flow Report with the FERC by February 28 of each year. The TESPP includes annual reporting of water temperature monitoring required in the Lake Chelan Settlement Agreement. This Annual Flow and Temperature Report meets the flow and temperature reporting requirements of License Articles 405 and 408. Due to weather and snow conditions that prevented retrieval of temperature loggers in January, Chelan PUD has requested of FERC an extension of time to April 30, 2013, for filing of this report.

Chelan PUD manages the level of Lake Chelan and flow releases through the powerhouse and into the Chelan River channel at the dam for power generation and other purposes. License Article 405 requires management of lake levels with priority given to maintaining minimum flows in the Chelan River (initiated in 2009) and reducing high spillway flows into the Chelan River to protect fish habitat. The Annual Lake Level Report documents Chelan PUD's decisions regarding operation of the powerhouse for lake level management to meet these Chelan River objectives, as well as recreation and other requirements. Annual lake level reports are filed with FERC and posted to Chelan PUD's public web page at: http://www.chelanpud.org/lc-Resource-Documents.cfm.

This Annual Flow Report includes two sections that correspond to the flow reporting requirements of the FERC order: Section 2, Chelan River Instream Flows and Section 3, Powerhouse Tailrace Security Flows. Section 4 of this report contains the water temperature monitoring that was conducted in 2012. In addition, the FERC order requires that Chelan PUD conduct general water quality assessments in years 6 (2012) and 8 (2014) sufficient to demonstrate that the Chelan River meets water quality standards for dissolved oxygen, total dissolved gas, turbidity and pH. Section 5 of this report contains water quality assessments conducted in 2012 that address this requirement.

SECTION 2: CHELAN RIVER INSTREAM FLOWS

2.1 Chelan River Instream Flows

Flow releases were provided throughout the year from the Low Level Outlet for minimum flows of at least 80 cfs in Reaches 1-3 (Figure 2-1). The runoff forecast for 2012 was in the upper 20 percent exceedance level, which is classified as a "wet year" for setting minimum flows during the annual runoff cycle. The 2012 minimum flow releases to Reaches 1-3 were at least 320 cfs from May 15 – July 15. Additional flow was provided from the Pump Station to the Reach 4 habitat channel for salmon and steelhead spawning during their respective spawning periods (Figure 2-2). The spawning flows from May 2 – May 15 were provided solely from the Low Level Outlet to assist in managing lake levels. There was one deviation below minimum flow requirements in 2012 due to a control system malfunction. Corrective measures were taken to prevent further occurrences. The FERC determined that the deviation did not constitute a violation of Article 405 of the license (Appendix C).

Flows were released from the Low Level Outlet and spillway as needed for lake level control, beginning May 1 and May 23, respectively. Flows for lake level control continued until August 10. These flow releases were managed to meet lake level target elevations and to avoid high spill levels that could damage the Reach 4 habitat channel. Flow releases for lake level control peaked at 6057 cfs daily average on July 16, with an hourly peak flow of 7030 for a few hours on July 15. Flow releases from the spillway and Low Level Outlet were also managed to provide one weekend whitewater boating event on September 15-16. Flows were ramped back down to minimum flows following the event, with ramping concluded on September 17.

Spawning flows were provided for steelhead trout from March 15 – May 14 and for Chinook salmon from October 15-November 30. The spawning flows were provided through the combination of the Low Level Outlet flows and Pump Station flows, maintaining flow levels of at least 320 cfs. At the end of the fall spawning period, flows from the Pump Station were ramped down one pump at a time to avoid fish stranding. Since "wet year" minimum flows of 320 cfs were required from May 15-July 15, there was no ramping down of flows at the end of the steelhead spawning period. Steelhead trout adults were observed spawning in the Reach 4 habitat channel beginning the last week in March. Spawning continued until May 16, with 6 redds counted by April 17 and one additional redd on May 16, for a total of 7 redds. Chinook fry were present in the Reach 4 habitat channel from mid April through June. Chinook spawning began on October 8 and was completed prior to November 30. There were a total of 426 redds counted in the Chelan River Reach 4, the tailrace and Columbia River at the confluence. There were 139 redds in the Reach 4 habitat channel and upstream pool, 231 in the tailrace and 56 in the Columbia River in Chelan River flows below the confluence.

A tabulation of average daily flows from the Low Level Outlet, Pump Station, combined flows into Reaches 1-3 and Reach 4, powerhouse discharge, spill discharge and hourly lake levels and powerhouse tailwater levels are presented in Appendix A. Quarterly hourly data is available at the internet site: http://www.chelanpud.org/lc-Resource-Documents.cfm.

Figure 2-1. Flow Releases to Reaches 1-3 of the Chelan River, 2012.

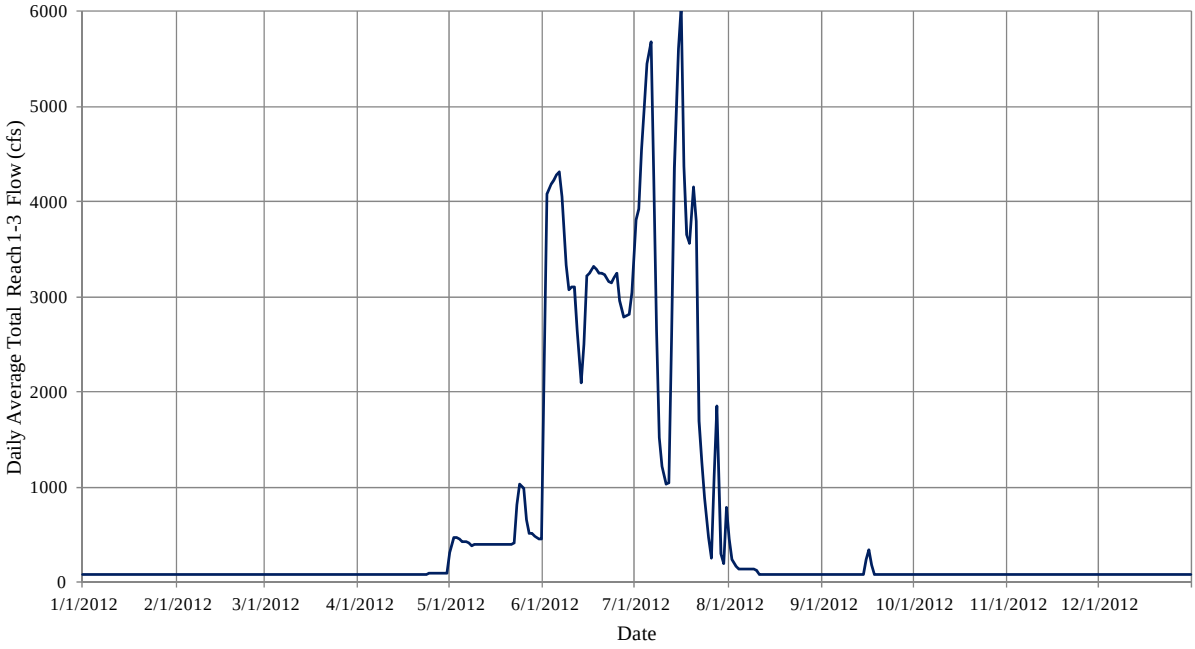
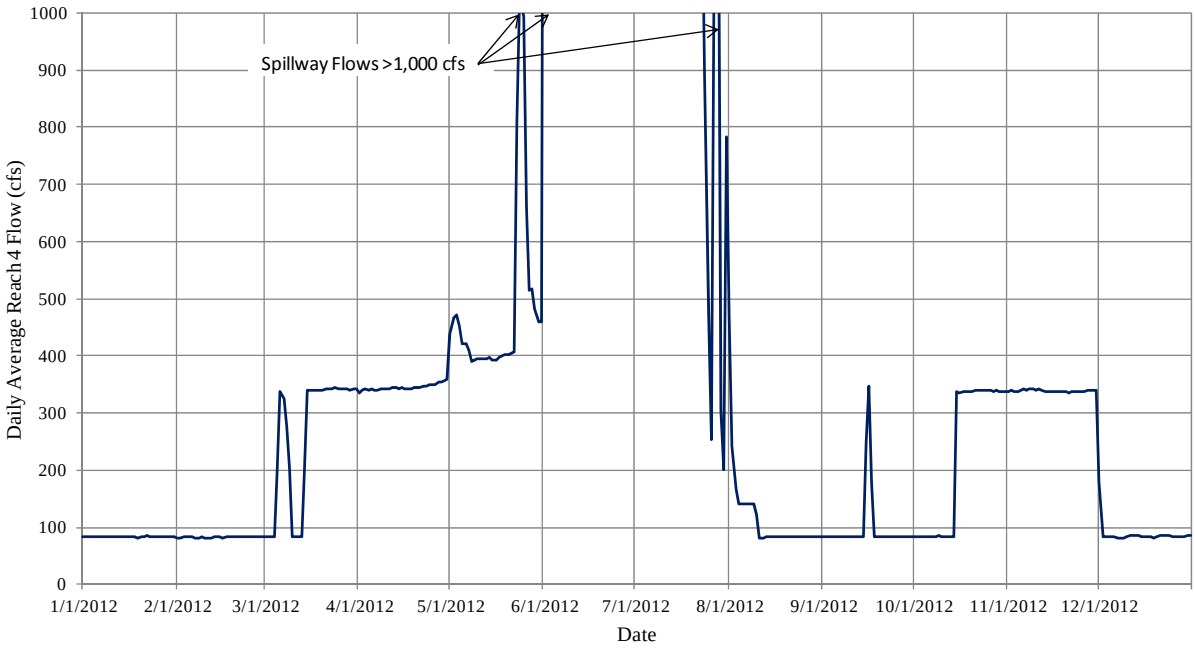


Figure 2-2. Flow Releases to Chelan River Reach 4, 2012.



2.2 Chelan River Ramping Rates

The Lake Chelan Settlement Agreement requires that ramping rates are to be established for the Chelan River to protect aquatic organisms from rapid fluctuations in water levels. The ramping rates for decreases in water levels are initially set at approximately two inches per hour during the period when juvenile salmon and steelhead fry may be present. The OCMP states that the two inches per hour ramping rates will remain in effect until biological evaluations have determined the actual ramping rates necessary to prevent stranding of fish in the Chelan River. The locations in the Chelan River where water level changes will be measured to determine operating criteria for compliance with ramping rates will be determined in consultation with the Chelan River Fishery Forum. A study will be conducted to determine the operating criteria for changes in flow from the Low Level Outlet, spillway and Pump Station. The results of this study will establish ramping procedures in terms of allowable flow reductions per hour for these sources of flow releases. Biological evaluations will determine the periods of time during the year when ramping rates will be applied to protect fry from stranding.

The year 2012 was the third full year of minimum flow operations for the Chelan River since completion of the Low Level Outlet, Reach 4 habitat channel, and Pump Station. Biological evaluations of fish populations with snorkel surveys in the Chelan River Reaches 1-3 and Reach 4 began in 2012. Results of those surveys have been provided to the Chelan River Fisheries Forum and will be included in the 2013 Biological Objectives Status Report. Observations during the snorkel surveys, steelhead spawning surveys (weekly March 15-June 1), summer observations during temperature logger replacement (monthly July, August, September) and fall during Chinook spawning surveys (weekly October – November) determined that Chinook salmon fry were present in the Reach 4 habitat channel during the months of April, May and June. No Chinook or steelhead fry were observed prior to mid April and after July. However, ramping rate operations for juvenile fish were followed throughout the year since the snorkel survey biological evaluations are just in their first year.

In 2012, Chelan PUD implemented operating criteria for compliance with the two inches per hour ramping rates that were refined in 2011 and managed flow releases using those operating criteria in conjunction with onsite monitoring of actual water level changes. The refined criteria performed well during the adjustments of spill flows that occurred from late May – early August and when ramping down from flows provided for whitewater boating in September. One additional refinement was made (Table 2-1), based on observation, and implemented in 2012.

Table 2-1. Refined Ramping Criteria (2012).

Decreasing Spill Ramping Rate Restrictions Except for Plant Safety and System Reliability, the following are License Compliance ramping rate restrictions when reducing spill:	
Maximum Spill Reduction Ramping Rates	
	Ramp Rate
Total Spill* cfs	cfs/hr
1000 < Total Spill	250
500 < Total Spill <= 1000	100
400 < Total Spill <= 500	50
220 ~~100~~ < Total Spill <= 400	30
80 < Total Spill <= **220** ~~100~~	20
* Total Spill = Low Level Outlet + Spill Gates Note: Only reduce spill during daylight hours (to aid fish movement from potential entrapment areas).	

SECTION 3: POWERHOUSE TAILRACE SECURITY FLOWS

3.1 Powerhouse Operations

There were 192 salmon redds with eggs incubating in the tailrace from spawning that occurred in 2011. Powerhouse operations for Chinook redd protection were studied to determine the maximum time period that powerhouse outages could last while still maintaining adequate oxygen levels in Chinook salmon redds. There were a number of partial day outages scheduled from January 1 – 31 and February 24 – March 9 to test the intragravel oxygen response in Chinook redds and to conserve water to maintain lake levels. The powerhouse generally ran continuously with both units in operation from February 1 – 24 and March 10 – 25. From March 26 through April 22, except for brief periods for removal of dissolved oxygen study equipment (3/26-28), at least one powerhouse unit at minimum generation (approximately 800 cfs) was kept in operation to maintain oxygen levels in Chinook salmon redds. The studies had demonstrated that minimum generation levels were sufficient to maintain oxygen levels. On April 9 the accumulated temperature units for emergence of Chinook salmon fry had been reached for the final Chinook spawning activity observed the previous November. The powerhouse was taken out of operation from April 23 – May 1 in order to refill to meet the May 1 minimum target elevation for Lake Chelan.

During the spawning period for steelhead, the powerhouse operated at minimum generation until April 22, was not operated again until May 1, then resumed intermittent operation through the rest of May. Steelhead spawning was observed in the Reach 4 habitat channel in 2012 between late March and mid May, with 7 redds in the habitat channel and canal outlet pool. No steelhead redds were observed in the tailrace.

During the Chinook spawning period in 2012, powerhouse daily average flows were maintained above 2000 cfs from October 1 –December 15, with the exception of a few hours with flows between 1000 - 2000 cfs. A total count of 426 Chinook redds were estimated to have been deposited in the Chelan River Reach 4 (139), tailrace (231), and downstream in the Chelan/Columbia River confluence and Columbia River (56). Powerhouse flows were generally above 2,000 cfs from December 16 – 31, with the exception of daytime flows at minimum generation (about 800 cfs) from December 16 – 20 for installation of oxygen monitoring equipment in Chinook redds and cylindrical egg tubes with Chinook eggs for egg-emergence survival studies. A single period of less than two-hours with no powerhouse flow was needed on December 19 for egg tube installation.

Water surface elevations in the tailrace can fluctuate by several feet over the course of a day due to changes in Columbia River flows that affect the backwater curve of the Rocky Reach reservoir. The water level fluctuations in the tailrace are somewhat reduced when the Chelan Powerhouse is operating. In past years, temporary dewatering of a few Chinook redds in shallow areas had been observed when the powerhouse was not operating and Columbia River flows were low. During tailrace spawning habitat construction in 2008 these areas were graded to prevent dewatering. The water levels in the tailrace remained above 708 feet most of the time and never dropped below 706 feet from January 1 – May 31 and October 15 – December 31. No dewatering of salmon redds was observed in 2012. Also, the limited area that is dewatered

during low tailwater levels is typically periodically exposed during September and early October, just prior to the initiation of spawning by Chinook salmon. This periodic exposure prevents the growth of periphyton (attached algae), leaving the substrate with a clean look that is readily visible even when submerged during higher tailwater levels. The minimum hourly tailwater level observed from September 1 – October 15, 2012, was 706.5 feet. During spawning surveys in both 2011 and 2012, observations recorded on redd location maps showed that Chinook avoided spawning on the area with "clean looking" substrate. The daily average tailwater levels measured at the powerhouse are shown in Figure 3-2.

Figure 3-1. Chelan Powerhouse Daily Average Flows, 2012.

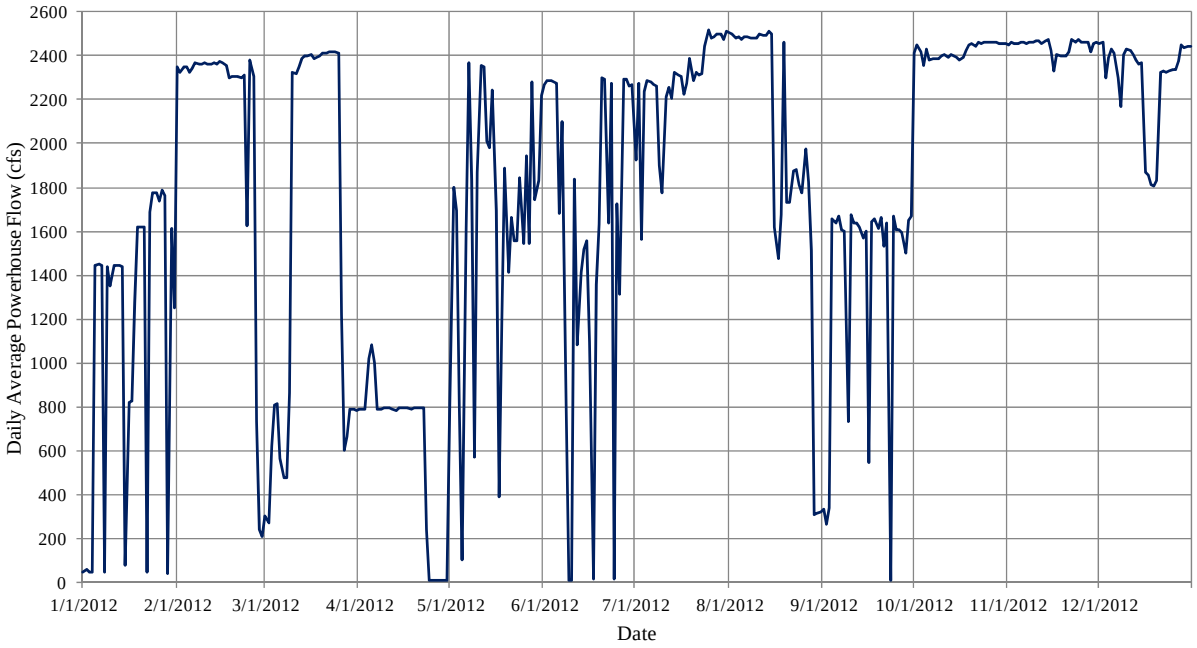
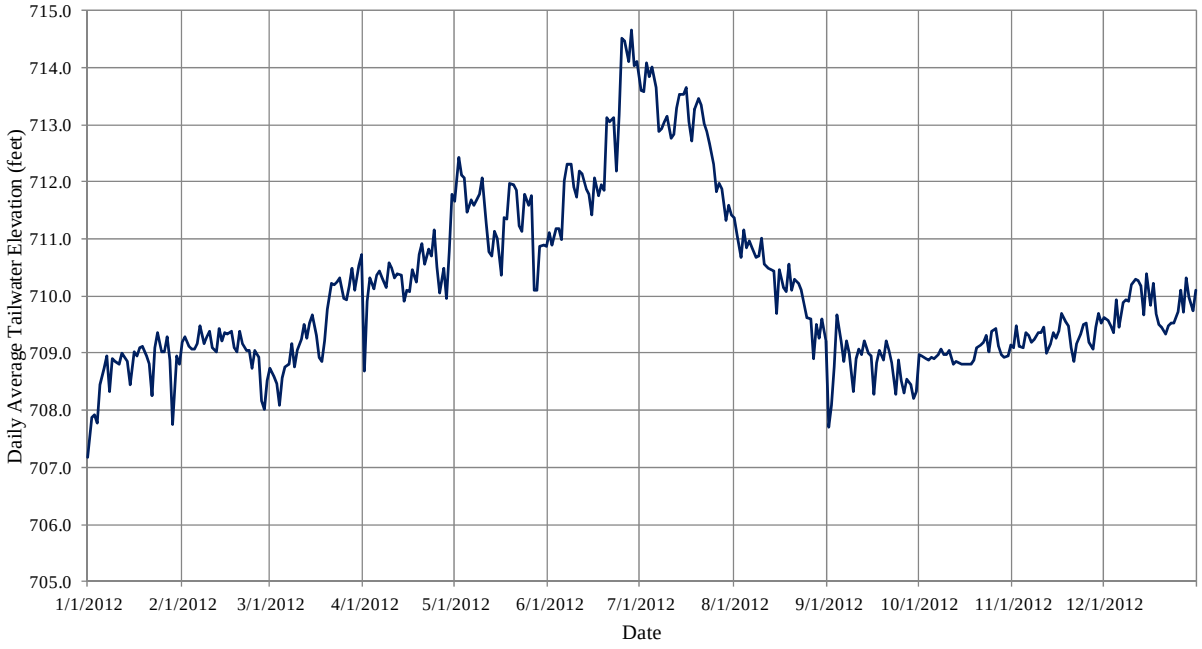


Figure 3-2. Chelan Powerhouse Daily Average Tailwater Elevations, 2012.



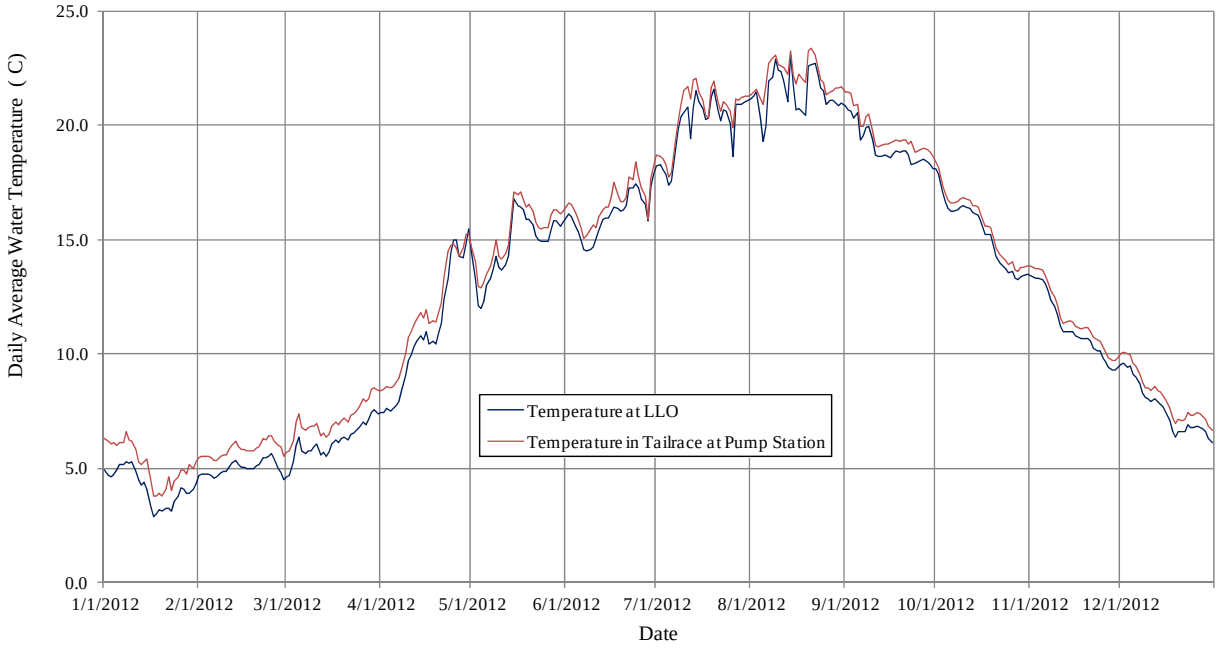
SECTION 4: WATER TEMPERATURE MONITORING

4.1 Water Temperatures Released to Chelan River and Tailrace

Automated water temperature monitoring equipment is installed at two locations, within the pipe that draws water from the base of the Chelan Dam and discharges to the Chelan River through the Low Level Outlet and in the Chelan Powerhouse Tailrace from a sensor mounted on the Pump Station intake screens. These monitoring locations measure the water temperatures that reflect the coolest water available for the Chelan River (Low Level Outlet temperature) and the average of water temperatures arriving at the face of Chelan Dam as drawn through the powerhouse intakes (Chelan Powerhouse Tailrace). Water temperatures measured in the tailrace also represent the temperature of water that is being discharged to the Reach 4 habitat channel when the Pump Station is in operation.

Water temperatures from these sources (Figure 4-1) show that generally there was little stratification in water temperatures at the face of Chelan Dam. There were a few days from late July through September when water temperatures released from the Low Level Outlet appear to have been slightly cooler than the average water temperature arriving at Chelan Dam from the outlet of Lake Chelan. The maximum daily average water temperature measured in the Low Level Outlet pipe and from the top of R1 was 23.1 °C. Hourly water temperatures peaked at 23.6 °C on August 14 and 20. Tailrace maximum daily average temperature was 23.4 °C, while hourly temperatures peaked at 23.7 °C, 24.1 °C, and 24.2 °C on August 14, 20 and 21.

Figure 4-1. Low Level Outlet and Powerhouse Tailrace Water Temperatures.



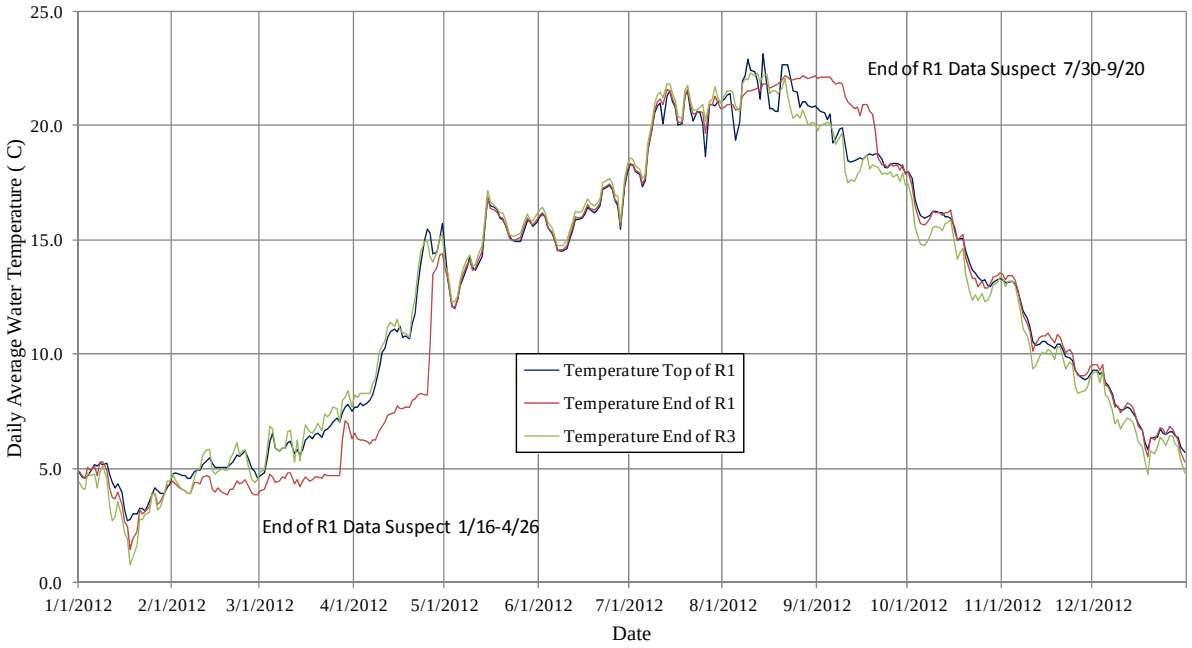
4.2 Water Temperatures in Chelan River Reaches 1-3.

Water temperatures are monitored at three locations with temperature recording data loggers (Onset HOBO Water Temp Pro v2) that are set to record the water temperature at hourly intervals. These locations are at the top of Reach 1, which measures the temperature of water entering the Chelan River from the Low Level Outlet and the spillway. The location of this temperature logger is set below the mixing zone for these sources of water. The second location is at the end of Reach 1, which is the reach of the Chelan River that has the lowest gradient and least profile shading, thus the greatest potential for water temperature heating during the spring and summer. The third location is at the end of Reach 3, where the Chelan River exits the series of cascades and falls that are the upstream barrier to anadromous fish. The temperature loggers at each location are exchanged several times during the year to retrieve the data. These data are reported quarterly during most of the year, with monthly reporting for July, August and September. These data reports are available at http://www.chelanpud.org/lc-Resource-Documents-WaterQuality.cfm.

There were anomalies in the temperature measurements recorded at the end of Reach 1 during two time periods, January 16 – April 26 and July 30 – September 20. The daily fluctuations in water temperature did not reflect the trends from past years and the temperatures did not compare well with the upstream and downstream locations. This device has been anchored just off the river bed in a sheltered nook behind a shoreline boulder and sand deposition was covering the device when retrieved in April. It is also at the downstream end of a rocky point bar that may have hyporheic flow discharging in the vicinity of this location. The anchor post for this device will be moved out further into the river channel during 2013.

The water temperatures recorded at these locations in 2012 demonstrated small increases in water temperature during March –August, but cooling from September – December (Figure 4-2). This is not unexpected because the water exiting Lake Chelan is affected by the heat sink effect of the lake's large volume. Water in Lake Chelan is still warming from March – August, but then retains this heat through the late summer and fall, thus water exiting the lake is cooler than sustainable at equilibrium with ambient solar and air temperature conditions through the summer, then tends to be warmer than sustainable through fall and early winter. The maximum daily average water temperatures recorded in 2012 were 23.1 °C, 22.2 °C and 22.3 °C, respectively from upstream to downstream locations. The highest hourly temperatures recorded were 23.6 °C, 23.1 °C, and 24.8 °C, respectively for the same locations.

Figure 4-2. Chelan River Reaches 1-3 Daily Average Water Temperatures.

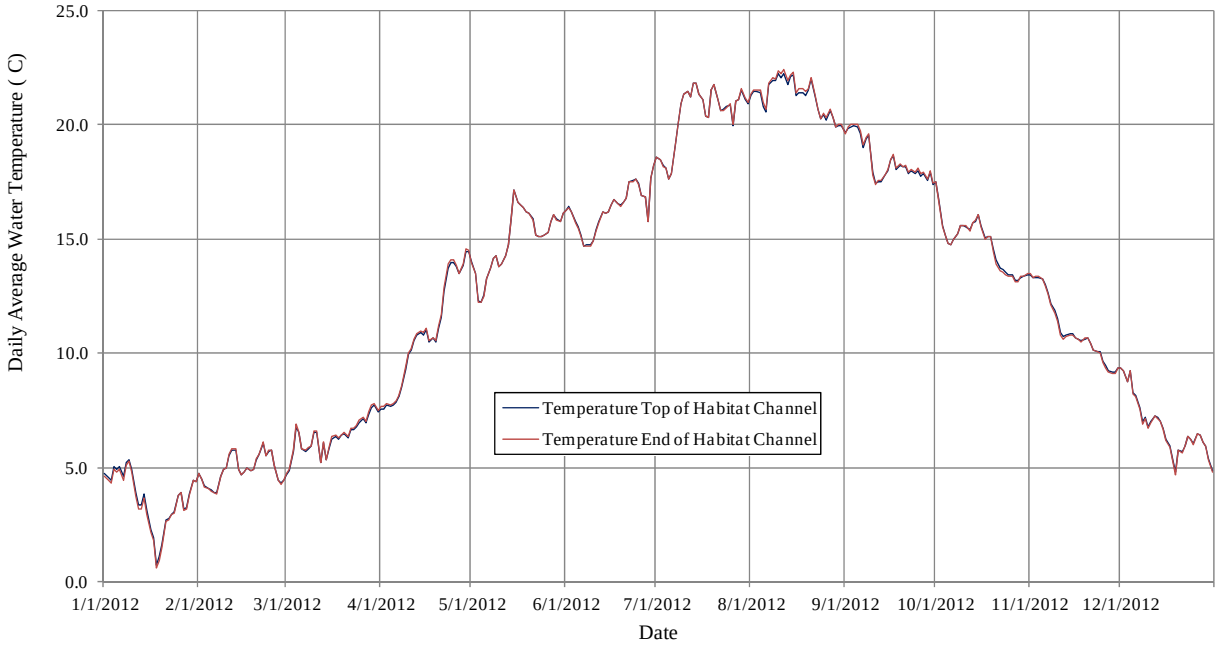


4.3 Water Temperatures in Chelan River Reach 4 Habitat Channel.

Water temperatures are monitored at hourly intervals at two locations (Onset HOBO Water Temp Pro v2), at the upper and lower end of the habitat channel. The upper location records either the water temperature exiting from the pool below the end of Reach 3 or the mixed flows from that source and the Pump Station canal outlet, when the pumps are in operation. The monitoring location at the end of the habitat channel is at the point where habitat channel flows enter into the tailrace, just upstream from where mixing of these flows is expected.

The daily average water temperature data from these locations did not show any evidence of heating as water passed through the habitat channel, despite the lack of any shade from vegetation under current, newly constructed, conditions (Figure 4-3). The maximum daily average temperatures recorded were 22.2 °C at the top and 22.4 °C at the end of the habitat channel. The maximum hourly temperatures were 24.8 °C and 24.9 °C at the upper and lower ends of the habitat channel.

Figure 4-3. Reach 4 Habitat Channel.



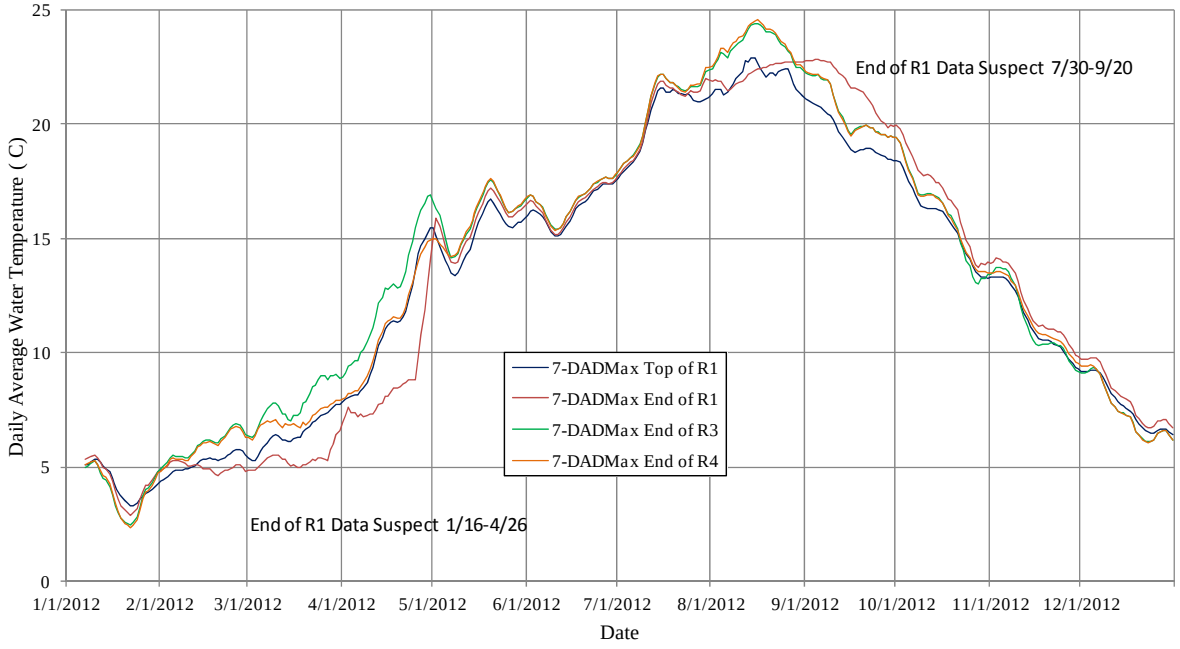
4.4 Chelan River 7-DADMax Water Temperatures Top Reach 1 to Bottom Reach 4.

Washington State water quality standards for temperature establish criteria based on the 7-DADMax (seven day average of daily maximum temperature). The 7-DADMax criterion for the Chelan River is currently 17.5 °C (see Section 5, Table 5-1), with an allowable human effect of 0.3 °C above natural conditions. Natural conditions have not been defined for the Chelan River due to its current status of a river in the initial stages of restoration. However, the temperature of water exiting Lake Chelan is the initial water temperature at the beginning of the Chelan River. This water is either provided exclusively from the Low Level Outlet, which draws the coolest water available at the face of the Chelan Dam, or is from a mix of water from the spillway and the Low Level Outlet. As water flows through the Chelan River, it either heats or cools, depending on the time of year, since water exiting Lake Chelan is thermally buffered from daily and seasonal environmental influences. The 7-DADMax from the fall through early spring may be warmer at the upper Chelan River (top of Reach 1) than at the lower end where it merges with the tailrace (end of Reach 4). As solar radiation and warmer air temperatures increase from spring through summer, the 7-DADMax will increase as water flows down the Chelan River. The 7-DADMax may be nearly identical at different locations, indicating that the water temperature had reach equilibrium with the external sources of heat gain or loss prior to reaching the downstream monitoring locations.

The 7-DADMax water temperatures from four locations, top of Reach 1, end of Reach 1, end of Reach 3 and end of the Reach 4 Habitat Channel are shown in Figure 4-4. During the periods when flows in Reach 4 are increased for Chinook and steelhead spawning, the water temperatures measured at the end of the Reach 4 Habitat Channel reflects the mix of water from

the tailrace and water exiting Reach 3. The difference in temperature is pronounced during the spring when steelhead spawning flows are provided by the pumping station (March 15 – May 15). Prior to and after the spring pumping period, the 7-DADMax at the end of Reach 3 and at the end of the Reach 4 Habitat Channel are nearly identical (Figure 4-4). The 7-DADMax at the top of Reach 1 exceeded the 17.5 °C criterion from July 1 – October 5, reaching a peak of 22.9 °C on August 14-15. The 7-DADMax at the end of Reach 4 exceeded the criterion by 0.1 °C on May 20, but then cooled, again exceeding the criterion from June 25 – October 6. The highest 7-DADMax reached 24.6 on August 15-16 °C. The highest 7-DADMax at the end of Reach 3 was 24.4 °C. The water temperature measurements at the end of Reach 1 appeared to be affected by hyporheic flows during August of 2012, so the actual 7-DADMax for that location is unknown. The temperature monitoring sited for the end of Reach 1 has been relocated (April 2013) further from the shoreline to assure that the site is measuring surface flows.

Figure 4-4. The 7-DADMax for Reaches 1 – 4.



SECTION 5: WATER QUALITY ASSESSMENT

General water quality assessment data was collected in 2012 to address the requirement that Chelan PUD conduct general water quality assessments in years 6 (2012) and 8 (2014) sufficient to demonstrate that the Chelan River meets water quality standards for dissolved oxygen, total dissolved gas, turbidity and pH. The 401 Certification specifies that this information is to be collected in Reach 4 for dissolved oxygen, turbidity and pH, whereas the total dissolved gas measurements are to be made in Reach 1 below the spillway of the Chelan Dam. Water quality criteria currently applicable to the Chelan River, which has designated aquatic life uses of salmonid spawning, rearing and migration, are shown in Table 5-1.

Table 5-1. Water Quality Criteria for Salmonid Spawning, Rearing and Migration.

	Water Temperature	Dissolved Oxygen	pH	Turbidity	Total Dissolved Gas
Criteria	7-DADMax <=17.5 °C	1 Day Min. 8.0 mg/l	6.5-8.5 Units	-	110 % Saturation
Allowable Human Effect	0.3 °C above natural conditions	0.2 mg/l	< 0.5 Units	5 NTU when Background <= 50 NTU	None

5.1 Assessment of Dissolved Oxygen, pH and Turbidity in Reach 4 Habitat Channel.

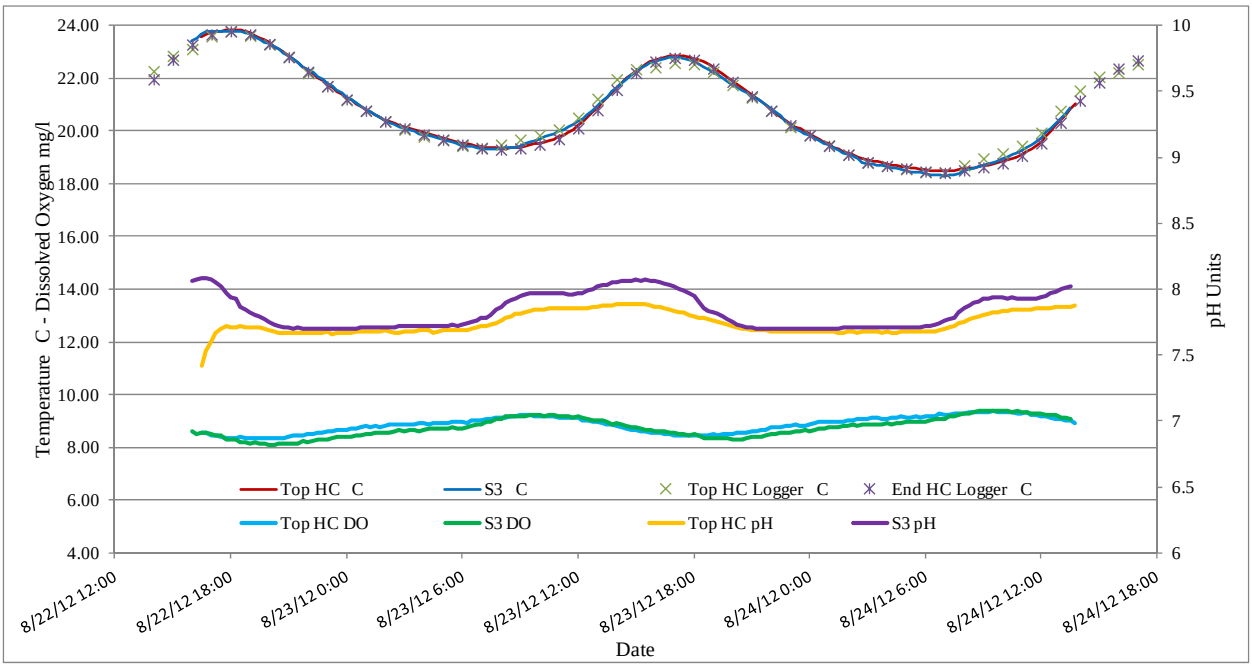
Measurements of water temperature, dissolved oxygen and pH were obtained from two locations in the Reach 4 Habitat Channel during August 22-24 and October 8-10 of 2012. Measurements were obtained using Hydrolab MS5 Minisondes that were programmed to record data every 15 minutes. One Minisonde was attached to the same anchor post that is used for the temperature recording data logger at the upper end of the Habitat Channel. The other Minisonde was attached to an anchor post that was placed in mid channel in the second pool up from the downstream end of the habitat channel (Figure 5-1).

Figure 5-1. Location of Water Quality Monitoring in Reach 4 Habitat Channel.

The dissolved oxygen and pH data collected were within the criteria specified for the current designated uses for the Chelan River (Table 5-1).The temperature, dissolved oxygen and pH data collected with the Minisondes are shown in Figures 5-2 and 5-3. The hourly temperature data regularly collected from the upper and lower end of the Reach 4 Habitat Channel are also shown in these figures. The water temperatures in the Chelan River do not meet the criteria for salmonid spawning, rearing and migration during the summer and the warmest temperatures are usually present during July and August. The dissolved oxygen levels in Figure 5-2 demonstrate, however, that despite water temperatures approaching 24 °C the dissolved oxygen level still met the water quality criterion of 8.0 mg/l. The approximate dissolved oxygen level of water at 100% saturation for a water temperature of 24 °C, adjusted for average barometric pressure at the elevation of the Reach 4 Habitat Channel, is 8.17 mg/l. Thus, the dissolved oxygen levels measured in August were near full saturation at the lowest point shown in Figure 5-2.

The water clarity in the Chelan River is very high throughout the year, except during high spill levels. A single turbidity measurement was taken on October 12, 2013, and the turbidity was 0.04 NTU. The water clarity in August was not visibly any less clear than in October. There is no background turbidity against which to compare the turbidity in the Reach 4 Habitat Channel since there is no construction activity and there are no active erosion sites within the Habitat Channel.

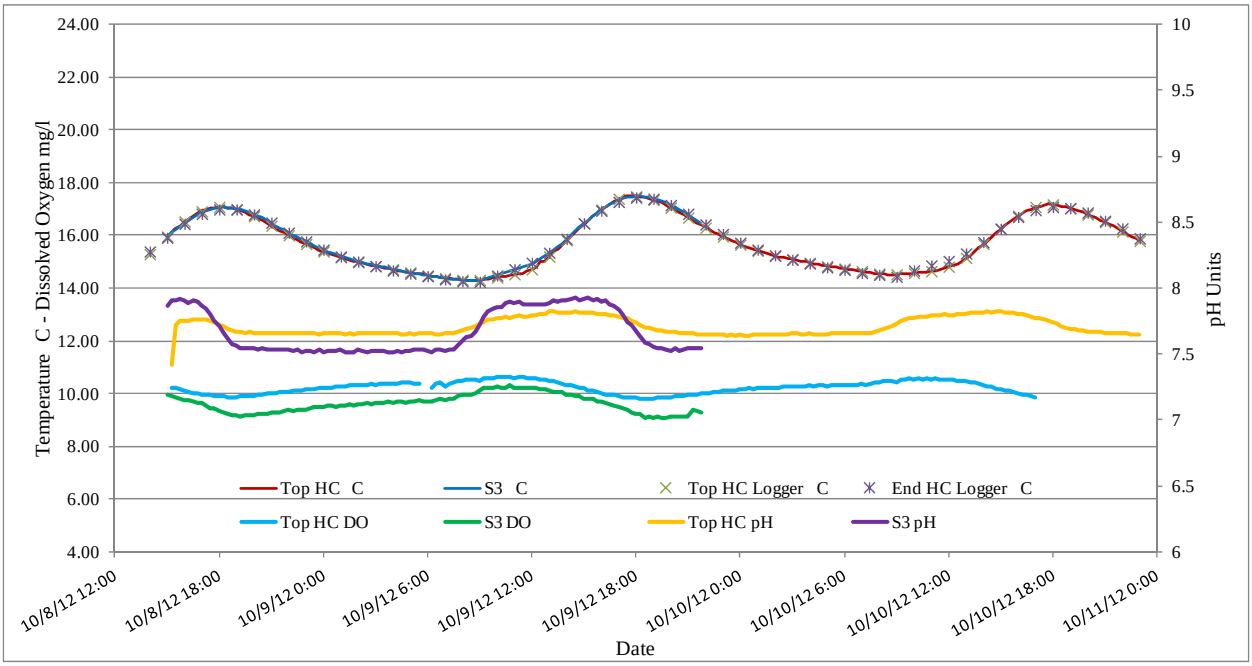
Figure 5-2. August Water Quality Data in Reach 4 Habitat Channel.



5.2 Assessment of Total Dissolved Gas in Reach 1 Below Chelan Dam Spillway.

There were no measurements for total dissolved gas taken below the Chelan Dam spillway in 2012. Total dissolved gas monitoring will be conducted in 2013 during spill.

Figure 5-3. October Water Quality Data in Reach 4 Habitat Channel.



SECTION 6: SUMMARY

Flow releases were provided throughout the year from the Low Level Outlet for minimum flows of at least 80 cfs in Reaches 1-3. The runoff forecast for 2012 indicated a wet water year, thus minimum flow releases to Reaches 1-3 were at least 320 cfs from May 15 – July 15. Additional flow was provided from the Pump Station to the Reach 4 habitat channel for salmon and steelhead spawning during their respective spawning periods (October 15 – November 30 and March 15 – May 15). There was one deviation below minimum flow requirements in 2012 due to a control system malfunction. Corrective measures were taken to prevent further occurrences. The FERC determined that the deviation did not constitute a violation of Article 405 of the license.

Flows were released from the Low Level Outlet and spillway as needed for lake level control, beginning May 1 and May 23, respectively. Flows for lake level control continued until August 10. These flow releases were managed to meet lake level target elevations and to avoid high spill levels that could damage the Reach 4 habitat channel. Flow releases for lake level control peaked at 6057 cfs daily average on July 16, with an hourly peak flow of 7030 for a few hours on July 15. Flow releases from the spillway and Low Level Outlet were also managed to provide one weekend whitewater boating event on September 15-16. Flows were ramped back down to minimum flows following the event, with ramping concluded on September 17.

In 2012, Chelan PUD implemented operating criteria for compliance with the two inches per hour ramping rates that were refined in 2011 and managed flow releases using those operating criteria in conjunction with onsite monitoring of actual water level changes. The refined criteria performed well during the adjustments of spill flows that occurred from late May – early August and when ramping down from flows provided for whitewater boating in September. One additional refinement was made based on observation, and implemented in 2012.

There were 192 salmon redds with eggs incubating in the tailrace from spawning that occurred in 2011. Powerhouse operations for Chinook redd protection were studied to determine the maximum time period that powerhouse outages could last while still maintaining adequate oxygen levels in Chinook salmon redds. There were a number of partial day outages scheduled from January 1 – 31 and February 24 – March 9 to test the intragravel oxygen response in Chinook redds and to conserve water to maintain lake levels. The powerhouse generally ran continuously with both units in operation from February 1 – 24 and March 10 – 25. From March 26 through April 22, except for brief periods for removal of dissolved oxygen study equipment (3/26-28), at least one powerhouse unit at minimum generation (approximately 800 cfs) was kept in operation to maintain oxygen levels in Chinook salmon redds. The studies had demonstrated that minimum generation levels were sufficient to maintain oxygen levels. On April 9 the accumulated temperature units for emergence of Chinook salmon fry had been reached for the final Chinook spawning activity observed the previous November.

During the spawning period for steelhead, the powerhouse operated at minimum generation until April 22, was not operated again until May 1, then resumed intermittent operation through the rest of May. Steelhead spawning was observed in the Reach 4 habitat channel in 2012 between

late March and mid May, with 7 redds in the habitat channel and canal outlet pool. No steelhead redds were observed in the tailrace.

During the Chinook spawning period in 2012, powerhouse daily average flows were maintained above 2000 cfs from October 1 –December 15, with the exception of a few hours with flows between 1000 - 2000 cfs. A total count of 426 Chinook redds were estimated to have been deposited in the Chelan River Reach 4 (139), tailrace (231), and downstream in the Chelan/Columbia River confluence and Columbia River (56).

Water temperatures were monitored at seven locations in the Chelan River and tailrace. There were a few days from late July through September when water temperatures released from the Low Level Outlet appear to have been slightly cooler than the average water temperature arriving at Chelan Dam from the outlet of Lake Chelan. Water temperatures demonstrated small increases during transit from the upper end of Reach 1 to the end of Reach 3 during March – August, but cooling from September – December Water temperatures neither increased nor decreased during transit through the Reach 4 habitat channel. The peak daily average water temperatures measured from upstream to downstream locations were 23.1 °C at the Low Level Outlet, 22.4 °C at the bottom of Reach 4, and 23.4 °C in the tailrace. The highest hourly temperatures recorded at these locations were 23.6 °C, 24.9 °C and 24.2 °C, respectively. The highest 7-DADMax temperatures recorded were 22.9 °C at the top of Reach 1, 24.4 °C at the end of Reach 3 and 24.6 °C at the bottom of Reach 4.

Water quality measurements in the Reach 4 Habitat Channel during 2-3 days in August and October met the criteria for dissolved oxygen, pH and turbidity. There was no monitoring of total dissolved gas below the Chelan Dam spillway in 2012.

APPENDIX A: DAILY AVERAGE LAKE CHELAN ELEVATIONS, POWERHOUSE FLOWS, TAILWATER ELEVATIONS AND CHELAN RIVER FLOWS FROM SPILL, LOW LEVEL OUTLET AND PUMPING STATION

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spill Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
1/1/2012	1088.8	50	707.2	84	0	84	0	84
1/2/2012	1088.8	60	707.9	84	0	84	0	84
1/3/2012	1088.8	50	707.9	84	0	84	0	84
1/4/2012	1088.9	50	707.8	84	0	84	0	84
1/5/2012	1088.9	1445	708.4	83	0	83	0	83
1/6/2012	1088.8	1449	708.7	83	0	83	0	83
1/7/2012	1088.7	1442	709.0	83	0	83	0	83
1/8/2012	1088.7	51	708.3	84	0	84	0	84
1/9/2012	1088.7	1438	708.9	83	0	83	0	83
1/10/2012	1088.6	1350	708.8	83	0	83	0	83
1/11/2012	1088.5	1446	708.8	83	0	83	0	83
1/12/2012	1088.5	1443	709.0	83	0	83	0	83
1/13/2012	1088.4	1445	708.9	83	0	83	0	83
1/14/2012	1088.4	1440	708.9	83	0	83	0	83
1/15/2012	1088.3	79	708.5	83	0	83	0	83
1/16/2012	1088.3	820	709.0	83	0	83	0	83
1/17/2012	1088.3	829	708.9	83	0	83	0	83
1/18/2012	1088.2	1278	709.1	82	0	82	0	82
1/19/2012	1088.2	1620	709.1	82	0	82	0	82
1/20/2012	1088.1	1618	709.0	83	0	83	0	83
1/21/2012	1088.1	1617	708.8	84	0	84	0	84
1/22/2012	1088.0	48	708.3	85	0	85	0	85
1/23/2012	1088.0	1690	709.1	84	0	84	0	84
1/24/2012	1088.0	1778	709.4	84	0	84	0	84
1/25/2012	1088.0	1778	709.0	84	0	84	0	84
1/26/2012	1087.9	1735	709.0	84	0	84	0	84
1/27/2012	1087.8	1788	709.3	83	0	83	0	83
1/28/2012	1087.7	1765	708.9	83	0	83	0	83
1/29/2012	1087.6	45	707.7	84	0	84	0	84
1/30/2012	1087.6	1612	709.0	83	0	83	0	83
1/31/2012	1087.6	1255	708.8	83	0	83	0	83
2/1/2012	1087.5	2350	709.2	82	0	82	0	82
2/2/2012	1087.4	2325	709.3	82	0	82	0	82
2/3/2012	1087.3	2350	709.1	83	0	83	0	83
2/4/2012	1087.2	2351	709.1	83	0	83	0	83
2/5/2012	1087.1	2324	709.1	83	0	83	0	83
2/6/2012	1087.0	2343	709.2	82	0	82	0	82
2/7/2012	1086.9	2366	709.5	82	0	82	0	82
2/8/2012	1086.7	2358	709.2	82	0	82	0	82
2/9/2012	1086.6	2360	709.3	82	0	82	0	82
2/10/2012	1086.5	2370	709.4	82	0	82	0	82
2/11/2012	1086.4	2364	709.1	82	0	82	0	82
2/12/2012	1086.3	2362	709.0	81	0	81	0	81
2/13/2012	1086.2	2368	709.4	82	0	82	0	82
2/14/2012	1086.1	2363	709.2	83	0	83	0	83
2/15/2012	1085.9	2372	709.4	82	0	82	0	82
2/16/2012	1085.8	2370	709.3	82	0	82	0	82
2/17/2012	1085.7	2352	709.4	82	0	82	0	82
2/18/2012	1085.6	2298	709.1	83	0	83	0	83
2/19/2012	1085.5	2302	709.0	83	0	83	0	83

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spill Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
2/20/2012	1085.4	2307	709.4	82	0	82	0	82
2/21/2012	1085.3	2305	709.2	83	0	83	0	83
2/22/2012	1085.2	2300	709.1	84	0	84	0	84
2/23/2012	1085.1	2310	709.0	84	0	84	0	84
2/24/2012	1085.0	1626	708.7	84	0	84	0	84
2/25/2012	1085.0	2378	709.0	83	0	83	0	83
2/26/2012	1084.9	2306	708.9	82	0	82	0	82
2/27/2012	1084.8	734	708.2	83	0	83	0	83
2/28/2012	1084.8	241	708.0	83	0	83	0	83
2/29/2012	1084.8	209	708.5	83	0	83	0	83
3/1/2012	1084.9	305	708.7	83	0	83	0	83
3/2/2012	1084.9	274	708.6	84	0	84	0	84
3/3/2012	1084.9	624	708.5	83	0	83	0	83
3/4/2012	1084.9	812	708.1	83	0	83	0	83
3/5/2012	1084.9	814	708.6	83	0	83	118	200
3/6/2012	1084.9	566	708.8	83	0	83	255	338
3/7/2012	1084.9	481	708.8	83	0	83	242	325
3/8/2012	1084.9	480	709.2	83	0	83	192	275
3/9/2012	1084.9	867	708.8	83	0	83	119	202
3/10/2012	1084.9	2323	709.1	82	0	82	0	82
3/11/2012	1084.8	2315	709.2	82	0	82	0	82
3/12/2012	1084.7	2352	709.5	82	0	82	0	82
3/13/2012	1084.6	2386	709.3	83	0	83	0	83
3/14/2012	1084.5	2400	709.5	83	0	83	123	206
3/15/2012	1084.5	2396	709.7	83	0	83	258	341
3/16/2012	1084.4	2404	709.3	84	0	84	257	341
3/17/2012	1084.3	2383	708.9	85	0	85	255	340
3/18/2012	1084.2	2391	708.9	84	0	84	255	339
3/19/2012	1084.1	2399	709.2	83	0	83	256	340
3/20/2012	1084.0	2408	709.8	83	0	83	258	340
3/21/2012	1083.9	2413	710.2	82	0	82	260	342
3/22/2012	1083.8	2415	710.2	82	0	82	260	342
3/23/2012	1083.7	2416	710.2	82	0	82	260	343
3/24/2012	1083.5	2420	710.3	82	0	82	261	343
3/25/2012	1083.4	2413	709.9	82	0	82	260	342
3/26/2012	1083.3	1220	709.9	82	0	82	259	341
3/27/2012	1083.3	602	710.2	82	0	82	261	343
3/28/2012	1083.4	664	710.5	82	0	82	260	342
3/29/2012	1083.4	792	710.1	82	0	82	258	340
3/30/2012	1083.5	792	710.5	83	0	83	259	342
3/31/2012	1083.5	786	710.7	83	0	83	261	343
4/1/2012	1083.5	788	708.7	83	0	83	253	336
4/2/2012	1083.5	793	709.9	83	0	83	258	341
4/3/2012	1083.5	792	710.3	83	0	83	258	341
4/4/2012	1083.6	1022	710.1	83	0	83	257	340
4/5/2012	1083.6	1085	710.4	83	0	83	258	341
4/6/2012	1083.5	1000	710.4	83	0	83	258	341
4/7/2012	1083.5	791	710.3	83	0	83	258	341
4/8/2012	1083.5	789	710.1	85	0	85	257	342
4/9/2012	1083.5	796	710.6	85	0	85	258	342

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spill Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
4/10/2012	1083.5	797	710.5	85	0	85	257	342
4/11/2012	1083.5	799	710.3	86	0	86	256	342
4/12/2012	1083.6	791	710.4	86	0	86	258	344
4/13/2012	1083.6	788	710.4	86	0	86	258	344
4/14/2012	1083.7	794	709.9	87	0	87	257	343
4/15/2012	1083.8	797	710.1	87	0	87	257	344
4/16/2012	1083.8	794	710.1	86	0	86	257	342
4/17/2012	1083.9	798	710.5	85	0	85	258	343
4/18/2012	1084.0	793	710.2	86	0	86	258	343
4/19/2012	1084.0	799	710.7	86	0	86	259	344
4/20/2012	1084.1	794	710.9	86	0	86	258	345
4/21/2012	1084.2	797	710.6	87	0	87	258	345
4/22/2012	1084.3	795	710.8	87	0	87	259	346
4/23/2012	1084.5	243	710.7	89	0	89	258	347
4/24/2012	1084.8	9	711.2	91	0	91	258	350
4/25/2012	1085.3	10	710.5	93	0	93	257	350
4/26/2012	1085.8	14	710.1	96	0	96	255	350
4/27/2012	1086.3	10	710.5	97	0	97	256	353
4/28/2012	1086.7	10	709.9	99	0	99	254	353
4/29/2012	1087.1	10	710.8	100	0	100	256	356
4/30/2012	1087.4	10	711.8	102	0	102	258	359
5/1/2012	1087.7	818	711.7	316	0	316	122	438
5/2/2012	1088.0	1802	712.4	467	0	467	0	467
5/3/2012	1088.1	1694	712.1	473	0	473	0	473
5/4/2012	1088.2	809	712.1	453	0	453	0	453
5/5/2012	1088.4	104	711.5	421	0	421	0	421
5/6/2012	1088.5	1614	711.7	421	0	421	0	421
5/7/2012	1088.6	2370	711.6	409	0	409	0	409
5/8/2012	1088.6	1834	711.7	391	0	391	0	391
5/9/2012	1088.8	570	711.8	393	0	393	0	393
5/10/2012	1089.0	1867	712.1	394	0	394	0	394
5/11/2012	1089.1	2356	711.3	395	0	395	0	395
5/12/2012	1089.2	2349	710.8	395	0	395	0	395
5/13/2012	1089.3	2011	710.7	396	0	396	0	396
5/14/2012	1089.4	1980	711.1	397	0	397	0	397
5/15/2012	1089.7	2245	711.0	393	0	393	0	393
5/16/2012	1090.2	1691	710.4	393	0	393	0	393
5/17/2012	1090.8	392	711.4	396	0	396	0	396
5/18/2012	1091.2	1190	711.3	399	0	399	0	399
5/19/2012	1091.4	1885	712.0	401	0	401	0	401
5/20/2012	1091.7	1415	711.9	403	0	403	0	403
5/21/2012	1091.9	1663	711.9	404	0	404	0	404
5/22/2012	1092.2	1560	711.2	407	0	407	0	407
5/23/2012	1092.5	1558	711.1	409	402	811	0	811
5/24/2012	1092.7	1846	711.8	410	619	1029	0	1029
5/25/2012	1092.9	1547	711.6	411	583	993	0	993
5/26/2012	1093.0	1947	711.8	412	249	661	0	661
5/27/2012	1093.2	1542	710.1	413	102	515	0	515
5/28/2012	1093.4	2282	710.1	414	102	516	0	516
5/29/2012	1093.6	1746	710.9	437	45	482	0	482

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spill Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
5/30/2012	1093.8	1834	710.9	459	0	459	0	459
5/31/2012	1094.0	2220	710.9	461	0	461	0	461
6/1/2012	1094.2	2268	711.1	463	1853	2316	0	2316
6/2/2012	1094.5	2284	710.9	464	3614	4078	0	4078
6/3/2012	1094.7	2283	711.2	466	3714	4180	0	4180
6/4/2012	1094.8	2278	711.2	467	3759	4226	0	4226
6/5/2012	1094.9	2273	711.0	468	3813	4281	0	4281
6/6/2012	1094.9	1684	712.0	469	3842	4311	0	4311
6/7/2012	1094.9	2100	712.3	469	3589	4058	0	4058
6/8/2012	1094.9	804	712.3	277	3052	3328	0	3328
6/9/2012	1095.0	10	711.9	78	2994	3072	0	3072
6/10/2012	1095.1	10	711.7	77	3032	3110	0	3110
6/11/2012	1095.1	1838	712.2	78	3029	3106	0	3106
6/12/2012	1095.1	1085	712.1	77	2567	2645	0	2645
6/13/2012	1095.3	1414	711.9	78	2023	2101	0	2101
6/14/2012	1095.5	1519	711.8	78	2422	2500	0	2500
6/15/2012	1095.7	1560	711.4	78	3145	3223	0	3223
6/16/2012	1095.8	1093	712.1	78	3168	3246	0	3246
6/17/2012	1096.0	20	711.8	78	3240	3319	0	3319
6/18/2012	1096.4	1359	712.0	79	3218	3297	0	3297
6/19/2012	1096.7	1631	711.8	80	3169	3249	0	3249
6/20/2012	1096.7	2296	713.1	80	3164	3244	0	3244
6/21/2012	1096.8	2293	713.1	80	3158	3238	0	3238
6/22/2012	1096.9	1640	713.1	80	3085	3164	0	3164
6/23/2012	1097.1	2275	712.2	80	3070	3151	0	3151
6/24/2012	1097.4	20	713.2	80	3124	3204	0	3204
6/25/2012	1097.7	1728	714.5	81	3165	3246	0	3246
6/26/2012	1097.8	1316	714.5	81	2876	2957	0	2957
6/27/2012	1097.8	2290	714.1	82	2711	2793	0	2793
6/28/2012	1097.9	2290	714.7	82	2717	2799	0	2799
6/29/2012	1098.0	2259	714.0	82	2729	2812	0	2812
6/30/2012	1098.1	2270	714.1	82	2968	3050	0	3050
7/1/2012	1098.2	1925	713.6	82	3732	3814	0	3814
7/2/2012	1098.4	2272	713.6	81	3844	3926	0	3926
7/3/2012	1098.5	1562	714.1	81	4453	4534	0	4534
7/4/2012	1098.4	2239	713.8	81	4912	4993	0	4993
7/5/2012	1098.3	2287	714.0	81	5368	5449	0	5449
7/6/2012	1098.1	2277	713.7	81	5598	5679	0	5679
7/7/2012	1098.1	2266	712.9	81	4136	4217	0	4217
7/8/2012	1098.2	2262	712.9	81	2557	2638	0	2638
7/9/2012	1098.5	1898	713.1	81	1435	1516	0	1516
7/10/2012	1098.9	1773	713.1	81	1138	1219	0	1219
7/11/2012	1099.2	2215	712.8	81	955	1036	0	1036
7/12/2012	1099.5	2255	712.8	81	963	1044	0	1044
7/13/2012	1099.7	2203	713.3	81	2505	2586	0	2586
7/14/2012	1099.8	2326	713.5	81	4272	4353	0	4353
7/15/2012	1099.9	2312	713.5	81	5521	5602	0	5602
7/16/2012	1099.8	2304	713.6	81	5976	6057	0	6057
7/17/2012	1099.8	2225	713.1	81	4292	4373	0	4373
7/18/2012	1099.9	2273	712.7	166	3479	3645	0	3645

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spill Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
7/19/2012	1099.9	2387	713.3	250	3314	3564	0	3564
7/20/2012	1099.9	2289	713.5	250	3904	4154	0	4154
7/21/2012	1099.8	2324	713.3	250	3537	3787	0	3787
7/22/2012	1099.9	2310	713.0	250	1448	1698	0	1698
7/23/2012	1099.9	2315	712.9	250	1010	1260	0	1260
7/24/2012	1099.9	2445	712.7	386	503	890	0	890
7/25/2012	1099.9	2517	712.3	377	98	476	0	476
7/26/2012	1099.9	2479	711.8	202	51	253	0	253
7/27/2012	1100.0	2488	712.0	320	791	1111	0	1111
7/28/2012	1099.9	2501	711.9	400	1455	1855	0	1855
7/29/2012	1099.9	2500	711.3	282	23	305	0	305
7/30/2012	1100.0	2475	711.6	200	0	200	0	200
7/31/2012	1100.0	2508	711.4	361	423	784	0	784
8/1/2012	1099.9	2507	711.4	363	101	464	0	464
8/2/2012	1099.9	2501	711.1	242	0	242	0	242
8/3/2012	1099.8	2482	710.7	166	0	166	0	166
8/4/2012	1099.8	2486	711.2	140	0	140	0	140
8/5/2012	1099.8	2476	710.8	140	0	140	0	140
8/6/2012	1099.8	2486	711.0	140	0	140	0	140
8/7/2012	1099.9	2484	710.8	140	0	140	0	140
8/8/2012	1099.9	2482	710.7	140	0	140	0	140
8/9/2012	1099.9	2480	710.7	140	0	140	0	140
8/10/2012	1099.8	2479	711.0	122	0	122	0	122
8/11/2012	1099.8	2500	710.6	82	0	82	0	82
8/12/2012	1099.7	2492	710.5	82	0	82	0	82
8/13/2012	1099.7	2492	710.5	83	0	83	0	83
8/14/2012	1099.6	2509	710.4	83	0	83	0	83
8/15/2012	1099.6	2496	709.7	83	0	83	0	83
8/16/2012	1099.5	1623	710.5	83	0	83	0	83
8/17/2012	1099.6	1479	710.1	83	0	83	0	83
8/18/2012	1099.6	1676	710.1	84	0	84	0	84
8/19/2012	1099.5	2462	710.6	84	0	84	0	84
8/20/2012	1099.5	1729	710.1	84	0	84	0	84
8/21/2012	1099.5	1734	710.3	84	0	84	0	84
8/22/2012	1099.5	1878	710.2	84	0	84	0	84
8/23/2012	1099.5	1884	710.1	84	0	84	0	84
8/24/2012	1099.4	1813	709.9	84	0	84	0	84
8/25/2012	1099.3	1774	709.6	84	0	84	0	84
8/26/2012	1099.2	1977	709.6	84	0	84	0	84
8/27/2012	1099.2	1825	708.9	84	0	84	0	84
8/28/2012	1099.1	1514	709.5	84	0	84	0	84
8/29/2012	1099.1	311	709.3	84	0	84	0	84
8/30/2012	1099.1	317	709.6	84	0	84	0	84
8/31/2012	1099.1	321	709.2	84	0	84	0	84
9/1/2012	1099.2	337	707.7	84	0	84	0	84
9/2/2012	1099.1	267	708.1	84	0	84	0	84
9/3/2012	1099.1	342	708.8	84	0	84	0	84
9/4/2012	1099.1	1654	709.7	84	0	84	0	84
9/5/2012	1099.1	1639	709.2	84	0	84	0	84
9/6/2012	1099.0	1668	708.9	84	0	84	0	84

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spill Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
9/7/2012	1098.9	1607	709.2	84	0	84	0	84
9/8/2012	1098.9	1601	709.0	84	0	84	0	84
9/9/2012	1098.9	735	708.3	84	0	84	0	84
9/10/2012	1098.8	1673	708.9	84	0	84	0	84
9/11/2012	1098.7	1639	709.1	84	0	84	0	84
9/12/2012	1098.6	1640	709.0	84	0	84	0	84
9/13/2012	1098.6	1618	709.2	84	0	84	0	84
9/14/2012	1098.5	1573	709.0	84	0	84	0	84
9/15/2012	1098.4	1603	708.9	248	0	248	0	248
9/16/2012	1098.4	546	708.3	347	0	347	0	347
9/17/2012	1098.3	1648	708.8	178	0	178	0	178
9/18/2012	1098.2	1660	709.0	83	0	83	0	83
9/19/2012	1098.2	1616	708.9	83	0	83	0	83
9/20/2012	1098.1	1664	709.2	83	0	83	0	83
9/21/2012	1098.0	1530	709.0	83	0	83	0	83
9/22/2012	1098.0	1637	708.8	83	0	83	0	83
9/23/2012	1097.9	10	708.3	83	0	83	0	83
9/24/2012	1097.9	1672	708.9	83	0	83	0	83
9/25/2012	1097.9	1609	708.5	83	0	83	0	83
9/26/2012	1097.8	1605	708.3	83	0	83	0	83
9/27/2012	1097.7	1593	708.5	83	0	83	0	83
9/28/2012	1097.7	1503	708.4	83	0	83	0	83
9/29/2012	1097.6	1649	708.2	83	0	83	0	83
9/30/2012	1097.5	1669	708.3	83	0	83	0	83
10/1/2012	1097.4	2408	709.0	83	0	83	0	83
10/2/2012	1097.3	2450	708.9	83	0	83	0	83
10/3/2012	1097.2	2415	708.9	83	0	83	0	83
10/4/2012	1097.0	2355	708.9	84	0	84	0	84
10/5/2012	1096.9	2430	708.9	83	0	83	0	83
10/6/2012	1096.8	2378	708.9	83	0	83	0	83
10/7/2012	1096.6	2385	709.0	83	0	83	0	83
10/8/2012	1096.5	2387	709.1	83	0	83	0	83
10/9/2012	1096.4	2388	709.0	83	0	83	2	85
10/10/2012	1096.2	2395	709.0	83	0	83	0	83
10/11/2012	1096.1	2404	709.0	83	0	83	0	83
10/12/2012	1096.0	2394	708.8	83	0	83	0	83
10/13/2012	1095.9	2403	708.9	83	0	83	0	83
10/14/2012	1095.8	2398	708.8	83	0	83	0	83
10/15/2012	1095.7	2395	708.8	83	0	83	254	337
10/16/2012	1095.8	2383	708.8	83	0	83	253	336
10/17/2012	1095.7	2394	708.8	83	0	83	255	338
10/18/2012	1095.6	2421	708.8	83	0	83	255	338
10/19/2012	1095.5	2445	708.9	83	0	83	254	337
10/20/2012	1095.6	2453	709.1	83	0	83	255	338
10/21/2012	1095.4	2445	709.1	83	0	83	256	339
10/22/2012	1095.3	2461	709.2	83	0	83	257	340
10/23/2012	1095.2	2455	709.3	83	0	83	257	340
10/24/2012	1095.1	2463	709.0	83	0	83	256	339
10/25/2012	1095.1	2464	709.4	83	0	83	256	339
10/26/2012	1095.0	2463	709.4	83	0	83	257	340

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spill Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
10/27/2012	1094.9	2463	709.1	83	0	83	256	339
10/28/2012	1094.8	2460	709.0	83	0	83	256	339
10/29/2012	1094.8	2453	708.9	83	0	83	254	337
10/30/2012	1094.8	2455	708.9	83	0	83	255	338
10/31/2012	1094.9	2452	709.1	83	0	83	256	338
11/1/2012	1095.0	2447	709.1	83	0	83	255	339
11/2/2012	1095.0	2463	709.5	83	0	83	257	340
11/3/2012	1095.0	2454	709.1	83	0	83	255	338
11/4/2012	1095.1	2456	709.1	83	0	83	255	338
11/5/2012	1095.2	2463	709.4	84	0	84	256	340
11/6/2012	1095.3	2460	709.3	86	0	86	256	342
11/7/2012	1095.3	2454	709.2	86	0	86	254	341
11/8/2012	1095.3	2459	709.3	86	0	86	256	342
11/9/2012	1095.2	2462	709.4	85	0	85	256	341
11/10/2012	1095.2	2464	709.4	85	0	85	256	341
11/11/2012	1095.1	2468	709.5	84	0	84	257	341
11/12/2012	1095.1	2455	709.0	84	0	84	254	339
11/13/2012	1095.0	2467	709.2	84	0	84	254	338
11/14/2012	1094.9	2471	709.4	83	0	83	255	338
11/15/2012	1094.9	2426	709.3	82	0	82	255	338
11/16/2012	1094.8	2328	709.4	82	0	82	255	337
11/17/2012	1094.7	2408	709.7	82	0	82	256	338
11/18/2012	1094.6	2397	709.5	82	0	82	255	337
11/19/2012	1094.6	2397	709.5	82	0	82	255	337
11/20/2012	1094.6	2395	709.1	82	0	82	255	337
11/21/2012	1094.6	2419	708.8	82	0	82	253	335
11/22/2012	1094.5	2476	709.2	82	0	82	255	337
11/23/2012	1094.5	2458	709.3	81	0	81	256	337
11/24/2012	1094.4	2473	709.5	81	0	81	256	338
11/25/2012	1094.3	2463	709.5	81	0	81	256	337
11/26/2012	1094.2	2463	709.2	83	0	83	255	338
11/27/2012	1094.1	2462	709.1	84	0	84	255	339
11/28/2012	1094.0	2417	709.5	84	0	84	256	339
11/29/2012	1093.9	2455	709.7	83	0	83	256	340
11/30/2012	1093.8	2460	709.5	83	0	83	256	339
12/1/2012	1093.8	2456	709.6	83	0	83	96	179
12/2/2012	1093.7	2460	709.6	83	0	83	0	83
12/3/2012	1093.6	2298	709.5	83	0	83	0	83
12/4/2012	1093.6	2395	709.4	83	0	83	0	83
12/5/2012	1093.5	2427	709.9	82	0	82	0	82
12/6/2012	1093.5	2413	709.4	82	0	82	0	82
12/7/2012	1093.4	2302	709.9	82	0	82	0	82
12/8/2012	1093.3	2170	709.9	82	0	82	0	82
12/9/2012	1093.2	2404	709.9	82	0	82	0	82
12/10/2012	1093.1	2427	710.2	83	0	83	0	83
12/11/2012	1093.0	2421	710.3	85	0	85	0	85
12/12/2012	1092.9	2406	710.3	85	0	85	0	85
12/13/2012	1092.8	2380	710.2	85	0	85	0	85
12/14/2012	1092.7	2363	709.7	85	0	85	0	85
12/15/2012	1092.6	2365	710.4	84	0	84	0	84

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spill Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
12/16/2012	1092.5	1870	709.8	84	0	84	0	84
12/17/2012	1092.5	1857	710.2	84	0	84	0	84
12/18/2012	1092.4	1815	709.7	84	0	84	0	84
12/19/2012	1092.4	1805	709.5	82	0	82	0	82
12/20/2012	1092.3	1833	709.5	83	0	83	0	83
12/21/2012	1092.3	2322	709.3	85	0	85	0	85
12/22/2012	1092.2	2330	709.5	85	0	85	0	85
12/23/2012	1092.1	2326	709.5	85	0	85	0	85
12/24/2012	1092.0	2330	709.5	85	0	85	0	85
12/25/2012	1091.9	2334	709.7	84	0	84	0	84
12/26/2012	1091.8	2337	710.1	84	0	84	0	84
12/27/2012	1091.7	2374	709.7	84	0	84	0	84
12/28/2012	1091.6	2448	710.3	83	0	83	0	83
12/29/2012	1091.5	2434	710.0	83	0	83	0	83
12/30/2012	1091.3	2445	709.7	85	0	85	0	85
12/31/2012	1091.2	2440	710.1	86	0	86	0	86

APPENDIX B: DAILY AVERAGE WATER TEMPERATURES

Date	Low Level Outlet Pipe -Auto- (Deg. C)	Top of Reach 1 -Logger- (Deg. C))	End of Reach 1 -Logger- (Deg. C)	End of Reach 3 -Logger- (Deg. C)	Top of R4 Habitat Channel -Logger- (Deg. C)	End of R4 Habitat Channel -Logger- (Deg. C)	Tailrace at Pump Intake -Auto- (Deg. C)	Tailrace at Pump Intake -Logger- (Deg. C)
1/1/2012	4.9	4.8	4.9	4.4	4.7	4.6	6.3	N/A
1/2/2012	4.7	4.6	4.7	4.2	4.6	4.4	6.2	5.2
1/3/2012	4.6	4.6	4.6	4.1	4.4	4.3	6.0	N/A
1/4/2012	4.7	4.7	5.0	4.8	5.0	4.9	6.1	N/A
1/5/2012	4.9	4.9	5.0	4.7	4.9	4.8	6.0	5.0
1/6/2012	5.2	5.1	5.1	4.7	5.0	4.9	6.1	5.1
1/7/2012	5.2	5.1	4.7	4.2	4.6	4.5	6.1	5.2
1/8/2012	5.3	5.3	5.3	4.9	5.2	5.1	6.6	5.5
1/9/2012	5.2	5.2	5.3	5.1	5.4	5.3	6.2	5.3
1/10/2012	5.3	5.2	4.9	4.6	4.9	4.8	6.2	5.3
1/11/2012	4.9	4.8	4.1	3.4	3.9	3.7	5.8	4.8
1/12/2012	4.5	4.4	3.7	2.7	3.4	3.2	5.3	4.4
1/13/2012	4.2	4.1	3.7	2.9	3.4	3.2	5.1	4.2
1/14/2012	4.4	4.3	4.0	3.5	3.8	3.7	5.3	4.4
1/15/2012	4.1	3.9	3.4	2.9	3.1	3.0	5.4	4.2
1/16/2012	3.3	3.2	2.7	2.2	2.3	2.2	4.4	3.4
1/17/2012	2.9	2.7	2.5	1.9	1.9	1.8	3.8	2.9
1/18/2012	3.0	2.8	1.5	0.8	0.7	0.6	3.8	2.8
1/19/2012	3.2	3.0	1.9	1.1	1.1	0.9	3.9	3.1
1/20/2012	3.1	3.0	2.2	1.6	1.6	1.5	3.8	3.0
1/21/2012	3.3	3.2	3.2	2.8	2.7	2.6	4.1	3.3
1/22/2012	3.3	3.2	3.0	2.8	2.8	2.7	4.6	3.5
1/23/2012	3.1	3.1	3.2	3.0	3.0	2.9	4.0	3.1
1/24/2012	3.6	3.6	3.3	3.1	3.1	3.0	4.4	3.6
1/25/2012	3.8	3.9	3.9	3.8	3.8	3.8	4.6	3.8
1/26/2012	4.1	4.1	3.9	3.9	3.9	3.9	4.9	4.1
1/27/2012	4.1	4.0	3.5	3.2	3.2	3.1	4.9	4.1
1/28/2012	3.9	3.9	3.5	3.3	3.3	3.2	4.7	3.9
1/29/2012	3.9	3.9	3.9	3.9	3.8	3.8	5.2	3.8
1/30/2012	4.1	4.2	4.3	4.5	4.4	4.4	5.0	4.2
1/31/2012	4.3	4.4	4.3	4.4	4.4	4.4	5.3	4.4
2/1/2012	4.7	4.8	4.5	4.8	4.7	4.8	5.4	4.8
2/2/2012	4.8	4.8	4.4	4.5	4.5	4.5	5.5	4.8
2/3/2012	4.8	4.7	4.1	4.2	4.2	4.2	5.5	4.8
2/4/2012	4.7	4.7	4.1	4.1	4.1	4.1	5.5	4.8
2/5/2012	4.7	4.7	4.0	4.0	4.0	4.0	5.4	4.7
2/6/2012	4.6	4.6	3.9	3.9	3.9	3.9	5.3	4.6
2/7/2012	4.6	4.6	3.9	3.9	3.9	3.8	5.3	4.6
2/8/2012	4.8	4.9	4.4	4.7	4.6	4.6	5.5	4.8
2/9/2012	4.8	4.9	4.4	4.9	4.9	4.9	5.6	4.9
2/10/2012	4.9	4.9	4.3	5.0	5.0	5.0	5.6	4.9
2/11/2012	5.1	5.2	4.6	5.6	5.5	5.6	5.8	5.1
2/12/2012	5.2	5.4	4.7	5.8	5.8	5.8	6.0	5.3
2/13/2012	5.4	5.5	4.6	5.8	5.8	5.8	6.2	5.5
2/14/2012	5.2	5.2	4.1	4.9	4.9	4.9	5.9	5.2
2/15/2012	5.0	5.0	4.0	4.7	4.7	4.7	5.8	5.1
2/16/2012	5.0	5.1	4.1	4.8	4.8	4.8	5.8	5.1
2/17/2012	5.0	5.1	4.0	5.0	5.0	5.0	5.8	5.0
2/18/2012	5.0	5.0	3.9	4.9	4.9	4.9	5.7	5.0
2/19/2012	5.0	5.1	3.9	4.9	4.9	4.9	5.8	5.0

Date	Low Level Outlet Pipe -Auto- (Deg. C)	Top of Reach 1 -Logger- (Deg. C))	End of Reach 1 -Logger- (Deg. C)	End of Reach 3 -Logger- (Deg. C)	Top of R4 Habitat Channel -Logger- (Deg. C)	End of R4 Habitat Channel -Logger- (Deg. C)	Tailrace at Pump Intake -Auto- (Deg. C)	Tailrace at Pump Intake -Logger- (Deg. C)
2/20/2012	5.1	5.2	4.1	5.4	5.3	5.4	5.9	5.1
2/21/2012	5.2	5.3	4.1	5.6	5.6	5.6	6.0	5.2
2/22/2012	5.4	5.6	4.4	6.1	6.1	6.1	6.3	5.6
2/23/2012	5.4	5.5	4.3	5.6	5.5	5.5	6.3	5.5
2/24/2012	5.5	5.7	4.4	5.8	5.7	5.7	6.4	5.6
2/25/2012	5.7	5.8	4.5	5.8	5.8	5.8	6.4	5.7
2/26/2012	5.4	5.5	4.3	5.2	5.1	5.1	6.2	5.4
2/27/2012	5.0	5.0	3.9	4.5	4.4	4.4	6.0	4.9
2/28/2012	4.8	4.9	3.8	4.4	4.3	4.3	5.9	4.7
2/29/2012	4.5	4.5	3.8	4.5	4.4	4.4	5.5	4.5
3/1/2012	4.6	4.7	4.0	4.9	4.7	4.7	5.7	4.7
3/2/2012	4.7	4.8	4.1	4.9	4.9	4.9	5.8	4.8
3/3/2012	5.2	5.4	4.4	5.8	5.7	5.7	6.2	5.3
3/4/2012	6.0	6.2	4.7	6.9	6.8	6.9	7.0	6.2
3/5/2012	6.3	6.6	4.6	6.7	6.5	6.6	7.4	6.4
3/6/2012	5.8	5.9	4.4	5.9	5.8	5.8	6.8	5.8
3/7/2012	5.7	5.8	4.5	5.8	5.7	5.7	6.6	5.7
3/8/2012	5.8	5.9	4.6	5.9	5.8	5.9	6.8	5.9
3/9/2012	5.8	5.9	4.6	5.9	5.9	6.0	6.8	5.9
3/10/2012	6.0	6.2	4.8	6.6	6.5	6.6	6.8	6.0
3/11/2012	6.1	6.2	4.8	6.6	6.6	6.6	6.9	6.1
3/12/2012	5.6	5.6	4.3	5.3	5.2	5.2	6.4	5.6
3/13/2012	5.7	5.8	4.5	6.3	6.1	6.1	6.5	5.8
3/14/2012	5.5	5.6	4.2	5.4	5.3	5.3	6.4	5.6
3/15/2012	5.7	5.8	4.4	6.2	5.8	5.9	6.5	5.8
3/16/2012	6.0	6.3	4.7	6.9	6.2	6.3	6.8	6.2
3/17/2012	6.3	6.4	4.5	6.6	6.4	6.4	7.0	6.3
3/18/2012	6.1	6.3	4.5	6.6	6.2	6.3	6.9	6.2
3/19/2012	6.3	6.5	4.6	6.7	6.4	6.4	7.1	6.4
3/20/2012	6.4	6.5	4.6	7.0	6.5	6.5	7.2	6.4
3/21/2012	6.2	6.4	4.6	6.6	6.3	6.3	7.0	6.3
3/22/2012	6.5	6.7	4.7	7.4	6.6	6.7	7.3	6.6
3/23/2012	6.5	6.7	4.7	7.3	6.7	6.7	7.4	6.6
3/24/2012	6.6	6.9	4.7	7.4	6.8	6.9	7.5	6.7
3/25/2012	6.8	7.0	4.7	7.7	7.0	7.1	7.7	6.9
3/26/2012	7.0	7.2	4.7	7.6	7.2	7.2	8.0	7.1
3/27/2012	6.9	7.0	4.7	7.0	7.0	7.0	7.9	7.0
3/28/2012	7.1	7.4	6.3	8.0	7.3	7.4	8.1	7.2
3/29/2012	7.5	7.7	7.1	8.1	7.6	7.7	8.5	7.5
3/30/2012	7.5	7.8	7.0	8.4	7.7	7.8	8.5	7.6
3/31/2012	7.4	7.5	6.3	7.7	7.5	7.5	8.4	7.4
4/1/2012	7.4	7.7	6.5	8.2	7.6	7.6	8.4	7.5
4/2/2012	7.4	7.7	6.3	8.1	7.6	7.6	8.5	7.5
4/3/2012	7.6	7.8	6.3	8.3	7.7	7.8	8.6	7.7
4/4/2012	7.5	7.8	6.2	8.3	7.6	7.7	8.5	7.6
4/5/2012	7.6	7.8	6.2	8.3	7.7	7.8	8.6	7.7
4/6/2012	7.8	8.0	6.1	8.3	7.9	7.9	8.7	7.8
4/7/2012	7.9	8.2	6.2	8.7	8.1	8.2	8.9	8.0
4/8/2012	8.4	8.7	6.3	9.0	8.5	8.6	9.4	8.5
4/9/2012	9.0	9.5	6.7	10.1	9.3	9.4	10.0	9.2

Date	Low Level Outlet Pipe -Auto- (Deg. C)	Top of Reach 1 -Logger- (Deg. C))	End of Reach 1 -Logger- (Deg. C)	End of Reach 3 -Logger- (Deg. C)	Top of R4 Habitat Channel -Logger- (Deg. C)	End of R4 Habitat Channel -Logger- (Deg. C)	Tailrace at Pump Intake -Auto- (Deg. C)	Tailrace at Pump Intake -Logger- (Deg. C)
4/10/2012	9.7	10.1	6.9	10.4	9.9	10.0	10.7	9.8
4/11/2012	9.9	10.3	7.0	10.5	10.1	10.2	10.9	10.1
4/12/2012	10.3	10.7	7.3	11.2	10.6	10.6	11.3	10.4
4/13/2012	10.6	11.0	7.4	11.4	10.8	10.9	11.5	10.7
4/14/2012	10.8	11.1	7.4	11.2	10.9	11.0	11.8	10.9
4/15/2012	10.6	11.0	7.7	11.5	10.8	10.9	11.6	10.7
4/16/2012	11.0	11.2	7.6	11.1	11.1	11.1	12.0	11.0
4/17/2012	10.4	10.7	7.6	10.9	10.5	10.6	11.4	10.5
4/18/2012	10.5	10.8	7.7	10.9	10.7	10.7	11.5	10.6
4/19/2012	10.4	10.7	7.7	10.7	10.5	10.5	11.4	10.5
4/20/2012	10.9	11.3	8.0	11.9	11.1	11.2	11.8	11.0
4/21/2012	11.3	11.8	8.1	12.4	11.6	11.7	12.2	11.4
4/22/2012	12.4	13.0	8.2	13.5	12.7	12.9	13.4	12.6
4/23/2012	13.3	13.9	8.3	14.5	13.8	13.9	14.5	13.8
4/24/2012	14.4	15.0	8.2	14.9	14.0	14.1	14.8	14.0
4/25/2012	15.0	15.4	8.2	14.9	14.0	14.1	14.8	14.0
4/26/2012	15.0	15.3	10.4	14.3	13.8	13.8	14.6	13.7
4/27/2012	14.3	14.4	13.5	14.1	13.5	13.5	14.3	13.4
4/28/2012	14.2	14.4	13.8	14.4	13.8	13.9	14.6	13.9
4/29/2012	14.8	15.1	14.3	15.1	14.5	14.5	15.2	14.5
4/30/2012	15.5	15.7	14.4	15.2	14.5	14.5	15.3	14.4
5/1/2012	14.4	14.4	13.8	13.9	14.0	14.0	14.7	13.8
5/2/2012	13.2	13.2	13.3	13.5	13.5	13.5	14.0	13.3
5/3/2012	12.1	12.1	12.1	12.3	12.3	12.2	12.9	12.2
5/4/2012	12.0	12.0	12.1	12.3	12.3	12.2	12.9	12.1
5/5/2012	12.3	12.3	12.4	12.5	12.5	12.5	13.1	12.4
5/6/2012	13.0	13.0	13.1	13.3	13.2	13.2	13.5	12.9
5/7/2012	13.3	13.3	13.5	13.8	13.7	13.7	13.8	13.4
5/8/2012	13.7	13.8	13.9	14.2	14.1	14.1	14.3	13.8
5/9/2012	14.3	14.3	14.1	14.3	14.3	14.2	15.0	14.3
5/10/2012	13.8	13.8	13.7	13.8	13.8	13.8	14.3	13.8
5/11/2012	13.7	13.7	13.7	13.9	13.9	13.9	14.2	13.7
5/12/2012	13.9	13.9	14.1	14.3	14.3	14.3	14.4	14.0
5/13/2012	14.2	14.3	14.5	14.8	14.7	14.7	14.8	14.3
5/14/2012	15.5	15.6	15.6	15.9	15.9	15.9	15.9	15.5
5/15/2012	16.8	16.9	16.8	17.2	17.1	17.1	17.1	16.8
5/16/2012	16.5	16.5	16.4	16.7	16.6	16.6	17.0	16.4
5/17/2012	16.4	16.4	16.3	16.5	16.5	16.5	17.1	16.4
5/18/2012	16.3	16.3	16.2	16.4	16.4	16.3	16.7	16.2
5/19/2012	15.9	15.9	16.0	16.2	16.2	16.2	16.4	16.0
5/20/2012	15.9	15.9	15.9	16.2	16.1	16.1	16.6	16.0
5/21/2012	15.7	15.7	15.6	15.9	15.9	15.8	16.2	15.7
5/22/2012	15.2	15.2	15.1	15.2	15.2	15.1	15.8	15.2
5/23/2012	15.0	15.0	15.0	15.1	15.1	15.1	15.5	15.0
5/24/2012	14.9	14.9	15.0	15.2	15.1	15.1	15.5	15.0
5/25/2012	14.9	14.9	15.0	15.2	15.2	15.2	15.5	15.0
5/26/2012	15.0	15.0	15.1	15.3	15.3	15.3	15.5	15.0
5/27/2012	15.4	15.5	15.6	15.8	15.8	15.8	16.1	15.5
5/28/2012	15.8	15.8	15.9	16.1	16.1	16.1	16.3	15.9
5/29/2012	15.8	15.8	15.8	15.9	15.9	15.8	16.3	15.8

Date	Low Level Outlet Pipe -Auto- (Deg. C)	Top of Reach 1 -Logger- (Deg. C))	End of Reach 1 -Logger- (Deg. C)	End of Reach 3 -Logger- (Deg. C)	Top of R4 Habitat Channel -Logger- (Deg. C)	End of R4 Habitat Channel -Logger- (Deg. C)	Tailrace at Pump Intake -Auto- (Deg. C)	Tailrace at Pump Intake -Logger- (Deg. C)
5/30/2012	15.6	15.6	15.6	15.8	15.8	15.8	16.1	15.6
5/31/2012	15.7	15.8	15.9	16.1	16.1	16.1	16.2	15.8
6/1/2012	16.0	16.0	16.1	16.3	16.3	16.3	16.4	16.0
6/2/2012	16.1	16.1	16.2	16.4	16.4	16.4	16.6	16.2
6/3/2012	16.0	16.0	16.0	16.2	16.2	16.2	16.5	16.0
6/4/2012	15.6	15.6	15.6	15.8	15.7	15.7	16.2	15.6
6/5/2012	15.3	15.3	15.3	15.5	15.5	15.5	15.9	15.4
6/6/2012	15.0	15.0	15.0	15.2	15.2	15.1	15.5	15.1
6/7/2012	14.6	14.6	14.5	14.7	14.7	14.7	15.0	14.6
6/8/2012	14.5	14.5	14.6	14.8	14.7	14.7	15.2	14.6
6/9/2012	14.6	14.5	14.6	14.8	14.7	14.7	15.5	14.7
6/10/2012	14.7	14.6	14.8	15.0	14.9	14.9	15.7	15.0
6/11/2012	15.1	15.1	15.2	15.4	15.4	15.4	15.5	15.1
6/12/2012	15.4	15.4	15.5	15.8	15.7	15.7	16.0	15.4
6/13/2012	15.9	15.9	16.0	16.2	16.2	16.2	16.3	15.9
6/14/2012	16.0	15.9	16.0	16.2	16.1	16.1	16.4	16.0
6/15/2012	15.9	15.9	16.0	16.2	16.2	16.2	16.4	16.0
6/16/2012	16.2	16.2	16.3	16.5	16.5	16.5	16.9	16.3
6/17/2012	16.4	16.5	16.6	16.8	16.7	16.7	17.5	16.7
6/18/2012	16.3	16.3	16.4	16.6	16.6	16.5	17.0	16.4
6/19/2012	16.3	16.2	16.3	16.5	16.5	16.4	16.7	16.3
6/20/2012	16.3	16.3	16.4	16.6	16.6	16.6	16.7	16.3
6/21/2012	16.5	16.5	16.6	16.8	16.8	16.8	16.8	16.5
6/22/2012	17.3	17.2	17.3	17.5	17.5	17.5	17.7	17.3
6/23/2012	17.3	17.3	17.3	17.6	17.5	17.5	17.6	17.3
6/24/2012	17.4	17.4	17.4	17.7	17.6	17.6	18.4	17.6
6/25/2012	17.3	17.2	17.3	17.5	17.4	17.4	17.7	17.3
6/26/2012	16.8	16.7	16.7	17.0	16.9	16.9	17.2	16.8
6/27/2012	16.6	16.5	16.7	16.9	16.8	16.8	16.9	16.6
6/28/2012	15.8	15.5	15.6	15.8	15.8	15.8	15.9	15.5
6/29/2012	17.3	17.3	17.5	17.7	17.7	17.7	17.7	17.4
6/30/2012	17.9	17.9	18.0	18.3	18.2	18.2	18.2	17.9
7/1/2012	18.2	18.3	18.4	18.6	18.6	18.6	18.7	18.3
7/2/2012	18.3	18.3	18.3	18.5	18.5	18.5	18.7	18.3
7/3/2012	18.0	18.0	18.0	18.2	18.2	18.2	18.5	18.1
7/4/2012	17.9	17.9	17.9	18.1	18.1	18.1	18.3	17.9
7/5/2012	17.4	17.3	17.5	17.7	17.6	17.6	17.8	17.4
7/6/2012	17.5	17.6	17.7	17.9	17.9	17.9	17.9	17.6
7/7/2012	18.9	18.9	18.9	19.2	19.2	19.2	19.4	19.0
7/8/2012	19.9	19.8	19.9	20.1	20.1	20.1	20.2	19.8
7/9/2012	20.4	20.5	20.7	21.0	20.9	20.9	20.9	20.5
7/10/2012	20.6	20.9	21.0	21.4	21.3	21.3	21.5	20.9
7/11/2012	20.8	21.0	21.2	21.5	21.4	21.4	21.7	21.1
7/12/2012	19.4	20.1	21.0	21.2	21.2	21.2	21.2	20.6
7/13/2012	20.8	21.3	21.6	21.8	21.8	21.8	22.0	21.6
7/14/2012	21.5	21.5	21.5	21.8	21.8	21.8	22.0	21.6
7/15/2012	21.1	21.1	21.1	21.4	21.4	21.4	21.5	21.1
7/16/2012	20.7	20.8	20.9	21.1	21.1	21.1	21.1	20.9
7/17/2012	20.3	20.0	20.2	20.4	20.4	20.4	20.4	20.1
7/18/2012	20.3	20.1	20.1	20.3	20.3	20.3	20.3	20.1

Date	Low Level Outlet Pipe -Auto- (Deg. C)	Top of Reach 1 -Logger- (Deg. C))	End of Reach 1 -Logger- (Deg. C)	End of Reach 3 -Logger- (Deg. C)	Top of R4 Habitat Channel -Logger- (Deg. C)	End of R4 Habitat Channel -Logger- (Deg. C)	Tailrace at Pump Intake -Auto- (Deg. C)	Tailrace at Pump Intake -Logger- (Deg. C)
7/19/2012	21.2	21.3	21.3	21.5	21.5	21.5	21.6	21.3
7/20/2012	21.6	21.5	21.6	21.8	21.8	21.7	21.9	21.6
7/21/2012	20.7	20.7	20.9	21.1	21.1	21.1	21.1	20.7
7/22/2012	20.2	20.2	20.5	20.7	20.6	20.6	20.6	20.3
7/23/2012	20.7	20.7	20.6	20.7	20.7	20.6	21.0	20.7
7/24/2012	20.6	20.6	20.6	20.8	20.8	20.8	20.9	20.6
7/25/2012	20.1	20.1	20.5	21.0	20.9	20.9	20.6	20.3
7/26/2012	18.6	18.7	19.7	20.2	20.0	20.0	19.9	19.6
7/27/2012	20.9	21.0	20.9	21.1	21.0	21.0	21.2	21.0
7/28/2012	20.9	20.9	20.9	21.2	21.1	21.1	21.1	20.9
7/29/2012	20.9	20.9	21.3	21.7	21.5	21.6	21.2	21.1
7/30/2012	21.0	21.1	21.0	21.3	21.1	21.1	21.3	21.2
7/31/2012	21.1	21.1	20.7	21.0	20.9	21.0	21.3	21.1
8/1/2012	21.2	21.2	20.8	21.3	21.3	21.3	21.3	21.1
8/2/2012	21.3	21.4	20.9	21.5	21.4	21.5	21.4	21.3
8/3/2012	21.4	21.4	20.9	21.5	21.4	21.5	21.6	21.4
8/4/2012	20.3	20.4	20.9	21.5	21.4	21.5	21.1	21.0
8/5/2012	19.3	19.4	20.7	20.9	20.8	21.0	20.9	20.8
8/6/2012	19.9	20.2	20.7	20.6	20.6	20.7	21.7	21.6
8/7/2012	21.9	21.9	21.3	21.8	21.7	21.8	22.7	22.6
8/8/2012	22.1	22.2	21.4	22.1	22.0	22.0	23.0	22.8
8/9/2012	22.9	22.9	21.5	22.0	21.9	22.0	23.1	22.9
8/10/2012	22.4	22.4	21.6	22.3	22.2	22.3	22.7	22.5
8/11/2012	22.4	22.4	21.6	22.2	22.1	22.2	22.6	22.4
8/12/2012	21.9	21.9	21.7	22.3	22.2	22.4	22.5	22.3
8/13/2012	21.1	21.2	21.5	21.9	21.8	21.9	22.2	22.1
8/14/2012	23.1	23.1	21.8	22.2	22.1	22.2	23.3	23.1
8/15/2012	21.7	21.7	21.8	22.3	22.2	22.3	22.2	21.9
8/16/2012	20.7	20.8	21.6	21.4	21.3	21.4	21.8	21.4
8/17/2012	20.7	20.8	21.7	21.5	21.4	21.6	22.3	21.9
8/18/2012	20.6	20.6	21.8	21.5	21.4	21.6	22.0	21.7
8/19/2012	20.5	20.6	21.8	21.4	21.3	21.4	21.9	21.7
8/20/2012	22.6	22.7	22.0	21.6	21.5	21.6	23.2	23.0
8/21/2012	22.7	22.6	22.2	22.1	22.0	22.1	23.4	23.0
8/22/2012	22.7	22.6	22.1	21.3	21.2	21.3	23.1	22.6
8/23/2012	22.2	22.1	22.0	20.8	20.7	20.7	22.5	22.2
8/24/2012	21.7	21.5	22.0	20.3	20.2	20.3	22.0	21.6
8/25/2012	21.5	21.4	22.1	20.5	20.5	20.5	21.9	21.5
8/26/2012	20.9	20.8	22.1	20.3	20.2	20.3	21.4	21.0
8/27/2012	21.1	21.0	22.2	20.7	20.6	20.7	21.4	21.1
8/28/2012	21.1	21.0	22.1	20.4	20.3	20.3	21.5	21.1
8/29/2012	21.0	20.9	22.1	20.0	19.9	19.9	21.7	20.8
8/30/2012	20.9	20.8	22.1	20.1	20.0	20.0	21.7	20.8
8/31/2012	21.0	20.9	22.2	20.1	20.0	20.0	21.7	20.9
9/1/2012	20.8	20.7	22.1	19.8	19.6	19.6	21.5	20.7
9/2/2012	20.7	20.6	22.1	20.0	19.9	19.9	21.4	20.4
9/3/2012	20.6	20.5	22.1	20.1	19.9	20.0	21.4	20.6
9/4/2012	20.3	20.3	22.1	20.1	19.9	20.0	20.9	20.4
9/5/2012	20.6	20.5	22.1	20.1	19.9	20.0	20.9	20.4
9/6/2012	19.4	19.2	21.9	19.8	19.6	19.7	20.0	19.4

Date	Low Level Outlet Pipe -Auto- (Deg. C)	Top of Reach 1 -Logger- (Deg. C))	End of Reach 1 -Logger- (Deg. C)	End of Reach 3 -Logger- (Deg. C)	Top of R4 Habitat Channel -Logger- (Deg. C)	End of R4 Habitat Channel -Logger- (Deg. C)	Tailrace at Pump Intake -Auto- (Deg. C)	Tailrace at Pump Intake -Logger- (Deg. C)
9/7/2012	19.5	19.4	21.8	19.2	19.0	19.1	20.0	19.6
9/8/2012	19.9	19.8	21.9	19.5	19.4	19.4	20.4	19.9
9/9/2012	20.0	19.9	21.8	19.7	19.6	19.6	20.5	20.0
9/10/2012	19.4	19.2	21.3	18.0	17.9	17.8	19.7	19.2
9/11/2012	18.7	18.5	21.0	17.5	17.4	17.4	19.1	18.7
9/12/2012	18.6	18.4	20.9	17.6	17.5	17.6	19.1	18.7
9/13/2012	18.7	18.5	20.8	17.6	17.5	17.5	19.1	18.7
9/14/2012	18.7	18.5	20.8	17.9	17.8	17.8	19.2	18.7
9/15/2012	18.7	18.6	20.5	18.1	18.0	18.0	19.2	18.7
9/16/2012	18.6	18.5	20.9	18.5	18.4	18.5	19.2	18.6
9/17/2012	18.8	18.7	20.9	18.7	18.7	18.7	19.3	18.8
9/18/2012	18.9	18.8	20.6	18.1	18.0	18.1	19.3	18.8
9/19/2012	18.8	18.7	20.5	18.3	18.2	18.3	19.3	18.8
9/20/2012	18.9	18.8	19.8	18.2	18.1	18.2	19.3	18.8
9/21/2012	18.9	18.7	18.6	18.1	18.2	18.2	19.4	18.7
9/22/2012	18.7	18.5	18.3	17.9	17.9	17.9	19.2	18.5
9/23/2012	18.3	18.2	18.3	18.0	18.0	18.0	19.3	18.3
9/24/2012	18.3	18.2	18.2	17.9	17.9	17.9	18.8	18.2
9/25/2012	18.4	18.3	18.3	18.0	18.0	18.1	18.9	18.4
9/26/2012	18.5	18.3	18.2	17.7	17.8	17.8	19.0	18.3
9/27/2012	18.5	18.4	18.3	17.9	17.9	17.9	19.0	18.4
9/28/2012	18.4	18.3	18.0	17.6	17.6	17.6	18.9	18.2
9/29/2012	18.3	18.2	18.3	17.9	17.9	18.0	18.8	18.3
9/30/2012	18.1	17.9	17.9	17.4	17.4	17.4	18.6	18.0
10/1/2012	18.1	18.0	18.0	17.5	17.5	17.5	18.4	18.1
10/2/2012	17.9	17.7	17.3	16.7	16.8	16.7	18.2	17.8
10/3/2012	17.1	16.8	16.5	15.6	15.6	15.6	17.4	17.0
10/4/2012	16.7	16.4	16.1	15.2	15.2	15.1	17.0	16.6
10/5/2012	16.4	16.1	15.7	14.8	14.8	14.8	16.7	16.4
10/6/2012	16.2	16.0	15.6	14.7	14.8	14.7	16.6	16.2
10/7/2012	16.2	16.0	15.8	14.9	15.0	15.0	16.6	16.2
10/8/2012	16.3	16.1	16.0	15.2	15.2	15.2	16.7	16.3
10/9/2012	16.4	16.2	16.3	15.6	15.6	15.6	16.8	16.4
10/10/2012	16.5	16.3	16.2	15.6	15.6	15.6	16.8	16.5
10/11/2012	16.4	16.2	16.2	15.5	15.5	15.6	16.8	16.4
10/12/2012	16.4	16.2	16.1	15.4	15.4	15.4	16.7	16.3
10/13/2012	16.2	16.0	16.2	15.7	15.7	15.7	16.5	16.1
10/14/2012	16.1	16.0	16.2	15.8	15.8	15.8	16.5	16.1
10/15/2012	16.1	15.9	16.3	15.9	16.0	16.1	16.4	16.0
10/16/2012	15.7	15.5	15.3	14.8	15.6	15.5	16.1	15.7
10/17/2012	15.2	15.0	15.0	14.1	15.0	15.0	15.6	15.2
10/18/2012	15.2	15.0	15.1	14.4	15.1	15.1	15.6	15.2
10/19/2012	15.2	15.0	15.2	14.7	15.1	15.1	15.5	15.2
10/20/2012	14.8	14.5	14.2	13.5	14.6	14.5	15.1	14.7
10/21/2012	14.3	14.0	13.7	12.7	14.1	13.9	14.6	14.2
10/22/2012	14.0	13.7	13.3	12.4	13.7	13.6	14.3	13.9
10/23/2012	13.8	13.5	13.3	12.6	13.7	13.6	14.2	13.8
10/24/2012	13.7	13.4	13.0	12.4	13.5	13.4	14.1	13.8
10/25/2012	13.5	13.2	13.2	12.7	13.4	13.4	13.9	13.6
10/26/2012	13.6	13.3	12.9	12.3	13.4	13.3	14.0	13.7

Date	Low Level Outlet Pipe -Auto- (Deg. C)	Top of Reach 1 -Logger- (Deg. C))	End of Reach 1 -Logger- (Deg. C)	End of Reach 3 -Logger- (Deg. C)	Top of R4 Habitat Channel -Logger- (Deg. C)	End of R4 Habitat Channel -Logger- (Deg. C)	Tailrace at Pump Intake -Auto- (Deg. C)	Tailrace at Pump Intake -Logger- (Deg. C)
10/27/2012	13.3	13.0	12.9	12.4	13.2	13.1	13.7	13.4
10/28/2012	13.2	13.0	13.1	12.6	13.2	13.1	13.6	13.3
10/29/2012	13.4	13.1	13.4	13.0	13.3	13.4	13.8	13.4
10/30/2012	13.4	13.3	13.5	13.1	13.4	13.4	13.8	13.5
10/31/2012	13.5	13.3	13.6	13.4	13.5	13.5	13.9	13.5
11/1/2012	13.5	13.3	13.5	13.3	13.4	13.5	13.9	13.5
11/2/2012	13.4	13.2	13.3	13.0	13.3	13.3	13.8	13.4
11/3/2012	13.3	13.2	13.5	13.2	13.3	13.3	13.7	13.4
11/4/2012	13.3	13.2	13.4	13.2	13.3	13.4	13.7	13.4
11/5/2012	13.3	13.1	13.2	13.0	13.2	13.2	13.7	13.3
11/6/2012	13.0	12.8	12.8	12.5	13.0	13.0	13.5	13.1
11/7/2012	12.8	12.4	12.2	11.9	12.6	12.6	13.2	12.8
11/8/2012	12.4	11.9	11.7	11.1	12.2	12.1	12.8	12.4
11/9/2012	12.1	11.6	11.3	10.8	11.9	11.8	12.4	12.1
11/10/2012	11.7	11.2	11.0	10.3	11.5	11.4	12.1	11.8
11/11/2012	11.2	10.6	10.2	9.3	10.9	10.8	11.6	11.3
11/12/2012	11.0	10.4	10.4	9.5	10.7	10.6	11.4	11.0
11/13/2012	10.9	10.5	10.8	9.9	10.8	10.7	11.4	11.0
11/14/2012	11.0	10.6	10.8	10.1	10.9	10.8	11.4	11.1
11/15/2012	11.0	10.6	10.8	10.0	10.8	10.8	11.4	11.0
11/16/2012	10.8	10.4	10.9	10.2	10.7	10.7	11.2	10.8
11/17/2012	10.7	10.4	10.7	10.1	10.6	10.6	11.2	10.8
11/18/2012	10.7	10.3	10.5	9.8	10.5	10.5	11.1	10.7
11/19/2012	10.7	10.5	10.8	10.3	10.6	10.6	11.1	10.8
11/20/2012	10.7	10.5	10.7	10.4	10.6	10.7	11.1	10.8
11/21/2012	10.5	10.2	10.4	9.8	10.4	10.4	11.0	10.6
11/22/2012	10.3	9.9	10.1	9.4	10.2	10.1	10.7	10.3
11/23/2012	10.2	9.9	10.2	9.7	10.1	10.1	10.6	10.2
11/24/2012	10.1	9.8	10.0	9.5	10.0	10.0	10.6	10.2
11/25/2012	9.8	9.3	9.3	8.6	9.7	9.6	10.3	9.9
11/26/2012	9.6	9.1	9.1	8.3	9.5	9.4	10.1	9.7
11/27/2012	9.4	9.0	9.1	8.4	9.2	9.2	9.8	9.5
11/28/2012	9.3	8.9	9.1	8.4	9.1	9.1	9.7	9.3
11/29/2012	9.3	8.9	9.2	8.6	9.2	9.1	9.7	9.3
11/30/2012	9.4	9.1	9.5	9.0	9.3	9.3	9.8	9.5
12/1/2012	9.5	9.3	9.5	9.2	9.4	9.4	10.0	9.6
12/2/2012	9.6	9.3	9.6	9.2	9.2	9.3	10.1	9.6
12/3/2012	9.4	9.1	9.3	8.8	8.8	8.7	10.0	9.5
12/4/2012	9.5	9.3	9.5	9.2	9.2	9.2	9.9	9.5
12/5/2012	9.1	8.8	8.7	8.2	8.3	8.2	9.6	9.2
12/6/2012	9.0	8.6	8.6	8.1	8.2	8.1	9.5	9.0
12/7/2012	8.7	8.3	8.2	7.6	7.6	7.5	9.1	8.7
12/8/2012	8.2	7.8	7.7	6.9	7.0	6.9	8.7	8.3
12/9/2012	8.1	7.7	7.8	7.1	7.2	7.1	8.5	8.1
12/10/2012	8.0	7.6	7.4	6.7	6.8	6.7	8.5	8.1
12/11/2012	7.9	7.5	7.6	7.0	7.0	7.0	8.4	8.0
12/12/2012	8.0	7.7	7.9	7.2	7.2	7.2	8.6	8.1
12/13/2012	7.9	7.6	7.8	7.1	7.2	7.2	8.4	8.0
12/14/2012	7.8	7.4	7.7	7.0	7.0	7.0	8.3	7.9
12/15/2012	7.7	7.3	7.4	6.7	6.7	6.7	8.1	7.7

Date	Low Level Outlet Pipe -Auto- (Deg. C)	Top of Reach 1 -Logger- (Deg. C))	End of Reach 1 -Logger- (Deg. C)	End of Reach 3 -Logger- (Deg. C)	Top of R4 Habitat Channel -Logger- (Deg. C)	End of R4 Habitat Channel -Logger- (Deg. C)	Tailrace at Pump Intake -Auto- (Deg. C)	Tailrace at Pump Intake -Logger- (Deg. C)
12/16/2012	7.4	7.0	6.8	6.2	6.2	6.2	8.0	7.5
12/17/2012	7.1	6.7	6.7	5.9	5.9	5.9	7.6	7.1
12/18/2012	6.6	6.1	5.9	5.3	5.3	5.3	7.2	6.7
12/19/2012	6.3	5.8	5.5	4.7	4.8	4.7	6.9	6.4
12/20/2012	6.6	6.3	6.4	5.8	5.8	5.7	7.2	6.6
12/21/2012	6.6	6.3	6.2	5.7	5.7	5.6	7.1	6.6
12/22/2012	6.6	6.4	6.5	5.9	6.0	6.0	7.1	6.7
12/23/2012	6.9	6.7	6.8	6.4	6.4	6.4	7.5	7.0
12/24/2012	6.8	6.6	6.7	6.2	6.2	6.2	7.3	6.9
12/25/2012	6.8	6.5	6.5	6.0	6.0	6.0	7.3	6.9
12/26/2012	6.8	6.6	6.8	6.5	6.5	6.5	7.4	6.9
12/27/2012	6.8	6.6	6.8	6.4	6.4	6.4	7.4	6.9
12/28/2012	6.7	6.4	6.5	6.1	6.1	6.1	7.3	6.8
12/29/2012	6.6	6.3	6.3	5.9	5.9	5.9	7.1	6.7
12/30/2012	6.3	6.0	5.7	5.3	5.4	5.3	6.9	6.4
12/31/2012	6.1	5.7	5.3	4.8	4.9	4.8	6.6	6.2

APPENDIX C: MINIMUM FLOW DEVIATION REPORTS

FEDERAL ENERGY REGULATORY COMMISSION
Washington, D. C. 20426

OFFICE OF ENERGY PROJECTS

Project No. 637-089-Washington
Lake Chelan Hydroelectric Project

February 4, 2013

Ms. Michelle Smith
Licensing & Compliance Manager
Public Utility District No. 1 of Chelan County
327 N. Wenatchee Ave.
Wenatchee, WA 98807-1231

Subject: Report on Minimum Flow Deviation Pursuant to Article 405 of the License

Dear Ms. Smith:

This is in response to your filing submitted on December 5, 2012, pertaining to an instream flow deviation that occurred at the Lake Chelan Hydroelectric Project, FERC No. 637. You submitted the filing pursuant to Article 405 of the license,[1] and your approved Operations Compliance and Monitoring Plan (Plan).[2]

License Requirements

Article 405 of the license requires you to implement a Plan that describes how you will comply with the instream flows, ramping rates, and tailrace flows, as set forth in Article 7 of the Lake Chelan Settlement Agreement (Agreement) and Chapter 7 of the Comprehensive Plan attached to the Agreement. Under the Agreement, you are required to maintain a minimum flow requirement of 80 cfs into the Chelan River. In addition, the project must not exceed two inches per hour ramping rate, for the purpose of preventing

[1] See, Order on Offer of Settlement and Issuing New License, 117 FERC ¶ 62,129, issued November 6, 2006.

[2] See, Order Modifying and Approving Operations Compliance and Monitoring Plan Article 405, 121 FERC 62,152, issued November 30, 2007.

stranding of fish in the Chelan River. Furthermore, under Article 405 of the license you are required to notify the Washington Department of Ecology (Ecology) and the Commission within 48 hours after you are aware of any deviation from the minimum flow requirements.

In accordance with the approved Plan, you are required to file a report with the Commission, within 30 days of any deviation from minimum flow requirements, lake levels or ramping rates. The report must to the extent possible, identify the cause, severity, and duration of the incident, and any observed or reported adverse environmental impacts resulting from the incident. The report must also include: operational data necessary to determine compliance with the license requirements regarding minimum flows, lake levels, and ramping rates, as appropriate; a description of any corrective measures implemented at the time of occurrence and the measures implemented or proposed to ensure that similar incidents will not recur; and comments or correspondence, if any, received from the resource agencies and others regarding the incident.

Instream Flow Deviation

In the filing, you explain that the required minimum flow of 80 cfs was not met on November 5, 2012, for about one hour. The incident started about 5:55 pm, when the instantaneous flow released into the Chelan River from the Low Level Outlet (LLO) fell below the minimum flow requirement of 80 cfs, and was rectified by 6:55 pm. You state that the flow reduction was due to a failure in the automated control system. Your operators took corrective action of the situation as soon as the alarm was triggered. The incident resulted in flows below minimum levels, from 73 cfs to 76.5 cfs for about one hour. In addition you state that due to the prompt response to the incident there were no ramping rate deviations or adverse biological effects as a result of the flow deviation.

You determined that to prevent further incidents from happening, the automatic control system regulating flows from the LLO has been disabled and the flow is now controlled manually. You state that the equipment for remote manual gate operation has been scheduled for installation and the LLO gates have been periodically adjusted on-site to maintain Chelan River flows above the minimum requirement until the remote operation equipment has been installed.

Furthermore, you state that you reported the deviations to the Commission's Portland Regional Office and Ecology via electronic correspondence on November 7, 2012, within 48 hours of when you became aware of the incident. No comments were received in reference to the incident.

Conclusion

After reviewing the information included in your report, we have determined that the minimum flow deviation that occurred on November 5, 2012, will not constitute a violation of Article 405 of the license. The incident was caused by a malfunction of the automated control system, and you restored the flow in a prompt manner. You indicate that the LLO will remain manual until the new remote operation equipment has been installed. No adverse biological impacts were observed as a result of the incident. Your filing adequately fulfills the reporting requirements pursuant to Article 405 of the license and your approved Plan. Thank you for your cooperation. If you have any questions concerning this letter, please contact Anumzziatta Purchiaroni at (202) 502-6191, or by e-mail at anumzziatta.purchiaroni@ferc.gov.

Sincerely,

William Guey-Lee

William Guey-Lee
Chief, Engineering Resources Branch
Division of Hydropower Administration
and Compliance



PUBLIC UTILITY DISTRICT NO. 1 *of* CHELAN COUNTY
P.O. Box 1231, Wenatchee, WA 98807-1231 • 327 N. Wenatchee Ave., Wenatchee, WA 98801
(509) 663-8121 • Toll free 1-888-663-8121 • www.chelanpud.org

December 5, 2012

VIA ELECTRONIC FILING

Honorable Kimberly D. Bose, Secretary
Nathaniel J. Davis, Sr., Deputy Secretary
FEDERAL ENERGY REGULATORY COMMISSION
888 First Street, NE
Washington, DC 20426

RE: Lake Chelan Hydroelectric Project No. 637 (Project)
Report on Minimum Flow Deviation for Chelan River

Dear Secretary Bose and Deputy Secretary Davis:

This letter is to provide you with Public Utility District No. 1 of Chelan County's (Chelan PUD) follow-up report on an instream flow deviation that occurred during the evening of November 5, 2012, on the Chelan River. This deviation was first reported by email to the Federal Energy Regulatory Commission (FERC) Portland Office (Douglas Johnson and Erich Gaedeke) and Washington Department of Ecology (Ecology) Central Regional Office (Charles McKinney and Patricia Irle) on November 7, 2012.

Summary of Deviation, Environmental Effects and Corrective Measures

On November 5, 2012, for a period of approximately one hour, the flow released into the Chelan River from the low level outlet fell below the minimum flow requirement of 80 cfs. The flow reduction was caused by an error of unknown cause in the automated control system. System operators took corrective action when alarms were triggered. The minimum flow during this episode was 73 cfs and the average flow for the hour ending at 1900 was 76.5 cfs. Due to the prompt corrective action and short duration of this flow reduction, there were no ramping rate deviations or adverse biological consequences resulting from the flow deviation. To prevent further incidents, the automatic control system regulating flows from the Low Level Outlet has been disabled and the flow is being controlled manually. Similar incidents with the automated flow control system occurred in May, 2011 and substantial efforts to modify the control system had effectively prevented any reoccurrences for 18 months. However, since this recent incident demonstrated that the automated system is still capable of closing the Low Level Outlet slide gates for no apparent reason, the automatic control system will remain disabled and the Low Level Outlet will be operated manually henceforth. Equipment for remote manual gate operation is scheduled for installation and the Low Level Outlet gates are being periodically adjusted on-site to maintain Chelan River flows above the minimum requirement until the remote operation equipment has been installed.

License Requirement

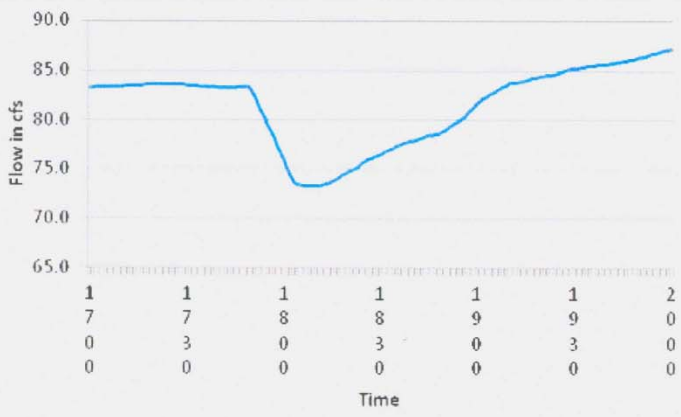
Article 405 requires Chelan PUD to implement the instream flows, ramping rates, and tailrace flows as set forth in Article 7 of the Lake Chelan Settlement Agreement and Chapter 7 of the Comprehensive Plan attached to the settlement agreement. The specific flow requirement that is the subject of this deviation report is to maintain a minimum flow of 80 cfs into the Chelan River. In accordance with FERC's Order Modifying and Approving Operations Compliance and Monitoring Plan, Article 405, issued November 30, 2007, when a flow deviation occurs, Chelan PUD is required to notify FERC and Ecology of the deviation within 48 hours of the time that Chelan PUD

became aware of the deviation. FERC and Ecology were notified via electronic submittal on November 7, 2012. Following the initial notification, Chelan PUD is required to file a report with FERC within 30 days of any deviation from minimum flow requirements. The report shall, to the extent possible, identify the cause, severity, and duration of the incident, any observed or reported adverse environmental impacts resulting from the incident, a description of any corrective measures implemented at the time of occurrence and the measures implemented or proposed to ensure that similar incidents do not recur; and comments or correspondence, if any, received from the resource agencies and others regarding the incident.

Detail Regarding Incident

On November 5, 2012, for a period of approximately one hour, the flow released into the Chelan River from the low level outlet fell below the minimum flow requirement of 80 cfs. The incident began about 5:55 pm, when the instantaneous flow fell below 80 cfs, and was rectified by 6:55 pm when flow again reached 80 cfs. The lowest instantaneous flow during this period was about 73.3 cfs. There were no ramping rate exceedances associated with this flow reduction. Spawning flows in Reach 4 of the Chelan River, which are supported by pump station flows, were above the 320 cfs minimum flow. The cause of the flow deviation is unknown, but it originated from an automated control malfunction. The flow was restored by manual operation.

The Chelan River flows during the deviation at the low level outlet are shown below:



If you have any questions regarding this incident, please contact me or Steven Hays at (509)661-4181.

Thank you,

Michelle Smith
Licensing & Compliance Manager
michelle.smith@chelanpud.org
(509)661-4180

Attachment: Email from Chelan PUD to FERC and Ecology and Ecology's response, November 7, 2012

cc: Washington Department of Ecology
Chelan River Fishery Forum

Sokolowski, Rosana

Subject: FW: Lake Chelan Project No. 637: Chelan River Minimum Flow Deviation

---

From: McKinney, Charlie (ECY) [mailto:cmck461@ECY.WA.GOV]
Sent: Wednesday, November 07, 2012 3:03 PM
To: Smith, Michelle; 'douglas.johnson@ferc.gov'; 'erich.gaedeke@ferc.gov'; Irle, Pat (ECY)
Cc: Truscott, Keith; Osborn, Jeff; Hays, Steve; Odell, Brian; Hudson, Kirk; Garrison, Dan; Sokolowski, Rosana
Subject: RE: Lake Chelan Project No. 637: Chelan River Minimum Flow Deviation

Thank you Michele for including us in the prompt notification.

Charlie McKinney

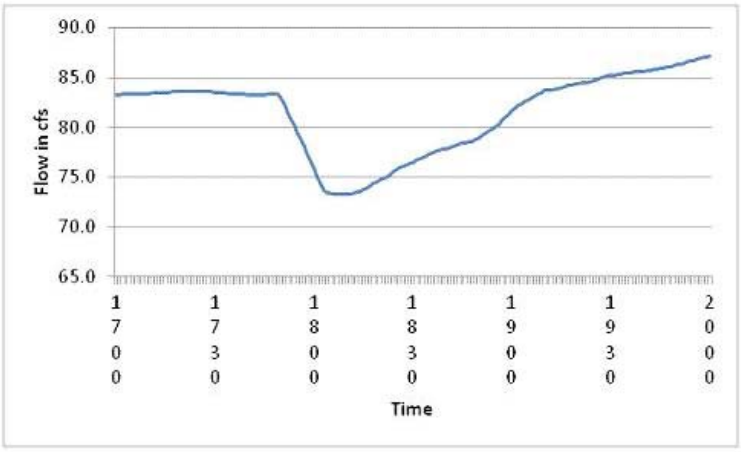
From: Smith, Michelle [mailto:michelle.smith@chelanpud.org]
Sent: Wednesday, November 07, 2012 2:53 PM
To: 'douglas.johnson@ferc.gov'; 'erich.gaedeke@ferc.gov'; Irle, Pat (ECY); McKinney, Charlie (ECY)
Cc: Truscott, Keith; Osborn, Jeff; Hays, Steve; Odell, Brian; Hudson, Kirk; Garrison, Dan; Sokolowski, Rosana
Subject: Lake Chelan Project No. 637: Chelan River Minimum Flow Deviation

Subject: Lake Chelan Project No 637 - Minimum Flow Deviation

This email is to provide you notification regarding a minimum flow deviation which occurred in the Chelan River.

On November 5, 2012, for a period of approximately one hour, the flow released into the Chelan River from the low level outlet fell below the minimum flow requirement of 80 cfs. The incident began about 5:55 pm, when the instantaneous flow fell below 80 cfs, and was rectified by 6:55 pm when flow again reached 80 cfs. The lowest instantaneous flow during this period was about 73.3 cfs. There were no ramping rate exceedances associated with this flow reduction. Spawning flows in Reach 4 of the Chelan River, which are supported by pump station flows, were above the 320 cfs minimum flow. The cause of the flow deviation is unknown, but it originated from an automated control malfunction. The flow was restored by manual operation.

The Chelan River flow at the low level outlet is shown below. A detailed report regarding this deviation will be filed within 30 days. Please contact Steve Hays at (509)661-4181 or me. Thank you.



Michelle Smith
Licensing & Compliance Manager
michelle.smith@chelanpud.org
(509)661-4180

APPENDIX D: CONSULTATION RECORD

Chelan PUD provided a draft of the 2012 Annual Flow Report to the USGS and members of the CRFF and LCRF in accordance with the requirements of the FERC Order Modifying and Approving Operations Compliance and Monitoring Plan, Article 405, under Ordering Paragraph (B):

> "The licensee shall allow the resource agencies, Tribes and non-governmental organizations specified under Article 405, 30 days to provide comments and/or recommendations on their report before filing with the FERC. The filing shall include comments and/or recommendations from the consulted entities and the licensee's response to any comments. If the licensee does not adopt a recommendation, the report shall include the licensee's reasons, based on project-specific information."

The following individuals were sent draft copies for review: One comment was provided and the requested information has been added to this report (see below).

NAME	***AGENCY***	***Comments***
Irle, Pat	Washington State Department of Ecology	See below
Caldwell, Brad	Washington State Department of Ecology	No comment
Korth, Jeffrey	Washington State Department of Fish and Wildlife	No comment
Simon, Graham	Washington State Department of Fish and Wildlife	No comment
Heiner, Bruce	Washington State Department of Fish and Wildlife	No comment
Willard, Catherine	United States Department of Agriculture – Forest Service	No comment
Martinez, Alex	United States Department of Agriculture – Forest Service	No comment
Glesne, Reed	National Park Service	No comment
Lewis, Steve	United States Fish and Wildlife Service	No comment
Domingue, Rich	National Marine Fisheries Services	No comment
Towey, Bill	Confederated Tribes of the Colville Reservation	No comment
Rose, Bob	Yakama Indian Nation	No comment
Merkle, Carl	Confederated Tribes of the Umatilla Indian Reservation	No comment
Goedde, Robert	City of Chelan	No comment
Archibald, Phil	Lake Chelan Sportsman Association	No comment
Drzymkowski, Robert	United States Geological Survey	No comment
Ernsberger, Tom	Washington State Parks and Recreation Commission	No comment
Snell, Nona	Washington State Recreation and Conservation Office	No comment
Petersen, Wai	Manson Parks and Recreation Department	No comment
Uhlhorn, Richard	Lake Chelan Recreation Association	No comment
O'Keefe, Thomas	American Whitewater	No comment

From: Irle, Pat (ECY) [mailto:PIRL461@ECY.WA.GOV]
Sent: Friday, April 05, 2013 2:48 PM
To: Hays, Steve
Subject: RE: Review Draft - Chelan River 2012 Annual Flow and Temperature Report

Thanks, Steve –
Lots of good info, as usual!
I like the plots in Figures 4-2 and 4-3. Any chance we could get an additional plot of the maximum daily temperatures for three locations: Start of R1, end of R3, and end of R4?
Or better yet (or in addition), 7-day average of the daily maximum temperature (7-DADMax)?
Pat