



**PUBLIC UTILITY DISTRICT NO. 1 of CHELAN COUNTY**  
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April 30, 2018

**VIA ELECTRONIC FILING**

Ms. Kimberly D. Bose, Secretary  
FEDERAL ENERGY REGULATORY COMMISSION  
888 First Street, NE  
Washington, DC 20426

Re: **Lake Chelan Hydroelectric Project No. 637**  
**Article 405, Article 408, Appendix D – 2017 Annual Flow and Water Temperature Report,**  
**including the Water Quality Assessment**

Dear Secretary Bose:

On September 10, 2013, the Federal Energy Regulatory Commission (Commission) issued its order<sup>1</sup> revising the reporting date to April 30 of each year for the Annual Flow and Water Temperature pursuant to Articles 405 and 408 of the license, and the Water Quality Certificate Condition V.A.(iii) for the Lake Chelan Hydroelectric Project (Project).

Chelan PUD hereby files the 2017 Annual Flow and Water Temperature Report, including the water quality assessment data collected in 2017. On March 20, 2018, 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 19, 2018. Please refer to Appendix C for the consultation documentation.

Please contact Scott Hopkins at (509) 661-4763 or me regarding any questions or comments regarding this request.

Sincerely,

Jeffrey G. Osborn  
License Compliance Supervisor  
[jeff.osborn@chelanpud.org](mailto:jeff.osborn@chelanpud.org)  
(509) 661-4176

Enclosure: 2017 Annual Flow and Water Temperature Report

cc: Erich Gaedeke, FERC Portland Regional Office  
Breean Zimmerman, Washington Department of Ecology  
Chelan River Fishery Forum

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<sup>1</sup> 144 FERC ¶ 62,221

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**LAKE CHELAN  
ANNUAL FLOW AND WATER  
TEMPERATURE REPORT  
2017**

**LICENSE ARTICLES 405 & 408**

**Final**

**LAKE CHELAN HYDROELECTRIC PROJECT  
FERC Project No. 637**

**April 30, 2018**



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

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## ***EXECUTIVE SUMMARY***

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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 Hydroelectric Project 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.

Flow releases were provided throughout the year from the Low Level Outlet for minimum flows of at least 80 cfs in Reaches 1-3. Chelan River flows were managed as runoff forecasts evolved for 2017. The runoff forecast on April 1 was 106% of average, which is classified as an “average year” for setting minimum flows during the annual runoff cycle. The 2017 minimum flow releases to Reaches 1-3 were at least 200 cfs from May 15 – July 15. As actual runoff volume was recorded, the forecast shifted to reflect a “wet year” and dictated a change in minimum flows in Reaches 1-3. Minimum flow releases to Reaches 1-3 were at least 320 cfs from May 23 – 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. Flows in the Reach 4 Habitat channel were at least 285 cfs from March 15 – July 15, except for a one-day reduction on March 23. Flows were reduced for 9 hours in the Reach 4 Habitat Channel to allow egg box placement for a steelhead egg to emergence survival study performed in 2017. Chelan River pumps were turned off in succession following approval from the Chelan River Fish Forum (CRFF) and brought back online in series. Water levels and the channel margins were monitored and there were no adverse effects on aquatic life. Additionally in 2017, the Pump Station was utilized to test the potential to trap adult Chinook salmon for broodstock for the Chelan Falls artificial propagation program; two pumps were operated from July 21 – August 21.

Flows were released from the spillway, as needed for lake level control, from May 22 – July 11. 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. Daily average spillway flow releases for lake level control peaked at 7,260 cfs on May 29, with the highest hourly flows of 7,581 cfs on May 30. Flow releases from the Low Level Outlet were also managed to provide whitewater boating flows on September 16 -17. Flows were ramped back down to minimum flows following the event, with ramping concluded on September 19.

There were 207 salmon redds with eggs incubating in the tailrace from spawning that occurred in the fall of 2016. Powerhouse operations to maintain minimum generation flows of over 800 cfs for Chinook salmon redd protection were implemented to maintain adequate oxygen levels in Chinook salmon redds. The powerhouse operated with one turbine at full capacity until April 1, except for one period of a few hours for maintenance on March 18, 2017.

Steelhead spawning surveys were conducted from March – May of 2017. A total count of 29 steelhead redds were observed in the Chelan River. The majority of these redds (23) were in the Reach 4 Habitat Channel and pool with an additional six redds in the Reach 4 overflow channel. Minimum flows through both channels were sustained through July 16. No steelhead spawning was observed in the tailrace in 2017.

During the fall 2017 Chinook salmon spawning period, powerhouse daily average flows were maintained above 2,200 cfs from October 15 – December 31, except during a four-day span for maintenance work. During this time from October 24 – 27, the powerhouse operated with one turbine running and flows averaging above 1200 cfs. A total count of 412 Chinook salmon redds were estimated to have been deposited in the Chelan River, including the Reach 4 Habitat Channel and pool (112), tailrace (204), and downstream in the Chelan/Columbia River confluence and Columbia River (96).

Water temperatures were monitored at seven locations in the Chelan River and tailrace. Water temperatures neither increased nor decreased during transit through the Reach 4 Habitat Channel. The maximum daily average water temperatures measured from upstream to downstream locations were 23.7 °C at the Low Level Outlet, 23.7 °C at the top of Reach 1, 22.7 °C at the end of Reach 1, 22.7 °C at the end of Reach 3, 23.0 °C at the top of Reach 4, 23.0 °C at the bottom of Reach 4, and 23.3 °C in the tailrace. The highest hourly temperatures recorded at these locations were 24.1 °C, 24.1 °C, 25.8 °C, 25.5 °C, 24.8 °C, 25.5 °C, and 24.2 °C, respectively. For the same locations the highest 7-DADMax temperatures recorded were 24.1 °C, 24.1 °C, 25.8 °C, 25.5 °C, 24.8 °C, 25.5 °C, and 23.8 °C.

## **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 the FERC on May 4, 2007 and the 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, to evaluate meeting minimum flow requirements, protection of fish habitat and protection of salmon and steelhead eggs incubating in the tailrace. The TESPP also includes annual reporting of water temperature monitoring required in the Lake Chelan Settlement Agreement. The order approving the OCMP requires that Chelan PUD shall file an Annual Flow Report with the FERC by February 28 of each year. Due to weather and snow conditions that frequently prevented retrieval of temperature loggers in January and February, the FERC granted a request from Chelan PUD to change the filing date of these annual reports to April 30. This Annual Flow and Temperature Report meets the flow and temperature reporting requirements of License Articles 405 and 408 for 2017.



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. This 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 2017. 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. After 2014, additional data was collected to document water quality assessments that further address this requirement by providing monitoring during the winter of 2015-2016 and to monitor a higher spill level. During late summer and fall of 2017, data was collected for turbidity, dissolved oxygen and pH. Section 5 of this report discusses information collected in 2017.

## ***SECTION 2: CHELAN RIVER INSTREAM FLOWS***

### ***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). Chelan River flows were managed as runoff forecasts evolved for 2017. The runoff forecast on April 1 was 106% of average, which is classified as an “average year” for setting minimum flows during the annual runoff cycle. The 2017 minimum flow releases to Reaches 1-3 were at least 200 cfs from May 15 – July 15. As actual runoff volume was recorded, the forecast shifted to reflect a “wet year” and dictated a change in minimum flows in Reaches 1-3. Minimum flow releases to Reaches 1-3 were at least 320 cfs from May 23 – 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. Flows in the Reach 4 Habitat channel were at least 285 cfs from March 15 – July 15, except for a one-day reduction on March 23. Flows were reduced for 9 hours in the Reach 4 Habitat Channel to allow egg box placement for a steelhead egg to emergence survival study performed in 2017. Chelan River pumps were turned off in succession following approval from the CRFF and brought back online in series. Water levels and the channel margins were monitored and there were no adverse effects on aquatic life. The Pump Station was utilized to test the potential to trap adult Chinook salmon for broodstock for the Chelan Falls artificial propagation program (a program included in the Habitat Conservation Plan for Rocky Reach Project); two pumps were operated from July 21 – August 21.

Flows were released from the spillway, as needed for lake level control, from May 22 – July 11. 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. Daily average spillway flow releases for lake level control peaked at 7,260 cfs on May 29, with the highest hourly flows of 7,581 cfs on May 30. Flow releases from the Low Level Outlet were also managed to provide whitewater boating flows on September 16 -17. Flows were ramped back down to minimum flows following the event, with ramping concluded on September 19.

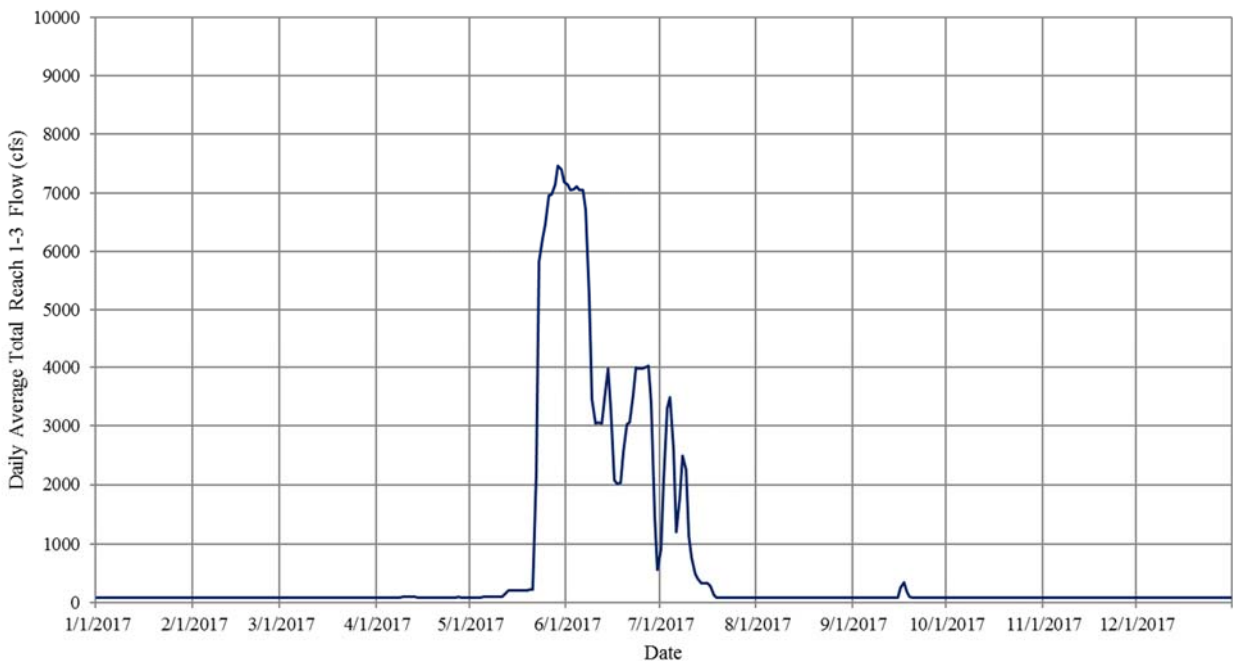
Spawning flows were provided for steelhead trout from March 15 – May 15 and for Chinook salmon from October 15 - November 30. In 2017, spawning flows were provided by using four instead of five pumps based on the methods that were approved by the CRFF and tested in 2016. This temporary change in 2016 was documented by Chelan PUD and FERC was notified by letters dated March 11, 2016 and October 13, 2016. In a letter dated March 13, 2017 and supplemented on November 29, 2017, Chelan PUD requested to amend the project Reach 4 pumped spawning flow requirements to provide 180 cfs from pumped operations and 80 cfs from the diversion dam for a total of 260 cfs. Chelan PUD received a FERC Order<sup>1</sup> dated December 7, 2017 that this request was approved. The spawning flows were provided through the combination of the Low Level Outlet flows and Pump Station flows, maintaining flow levels of at least 285 cfs during the spring steelhead spawning period, except during the 9 hours during the egg box placement mentioned earlier. Flows also generally exceeded 285 cfs from late April – May due to spill. During the Chinook spawning period, the flow ranged from 283 cfs – 291 cfs. At the end of the Chinook spawning period, flows from the Pump Station were ramped down one

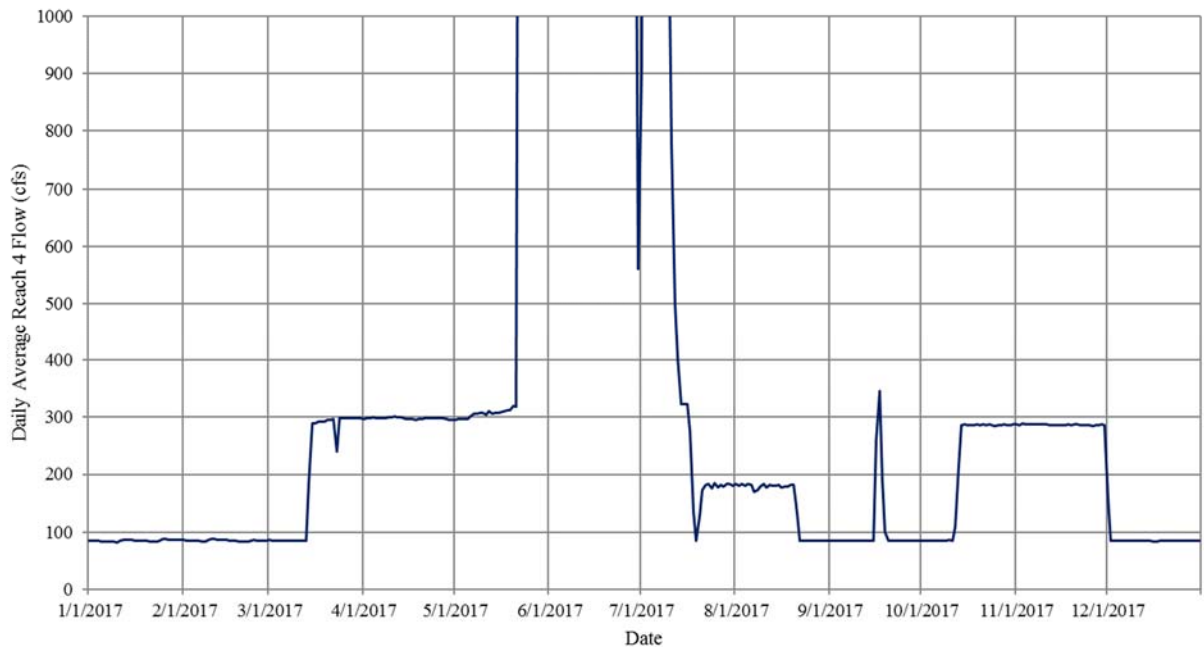
<sup>1</sup> *Order Amending Minimum Pumped Spawning Flow and Related License Requirements.* 161 FERC ¶ 62,182

pump at a time to avoid fish stranding. Steelhead spawning surveys were conducted from March – May of 2017. A total count of 29 steelhead redds were observed in the Chelan River. The majority of these redds (23) were in the Reach 4 Habitat Channel and pool with an additional six redds in the Reach 4 overflow channel. Minimum flows through both channels were sustained through July 16. No steelhead spawning was observed in the tailrace in 2017. Chinook fry were observed during snorkel surveys to be rearing in the Reach 4 Habitat Channel in mid-April and mid-May, but no fry were observed in July. High spill levels prevented conducting snorkel surveys in June. Chinook spawning began by October 7 and was completed prior to November 25. There were a total of 412 redds counted in the Chelan River Reach 4, the tailrace and Columbia River at the confluence. There were 112 redds in the Reach 4 Habitat Channel and upstream pool, 204 in the tailrace and 96 in the Columbia River in Chelan River currents 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. Hourly data reported quarterly is available Chelan PUD’s web page under Licensing and Compliance, Lake Chelan License Implementation, Resource Documents.

**Figure 2-1. Flow Releases to Reaches 1-3 of the Chelan River, 2017.**



**Figure 2-2. Flow Releases to Chelan River Reach 4, 2017.**

### **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 were 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.

The year 2017 was the eighth 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 were included in the 2017 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 salmon spawning surveys (weekly October – November) have only observed Chinook salmon fry in the Reach 4 Habitat Channel during the months of February through June. Chinook or steelhead fry have not been observed in significant numbers prior to February and after July. However, ramping rate operations for juvenile fish were followed throughout the year since refinement of ramping rates has not yet concluded.

Chelan PUD continued to implement operating criteria for compliance with the two inches per hour ramping rates that were refined in 2011 and further developed from 2014 - 2016 to improve instructions on the timing of flow changes. These improved instructions are shown in Table 2-1.

Table 2-1. Final Ramping Criteria (2016).

Chelan River Maximum Allowable Spill Reduction Ramping Rates		
Chelan Hydro License Compliance		
Revised 10/10/2016		
Whenever making a change in total spill, enter the table below at the “Total Current Spill” on the left, read “Maximum Allowable Spill Reduction Ramping Rate” on the right. <b>**NOTE</b> – if spill is reduced to a lower bandwidth, the ramp rate will change at the point (i.e. spill starts at 1100 cfs and you want to change to 800 cfs, it would be 200 cfs/hr for 30 minutes (until 1000 cfs is reached), then 100 cfs/hr for 2 hours until 800 cfs is reached).		
Only reduce spill during daylight hours (to aid fish movement from potential entrapment areas).		
Total Current Spill = Spill Gates + Low Level Outlet cfs	Maximum Allowable Spill Reduction Ramping Rate	
	Fry are Present Along Riverbank Mar 15 to Sep 15 cfs/hr	No Fry Are Present Along Riverbank Sep 16 to Mar 14 cfs/hr
1000 < Total Current Spill	200	250
600 < Total Current Spill <= 1000	100	100
500 < Total Current Spill <= 600	50	50
220 < Total Current Spill <= 500	25	30
80 < Total Current Spill <= 220	20	20

### ***SECTION 3: POWERHOUSE TAILRACE SECURITY FLOWS***

#### ***Powerhouse Operations***

There were 448 salmon redds with eggs incubating in the tailrace from spawning that occurred in the fall of 2016. Powerhouse operations to maintain minimum generation flows of over 800 cfs for Chinook redd protection were implemented to maintain adequate oxygen levels in Chinook salmon redds. The powerhouse operated with at least one turbine at near full capacity, except for one period of a few hours for maintenance on March 18, 2017.

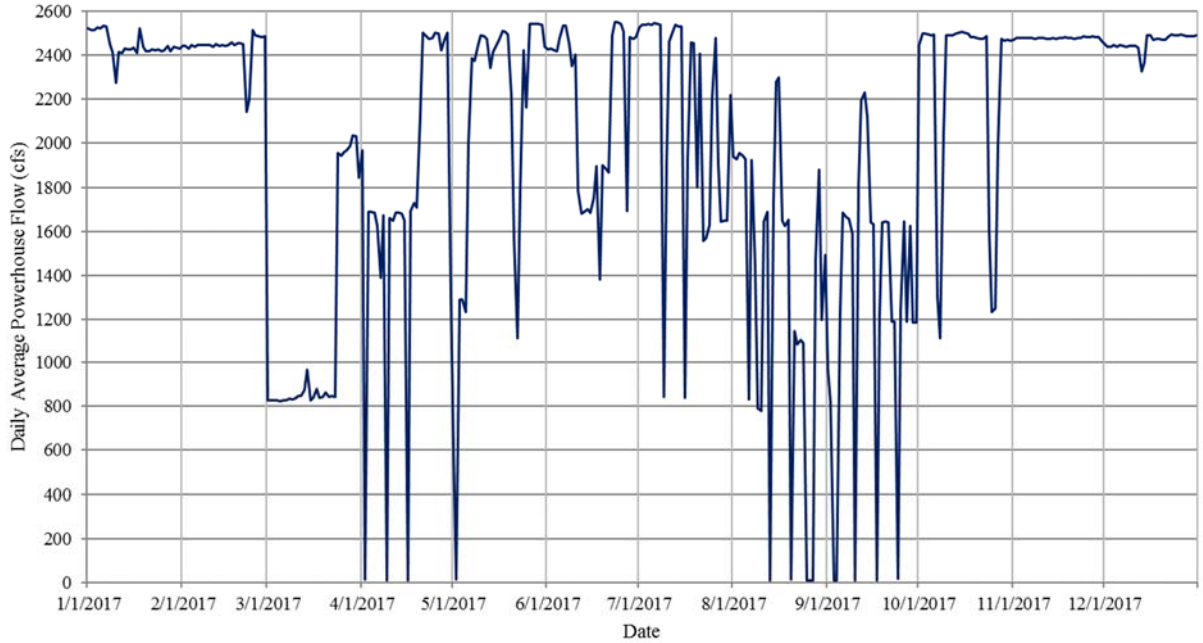
From April 1 – May 31, the powerhouse was operated with at least one turbine at near full capacity, except for periods during annual maintenance (Appendix A). Steelhead spawning surveys were conducted from March – May, with 29 redds counted in the Habitat Channel, but no steelhead spawning was observed in the tailrace in 2017.

During the Chinook spawning period, powerhouse daily average flows were maintained above 2,200 cfs from October 15 – November 30 except during a four-day span for maintenance work. During this time from October 24 – 27, the powerhouse operated with one turbine running and flows averaging above 1200 cfs. A total count of 412 Chinook redds were estimated to have been deposited in the Chelan River, including the Reach 4 Habitat Channel and pool (112), tailrace (204), and downstream in the Chelan/Columbia River confluence and Columbia River (96).

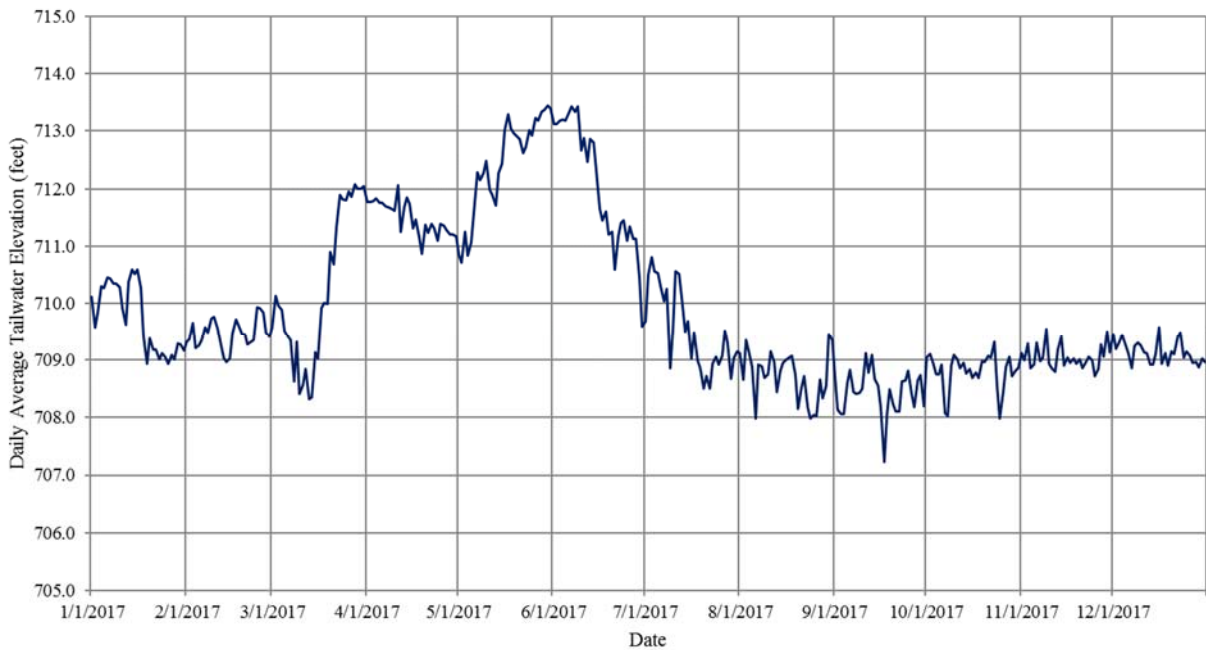
Powerhouse flows were above 2,200 cfs from December 1 – 31. The daily average powerhouse flows are shown in Figure 3-1.

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 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, and this area was again excavated and graded in summers of 2014 and 2016 to remove river gravels that had accumulated since 2008 and in spring 2016. The water levels in the tailrace remained above 708.0 feet most of the time and never dropped below 707.4 feet from January 1 – May 31 and October 15 – December 31. The daily average tailwater levels measured at the powerhouse are shown in Figure 3-2.

**Figure 3-1. Chelan Powerhouse Daily Average Flows, 2017.**



**Figure 3-2. Chelan Powerhouse Daily Average Tailwater Elevations, 2017.**



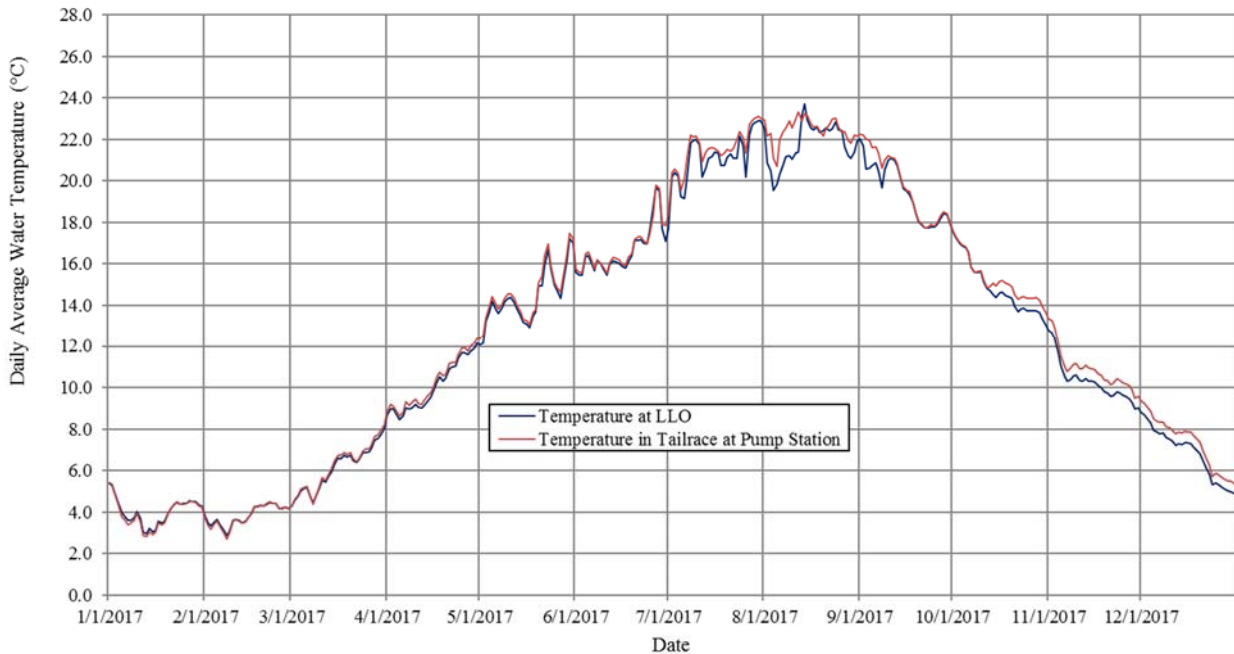
## **SECTION 4: WATER TEMPERATURE MONITORING**

### **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 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) generally show little stratification in water temperatures at the face of Chelan Dam. The maximum daily average water temperature measured in the Low Level Outlet pipe was 23.7 °C. Hourly water temperatures peaked at 24.1 °C on August 13-14. Tailrace maximum daily average temperature was 23.3 °C, while hourly temperatures peaked at 23.8 °C on August 14.

**Figure 4-1. Low Level Outlet and Tailrace Daily Average Water Temperatures.**



### **Water Temperatures in Chelan River Reaches 1-3.**

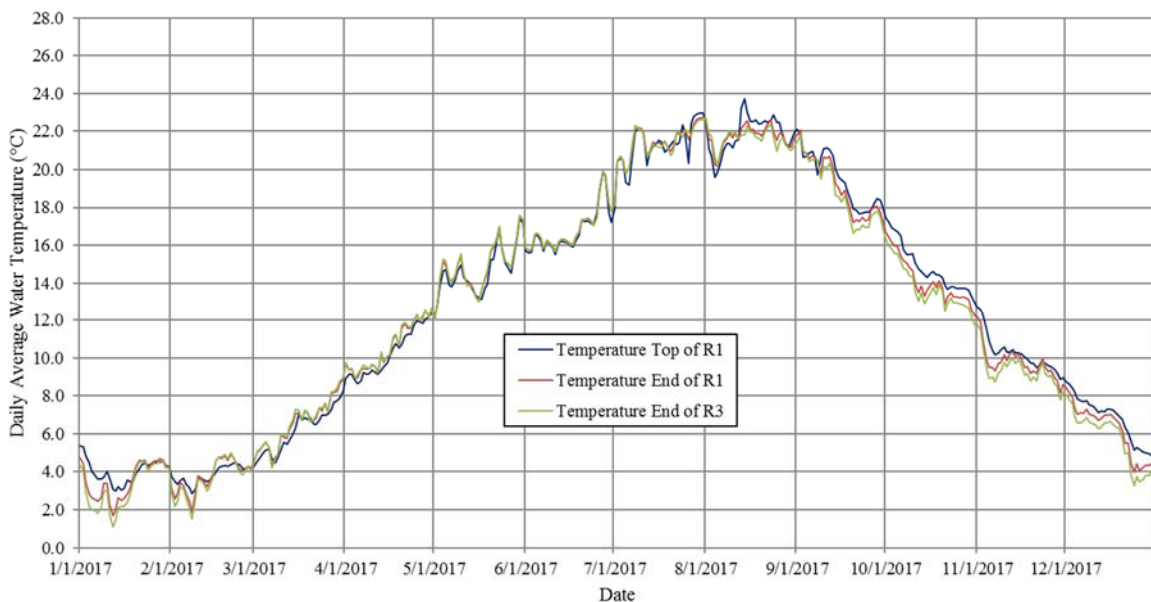
Water temperatures are monitored at three locations with temperature recording data loggers (Onset HOBO Water Temp Pro v2) that are set to record the water temperature at hourly intervals. These locations are at the top of Reach 1, which measures the temperature of water entering the Chelan River from 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 data logger at this site was lost due to apparent theft or vandalism which resulted in missing data from the beginning of the year through March 15, with Low Level Outlet data substituted for Figure 4-2. The logger was replaced upon discovery. 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 barriers 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 on Chelan PUD’s web page under Licensing and Compliance, Lake Chelan License Implementation, Resource Documents.

The water temperatures recorded in Reaches 1-3 in 2017 demonstrated small differences in daily average water temperature between Reaches (Figure 4-2), with the greatest differences in the winter due to cooling of the warmer lake water as it moved downstream. In contrast, the daily maximum water temperature increased above the temperature at the Low Level Outlet during summer and decreased during the fall. This is not unexpected because the water exiting Lake Chelan is influenced 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 winter. The maximum daily average water temperatures recorded in 2017 were 23.7 °C at the top of Reach 1, 22.7 °C at the end of Reach 1, and 22.7 °C at the end of Reach 3. The highest hourly temperatures recorded were 24.1 °C, 25.8 °C, and 25.5 °C, respectively for the top of Reach 1, end of Reach 1 and end of Reach 3. The highest temperature recorded was at the end of Reach 1 on July 31.

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

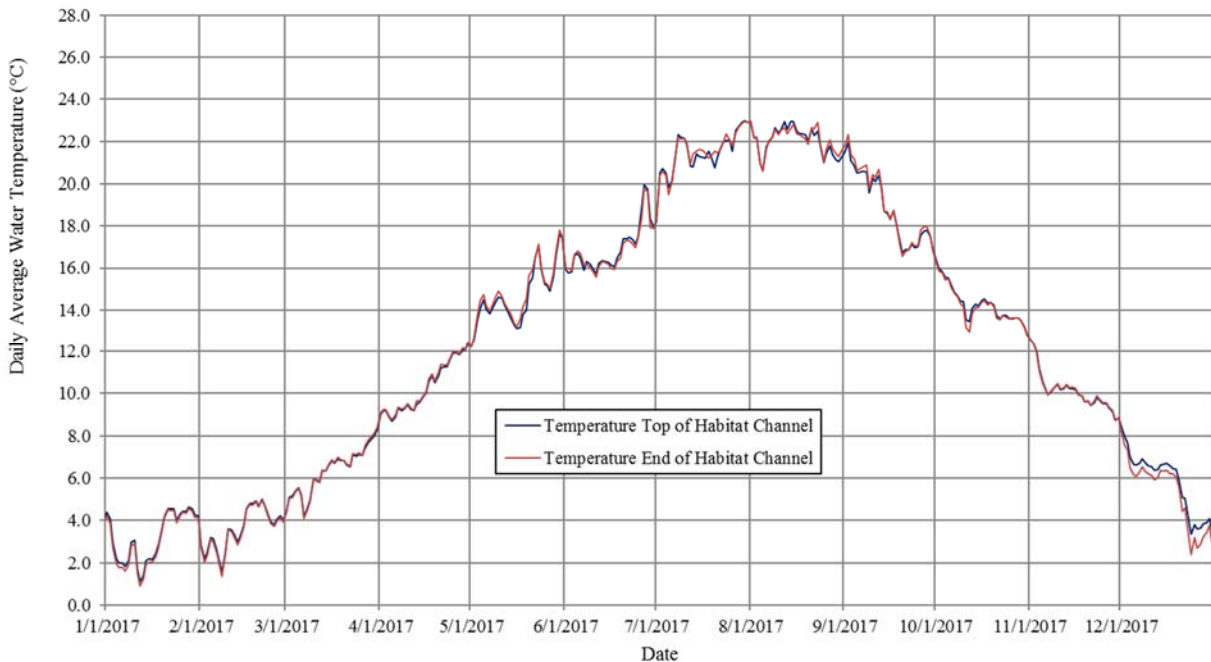


**Water Temperatures in Chelan River Reach 4 Habitat Channel.**

Water temperatures are monitored at hourly intervals at two locations (Onset HOB0 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 Habitat Channel flow mixes with the tailrace. Data from this site was not available due to equipment malfunction from June 8 through July 25. Data from the neighboring tailrace probe was substituted for Figure 4-3. The dysfunctional probe from the Habitat Channel was replaced on July 25.

The daily average water temperature data from these locations did not show any evidence of heating as water passed through the Habitat Channel (Figure 4-3). The maximum daily average temperatures recorded were 23.0 °C at the top and 23.0 °C also at the end of the Habitat Channel. The maximum hourly temperatures were 24.8 °C and 25.5 °C at the upper and lower ends of the Habitat Channel. These peak temperatures were recorded on August 23 and August 22-23, respectively.

**Figure 4-3. Reach 4 Habitat Channel Daily Average Water Temperatures.**



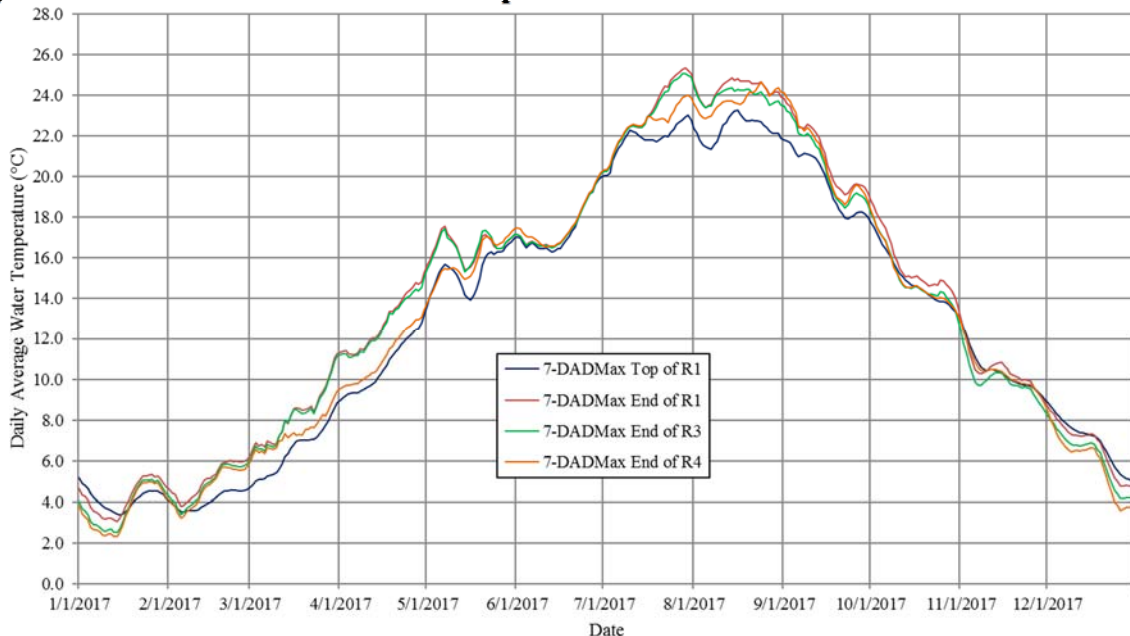
**Chelan River 7-DADMax Water Temperatures Top Reach 1 to Bottom Reach 4.**

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 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 reached 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). However, cooler tailrace water provided from July 20 - August 21 effectively lowered the 7-DADMax by a small amount. The 7-DADMax at the top of Reach 1 exceeded the 17.5 °C criterion on June 21, with exceedances extending through October 2, reaching a peak of 23.3 °C on August 16. The 7-DADMax at the end of Reach 4 exceeded the criterion on June 1, with exceedances continuing through October 3. The highest 7-DADMax reached 24.7 °C on August 24. The highest 7-DADMax at the ends of Reach 1 and Reach 3 were 25.3 °C and 25.1 °C, respectively.

**Figure 4-4. The 7-DADMax Water Temperatures for Reaches 1 – 4.**



## **SECTION 5: WATER QUALITY ASSESSMENT**

General water quality assessment data was collected from September –December in 2017 to provide additional continuous monitoring. The requirement for general water quality assessment is 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 (FERC Order, March 5, 2013). 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 a designated aquatic life use 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

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

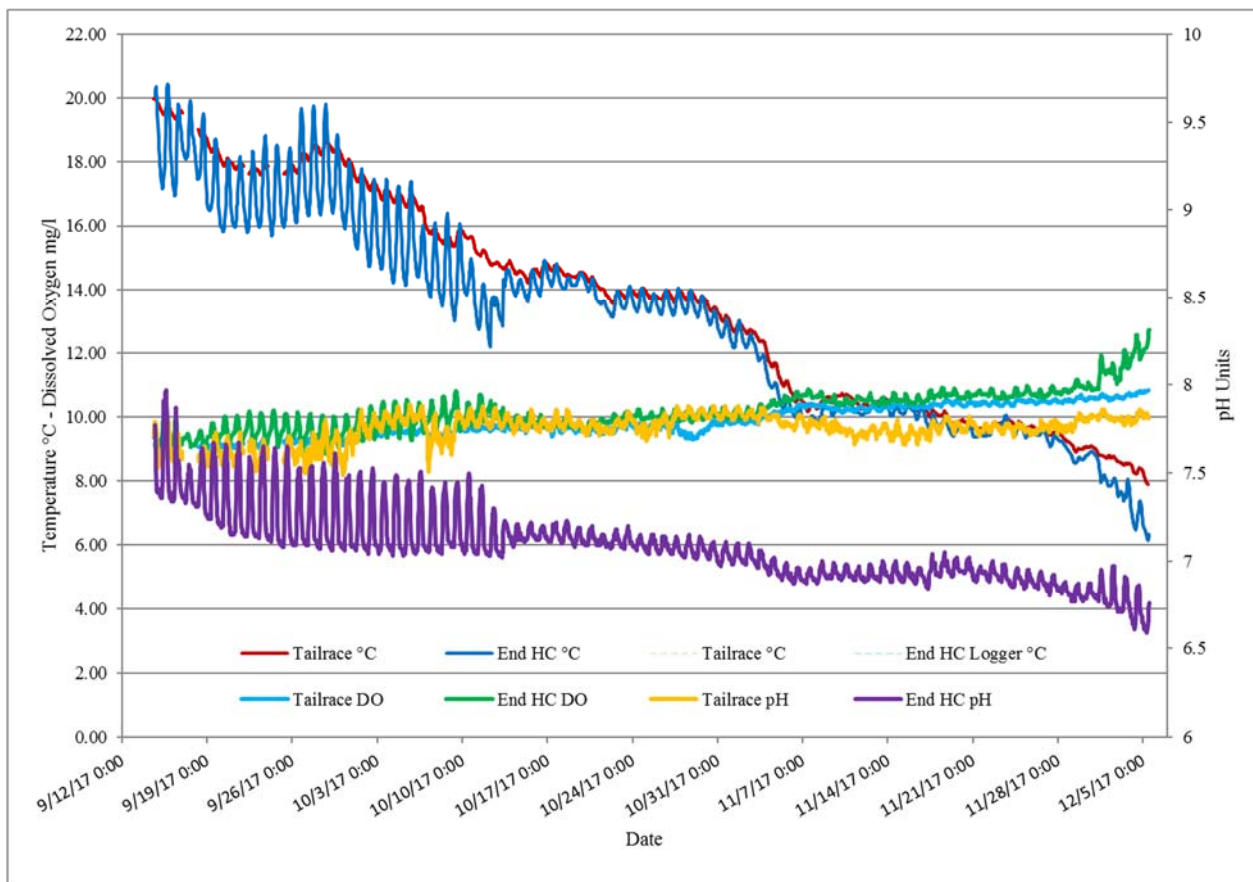
Measurements of water temperature, dissolved oxygen and pH were obtained from the downstream terminus of the Reach 4 Habitat Channel from September 14 to December 5, 2017. Measurements were obtained using Hydrotech DS5 compact sondes that were programmed to record data every hour. One DS5 sonde was attached to the same anchor post that is used for the temperature recording data logger at the lower end of the Habitat Channel. The other DS5 sonde was attached to the anchor post that is used for the temperature logger in the tailrace. Data from the tailrace DS5 sonde was removed from the analysis on portions of three periods, 9/17-9/18, 9/22 and 9/24-9/25, due to low water levels that dewatered the DS5 sonde or otherwise resulted in faulty readings.

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 DS5 sondes are shown in Figure 5-1. The dissolved oxygen levels in Figure 5-1 demonstrate that the dissolved oxygen level in both the Habitat Channel and tailrace met the water quality criterion of 8.0 mg/l. The pH readings from both DS5 sondes were within the water quality criteria of 6.5 – 8.5.

The pH from the DS5 sonde in the Habitat Channel initially drifted into lower values, stabilizing near 7.1 for nighttime readings that were not affected by daytime photosynthesis. The pH sensor appeared stable until the end of October, when pH readings again began declining. The pH sensor was determined to have failed and replaced when the DS5 sonde was sent to the manufacturer for repair after deployment.

The pH readings in the tailrace remained fairly stable until the end of the deployment, when readings drifted higher. The tendency of the pH sensor to drift toward higher pH readings during extended (> 30 days) deployments has been observed in previous deployments in the Habitat Channel. The drift toward higher pH values is presumed due to depletion of the reference sensor KCL concentration over time and possibly fouling of the Teflon reference junction that emits the KCL electrolyte necessary for pH measurement. This pH sensor was functioning properly after recalibration during annual maintenance.

**Figure 5-1. Dissolved Oxygen and pH Data in Reach 4 Habitat Channel and Tailrace.**

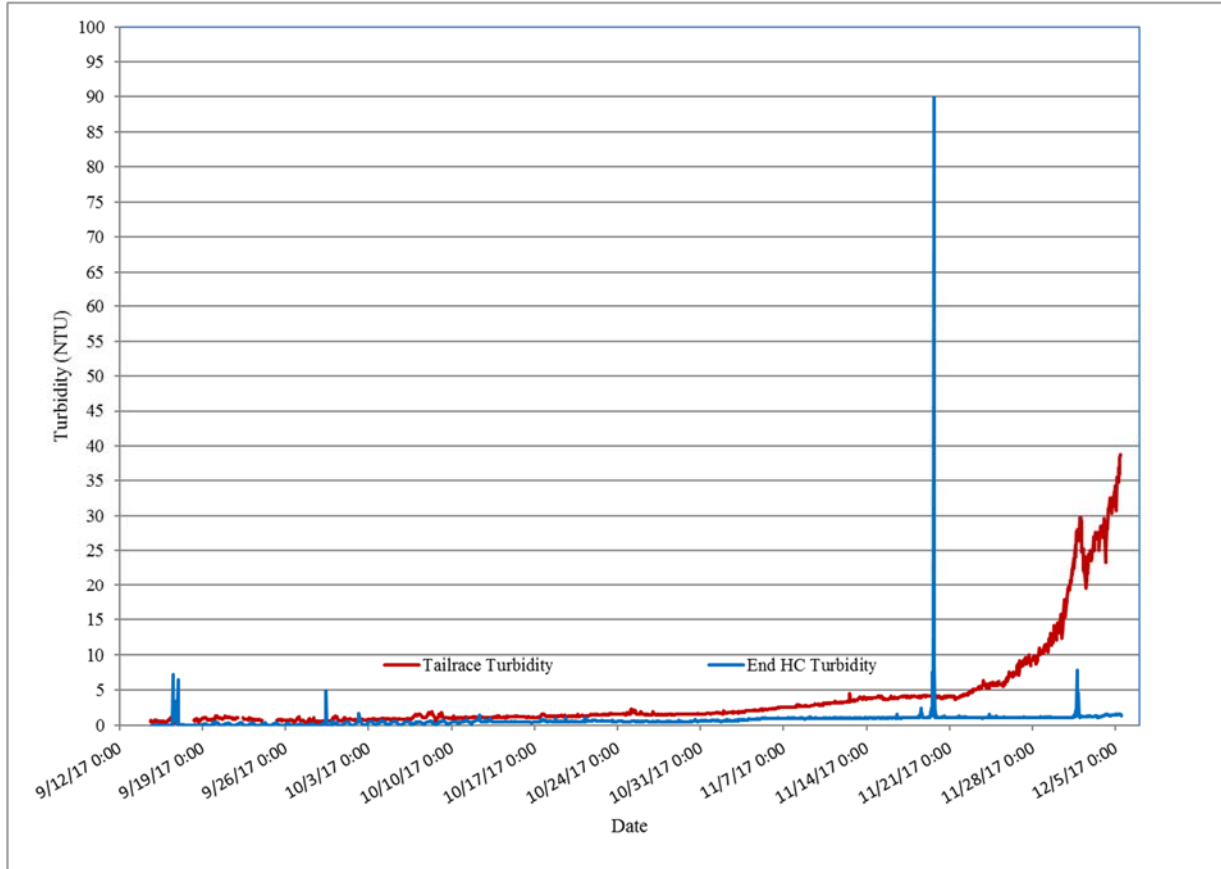


Turbidity measurements were recorded hourly during these deployments. The turbidity in the Habitat Channel was below 5 NTU throughout the deployment, with the exception of five hourly readings on 9/16 (7.3, 6.5), 11/19 (89.9, 8.2), and 12/1 (7.8). The first events were on the first day of increased flows released for a two-day kayaking event in the upper reaches of the Chelan River. This flow release resulted in washing dust or other deposits on these upstream shorelines that had been at minimum flow levels since spill for lake level control ended on July 18. The

higher turbidity event on November 19 was during peak spawning of Chinook salmon in the Habitat Channel and, due to its very brief duration, likely the result of redd digging activity a short distance upstream from the turbidity sensor. The event on December 1 was several hours after the termination of 200 cfs of pumped flow, which marked the end of pumped flow provided during the Chinook spawning period.

The turbidity in the tailrace also was below 5 NTU until November 23, but the NTU readings were slowly increasing over the course of the deployment and the rate of increase accelerated late in the deployment. This increase in NTU is believed due to algal fouling of the turbidity sensor since the DS5 sonde in the tailrace had considerable algae growth on the housing when removed on December 5. The turbidity sensor has a self-cleaning brush that was set at deployment to wipe the sensor lens twice prior to each hourly measurement, but it appears that this function may not have been working during the deployment. The turbidity sensor in the Habitat Channel also did not record lens cleaning in the log files despite having been programmed for two brush cycles prior to each hourly measurement. There was a small increase in the NTU measurements in the Habitat Channel over time, however perhaps due to the higher flow velocity at this deployment site there was far less algae growth on the DS5 sonde housing when it was removed on December 5. The proper function and recording of the self-cleaning component of the turbidity sensors was also addressed in the service and repair order to the manufacturer at the end of the deployment.

**Figure 5-2. Turbidity Data in Reach 4 Habitat Channel and Tailrace.**



## ***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. Chelan River flows were managed as runoff forecasts evolved for 2017. The runoff forecast on April 1 was 106% of average, which is classified as an “average year” for setting minimum flows during the annual runoff cycle. The 2017 minimum flow releases to Reaches 1-3 were at least 200 cfs from May 15 – July 15. As actual runoff volume was recorded, the forecast shifted to reflect a “wet year” and dictated a change in minimum flows in Reaches 1-3. Minimum flow releases to Reaches 1-3 were at least 320 cfs from May 23 – 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. Flows in the Reach 4 Habitat channel were at least 285 cfs from March 15 – July 15, except for a one-day reduction on March 23. Flows were reduced for 9 hours in the Reach 4 Habitat Channel to allow egg box placement for a steelhead egg to emergence survival study performed in 2017. Chelan River pumps were turned off in succession and brought back online in series. This final schedule was developed and emails, dated March 22, 2017 and March 23, 2017, were sent for concurrence from the Chelan River Fish Forum (CRFF). Water levels and the channel margins were monitored and there were no adverse effects on aquatic life. The Pump Station was utilized to test the potential to trap adult Chinook salmon for broodstock for the Chelan Falls program; two pumps were operated from July 21 – August 21.

Flows were released from the spillway, as needed for lake level control, from May 22 – July 11. 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. Daily average spillway flow releases for lake level control peaked at 7,260 cfs on May 29, with the highest hourly flows of 7,581 cfs on May 30. Flow releases from the Low Level Outlet were also managed to provide whitewater boating flows on September 16 -17. Flows were ramped back down to minimum flows following the event, with ramping concluded on September 19.

There were 207 salmon redds with eggs incubating in the tailrace from spawning that occurred in the fall of 2016. Powerhouse operations to maintain minimum generation flows of over 800 cfs for Chinook salmon redd protection were implemented to maintain adequate oxygen levels in Chinook salmon redds. The powerhouse operated with one turbine at full capacity until April 1, except for one period of a few hours for maintenance on March 18, 2017.

Steelhead spawning surveys were conducted from March – May of 2017. A total count of 29 steelhead redds were observed in the Chelan River. The majority of these redds (23) were in the Reach 4 Habitat Channel and pool with an additional six redds in the Reach 4 overflow channel. Minimum flows through both channels were sustained through July 16. No steelhead spawning was observed in the tailrace in 2017.

During the fall 2017 Chinook salmon spawning period, powerhouse daily average flows were maintained above 2,200 cfs from October 15 – December 31 except during a four-day span for maintenance work. During this time from October 24 – 27, the powerhouse operated with one



turbine running and flows averaging above 1200 cfs. A total count of 412 Chinook salmon redds were estimated to have been deposited in the Chelan River, including the Reach 4 Habitat Channel and pool (112), tailrace (204), and downstream in the Chelan/Columbia River confluence and Columbia River (96).

Water temperatures were monitored at seven locations in the Chelan River and tailrace. Water temperatures neither increased nor decreased during transit through the Reach 4 Habitat Channel. The maximum daily average water temperatures measured from upstream to downstream locations were 23.7 °C at the Low Level Outlet, 23.7 °C at the top of Reach 1, 22.7 °C at the end of Reach 1, 22.7 °C at the end of Reach 3, 23.0 °C at the top of Reach 4, 23.0 °C at the bottom of Reach 4, and 23.3 °C in the tailrace. The highest hourly temperatures recorded at these locations were 24.1 °C, 24.1 °C, 25.8 °C, 25.5 °C, 24.8 °C, 25.5 °C, and 24.2 °C, respectively. For the same locations the highest 7-DADMax temperatures recorded were 24.1 °C, 24.1 °C, 25.8 °C, 25.5 °C, 24.8 °C, 25.5 °C, and 23.8 °C.

All correspondences regarding operations that pertain to this report can be found on the District's external website located at [www.chelanpud.org](http://www.chelanpud.org).

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

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Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spillway Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
1/1/2017	1092.3	2523	710.1	85	0	85	0	85
1/2/2017	1092.2	2514	709.6	84	0	84	0	84
1/3/2017	1092.1	2514	709.8	84	0	84	0	84
1/4/2017	1091.9	2525	710.3	84	0	84	0	84
1/5/2017	1091.8	2524	710.3	84	0	84	0	84
1/6/2017	1091.7	2536	710.5	84	0	84	0	84
1/7/2017	1091.6	2530	710.4	84	0	84	0	84
1/8/2017	1091.5	2450	710.3	83	0	83	0	83
1/9/2017	1091.4	2416	710.3	83	0	83	0	83
1/10/2017	1091.3	2275	710.3	83	0	83	0	83
1/11/2017	1091.1	2415	709.9	85	0	85	0	85
1/12/2017	1091.0	2412	709.6	87	0	87	0	87
1/13/2017	1090.9	2429	710.4	87	0	87	0	87
1/14/2017	1090.8	2425	710.6	86	0	86	0	86
1/15/2017	1090.7	2427	710.5	86	0	86	0	86
1/16/2017	1090.6	2436	710.6	86	0	86	0	86
1/17/2017	1090.6	2410	710.3	85	0	85	0	85
1/18/2017	1090.5	2524	709.4	85	0	85	0	85
1/19/2017	1090.3	2438	708.9	85	0	85	0	85
1/20/2017	1090.1	2418	709.4	84	0	84	0	84
1/21/2017	1090.0	2419	709.2	84	0	84	0	84
1/22/2017	1090.0	2425	709.2	83	0	83	0	83
1/23/2017	1089.9	2423	709.0	83	0	83	0	83
1/24/2017	1089.7	2426	709.1	86	0	86	0	86
1/25/2017	1089.6	2419	709.0	88	0	88	0	88
1/26/2017	1089.5	2423	708.9	88	0	88	0	88
1/27/2017	1089.4	2442	709.1	87	0	87	0	87
1/28/2017	1089.3	2419	709.0	87	0	87	0	87
1/29/2017	1089.1	2440	709.3	87	0	87	0	87
1/30/2017	1089.0	2436	709.3	86	0	86	0	86
1/31/2017	1088.9	2430	709.2	86	0	86	0	86
2/1/2017	1088.8	2444	709.3	86	0	86	0	86
2/2/2017	1088.7	2444	709.4	86	0	86	0	86
2/3/2017	1088.5	2430	709.6	85	0	85	0	85
2/4/2017	1088.4	2445	709.2	85	0	85	0	85
2/5/2017	1088.3	2438	709.3	84	0	84	0	84
2/6/2017	1088.2	2446	709.3	84	0	84	0	84
2/7/2017	1088.1	2445	709.6	84	0	84	0	84
2/8/2017	1088.0	2446	709.5	84	0	84	0	84
2/9/2017	1087.9	2448	709.7	86	0	86	0	86
2/10/2017	1087.9	2447	709.8	88	0	88	0	88
2/11/2017	1087.8	2439	709.6	87	0	87	0	87
2/12/2017	1087.7	2450	709.3	87	0	87	0	87
2/13/2017	1087.5	2442	709.0	87	0	87	0	87
2/14/2017	1087.4	2446	709.0	86	0	86	0	86
2/15/2017	1087.3	2442	709.0	86	0	86	0	86
2/16/2017	1087.2	2446	709.5	85	0	85	0	85
2/17/2017	1087.1	2460	709.7	85	0	85	0	85

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spillway Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
2/18/2017	1087.0	2446	709.6	84	0	84	0	84
2/19/2017	1086.9	2455	709.5	84	0	84	0	84
2/20/2017	1086.8	2453	709.5	84	0	84	0	84
2/21/2017	1086.7	2452	709.3	83	0	83	0	83
2/22/2017	1086.6	2145	709.3	83	0	83	0	83
2/23/2017	1086.5	2200	709.3	85	0	85	0	85
2/24/2017	1086.4	2515	709.9	86	0	86	0	86
2/25/2017	1086.3	2492	709.9	85	0	85	0	85
2/26/2017	1086.2	2485	709.8	85	0	85	0	85
2/27/2017	1086.0	2483	709.5	84	0	84	0	84
2/28/2017	1085.9	2486	709.4	85	0	85	0	85
3/1/2017	1085.8	829	709.6	86	0	86	0	86
3/2/2017	1085.7	827	710.1	86	0	86	0	86
3/3/2017	1085.7	828	710.0	85	0	85	0	85
3/4/2017	1085.6	827	709.9	85	0	85	0	85
3/5/2017	1085.6	825	709.5	85	0	85	0	85
3/6/2017	1085.6	826	709.4	85	0	85	0	85
3/7/2017	1085.6	825	709.3	85	0	85	0	85
3/8/2017	1085.6	833	708.6	85	0	85	0	85
3/9/2017	1085.6	830	709.3	85	0	85	0	85
3/10/2017	1085.6	837	708.4	85	0	85	0	85
3/11/2017	1085.6	847	708.6	85	0	85	0	85
3/12/2017	1085.6	846	708.8	85	0	85	0	85
3/13/2017	1085.6	877	708.3	85	0	85	0	85
3/14/2017	1085.6	966	708.4	85	0	85	99	184
3/15/2017	1085.6	825	709.1	86	0	86	203	289
3/16/2017	1085.7	839	709.0	88	0	88	201	289
3/17/2017	1085.7	878	709.9	88	0	88	205	293
3/18/2017	1085.8	840	710.0	88	0	88	204	292
3/19/2017	1085.9	842	710.0	88	0	88	204	292
3/20/2017	1085.9	865	710.9	88	0	88	207	296
3/21/2017	1086.0	842	710.7	89	0	89	206	295
3/22/2017	1086.0	845	711.3	89	0	89	208	296
3/23/2017	1086.0	841	711.9	89	0	89	151	239
3/24/2017	1086.1	1955	711.8	89	0	89	210	299
3/25/2017	1086.1	1942	711.8	89	0	89	209	298
3/26/2017	1086.0	1960	712.0	89	0	89	210	299
3/27/2017	1086.0	1968	711.9	89	0	89	209	298
3/28/2017	1086.0	1989	712.1	89	0	89	209	298
3/29/2017	1086.0	2036	712.0	89	0	89	209	298
3/30/2017	1086.0	2030	712.0	89	0	89	210	298
3/31/2017	1086.0	1845	712.0	88	0	88	210	298
4/1/2017	1086.0	1967	711.8	88	0	88	208	297
4/2/2017	1086.0	13	711.8	90	0	90	209	299
4/3/2017	1086.1	1690	711.8	89	0	89	209	299
4/4/2017	1086.1	1689	711.8	89	0	89	210	299
4/5/2017	1086.1	1686	711.8	89	0	89	210	299
4/6/2017	1086.1	1623	711.8	89	0	89	209	299

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spillway Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
4/7/2017	1086.2	1388	711.7	90	0	90	209	298
4/8/2017	1086.3	1673	711.7	90	0	90	208	298
4/9/2017	1086.4	10	711.7	91	0	91	209	300
4/10/2017	1086.5	1661	711.6	91	0	91	209	300
4/11/2017	1086.6	1647	712.1	91	0	91	211	302
4/12/2017	1086.7	1685	711.3	91	0	91	209	300
4/13/2017	1086.8	1683	711.7	92	0	92	208	300
4/14/2017	1086.9	1683	711.8	90	0	90	208	298
4/15/2017	1086.9	1647	711.7	87	0	87	209	296
4/16/2017	1087.0	10	711.3	89	0	89	209	297
4/17/2017	1087.1	1695	711.5	88	0	88	208	297
4/18/2017	1087.1	1729	711.2	89	0	89	207	296
4/19/2017	1087.2	1709	710.9	89	0	89	207	296
4/20/2017	1087.3	2123	711.4	89	0	89	208	297
4/21/2017	1087.3	2502	711.2	90	0	90	209	299
4/22/2017	1087.4	2486	711.4	89	0	89	209	298
4/23/2017	1087.4	2474	711.3	90	0	90	208	298
4/24/2017	1087.4	2480	711.1	90	0	90	208	298
4/25/2017	1087.5	2501	711.4	90	0	90	209	299
4/26/2017	1087.5	2498	711.4	90	0	90	208	298
4/27/2017	1087.6	2423	711.3	91	0	91	208	298
4/28/2017	1087.6	2475	711.2	89	0	89	208	297
4/29/2017	1087.7	2503	711.2	87	0	87	209	295
4/30/2017	1087.7	1295	711.2	87	0	87	209	295
5/1/2017	1087.9	602	710.8	88	0	88	208	295
5/2/2017	1088.0	14	710.7	89	0	89	207	296
5/3/2017	1088.1	1290	711.2	88	0	88	208	297
5/4/2017	1088.3	1289	710.8	89	0	89	207	297
5/5/2017	1088.7	1235	711.1	91	0	91	207	297
5/6/2017	1089.4	2000	711.6	94	0	94	208	301
5/7/2017	1089.9	2385	712.3	95	0	95	210	306
5/8/2017	1090.3	2374	712.2	96	0	96	210	306
5/9/2017	1090.5	2445	712.3	97	0	97	210	307
5/10/2017	1090.7	2492	712.5	97	0	97	211	308
5/11/2017	1091.1	2488	712.0	95	0	95	210	305
5/12/2017	1091.6	2475	711.9	149	0	149	161	310
5/13/2017	1092.0	2342	711.7	204	0	204	102	306
5/14/2017	1092.3	2415	712.3	205	0	205	103	308
5/15/2017	1092.5	2446	712.4	205	0	205	103	307
5/16/2017	1092.7	2470	713.0	205	0	205	103	309
5/17/2017	1092.9	2512	713.3	206	0	206	104	310
5/18/2017	1093.0	2507	713.0	208	0	208	104	311
5/19/2017	1093.1	2495	713.0	208	0	208	104	312
5/20/2017	1093.2	2212	712.9	216	0	216	104	320
5/21/2017	1093.5	1568	712.9	214	0	214	104	318
5/22/2017	1094.0	1110	712.6	219	1981	2200	69	2269
5/23/2017	1094.5	1783	712.7	218	5603	5821	11	5833
5/24/2017	1094.9	2422	713.0	218	6000	6219	0	6219

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spillway Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
5/25/2017	1095.1	2165	712.9	165	6303	6467	0	6467
5/26/2017	1095.1	2542	713.2	145	6811	6956	0	6956
5/27/2017	1095.2	2543	713.2	203	6769	6973	0	6973
5/28/2017	1095.3	2542	713.3	205	6939	7144	0	7144
5/29/2017	1095.6	2543	713.4	200	7260	7460	0	7460
5/30/2017	1096.0	2539	713.5	200	7202	7402	0	7402
5/31/2017	1096.4	2438	713.4	200	6990	7190	0	7190
6/1/2017	1096.7	2425	713.1	200	6936	7136	0	7136
6/2/2017	1096.9	2430	713.1	200	6852	7052	0	7052
6/3/2017	1097.1	2421	713.2	200	6856	7056	0	7056
6/4/2017	1097.2	2419	713.2	200	6915	7115	0	7115
6/5/2017	1097.1	2478	713.2	200	6853	7053	0	7053
6/6/2017	1097.1	2536	713.3	233	6816	7049	0	7049
6/7/2017	1097.0	2535	713.4	200	6507	6707	0	6707
6/8/2017	1097.2	2449	713.3	203	5018	5221	0	5221
6/9/2017	1097.5	2350	713.4	202	3259	3460	0	3460
6/10/2017	1097.6	2401	712.7	200	2849	3049	0	3049
6/11/2017	1097.7	1785	712.9	201	2864	3065	0	3065
6/12/2017	1097.9	1682	712.5	201	2845	3045	0	3045
6/13/2017	1098.0	1690	712.9	200	3259	3459	0	3459
6/14/2017	1097.9	1699	712.8	200	3786	3986	0	3986
6/15/2017	1097.9	1685	712.3	208	3083	3291	0	3291
6/16/2017	1098.0	1754	711.6	209	1875	2083	0	2083
6/17/2017	1098.1	1898	711.5	200	1820	2020	0	2020
6/18/2017	1098.3	1381	711.6	200	1836	2036	0	2036
6/19/2017	1098.4	1901	711.2	351	2205	2556	0	2556
6/20/2017	1098.5	1885	711.2	501	2522	3023	0	3023
6/21/2017	1098.8	1869	710.6	499	2557	3056	0	3056
6/22/2017	1098.8	2492	711.2	500	3039	3539	0	3539
6/23/2017	1098.7	2551	711.4	500	3495	3995	0	3995
6/24/2017	1098.7	2550	711.4	500	3485	3985	0	3985
6/25/2017	1098.7	2543	711.1	500	3485	3985	0	3985
6/26/2017	1098.8	2508	711.3	500	3497	3997	0	3997
6/27/2017	1098.9	1694	711.1	500	3524	4024	0	4024
6/28/2017	1098.9	2482	711.1	500	2901	3402	0	3402
6/29/2017	1098.9	2476	710.5	500	972	1472	0	1472
6/30/2017	1099.1	2481	709.6	509	50	560	0	560
7/1/2017	1099.3	2525	709.7	515	396	911	0	911
7/2/2017	1099.4	2540	710.5	515	1573	2088	0	2088
7/3/2017	1099.5	2539	710.8	506	2804	3310	0	3310
7/4/2017	1099.4	2544	710.6	500	2993	3493	0	3493
7/5/2017	1099.3	2537	710.5	500	2099	2600	0	2600
7/6/2017	1099.3	2545	710.3	501	701	1202	0	1202
7/7/2017	1099.4	2544	710.0	500	1286	1786	0	1786
7/8/2017	1099.4	2538	710.3	500	1998	2498	0	2498
7/9/2017	1099.4	844	708.9	500	1739	2239	0	2239
7/10/2017	1099.5	1900	709.5	500	646	1146	0	1146
7/11/2017	1099.5	2461	710.6	500	276	776	0	776

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spillway Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
7/12/2017	1099.5	2507	710.5	501	0	501	0	501
7/13/2017	1099.5	2537	710.1	404	0	404	0	404
7/14/2017	1099.5	2529	709.5	323	0	323	0	323
7/15/2017	1099.5	2528	709.7	323	0	323	0	323
7/16/2017	1099.6	840	709.0	323	0	323	0	323
7/17/2017	1099.6	1926	709.5	276	0	276	0	276
7/18/2017	1099.6	2458	709.0	136	0	136	0	136
7/19/2017	1099.6	2454	708.9	85	0	85	0	85
7/20/2017	1099.6	1799	708.5	85	0	85	44	129
7/21/2017	1099.6	2408	708.7	85	0	85	87	172
7/22/2017	1099.6	1556	708.5	85	0	85	97	182
7/23/2017	1099.6	1570	708.9	86	0	86	97	183
7/24/2017	1099.7	1627	709.1	85	0	85	90	175
7/25/2017	1099.6	2205	708.9	85	0	85	99	184
7/26/2017	1099.6	2478	709.1	85	0	85	91	176
7/27/2017	1099.7	1907	709.5	85	0	85	97	182
7/28/2017	1099.7	1646	709.3	85	0	85	94	179
7/29/2017	1099.7	1647	708.7	85	0	85	98	183
7/30/2017	1099.7	1647	709.0	85	0	85	99	184
7/31/2017	1099.7	2218	709.2	85	0	85	96	181
8/1/2017	1099.6	1938	709.1	85	0	85	98	183
8/2/2017	1099.6	1929	708.7	85	0	85	95	180
8/3/2017	1099.6	1955	709.3	85	0	85	98	183
8/4/2017	1099.5	1945	709.1	85	0	85	94	179
8/5/2017	1099.5	1926	708.9	85	0	85	98	183
8/6/2017	1099.5	830	708.0	85	0	85	97	182
8/7/2017	1099.5	1923	708.9	85	0	85	84	169
8/8/2017	1099.5	1451	708.9	85	0	85	88	173
8/9/2017	1099.5	793	708.7	85	0	85	94	179
8/10/2017	1099.6	780	708.8	85	0	85	98	183
8/11/2017	1099.6	1644	709.2	85	0	85	91	176
8/12/2017	1099.6	1689	709.0	85	0	85	96	181
8/13/2017	1099.7	10	708.4	85	0	85	95	180
8/14/2017	1099.7	1733	708.8	85	0	85	95	180
8/15/2017	1099.6	2277	708.9	85	0	85	96	181
8/16/2017	1099.5	2301	709.0	85	0	85	93	178
8/17/2017	1099.4	1648	709.0	85	0	85	94	179
8/18/2017	1099.4	1626	709.1	85	0	85	93	178
8/19/2017	1099.3	1652	708.7	85	0	85	97	182
8/20/2017	1099.3	15	708.2	85	0	85	96	181
8/21/2017	1099.3	1140	708.5	85	0	85	47	132
8/22/2017	1099.3	1084	708.7	85	0	85	0	85
8/23/2017	1099.3	1103	708.2	85	0	85	0	85
8/24/2017	1099.3	1088	708.0	85	0	85	0	85
8/25/2017	1099.2	10	708.0	85	0	85	0	85
8/26/2017	1099.2	10	708.0	85	0	85	0	85
8/27/2017	1099.3	10	708.7	85	0	85	0	85
8/28/2017	1099.3	1474	708.3	85	0	85	0	85



Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spillway Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
8/29/2017	1099.2	1880	708.5	85	0	85	0	85
8/30/2017	1099.2	1198	709.5	85	0	85	0	85
8/31/2017	1099.2	1492	709.3	85	0	85	0	85
9/1/2017	1099.1	971	708.7	85	0	85	0	85
9/2/2017	1099.1	815	708.1	85	0	85	0	85
9/3/2017	1099.1	10	708.1	85	0	85	0	85
9/4/2017	1099.1	10	708.1	85	0	85	0	85
9/5/2017	1099.1	1225	708.6	85	0	85	0	85
9/6/2017	1099.1	1683	708.8	85	0	85	0	85
9/7/2017	1099.0	1666	708.4	85	0	85	0	85
9/8/2017	1099.0	1658	708.4	85	0	85	0	85
9/9/2017	1099.0	1589	708.4	85	0	85	0	85
9/10/2017	1099.0	10	708.5	85	0	85	0	85
9/11/2017	1098.9	1807	709.1	85	0	85	0	85
9/12/2017	1098.8	2194	708.8	85	0	85	0	85
9/13/2017	1098.7	2230	709.1	85	0	85	0	85
9/14/2017	1098.6	2118	708.7	85	0	85	0	85
9/15/2017	1098.5	1642	708.6	85	0	85	0	85
9/16/2017	1098.4	1633	708.2	255	4	258	0	258
9/17/2017	1098.3	10	707.2	346	0	346	0	346
9/18/2017	1098.3	1220	708.0	191	0	191	0	191
9/19/2017	1098.2	1641	708.5	100	0	100	0	100
9/20/2017	1098.1	1645	708.2	85	0	85	0	85
9/21/2017	1098.0	1643	708.1	85	0	85	0	85
9/22/2017	1098.0	1192	708.1	85	0	85	0	85
9/23/2017	1097.9	1190	708.6	85	0	85	0	85
9/24/2017	1097.9	19	708.6	85	0	85	0	85
9/25/2017	1097.9	1241	708.8	85	0	85	0	85
9/26/2017	1097.8	1643	708.4	85	0	85	0	85
9/27/2017	1097.7	1189	708.2	85	0	85	0	85
9/28/2017	1097.6	1625	708.6	85	0	85	0	85
9/29/2017	1097.6	1188	708.7	85	0	85	0	85
9/30/2017	1097.5	1187	708.2	85	0	85	0	85
10/1/2017	1097.4	2448	709.0	85	0	85	0	85
10/2/2017	1097.2	2498	709.1	85	0	85	0	85
10/3/2017	1097.1	2500	709.0	85	0	85	0	85
10/4/2017	1097.0	2494	708.7	85	0	85	0	85
10/5/2017	1096.8	2490	708.8	85	0	85	1	86
10/6/2017	1096.7	2496	708.9	85	0	85	0	85
10/7/2017	1096.6	1300	708.1	85	0	85	0	85
10/8/2017	1096.5	1111	708.0	85	0	85	0	85
10/9/2017	1096.4	2040	708.9	85	0	85	0	85
10/10/2017	1096.3	2490	709.1	85	0	85	1	86
10/11/2017	1096.1	2490	709.0	85	0	85	0	85
10/12/2017	1096.0	2492	708.9	85	0	85	24	109
10/13/2017	1095.8	2500	708.9	85	0	85	131	216
10/14/2017	1095.7	2504	708.8	85	0	85	202	287
10/15/2017	1095.5	2505	708.8	85	0	85	202	287

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spillway Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
10/16/2017	1095.4	2501	708.7	85	0	85	201	286
10/17/2017	1095.3	2499	708.8	85	0	85	200	285
10/18/2017	1095.2	2484	708.7	85	0	85	201	286
10/19/2017	1095.1	2484	709.0	85	0	85	202	287
10/20/2017	1095.1	2479	709.0	85	0	85	201	286
10/21/2017	1095.0	2474	709.1	85	0	85	202	287
10/22/2017	1095.1	2475	709.0	85	0	85	202	287
10/23/2017	1095.0	2487	709.3	85	0	85	203	288
10/24/2017	1094.9	1600	708.5	85	0	85	201	286
10/25/2017	1094.9	1233	708.0	85	0	85	199	284
10/26/2017	1094.9	1252	708.4	85	0	85	200	285
10/27/2017	1094.9	1989	708.9	85	0	85	201	286
10/28/2017	1094.8	2476	709.1	85	0	85	202	287
10/29/2017	1094.7	2467	708.7	85	0	85	202	287
10/30/2017	1094.6	2470	708.8	85	0	85	201	287
10/31/2017	1094.5	2466	708.9	86	0	86	202	288
11/1/2017	1094.4	2472	709.1	86	0	86	202	288
11/2/2017	1094.3	2478	709.0	85	0	85	201	287
11/3/2017	1094.2	2480	709.3	85	0	85	204	289
11/4/2017	1094.1	2477	708.9	85	0	85	203	288
11/5/2017	1094.0	2478	708.9	85	0	85	202	287
11/6/2017	1093.8	2480	709.3	85	0	85	203	288
11/7/2017	1093.7	2478	709.0	85	0	85	202	287
11/8/2017	1093.6	2476	709.0	85	0	85	202	287
11/9/2017	1093.5	2478	709.5	85	0	85	203	288
11/10/2017	1093.4	2478	708.9	85	0	85	202	287
11/11/2017	1093.3	2478	708.9	85	0	85	202	287
11/12/2017	1093.2	2474	708.8	85	0	85	201	285
11/13/2017	1093.1	2475	709.2	84	0	84	201	285
11/14/2017	1093.0	2479	709.4	84	0	84	202	286
11/15/2017	1092.9	2475	708.9	85	0	85	201	286
11/16/2017	1092.8	2478	709.0	85	0	85	201	286
11/17/2017	1092.6	2477	709.0	85	0	85	201	286
11/18/2017	1092.5	2483	709.0	85	0	85	202	287
11/19/2017	1092.4	2477	708.9	85	0	85	201	286
11/20/2017	1092.3	2478	709.0	85	0	85	202	287
11/21/2017	1092.2	2476	708.9	85	0	85	202	287
11/22/2017	1092.2	2479	709.0	85	0	85	201	287
11/23/2017	1092.7	2477	709.1	85	0	85	201	286
11/24/2017	1093.2	2485	709.0	85	0	85	200	285
11/25/2017	1093.4	2484	708.7	85	0	85	201	286
11/26/2017	1093.5	2481	708.8	85	0	85	200	285
11/27/2017	1093.6	2485	709.3	85	0	85	201	287
11/28/2017	1093.6	2484	709.1	85	0	85	201	286
11/29/2017	1093.6	2482	709.5	85	0	85	203	288
11/30/2017	1093.6	2466	709.1	85	0	85	201	286
12/1/2017	1093.5	2452	709.4	85	0	85	74	159
12/2/2017	1093.5	2440	709.2	85	0	85	0	85

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spillway Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
12/3/2017	1093.5	2440	709.3	85	0	85	0	85
12/4/2017	1093.4	2448	709.4	85	0	85	0	85
12/5/2017	1093.3	2439	709.3	85	0	85	0	85
12/6/2017	1093.3	2448	709.1	85	0	85	0	85
12/7/2017	1093.2	2442	708.9	85	0	85	0	85
12/8/2017	1093.1	2439	709.2	85	0	85	0	85
12/9/2017	1093.0	2441	709.3	85	0	85	0	85
12/10/2017	1093.0	2442	709.3	85	0	85	0	85
12/11/2017	1092.9	2441	709.1	85	0	85	0	85
12/12/2017	1092.8	2435	709.1	85	0	85	0	85
12/13/2017	1092.7	2329	708.9	85	0	85	0	85
12/14/2017	1092.6	2366	708.9	85	0	85	0	85
12/15/2017	1092.5	2490	709.1	84	0	84	0	84
12/16/2017	1092.4	2492	709.6	84	0	84	0	84
12/17/2017	1092.3	2471	708.9	84	0	84	0	84
12/18/2017	1092.2	2474	709.1	84	0	84	0	84
12/19/2017	1092.2	2473	708.9	84	0	84	0	84
12/20/2017	1092.1	2471	709.2	85	0	85	0	85
12/21/2017	1092.0	2470	709.1	85	0	85	0	85
12/22/2017	1091.9	2485	709.4	85	0	85	0	85
12/23/2017	1091.8	2494	709.5	85	0	85	0	85
12/24/2017	1091.7	2492	709.0	85	0	85	0	85
12/25/2017	1091.6	2492	709.2	85	0	85	0	85
12/26/2017	1091.5	2495	709.1	85	0	85	0	85
12/27/2017	1091.4	2490	709.0	85	0	85	0	85
12/28/2017	1091.3	2488	709.0	85	0	85	0	85
12/29/2017	1091.2	2485	708.9	85	0	85	0	85
12/30/2017	1091.2	2488	709.0	85	0	85	0	85
12/31/2017	1091.0	2489	709.0	85	0	85	0	85

***APPENDIX B: DAILY AVERAGE WATER TEMPERATURES***

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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)
1/1/2017	5.4	N/A	4.8	4.4	4.4	4.2	5.4	5.4
1/2/2017	5.3	N/A	4.4	4.0	4.0	3.9	5.3	5.3
1/3/2017	4.8	N/A	3.5	2.9	2.9	2.7	4.8	4.8
1/4/2017	4.5	N/A	2.8	2.2	2.2	1.9	4.4	4.4
1/5/2017	4.0	N/A	2.6	2.0	2.0	1.8	3.8	3.8
1/6/2017	3.8	N/A	2.6	2.0	2.0	1.8	3.6	3.7
1/7/2017	3.6	N/A	2.5	1.8	1.8	1.6	3.4	3.5
1/8/2017	3.6	N/A	2.6	2.1	2.1	1.9	3.5	3.6
1/9/2017	3.7	N/A	3.4	3.0	3.0	2.8	3.6	3.6
1/10/2017	4.0	N/A	3.4	3.0	3.0	2.9	4.0	4.0
1/11/2017	3.7	N/A	2.3	1.7	1.7	1.5	3.5	3.6
1/12/2017	3.1	N/A	1.7	1.1	1.1	0.9	2.9	3.0
1/13/2017	3.0	N/A	2.0	1.4	1.4	1.2	2.8	2.9
1/14/2017	3.2	N/A	2.6	2.1	2.1	1.9	3.1	3.1
1/15/2017	3.0	N/A	2.5	2.2	2.2	2.0	2.9	3.0
1/16/2017	3.1	N/A	2.6	2.2	2.2	2.0	3.0	3.1
1/17/2017	3.6	N/A	2.9	2.4	2.4	2.3	3.5	3.5
1/18/2017	3.5	N/A	3.1	2.8	2.8	2.7	3.4	3.4
1/19/2017	3.5	N/A	3.8	3.5	3.6	3.5	3.5	3.5
1/20/2017	3.9	N/A	4.3	4.2	4.2	4.1	3.9	3.9
1/21/2017	4.2	N/A	4.6	4.5	4.6	4.5	4.2	4.2
1/22/2017	4.4	N/A	4.6	4.5	4.5	4.5	4.4	4.4
1/23/2017	4.5	N/A	4.6	4.5	4.6	4.5	4.5	4.5
1/24/2017	4.4	N/A	4.2	4.0	4.0	3.9	4.4	4.4
1/25/2017	4.4	N/A	4.4	4.3	4.3	4.2	4.4	4.4
1/26/2017	4.4	N/A	4.6	4.4	4.4	4.4	4.4	4.4
1/27/2017	4.5	N/A	4.5	4.4	4.4	4.4	4.5	4.6
1/28/2017	4.5	N/A	4.7	4.6	4.6	4.6	4.5	4.5
1/29/2017	4.5	N/A	4.6	4.5	4.5	4.4	4.5	4.5
1/30/2017	4.3	N/A	4.3	4.2	4.2	4.1	4.3	4.3
1/31/2017	4.3	N/A	4.3	4.2	4.2	4.1	4.2	4.3
2/1/2017	3.8	N/A	3.1	2.9	2.9	2.7	3.7	3.7
2/2/2017	3.5	N/A	2.6	2.2	2.2	2.0	3.3	3.4
2/3/2017	3.3	N/A	2.8	2.5	2.5	2.3	3.2	3.3
2/4/2017	3.5	N/A	3.4	3.2	3.2	3.1	3.4	3.5
2/5/2017	3.7	N/A	3.3	3.1	3.1	3.0	3.6	3.6
2/6/2017	3.3	N/A	2.9	2.6	2.6	2.5	3.3	3.3
2/7/2017	3.2	N/A	2.4	2.1	2.1	1.9	3.0	3.1
2/8/2017	2.9	N/A	1.9	1.5	1.5	1.4	2.7	2.8
2/9/2017	3.1	N/A	2.9	2.5	2.5	2.4	3.0	3.0
2/10/2017	3.6	N/A	3.8	3.6	3.6	3.5	3.6	3.6
2/11/2017	3.7	N/A	3.7	3.5	3.5	3.5	3.6	3.6
2/12/2017	3.6	N/A	3.5	3.3	3.3	3.2	3.6	3.6
2/13/2017	3.5	N/A	3.2	3.0	3.0	2.9	3.5	3.5
2/14/2017	3.6	N/A	3.5	3.2	3.3	3.1	3.5	3.6
2/15/2017	3.7	N/A	3.9	3.8	3.8	3.7	3.7	3.7
2/16/2017	4.0	N/A	4.6	4.6	4.6	4.5	4.0	4.0

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)
2/17/2017	4.2	N/A	4.8	4.8	4.8	4.8	4.3	4.3
2/18/2017	4.3	N/A	4.7	4.8	4.8	4.7	4.3	4.3
2/19/2017	4.3	N/A	4.9	4.9	4.9	4.9	4.3	4.3
2/20/2017	4.3	N/A	4.6	4.7	4.7	4.6	4.3	4.3
2/21/2017	4.4	N/A	4.9	5.0	5.0	5.0	4.4	4.4
2/22/2017	4.5	N/A	4.7	4.7	4.7	4.7	4.5	4.5
2/23/2017	4.4	N/A	4.4	4.3	4.3	4.2	4.4	4.5
2/24/2017	4.4	N/A	4.1	4.0	3.9	3.9	4.4	4.4
2/25/2017	4.2	N/A	4.1	3.8	3.8	3.7	4.1	4.2
2/26/2017	4.2	N/A	4.2	4.1	4.1	4.0	4.2	4.2
2/27/2017	4.2	N/A	4.3	4.2	4.2	4.2	4.2	4.2
2/28/2017	4.2	N/A	4.2	4.1	4.0	3.9	4.2	4.2
3/1/2017	4.3	N/A	4.6	4.5	4.4	4.4	4.3	4.3
3/2/2017	4.6	N/A	5.1	5.1	5.1	5.0	4.6	4.6
3/3/2017	4.7	N/A	5.1	5.2	5.2	5.1	4.8	4.8
3/4/2017	5.0	N/A	5.4	5.4	5.4	5.3	5.1	5.1
3/5/2017	5.2	N/A	5.5	5.6	5.6	5.5	5.2	5.2
3/6/2017	5.2	N/A	5.3	5.2	5.2	5.1	5.2	5.3
3/7/2017	4.7	N/A	4.3	4.2	4.2	4.1	4.7	4.7
3/8/2017	4.5	N/A	4.8	4.6	4.6	4.5	4.4	4.5
3/9/2017	4.8	N/A	4.9	5.0	5.0	4.9	4.8	4.8
3/10/2017	5.2	N/A	6.0	6.0	6.0	6.0	5.2	5.3
3/11/2017	5.6	N/A	5.8	5.9	5.9	5.9	5.7	5.6
3/12/2017	5.5	N/A	5.8	5.9	5.8	5.8	5.5	5.5
3/13/2017	5.7	N/A	6.3	6.4	6.4	6.4	5.8	5.8
3/14/2017	6.0	N/A	6.6	6.8	6.3	6.3	6.1	6.1
3/15/2017	6.3	N/A	7.1	7.3	6.6	6.6	6.5	6.4
3/16/2017	6.6	7.1	7.1	7.3	6.8	6.9	6.8	6.7
3/17/2017	6.6	6.7	6.7	6.7	6.7	6.7	6.7	6.7
3/18/2017	6.7	6.9	7.1	7.2	6.9	7.0	6.9	6.9
3/19/2017	6.7	6.8	7.1	7.1	6.8	6.9	6.8	6.8
3/20/2017	6.7	6.8	6.7	6.6	6.8	6.8	6.9	6.9
3/21/2017	6.5	6.6	6.7	6.8	6.6	6.6	6.6	6.6
3/22/2017	6.4	6.5	6.8	6.9	6.5	6.6	6.5	6.5
3/23/2017	6.6	6.7	7.4	7.4	7.1	7.1	6.6	6.7
3/24/2017	6.9	7.0	7.2	7.3	7.1	7.1	7.0	7.0
3/25/2017	6.9	7.0	7.6	7.6	7.1	7.2	7.0	7.1
3/26/2017	6.9	7.0	7.1	7.2	7.1	7.1	7.0	7.1
3/27/2017	7.1	7.3	8.1	8.2	7.4	7.5	7.3	7.3
3/28/2017	7.5	7.7	8.2	8.2	7.7	7.8	7.6	7.6
3/29/2017	7.6	7.7	8.2	8.4	7.8	7.9	7.7	7.8
3/30/2017	7.7	7.9	8.7	8.8	8.0	8.2	7.9	7.9
3/31/2017	8.0	8.2	8.9	9.0	8.3	8.4	8.2	8.2
4/1/2017	8.7	8.9	9.7	9.8	9.0	9.1	8.9	8.9
4/2/2017	9.0	9.2	9.3	9.4	9.2	9.2	9.2	9.0
4/3/2017	9.0	9.1	9.5	9.4	9.2	9.2	9.1	9.1
4/4/2017	8.7	8.8	8.9	8.9	8.9	8.9	8.8	8.8

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)
4/5/2017	8.5	8.6	9.0	9.1	8.7	8.8	8.6	8.6
4/6/2017	8.6	8.8	9.3	9.4	8.9	9.0	8.8	8.8
4/7/2017	9.0	9.2	9.5	9.6	9.3	9.4	9.3	9.2
4/8/2017	9.0	9.1	9.4	9.5	9.2	9.3	9.2	9.1
4/9/2017	9.0	9.2	9.5	9.4	9.3	9.3	9.3	9.1
4/10/2017	9.2	9.4	9.6	9.7	9.5	9.5	9.5	9.4
4/11/2017	9.1	9.2	9.5	9.5	9.3	9.3	9.2	9.2
4/12/2017	9.0	9.2	9.2	9.3	9.2	9.2	9.2	9.1
4/13/2017	9.1	9.4	10.2	10.3	9.5	9.6	9.4	9.3
4/14/2017	9.3	9.5	9.8	9.8	9.6	9.7	9.6	9.6
4/15/2017	9.5	9.7	10.1	10.1	9.8	9.9	9.7	9.7
4/16/2017	9.8	10.1	10.2	10.1	10.0	10.1	10.0	9.9
4/17/2017	10.2	10.5	11.0	11.1	10.6	10.7	10.5	10.4
4/18/2017	10.5	10.8	11.2	11.3	10.8	10.9	10.7	10.7
4/19/2017	10.3	10.5	10.6	10.7	10.5	10.6	10.6	10.5
4/20/2017	10.5	10.7	11.6	11.7	10.8	11.0	10.7	10.7
4/21/2017	10.9	11.2	11.8	11.9	11.2	11.4	11.2	11.2
4/22/2017	11.0	11.2	11.6	11.7	11.3	11.4	11.2	11.2
4/23/2017	11.0	11.3	11.6	11.6	11.3	11.3	11.2	11.2
4/24/2017	11.4	11.7	12.0	11.9	11.7	11.7	11.6	11.6
4/25/2017	11.7	11.9	12.3	12.3	11.9	12.0	11.9	11.9
4/26/2017	11.7	11.9	12.0	12.0	11.9	11.9	11.9	11.9
4/27/2017	11.6	11.8	12.2	12.1	11.8	11.9	11.8	11.8
4/28/2017	11.8	12.0	12.5	12.6	12.0	12.2	12.0	12.0
4/29/2017	11.9	12.1	12.1	12.1	12.1	12.1	12.1	12.1
4/30/2017	12.1	12.4	12.6	12.7	12.4	12.4	12.4	12.3
5/1/2017	12.1	12.3	12.1	12.0	12.2	12.2	12.4	12.2
5/2/2017	12.2	12.8	12.9	12.9	12.6	12.7	12.5	12.3
5/3/2017	13.2	13.8	14.3	14.2	13.5	13.8	13.4	13.4
5/4/2017	13.7	14.7	15.1	15.3	14.1	14.4	14.0	13.8
5/5/2017	14.2	14.7	14.9	15.1	14.5	14.7	14.4	14.3
5/6/2017	13.8	13.9	14.2	14.2	14.1	14.2	14.1	13.9
5/7/2017	13.6	13.8	14.1	14.0	13.8	14.0	13.8	13.7
5/8/2017	13.9	14.1	14.4	14.3	14.1	14.2	14.1	14.0
5/9/2017	14.2	14.7	15.0	15.0	14.4	14.7	14.4	14.3
5/10/2017	14.3	15.0	15.4	15.5	14.6	14.9	14.6	14.4
5/11/2017	14.4	14.3	14.4	14.6	14.6	14.7	14.6	14.5
5/12/2017	14.1	14.1	14.0	13.8	14.3	14.3	14.4	14.2
5/13/2017	13.8	14.0	14.0	13.9	13.9	14.0	14.0	13.9
5/14/2017	13.5	13.6	13.8	13.8	13.6	13.8	13.7	13.5
5/15/2017	13.2	13.4	13.3	13.3	13.3	13.4	13.3	13.2
5/16/2017	13.1	13.2	13.1	13.0	13.1	13.2	13.3	13.1
5/17/2017	12.9	13.2	13.6	13.6	13.2	13.6	13.0	13.0
5/18/2017	13.5	13.7	14.2	14.2	13.8	14.2	13.7	13.5
5/19/2017	13.7	13.9	14.6	14.7	14.0	14.5	13.8	13.7
5/20/2017	14.9	15.2	15.7	15.7	15.2	15.7	15.1	15.0
5/21/2017	15.0	15.2	15.9	16.0	15.5	15.9	15.4	15.3



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)
5/22/2017	15.9	16.2	16.3	16.2	16.5	16.5	16.4	16.3
5/23/2017	16.7	16.9	17.0	17.0	17.1	17.2	17.0	16.7
5/24/2017	15.8	15.8	15.9	15.9	15.9	16.0	15.9	15.8
5/25/2017	15.0	15.1	15.2	15.1	15.2	15.3	15.1	15.0
5/26/2017	14.7	14.8	15.1	15.0	15.1	15.2	14.9	14.8
5/27/2017	14.3	14.5	14.8	14.8	14.9	15.0	14.6	14.5
5/28/2017	15.2	15.4	15.5	15.5	15.6	15.8	15.4	15.3
5/29/2017	16.2	16.4	16.6	16.6	16.6	16.8	16.4	16.3
5/30/2017	17.2	17.5	17.6	17.6	17.6	17.8	17.5	17.4
5/31/2017	17.0	17.2	17.3	17.3	17.4	17.5	17.2	17.1
6/1/2017	15.6	15.7	15.9	15.9	16.0	16.0	15.8	15.6
6/2/2017	15.5	15.6	15.7	15.7	15.8	16.0	15.6	15.5
6/3/2017	15.4	15.6	15.8	15.8	15.8	15.9	15.6	15.5
6/4/2017	16.4	16.5	16.6	16.5	16.6	16.6	16.5	16.4
6/5/2017	16.4	16.5	16.6	16.6	16.7	16.8	16.6	16.5
6/6/2017	16.1	16.2	16.4	16.4	16.5	16.7	16.3	16.2
6/7/2017	15.7	15.7	15.8	15.8	15.9	16.2	15.7	15.7
6/8/2017	16.2	16.2	16.3	16.3	16.3	NA	16.2	16.2
6/9/2017	16.0	16.1	16.1	16.1	16.2	NA	16.0	15.9
6/10/2017	15.8	15.9	15.9	15.9	16.0	NA	15.9	15.8
6/11/2017	15.5	15.5	15.7	15.7	15.7	NA	15.6	15.5
6/12/2017	16.0	16.1	16.2	16.2	16.2	NA	16.1	16.0
6/13/2017	16.1	16.2	16.3	16.3	16.4	NA	16.3	16.2
6/14/2017	16.1	16.2	16.3	16.3	16.3	NA	16.3	16.2
6/15/2017	16.0	16.1	16.2	16.2	16.3	NA	16.2	16.1
6/16/2017	15.9	16.0	16.1	16.1	16.1	NA	16.0	15.9
6/17/2017	15.8	15.9	16.0	16.0	16.1	NA	15.9	15.9
6/18/2017	16.1	16.2	16.4	16.4	16.5	NA	16.3	16.2
6/19/2017	16.4	16.5	16.7	16.7	16.8	NA	16.5	16.4
6/20/2017	17.1	17.3	17.3	17.3	17.4	NA	17.2	17.1
6/21/2017	17.1	17.3	17.4	17.3	17.4	NA	17.3	17.1
6/22/2017	17.2	17.3	17.4	17.4	17.5	NA	17.3	17.2
6/23/2017	17.0	17.2	17.3	17.3	17.3	NA	17.2	17.1
6/24/2017	17.0	17.1	17.1	17.1	17.1	NA	17.0	16.9
6/25/2017	17.6	17.7	17.5	17.4	17.5	NA	17.4	17.3
6/26/2017	18.8	18.9	18.8	18.8	18.8	NA	18.3	18.3
6/27/2017	19.7	19.9	19.9	19.9	19.9	NA	19.8	19.6
6/28/2017	19.5	19.6	19.7	19.7	19.8	NA	19.6	19.5
6/29/2017	17.7	17.8	18.2	18.2	18.3	NA	17.9	17.8
6/30/2017	17.1	17.2	17.8	17.8	17.9	NA	17.9	17.8
7/1/2017	17.7	18.0	18.3	18.2	18.2	NA	18.4	18.3
7/2/2017	20.2	20.4	20.5	20.4	20.5	NA	20.4	20.3
7/3/2017	20.4	20.6	20.7	20.7	20.7	NA	20.6	20.5
7/4/2017	20.2	20.4	20.4	20.4	20.5	NA	20.4	20.2
7/5/2017	19.2	19.3	19.8	19.8	19.8	NA	19.5	19.4
7/6/2017	19.1	19.2	20.1	20.1	20.1	NA	20.1	20.1
7/7/2017	20.2	20.4	21.1	21.0	21.0	NA	21.1	21.0

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)
7/8/2017	21.8	21.9	22.3	22.3	22.3	NA	22.2	22.0
7/9/2017	22.0	22.2	22.2	22.2	22.2	NA	22.1	21.8
7/10/2017	22.0	22.2	22.2	22.1	22.2	NA	22.2	22.0
7/11/2017	21.7	21.8	21.9	21.8	21.9	NA	21.8	21.7
7/12/2017	20.2	20.2	20.7	20.7	20.8	NA	20.9	20.8
7/13/2017	20.6	20.8	20.9	20.8	20.8	NA	21.4	21.3
7/14/2017	21.1	21.2	21.4	21.3	21.4	NA	21.6	21.4
7/15/2017	21.1	21.3	21.3	21.2	21.3	NA	21.6	21.5
7/16/2017	21.4	21.5	21.4	21.2	21.2	NA	21.6	21.4
7/17/2017	21.3	21.4	21.3	21.1	21.2	NA	21.4	21.3
7/18/2017	20.7	20.9	21.5	21.5	21.5	NA	21.2	21.0
7/19/2017	20.8	21.0	21.2	21.2	21.2	NA	21.3	21.3
7/20/2017	21.1	21.3	20.9	20.7	20.8	NA	21.5	21.4
7/21/2017	21.3	21.5	21.2	21.0	21.2	NA	21.4	21.3
7/22/2017	21.1	21.3	21.9	21.9	21.6	NA	21.6	21.4
7/23/2017	21.1	21.4	21.8	22.0	22.0	NA	22.0	21.9
7/24/2017	22.1	22.3	22.0	21.7	22.0	NA	22.4	22.2
7/25/2017	21.7	21.8	22.1	22.1	22.1	NA	22.1	22.0
7/26/2017	20.2	20.3	21.6	22.0	21.5	21.8	21.4	21.3
7/27/2017	22.2	22.4	21.9	21.7	22.5	22.4	22.7	22.7
7/28/2017	22.7	22.8	22.4	22.2	22.7	22.6	22.9	22.8
7/29/2017	22.8	22.9	22.7	22.5	22.9	22.9	23.0	23.0
7/30/2017	22.9	23.0	22.7	22.6	23.0	23.0	23.1	23.0
7/31/2017	22.9	23.0	22.7	22.6	22.9	22.9	23.0	23.0
8/1/2017	22.5	22.6	22.7	22.7	23.0	23.0	23.0	22.9
8/2/2017	20.9	21.1	21.6	21.9	22.1	22.1	22.2	22.2
8/3/2017	20.5	20.7	21.5	21.7	22.2	22.1	22.3	22.2
8/4/2017	19.5	19.6	20.3	20.6	21.0	20.9	21.1	21.0
8/5/2017	19.8	19.9	20.2	20.2	20.6	20.6	20.7	20.8
8/6/2017	20.3	20.4	20.9	21.0	21.7	21.6	22.0	21.9
8/7/2017	20.8	21.0	21.4	21.5	22.0	22.0	22.4	22.3
8/8/2017	21.2	21.3	21.6	21.7	22.2	22.2	22.6	22.6
8/9/2017	21.2	21.4	21.9	22.0	22.6	22.6	22.9	22.8
8/10/2017	21.0	21.1	21.7	21.8	22.4	22.3	22.5	22.5
8/11/2017	21.3	21.5	21.9	22.0	22.6	22.5	23.0	22.9
8/12/2017	21.4	21.6	21.5	21.6	22.9	22.6	23.3	23.3
8/13/2017	23.1	23.2	22.2	21.8	22.6	22.4	22.9	22.7
8/14/2017	23.7	23.7	22.4	21.8	22.9	22.6	23.2	23.2
8/15/2017	22.9	23.0	22.5	22.3	23.0	22.8	23.2	23.1
8/16/2017	22.5	22.5	22.1	22.0	22.5	22.4	22.7	22.7
8/17/2017	22.5	22.5	22.1	21.9	22.4	22.3	22.6	22.5
8/18/2017	22.6	22.6	21.9	21.7	22.4	22.2	22.6	22.6
8/19/2017	22.3	22.4	21.9	21.6	22.3	22.1	22.4	22.4
8/20/2017	22.4	22.4	21.8	21.5	22.0	21.9	22.2	22.2
8/21/2017	22.5	22.5	22.1	22.0	22.6	22.6	22.5	22.5
8/22/2017	22.4	22.5	22.4	22.2	22.3	22.6	22.7	22.6
8/23/2017	22.5	22.6	22.6	22.4	22.5	22.9	23.0	22.8

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)
8/24/2017	22.8	22.9	22.0	21.7	21.8	21.9	23.0	22.8
8/25/2017	22.5	22.5	21.5	20.9	21.0	21.1	22.6	22.4
8/26/2017	22.4	22.5	21.9	21.4	21.5	21.7	22.3	22.2
8/27/2017	21.6	21.7	21.9	21.7	21.8	22.1	22.4	22.3
8/28/2017	21.2	21.3	21.4	21.3	21.4	21.6	21.9	21.8
8/29/2017	21.1	21.2	21.2	21.1	21.1	21.4	21.8	21.7
8/30/2017	21.4	21.5	21.1	21.0	21.0	21.3	22.2	22.1
8/31/2017	21.9	22.0	21.7	21.3	21.3	21.6	22.1	22.1
9/1/2017	22.0	22.1	21.8	21.4	21.5	21.8	22.3	22.1
9/2/2017	21.7	21.8	22.0	21.9	21.9	22.3	22.2	22.0
9/3/2017	20.6	20.6	20.9	21.0	21.1	21.4	22.0	22.1
9/4/2017	20.6	20.7	20.9	20.7	20.8	21.2	21.9	22.1
9/5/2017	20.7	20.8	20.5	20.4	20.5	20.6	21.6	21.6
9/6/2017	20.9	21.0	20.7	20.5	20.5	20.7	21.6	21.6
9/7/2017	20.5	20.6	20.6	20.5	20.6	20.8	21.4	21.3
9/8/2017	19.7	19.7	20.4	20.5	20.5	20.9	20.6	20.5
9/9/2017	20.5	20.6	19.8	19.5	19.6	19.8	21.0	21.0
9/10/2017	21.0	21.1	20.6	20.2	20.2	20.4	21.2	21.1
9/11/2017	21.1	21.1	20.6	20.1	20.1	20.3	21.1	21.0
9/12/2017	21.0	21.0	20.7	20.3	20.4	20.7	21.1	21.0
9/13/2017	20.7	20.7	20.1	19.8	19.8	19.9	20.8	20.7
9/14/2017	20.1	20.1	19.3	18.7	18.7	18.7	20.2	20.0
9/15/2017	19.6	19.6	19.0	18.5	18.6	18.7	19.7	19.6
9/16/2017	19.5	19.5	18.7	18.3	18.3	18.3	19.6	19.4
9/17/2017	19.3	19.3	18.9	18.6	18.7	18.8	19.5	19.6
9/18/2017	18.9	18.9	18.4	18.0	18.1	18.1	18.9	18.9
9/19/2017	18.4	18.4	17.7	17.2	17.3	17.2	18.5	18.3
9/20/2017	18.0	18.0	17.2	16.6	16.7	16.6	18.1	17.9
9/21/2017	17.9	17.8	17.3	16.8	16.9	16.8	17.9	17.8
9/22/2017	17.7	17.7	17.2	16.8	16.9	16.8	17.7	17.6
9/23/2017	17.7	17.7	17.5	17.1	17.1	17.2	17.8	17.7
9/24/2017	17.8	17.7	17.3	16.9	17.0	17.0	17.9	17.9
9/25/2017	17.8	17.8	17.4	17.0	17.0	17.1	17.8	17.7
9/26/2017	17.9	17.9	17.9	17.5	17.5	17.8	18.0	17.9
9/27/2017	18.2	18.2	18.0	17.7	17.8	18.0	18.3	18.3
9/28/2017	18.4	18.5	18.1	17.8	17.8	18.0	18.5	18.5
9/29/2017	18.4	18.4	17.7	17.5	17.5	17.5	18.4	18.4
9/30/2017	18.0	18.0	17.2	16.9	16.9	16.8	18.0	18.0
10/1/2017	17.5	17.5	16.7	16.3	16.4	16.2	17.6	17.5
10/2/2017	17.3	17.2	16.4	16.0	16.0	15.9	17.3	17.3
10/3/2017	17.0	16.9	16.2	15.8	15.8	15.8	17.1	17.0
10/4/2017	16.9	16.8	16.0	15.6	15.6	15.4	16.9	16.9
10/5/2017	16.8	16.7	15.9	15.5	15.5	15.5	16.8	16.8
10/6/2017	16.6	16.5	15.4	15.1	15.2	15.1	16.6	16.5
10/7/2017	15.9	15.8	15.2	14.8	14.8	14.8	15.9	15.8
10/8/2017	15.6	15.5	15.0	14.7	14.7	14.6	15.6	15.6
10/9/2017	15.6	15.5	14.8	14.4	14.4	14.3	15.6	15.6

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)
10/10/2017	15.6	15.6	14.7	14.4	14.4	14.1	15.7	15.7
10/11/2017	15.2	15.1	14.0	13.5	13.6	13.2	15.2	15.2
10/12/2017	14.8	14.7	13.5	13.0	13.5	13.0	14.9	14.9
10/13/2017	14.7	14.6	13.8	13.5	14.1	13.8	14.9	14.8
10/14/2017	14.5	14.4	13.3	12.9	14.3	14.1	15.1	14.6
10/15/2017	14.4	14.3	13.6	13.2	14.2	14.1	14.9	14.5
10/16/2017	14.6	14.5	13.9	13.5	14.4	14.4	15.1	14.7
10/17/2017	14.6	14.6	14.1	13.8	14.5	14.5	15.2	14.7
10/18/2017	14.5	14.4	13.8	13.4	14.3	14.2	15.1	14.5
10/19/2017	14.4	14.4	14.1	13.9	14.4	14.4	15.0	14.5
10/20/2017	14.3	14.3	13.8	13.6	14.2	14.2	14.9	14.4
10/21/2017	14.0	13.9	12.8	12.5	13.7	13.6	14.5	14.0
10/22/2017	13.7	13.7	13.2	12.9	13.6	13.5	14.3	13.8
10/23/2017	13.8	13.8	13.5	13.2	13.8	13.7	14.4	13.9
10/24/2017	13.9	13.8	13.3	13.0	13.7	13.7	14.4	13.9
10/25/2017	13.7	13.7	13.3	13.0	13.6	13.6	14.3	13.8
10/26/2017	13.7	13.7	13.2	12.9	13.6	13.6	14.3	13.8
10/27/2017	13.7	13.7	13.2	12.8	13.6	13.6	14.4	13.8
10/28/2017	13.8	13.7	13.2	12.8	13.6	13.6	14.4	13.8
10/29/2017	13.6	13.6	13.1	12.7	13.5	13.5	14.3	13.6
10/30/2017	13.4	13.3	12.6	12.2	13.2	13.2	14.0	13.4
10/31/2017	13.1	13.0	12.2	11.7	12.8	12.8	13.6	13.0
11/1/2017	12.8	12.7	12.2	11.8	12.6	12.6	13.4	12.8
11/2/2017	12.7	12.6	11.9	11.5	12.4	12.4	13.3	12.6
11/3/2017	12.4	12.2	10.9	10.5	12.0	11.9	12.9	12.4
11/4/2017	11.7	11.5	9.9	9.4	11.2	11.1	12.1	11.6
11/5/2017	11.0	10.9	9.5	8.9	10.6	10.5	11.5	11.0
11/6/2017	10.6	10.4	9.5	9.0	10.2	10.2	11.0	10.5
11/7/2017	10.3	10.2	9.3	8.8	10.0	9.9	10.8	10.3
11/8/2017	10.4	10.3	9.7	9.2	10.1	10.1	10.9	10.4
11/9/2017	10.6	10.5	9.8	9.3	10.3	10.3	11.1	10.5
11/10/2017	10.6	10.6	10.2	9.7	10.4	10.5	11.2	10.6
11/11/2017	10.4	10.3	9.9	9.5	10.2	10.2	10.9	10.4
11/12/2017	10.3	10.3	10.2	9.8	10.2	10.3	10.9	10.3
11/13/2017	10.4	10.4	10.3	10.0	10.4	10.4	11.1	10.5
11/14/2017	10.3	10.3	10.1	9.7	10.2	10.2	10.9	10.3
11/15/2017	10.3	10.3	10.2	9.9	10.2	10.3	10.9	10.3
11/16/2017	10.3	10.2	10.0	9.7	10.2	10.2	10.8	10.3
11/17/2017	10.1	10.0	9.5	9.1	9.9	9.9	10.7	10.1
11/18/2017	10.0	9.9	9.6	9.2	9.9	9.9	10.6	10.0
11/19/2017	9.8	9.7	9.2	8.8	9.6	9.6	10.4	9.8
11/20/2017	9.8	9.7	9.3	9.0	9.6	9.7	10.3	9.8
11/21/2017	9.6	9.5	9.2	8.8	9.4	9.5	10.1	9.6
11/22/2017	9.6	9.6	9.6	9.3	9.6	9.7	10.2	9.6
11/23/2017	9.8	9.8	9.9	9.8	9.8	9.9	10.4	9.8
11/24/2017	9.7	9.7	9.5	9.2	9.7	9.7	10.4	9.7
11/25/2017	9.6	9.6	9.3	9.0	9.5	9.6	10.2	9.6

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)
11/26/2017	9.6	9.5	9.4	9.1	9.5	9.5	10.2	9.6
11/27/2017	9.5	9.4	9.0	8.6	9.3	9.3	10.1	9.5
11/28/2017	9.3	9.2	8.8	8.5	9.2	9.2	9.9	9.3
11/29/2017	9.0	8.9	8.1	7.8	8.7	8.7	9.5	9.0
11/30/2017	9.0	9.0	8.6	8.2	8.8	8.9	9.6	9.0
12/1/2017	8.8	8.8	8.4	8.1	8.4	8.2	9.3	8.8
12/2/2017	8.7	8.6	8.2	7.8	8.0	7.5	9.2	8.7
12/3/2017	8.5	8.4	8.0	7.6	7.7	7.4	9.1	8.5
12/4/2017	8.3	8.2	7.4	6.9	7.0	6.5	8.8	8.3
12/5/2017	8.0	7.8	7.0	6.6	6.7	6.2	8.5	7.9
12/6/2017	7.8	7.8	7.1	6.6	6.6	6.1	8.4	7.8
12/7/2017	7.8	7.7	7.1	6.6	6.7	6.3	8.3	7.7
12/8/2017	7.8	7.7	7.3	6.8	6.9	6.5	8.3	7.8
12/9/2017	7.6	7.5	7.0	6.6	6.7	6.3	8.1	7.5
12/10/2017	7.5	7.5	7.0	6.5	6.6	6.2	8.1	7.5
12/11/2017	7.4	7.4	6.9	6.5	6.5	6.1	8.0	7.4
12/12/2017	7.2	7.1	6.7	6.3	6.4	5.9	7.7	7.2
12/13/2017	7.3	7.2	6.8	6.3	6.4	6.0	7.8	7.3
12/14/2017	7.2	7.2	7.0	6.6	6.6	6.4	7.8	7.2
12/15/2017	7.3	7.3	7.0	6.6	6.6	6.4	7.9	7.3
12/16/2017	7.3	7.3	7.0	6.7	6.7	6.4	7.9	7.3
12/17/2017	7.3	7.2	6.9	6.5	6.6	6.2	7.9	7.3
12/18/2017	7.1	7.1	6.7	6.4	6.4	6.2	7.7	7.1
12/19/2017	7.0	6.9	6.6	6.3	6.4	6.1	7.5	6.9
12/20/2017	6.8	6.8	6.2	5.8	5.9	5.6	7.4	6.8
12/21/2017	6.4	6.4	5.5	5.0	5.1	4.4	6.9	6.4
12/22/2017	6.1	6.0	5.5	5.0	5.1	4.6	6.6	6.1
12/23/2017	5.8	5.6	4.4	3.9	4.1	3.3	6.2	5.7
12/24/2017	5.3	5.2	4.0	3.3	3.4	2.4	5.7	5.2
12/25/2017	5.4	5.3	4.4	3.8	3.8	3.2	5.9	5.4
12/26/2017	5.3	5.2	4.1	3.5	3.6	2.7	5.8	5.3
12/27/2017	5.2	5.1	4.2	3.6	3.6	2.9	5.7	5.1
12/28/2017	5.1	5.0	4.3	3.8	3.8	3.2	5.6	5.0
12/29/2017	5.0	4.9	4.3	3.8	3.9	3.4	5.5	4.9
12/30/2017	5.0	4.9	4.4	4.0	4.1	3.8	5.5	4.9
12/31/2017	4.9	4.8	4.1	3.5	3.6	3.0	5.4	4.8

***APPENDIX C: CONSULTATION RECORD***

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On March 20, 2018, Chelan PUD provided a draft of the 2017 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 a 30-day review period. No comments were received.

<i>NAME</i>	<i>AGENCY</i>	<i>Comments</i>
Zimmrman, Breean	Washington State Department of Ecology	-
Peterschmidt, Mark	Washington State Department of Ecology	-
Bowen, David	Washington State Department of Ecology	-
Pacheco, Jim	Washington State Department of Ecology	-
Simon, Graham	Washington State Department of Fish and Wildlife	-
Maitland, Travis	Washington State Department of Fish and Wildlife	-
Grover Wier, Kari	United States Department of Agriculture – Forest Service	-
Willard, Paul	United States Department of Agriculture – Forest Service	-
Johnson, Emily	United States Department of Agriculture – Forest Service	-
Rawhouser, Ashley	National Park Service	-
Anthony, Hugh	National Park Service	-
Lewis, Steve	United States Fish and Wildlife Service	-
Yeager, Justin	National Marine Fisheries Services	-
Towey, Bill	Confederated Tribes of the Colville Reservation	-
Rose, Bob	Yakama Indian Nation	-
Merkle, Carl	Confederated Tribes of the Umatilla Indian Reservation	-
Cooney, Mike	City of Chelan	-
Archibald, Phil	Lake Chelan Sportsman Association	-
Elwell, Nick	United States Geological Survey	-
Ernsberger, Tom	Washington State Parks and Recreation Commission	-
Snell, Nona	Washington State Recreation and Conservation Office	-
Uhlhorn, Richard	Lake Chelan Recreation Association	-
O'Keefe, Thomas	American Whitewater	-

## Sokolowski, Rosana

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**From:** Hopkins, Scott  
**Sent:** Tuesday, March 20, 2018 11:02 AM  
**To:** Ashley Rawhouser; Bitterman, Deborah; Bob Rose; Breean Zimmerman; Buehn, Scott; Campbell, Rob; Carl Merkle; Clement, Marcie; David Bowen; Emily Johnson ; Graham Simon; Hays, Steve; Hugh Anthony; Jim Pacheco; Justin Yeager; Kari Grover Wier; M. Cooney; Mark Peterschmidt; Nick Elwell; Nona Snell; Osborn, Jeff; Paul Willard; Phil Archibald; Richard Uhlhorn; Smith, Michelle; Sokolowski, Rosana; Steve Lewis; Thomas O'Keefe; Tom Ernsberger; Towey, Bill; Travis Maitland; Underwood, Alene; Von Reis, Charles; Willard, Catherine  
**Subject:** For Review - Draft Lake Chelan Annual Flow and Temperature Report 2017  
**Attachments:** 2017 Annual Flow and Temperature Report - DRAFT.docx; 2017 Annual Flow and Temperature Report - DRAFT.pdf

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](http://www.chelanpud.org)<<http://www.chelanpud.org>>

To: Chelan River Fishery Forum:

- Washington Department of Ecology
- Washington Department of Fish and Wildlife
- United States Forest Service
- National Park Service
- United States Fish and Wildlife Service
- National Marine Fisheries Service
- CCT (Colville)
- YN (Yakama)
- CTUIR (Umatilla tribe)
- Lake Chelan Sportsman Association
- United States Geological Survey



Washington State Parks and Recreation Commission  
Washington State Recreation and Conservation Office  
City of Chelan  
Manson Parks and Recreation Department  
Lake Chelan Recreation Association  
American Whitewater

From: Scott Hopkins, Fisheries Biologist II

Public Utility District No. 1 of Chelan County (Chelan PUD)

scott.hopkins@chelanpud.org<mailto:scott.hopkins@chelanpud.org>

(509)661-4763

Re: Lake Chelan Hydroelectric Project No. 637 (Project)  
License Articles 405a and 408; Appendix D 401 Water Quality Certification Condition V.C.i)  
Draft Lake Chelan Annual Flow and Water Temperature Report 2017

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Dear Chelan River Fishery Forum and Other Parties:

In accordance with Articles 405 and 408 of the Lake Chelan Hydroelectric Project License, Chelan PUD invites comments on the Draft Lake Chelan Annual Flow and Water Temperature Report 2017 (attached).

Please submit your comment letters on or before 3:00 p.m., April 19, 2018 to Scott Hopkins via email at scott.hopkins@chelanpud.org<mailto:scott.hopkins@chelanpud.org>. I have provided the report in both MSWORD and PDF formats for your convenience. Please feel free to use the review features in MSWORD to make your suggested edits. However, in order to facilitate documentation of your comments and Chelan PUD's responses to comments regarding significant substantive issues, please provide those comments and any supportive rationales or data in a separate document so that it can be incorporated into the record of consultation.

Pursuant to License Article 405, Chelan PUD will file the Final Lake Chelan Annual Flow and Water Temperature Report with FERC and post it to the Lake Chelan License Implementation web page.

All comments received will be appended to the Final Lake Chelan Annual Flow and Water Temperature Report 2017 with a notation regarding how each comment or recommendation was incorporated in the report, or, if not incorporated, the reasons why the comment was not incorporated.

If you have any questions, please do not hesitate to contact me at (509-661-4763).

Scott Hopkins  
Fisheries Biologist  
Chelan County PUD  
509-661-4763 (office)  
509-630-2708 (cell)  
[Scott.Hopkins@chelanpud.org](mailto:Scott.Hopkins@chelanpud.org)