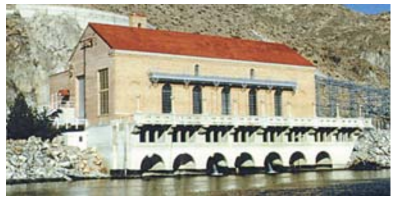
  

PUBLIC UTILITY DISTRICT NO. 1 *of* CHELAN COUNTY
P.O. Box 1231, Wenatchee, WA 98807-1231 • 327 N. Wenatchee Ave., Wenatchee, WA 98801
(509) 663-8121 • Toll free 1-888-663-8121 • www.chelanpud.org

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 408, Appendix D Water Quality Certification Condition IV.E. and Settlement Agreement Article 7(c)(2) – 2013 Final Biological Objectives Status Report

Dear Secretary Bose and Deputy Secretary Davis:

On November 28, 2007, the Federal Energy Regulatory Commission (Commission) issued the "*Order Approving Threatened and Endangered Species Plan under Article 408*"[1] requiring that draft and final biological objectives status reports be completed in years 4, 6, 8, and 10 of the license.[2] However, the Public Utility District No. 1 of Chelan County (Chelan PUD) filed a request on March 11, 2010, to revise the schedule to submit the draft and final reports to correspond with the first year implementation of the completed Chelan River habitat improvements and the initiation of minimum flows, which was October 15, 2009. On May 19, 2010, the Commission granted the Chelan PUD to file the reports in Years 2013, 2015, 2017 and 2019.[3]

Chelan PUD hereby files the 2013 Final Biological Objectives Status Report. On March 15, 2013, a final draft of this report was provided to the resource agencies, Tribes and non-governmental organizations specified for review.[4] Please refer to Appendix B for the consultation documentation.

[1] 121 FERC ¶ 62,143 (2007)
[2] 117 FERC ¶ 62,129 (2006)
[3] 131 FERC ¶ 62,151 (2010)
[4] *See* http://www.chelanpud.org/departments/licensingCompliance/LC_implementation/corres/40363.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 Fishery Forum

Enclosure: 2013 Final Biological Objectives Status Report

CHELAN RIVER BIOLOGICAL OBJECTIVES 2013 STATUS REPORT

LICENSE ARTICLE 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

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 (License), 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 15, 2009.

The License incorporated conditions regarding biological objectives that were anticipated to be achieved in the Chelan River and Project tailrace. These biological objectives are set forth in the Chelan River Biological Evaluation and Implementation Plan (CRBEIP), which is part of the Lake Chelan Settlement Agreement (October 8, 2003) and is incorporated into the License as Appendix A. The Washington State Department of Ecology (Ecology) incorporated these biological objectives into their 401 Water Quality Certification for the Lake Chelan Hydroelectric Project (Certification) and the FERC, in turn, incorporated the terms and conditions of the Certification into the License. One of the conditions incorporated into the License requires Chelan PUD to file Biological Objectives Status Reports every two years, beginning four years after the effective date of the License. On March 11, 2010, Chelan PUD filed for an extension of time to complete the structural changes to the Project necessary to implement minimum flows and other measures necessary for achievement of the biological objectives, and also to change the dates for the Biological Objectives Status Reports such that they would begin four years after implementation of the minimum flows. On May 19, 2010, FERC granted this time extension, which set the date for the first report to be due April 30, 2013. The License requires that a draft report be provided to Ecology and the Chelan River Fisheries Forum by February 28, 2013.

The Biological Objectives Status Report is to: (1) summarize the results of monitoring and evaluation program detailed in the CRBEIP and evaluate the need for modifications to that program; (2) describe the degree to which the biological objectives have been achieved, and the prospects for achieving those objectives in the next reporting period; (3) review management options taken to meet those biological objectives; and (4) recommend any new or modified restoration and/or monitoring and evaluation measures that are needed to meet, to the extent practicable, the biological objectives. Such recommendations shall contain a schedule for timely implementation. The Chelan River study reaches and biological objectives are shown in Figure 1-1 and Table 1-1 at the end of this Section.

This report describes the results of monitoring and evaluation programs that have been implemented since placement of spawning gravels in the Project tailrace (2008) and completion of the spawning and rearing habitat in Reach 4 of the Chelan River (Habitat Channel) and implementation of minimum flows (October 2009). This report is organized into four sections that pertain to specific biological objectives described in the CRBEIP: (1) Chinook salmon and steelhead spawning and incubation; (2) Chinook salmon and steelhead rearing; (3) Reaches 1-3 fish community with emphasis on cutthroat trout and use of Reach 4 by other species; and (4) monitoring of factors that meet or limit achievement of a functional aquatic ecosystem. There are specific measurement objectives for the first three sections of this report, including spawning survey counts, distribution of redds, intragravel dissolved oxygen levels, egg to fry emergence survival rates and presence of rearing juveniles. Additionally, the measurement objective for cutthroat includes the presence of 200 fish at various age classes The fourth section of this report pertains to general ecological measurements of habitat quality, including both natural limiting factors and Project effects, as they pertain to achievement of a community of organisms that is healthy and diverse (CRBEIP, 4.1). The monitoring and evaluation programs addressing ecosystem function include water temperature monitoring, other water quality assessments (dissolved oxygen, pH, turbidity and total dissolved gas), aquatic macroinvertebrate sampling, riparian zone regeneration, and other stream characteristics that may be noted during snorkel surveys and other activities.

Figure 1-1. Chelan River Study Reaches and Objectives.

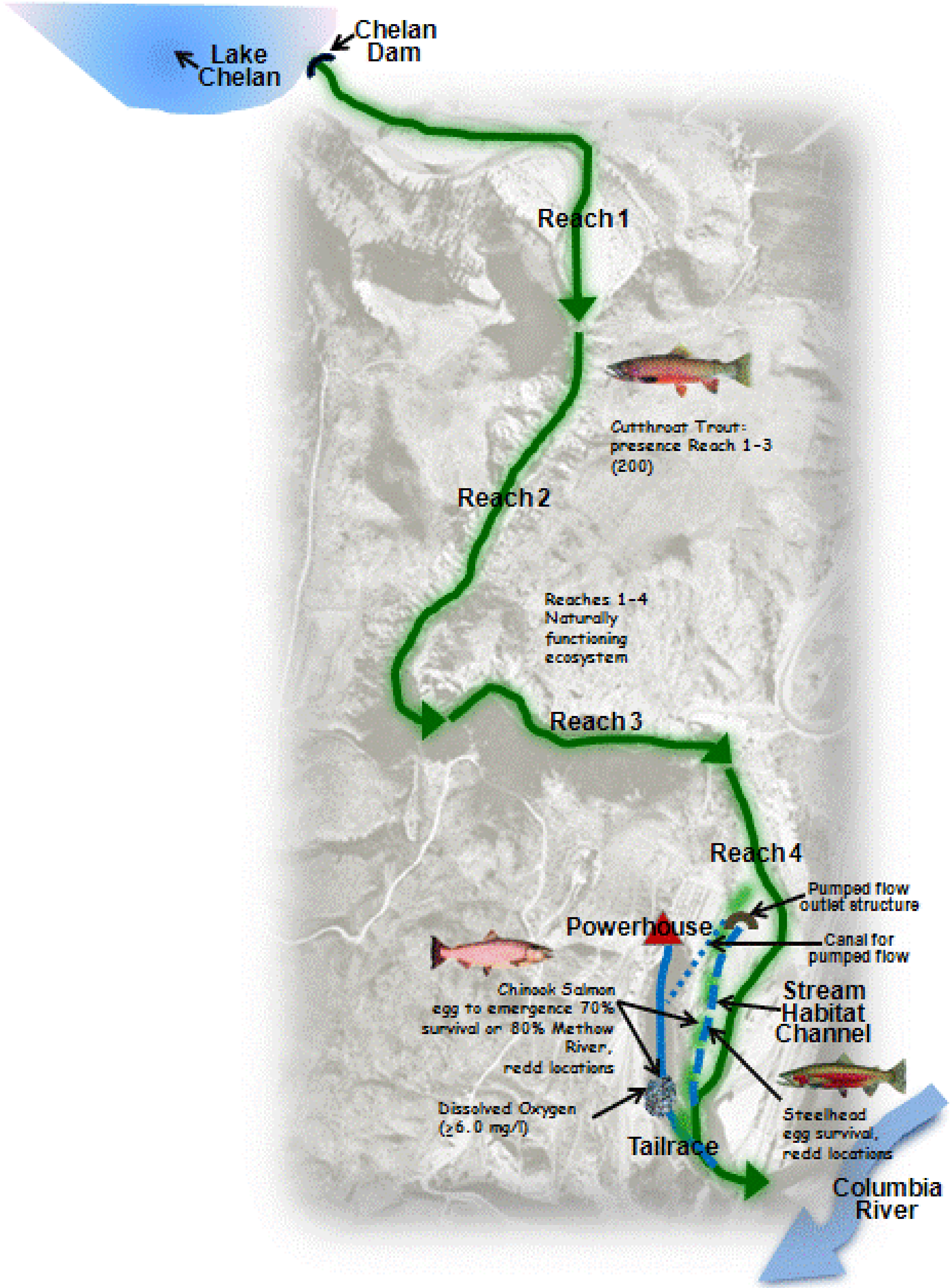


Table 1-1. Chelan River Biological Objectives.

Biological Objective		Location	Status	Expected Outcome
Chinook	Adult production	Habitat Channel, tailrace	Ongoing - 2019	Expect to achieve
	Spawning habitat	Habitat Channel, tailrace	Complete	Achieved. Built 2 acres in Habitat Channel; 1.75 acres in tailrace
	Spawning habitat use	Habitat Channel, tailrace	Ongoing - 2019	Achieved. 2010/398 redds, 2011/413 redds, 2012/426 redds
	Spawning habitat quality	Habitat Channel, tailrace	2011 - 2015	Expect to achieve. Dissolved oxygen study. Likely achievable with one turbine at minimum generation every 4 hours December – March. Other alternatives may be studied.
	Spawning success	Habitat Channel, tailrace	2011 - 2015	Expect to achieve
	Juvenile rearing success	Habitat Channel, tailrace	2009 - 2019	Expect to achieve
Steelhead	Adult production	Habitat Channel	2014 - 2019	Expect to achieve or agree likely met. Habitat Channel only because no steelhead have been observed spawning in tailrace flow.
	Spawning habitat	Habitat Channel	Complete	Achieved. Built 2 acres in Habitat Channel
	Spawning habitat use	Habitat Channel	Ongoing - 2019	Expect to achieve. 2010/16 redds, 2011/22 redds, 2012/7 redds. Habitat Channel only because no steelhead have been observed spawning in tailrace flow.
	Spawning habitat quality	Habitat Channel	2011 - 2015	Expect to achieve. Habitat Channel only because no steelhead have been observed spawning in tailrace flow.
	Spawning success	Habitat Channel	2011 - 2015	Expect to achieve
	Juvenile rearing success	Habitat Channel	2012 - 2019	Expect to achieve or change water quality standard to best attainable use –Use Attainability Analysis (UAA)
Cutthroat	200 resident fish	(R1-3)	2009 - 2019	Expect to achieve or recommend new goal to Chelan River Fishery Forum. Change water quality standard to best attainable use –Use Attainability Analysis (UAA)
Temperature	Settlement Agreement operations to facilitate objectives	R1-Habitat Channel	2009 - 2019	Expect to achieve biological objectives. Change water quality standard to best attainable use –Use Attainability Analysis (UAA)
Flow	Settlement Agreement operations to facilitate objectives	Penstock, R1, Habitat Channel	2009 - 2019	Achieved. Minimum flows, Habitat Channel pumped flows for spawning, seasonal ramped up flows

SECTION 2: CHINOOK SALMON AND STEELHEAD SPAWNING AND INCUBATION

2.1 Chinook salmon Spawning Redd Surveys

The CRBEIP states, "salmon and steelhead spawning habitat will be created in Reach 4 and the tailrace, with the objective to create suitable depth, cover, velocity and substrate conditions for these fish. These parameters can be measured independently of fish use, although fish use is the best evidence of achievement. The criteria for achievement are to document that habitat was created and maintained, in accordance with the preference curves established in the IFIM study. Alternatively, if adult fish runs are strong and colonization occurs during the evaluation period, then the presence and success of spawning fish will also be considered in the determination of achievement. Achievement will be evident if spawning fish are distributed in suitable areas in the tailrace, Reach 4 and below the confluence of Reach 4 and the tailrace. Lack of fish will not be termed a failure without evidence that a Project effect prevented fish from using the habitat."

Chinook salmon spawning has been observed in the Project tailrace at its confluence with the Columbia River since the 1980s, with redd counts prior to 1993 ranging from 16 – 69 redds per year (Chelan PUD, 1991). Documented redd counts (Hillman, personal communication) since 1998 (Table 2-1) steadily increased over the years as bed load accumulations increased the area of useable spawning habitat, which was a result of natural gravel movement during spill operations under previous licenses for the Project. The fish per redd (FPR) and escapement estimates in Table 2-1 are based on the male:female sex ratio of summer Chinook salmon sampled at Wells Dam (Hillman, personal communication).

Since gravel placement in the tailrace and construction of the Habitat Channel, the combined Chinook salmon redd counts in the tailrace, in the Habitat Channel and in the Columbia River below the confluence have increased from 86 in 2007 and 153 in 2008 to 426 in 2012 (Table 2-2). Prior to 2008, the highest redd count was 253. Redd counts were made by floating the tailrace and Chelan/Columbia river confluence by raft and in the Habitat Channel by surveys from both shorelines. Redd counts from 2010 – 2012 were made approximately weekly (Appendix A) from the initiation of spawning in October until after spawning had concluded in late November. Prior to 2010, redd counts were taken periodically through the season, but not always on a weekly basis. The late redd counts may include redds believed to be from coho based on either their late timing or observations of fish on the redds (20 in 2009, 5 in 2011).

Table 2-1. Chelan River Chinook salmon Redd Counts and Escapement Estimates.

Year	FPR	Redds	Escapement
1998	3.00	30	90
1999	2.20	63	139
2000	3.40	196	666
2001	4.10	240	984
2002	2.30	253	582
2003	2.42	173	419
2004	2.27	185	420
2005	2.93	179	524
2006	2.02	208	420
2007	2.20	86	189
2008	3.25	153	497
2009	2.54	246	625
2010	2.81	398	1118
2011	3.10	413	1280
2012	3.07	426	1308

Figure 2-1. Chelan River Historical Redd Counts.

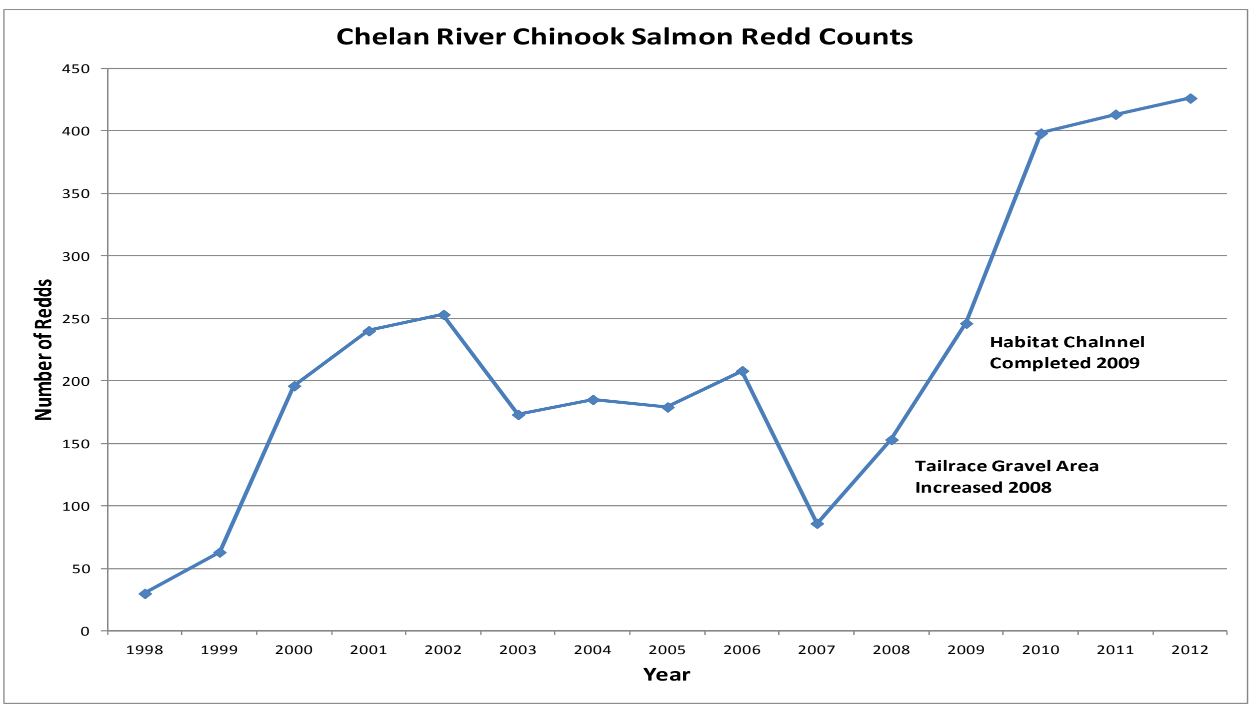


Table 2-2. Chelan River Chinook and Coho Salmon Redd Count Distributions.

Year	Tailrace	Reach 4	Columbia R	Total
2008	153	NA	In tailrace count	153
2009	129	79	58	266
2010	234	115	49	398
2011	192	178	48	418
2012	231	139	56	426

The distribution of these redds appears to meet, for Chinook salmon, the biological objective to create salmon and steelhead spawning habitat in Reach 4 and the tailrace. As stated in the CRBEIP: "Achievement will be evident if spawning fish are distributed in suitable areas in the tailrace, Reach 4 and below the confluence of Reach 4 and the tailrace". Most of the Chinook salmon that pioneered use of this habitat were Wells stock Upper Columbia Summer Chinook salmon, which were derived from a stock that spawned in the mainstem Columbia in deep water. The added spawning area in the tailrace is fairly deep, which is typical of the remaining Chinook salmon spawning areas in the Columbia River below Wells Dam.

2.2 __Steelhead Spawning Redd Surveys__

Steelhead spawning has been observed in Reach 4, primarily in the Habitat Channel, in each of the three years since steelhead spawning flows were first provided in 2010. The number of redds has varied, with 11 redds in 2010, 21 redds in 2011 and 7 redds in 2012. The steelhead redd surveys in 2011 and 2012 were made weekly, beginning in late March and continuing until high flows precluded further observations (June 1 in 2011, May 16 in 2012). The surveys in 2010 were less frequent. Surveys are conducted by observing from high points overlooking the tailrace and pool area and walking both shores of the Habitat Channel.

The first redds observed have been during the last week in March, with the majority of spawning initiated in April into the first week in May. In 2011, one redd was initiated at the end of May. Steelhead redds have been distributed throughout the Habitat Channel and a few redds have been in the pool formed by the hydraulic control structure. Only one redd, in 2011, has been observed below the Habitat Channel. However, that redd was at the edge of the shoreline in flow that was coming from the Habitat Channel. Most of the redds have been in the vicinity of cover from either boulders or log structures. Steelhead redds have been located in areas with smaller substrate, primarily in sandy gravels less than two inches in diameter. There are limited amounts of this smaller substrate except in the lower part of the Habitat Channel and in the pool area.

Another factor that may be affecting the habitat available for steelhead spawning is that flow in the Habitat Channel may be greater than desired to provide the preferred velocities for this species. The pumping station is designed to provide 240 cfs under low tailwater conditions, which when combined with the 80 cfs minimum flow in Reach 1 of the Chelan River yields the design minimum spawning flow of 320 cfs. In spring, when steelhead spawning occurs, the tailwater level is usually not low and the discharge from the pumps under that condition typically result in Habitat Channel flows of 340 cfs or greater. Depth and velocity measurements taken in

2011 at steelhead redds were often greater than the expected preference for this species. Also, the higher flows reduce the available low velocity habitat preferred by Chinook salmon fry, which are rearing in the Habitat Channel from April – June. The Chelan River Fisheries Forum will be discussing a test of a lower flow in 2014, which could be achieved by using only four of the five pumps. The test would evaluate whether reducing the flow would provide better conditions for steelhead spawning and Chinook salmon fry rearing.

2.3 Chinook salmon Redd Protection Flows

The License required that the Project be operated to achieve the CRBEIP biological objective to provide conditions suitable for Chinook salmon survival from egg to emergence. Specifically the requirement is to operate the Project powerhouse to maintain intragravel dissolved oxygen (IGDO) levels of 6.0 mg/l or higher to support survival of Chinook salmon from egg deposition to emergence. If it is not reasonable and feasible to operate the powerhouse to meet this requirement, or if the spawning gravel placed in the tailrace does not have sufficient permeability to meet this requirement, then the CRBEIP allows for alternative actions, such as use of the pump station to increase water circulation in the tailrace or physical modification of the habitat through addition of more permeable substrate and/or use of pumps and pipes under the substrate to create upwelling flows within the spawning gravel.

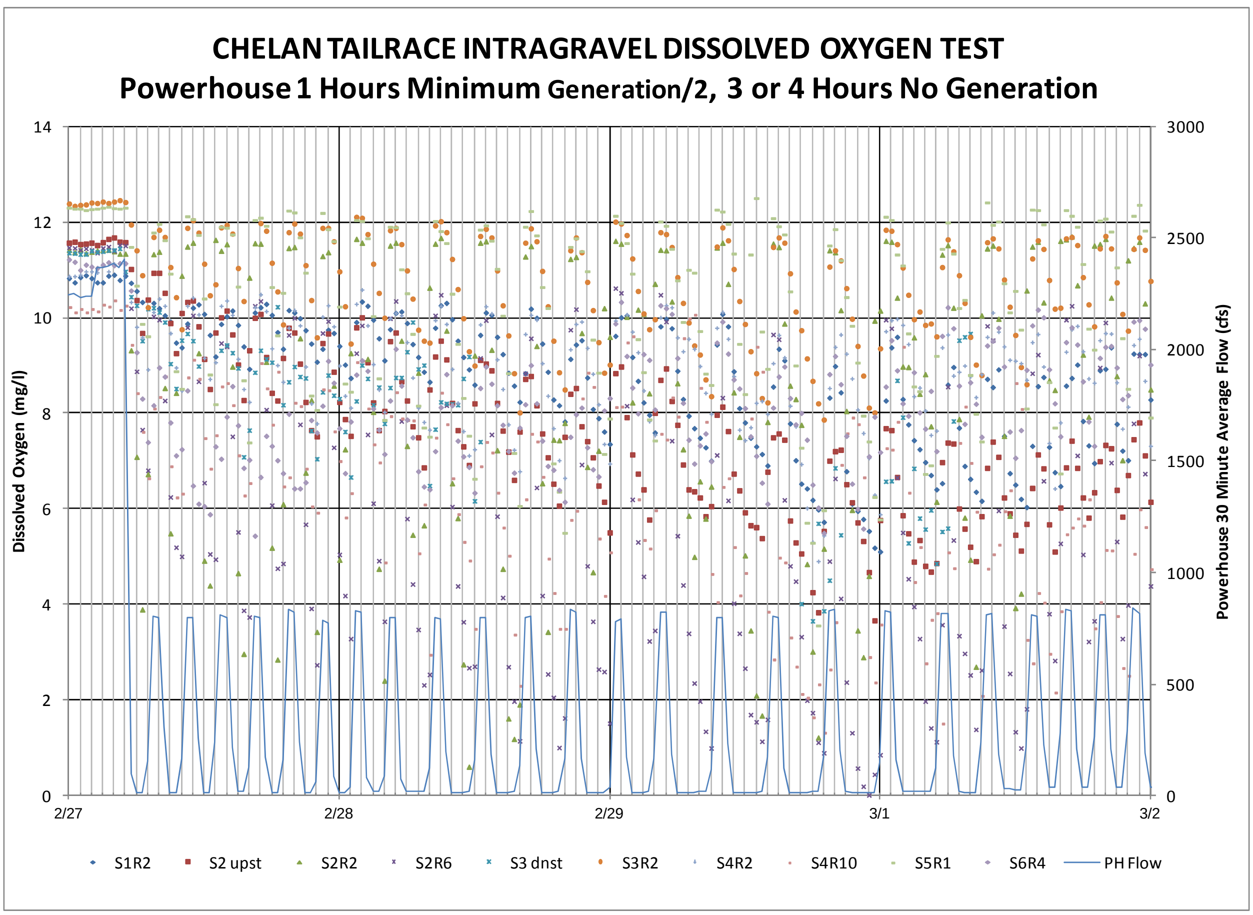
A study conducted during the relicensing investigations indicated that IGDO levels of 6.0 mg/l may be maintain within Chinook salmon redds during extended periods with no generation or flows from the powerhouse. BioAnalysts, Inc (2003) reported "At no time during the different treatment periods did the average IGDO level fall below 7.0 mg/L, nor did individual redds experience prolonged exposure to IGDO levels below 6.0 mg/L. The lowest recording was 5.2 mg/L, which occurred briefly during treatment 5 (three-day powerhouse shutdown) in a deep-water redd (>6 feet deep)." Based on this information, studies to determine the level of powerhouse operation needed to meet IGDO requirements were initiated in the fall of 2011. For prior years through the spring incubation period of 2011, powerhouse operations and pump station operations were scheduled to provide flow circulation intended to meet or exceed conditions tested in 2003. These operations are described in the Annual Flow Reports for 2009, 2010, and 2011.

The IGDO study conducted from December 2011 – March 2012 determined that IGDO may not have been maintained at or above 6.0 mg/l in Chinook salmon redds during extended periods when the powerhouse was not operating, at least not after March 1. The study plan intended to monitor up to ten redds with dissolved oxygen and temperature sensors (Hydrolab Minisondes) replicating the study methods used in 2003, but with greater replication (ten redds instead of five) to cover the greater extent of spawning area that exists now that spawning gravels have been placed in the tailrace. The IGDO study was combined with an egg-emergent fry survival study to address that component of the biological objectives (discussed in the next section).

Due to low snowfall and early concern regarding the ability to meet refill target elevations for Lake Chelan, a series of powerhouse on/powerhouse off tests were conducted in December 2011 and January, 2012. In December, the IGDO levels in the four monitored redds generally remained above 6.0 mg/l even during periods of up to 23 hours with no powerhouse flow. Testing between January 6-17 continued with no powerhouse flow for up to 11 hours duration, followed by an hour with one unit running at minimum output. The IGDO levels remained well above 6.0 mg/l in four of five redds. Tests continued from January 17 – 31, with different durations of periods with no powerhouse flow, and IGDO levels remained generally well above 6.0 mg/l. Due to higher runoff forecasts, testing of periods with no powerhouse flow was discontinued until late February in order to draft water from Lake Chelan to increase Chelan PUD's ability to limit spill levels during summer snow melt in order to protect the Habitat Channel from high flows expected in June and July.

Testing resumed the last week of February with 10 redds now monitored, but these tests gave different results. Tests were scheduled to determine if periods of one hour at minimum generation, followed by either two, three or four hours with no powerhouse flow, would be adequate to protect Chinook salmon redds. During these tests, IGDO levels declined to below 6.0 mg/l in three of the ten redds within just a few cycles of only two hours with no powerhouse flow. The cycles with three hours of no flow resulted with three redds dropping below 4 mg/l and two other redds dropped to around 5.5 mg/l. The four hour cycles showed that nine of the ten redds had IGDO excursions below 6.0 mg/l, with several showing very low IGDO levels (Figure 2-2). IGDO levels returned to above 6.0 mg/l after four hours of continuous minimum generation in nine of the ten redds.

Figure 2-2. IGDO Levels In Chinook salmon Redds During Spring Tests, 2012.



During the removal of the Minisondes in late March, the divers doing the work commented on the heavy growth of periphyton, particularly what appeared to be Didymo, on the river bed. A sample was sent to Jenifer Parsons, Washington Department of Ecology, who confirmed that the sample was Didymo. Didymo blooms have been mentioned in the literature as possibly causing reduced intragravel flows and survival in trout redds (Bickel, T.O. and G.P. Closs 2008). The divers were the same individuals from BioAnalysts that had conducted the study in 2001, and they did not recall any such heavy periphyton growth covering the Chinook salmon redds during that study. Since algal blooms are commonly related to increasing day length and water temperatures, it is possible that the growth of a thick periphyton mat over the redds occurred between the tests from December and January and the tests in late February and March. The difference in IGDO level response between the early test periods and the last testing may have been, at least in part, related to algal growth fouling the gravel surface where water exchange occurs.

A new series of tests was conducted during the 2012-2013 Chinook salmon egg incubation period. In this test, again ten Chinook salmon redds are being monitored with Minisondes (Table 2-3). However, in this study, the tests were designed to gradually approach testing periods of time with no powerhouse flow and the period of time with no powerhouse flow was limited to a maximum of three hours. The test cycles began with short periods of only minimum generation (about 800 cfs) with full flow (2,500 cfs) most of the time, which then progressed to running full time at only 800 cfs, then cycles of two hours at 800 cfs, followed by two hours of no flow. During two 3.5 day test periods with that operation (February 15 – 18 and February 22-25), the IGDO levels remained above 9.0 mg/l in all redds except for one, where the IGDO dropped to near 7.0 mg/l.

Tests since February 25, 2013, focused on identifying an operation that will maintain oxygen levels above 6.0 mg/l, but minimize powerhouse operation so that Lake Chelan can be refilled to meet lake level targets in May and June. Beginning February 26, test operations consisted of extended periods where either two hours or three consecutive hours with no powerhouse flow have been followed by only one hour with the powerhouse at minimum generation. During this test series, which ended March 5, oxygen levels in most redds remained above 6.0 mg/l, but one redd located near the lower end of the study area and just upstream of the confluence with the Columbia River had eight readings (taken every 30 minutes) between 5.5-6.0 mg/l. This redd is in gravels that naturally accrued to this area and is not within the area that was created or modified as part of the Chelan River and tailrace habitat construction project. One other redd had a single excursion of 5.8 mg/l, but the rest of the redds remained above 7.0 mg/l during this test period (Figure 2-4).

The final series of tests was designed to periodically flush the spawning gravel with powerhouse operations of several hours at minimum generation, followed by repeating cycles of three hours with no powerhouse flow followed by one hour at minimum generation. The results of the first two tests with ten cycles, then with 12, 14, and 16 cycles, with the cycles indicated by orange shading, are shown in Figure 2-4.

The results of the dissolved oxygen monitoring in 2013 indicate that operation of the powerhouse with one turbine at minimum generation (approximately 800 cfs) maintained intragravel dissolved oxygen levels above 6.0 mg/l during the tests in both 2012 and 2013. The 2013 results also indicate that IGDO levels above 6.0 mg/l can be maintained with periods of two or three hours with no powerhouse flow, even over repeating cycles. The growth of periphyton, including Didymo, in 2013 appeared to be less robust than observed in the spring of 2012, however it is unknown whether the low dissolved oxygen levels observed in February, 2012, were due in part to periphyton. Further tests to confirm this finding and refine the criteria for powerhouse operations will be conducted during the 2013-2014 Chinook salmon egg incubation period. In addition, as will be discussed in Section 2.5, additional studies of survival of Chinook salmon from egg to emergent fry will be needed to determine that powerhouse operations are meeting the egg to fry survival objectives. The expected outcome of these studies is that these biological objectives will be achieved through further refinement of powerhouse operating criteria for protection of Chinook salmon redds during the incubation and emergence period.

Table 2-3. Chinook salmon Redd Protection Flow Tests, 2012-2013.

Date Begin Test	Date End Test	Powerhouse Test Conditions	Number of Low Flow Cycles	Notes
12/1/2012	12/15/2012	Full - 24 hours (h)		
12/16/2012	12/20/2012	Full - >16 h, Min <8 h		
12/20/2012	1/25/2013	Full - 24 h		
1/25/2013	1/28/2013	Full - 2 h, Min - 4 h	13	
1/31/2013	2/4/2013	Full - 2 h, Min - 10 h	7	
2/8/2013	2/10/2013	Full - 2 h, Min - 22 h	3	2 h off in 1st cycle for dive work
2/14/2013	2/18/2013	Min - 2 h, Off - 2 h	21	
2/21/2013	2/25/2013	Min - 2 h, Off - 2 h	21	
2/25/2013	2/26/2013	Min - 24 h	1	
2/26/2013	2/27/2013	Min - 1 h, Off - 2 h	8	
2/27/2013	2/28/2013	Min - 1 h, Off - 3 h	6	
2/28/2013	3/3/2013	Min - 1 h, Off - 2 h	27	
3/4/2013	3/5/2013	Min - 1 h, Off - 3 h	10	5 h at Min at end of 10th cycle
3/5/2013	3/7/2013	Min - 1 h, Off - 3 h	10	5 h at Min at end of 10th cycle
3/7/2013	3/9/2013	Min - 1 h, Off - 3 h	12	5 h at Min at end of 12th cycle
3/9/2013	3/14/2013	Min - 1 h, Off - 3 h	14	5 h at Min at end of 14th cycle
3/14/2013	3/17/2013	Min - 1 h, Off - 3 h	16	5 h at Min at end of 16th cycle
3/17/2013	3/17/2013	Min - 1 h, Off - 3 h	16	5 h at Min at end of 16th cycle
3/17/2013	3/20/2013	Min - 1 h, Off - 3 h	16	End of Study
Powerhouse Conditions: Full >2200 cfs, Partial 900-2200 cfs, Min 800- 900 cfs, Off <100 cfs				

Figure 2-3. Chinook salmon redds with dissolved oxygen monitoring, 2012-13.

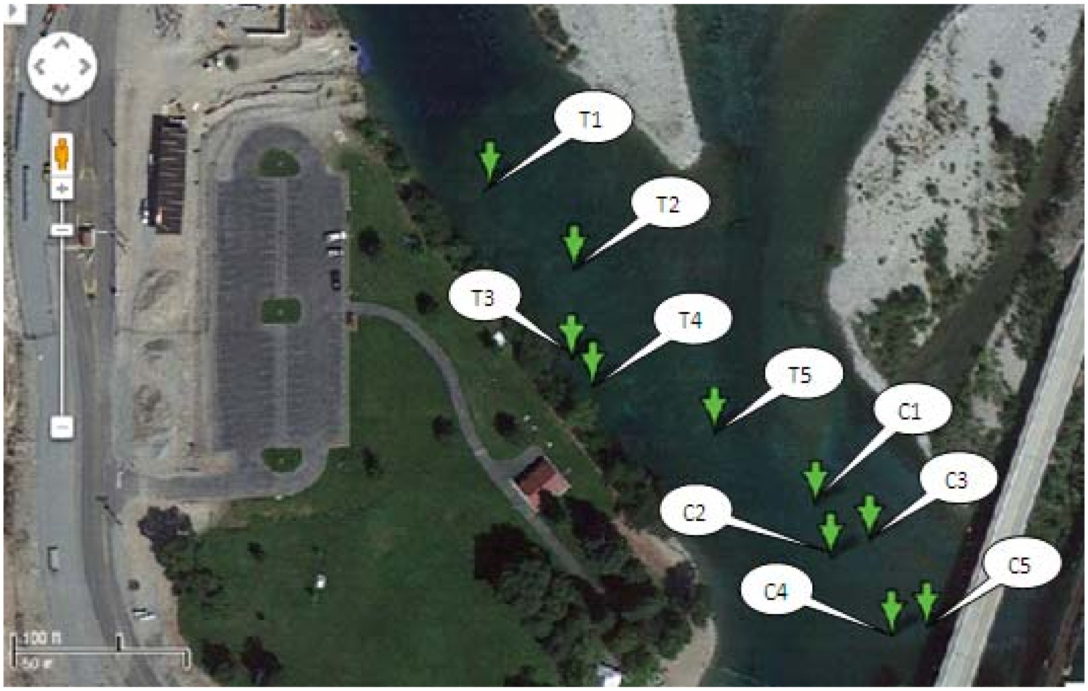
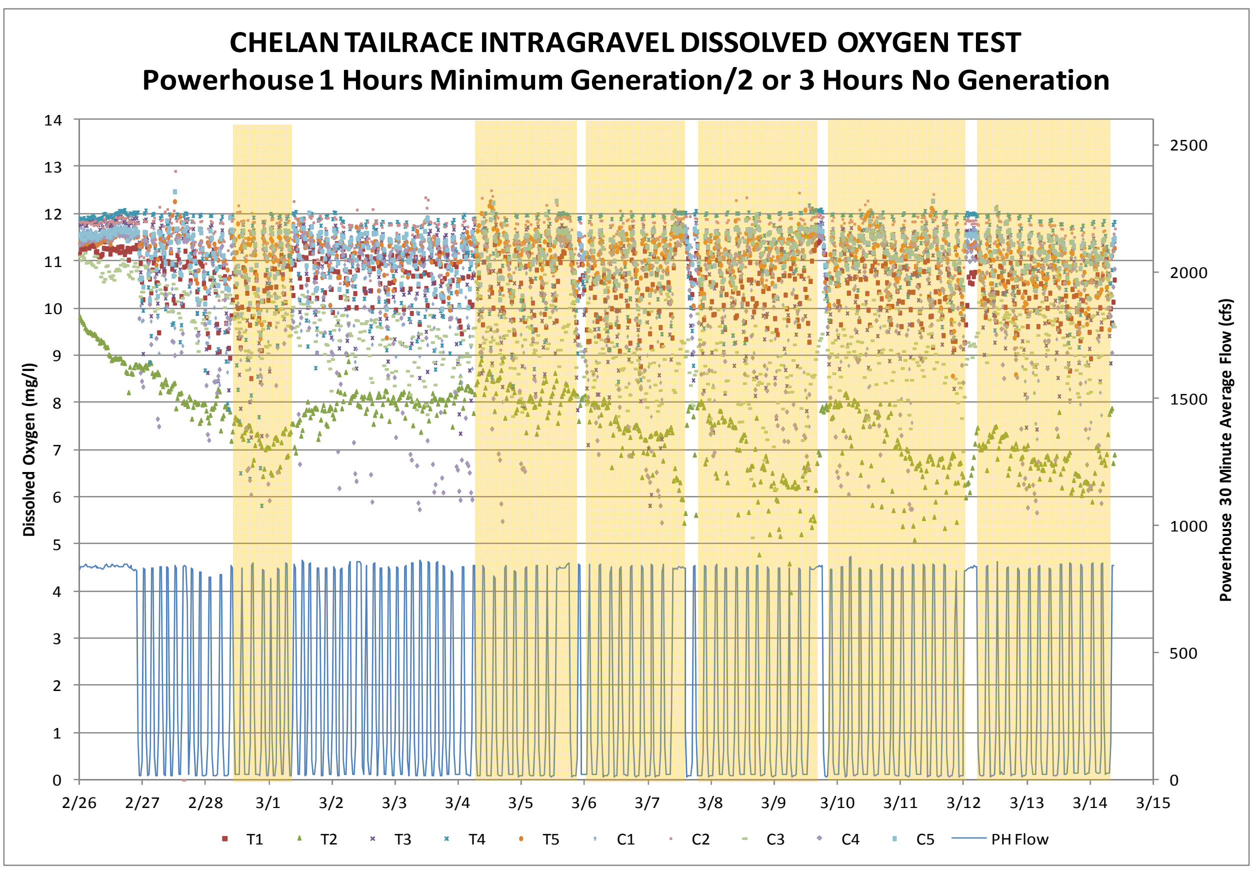


Figure 2-4. IGDO Levels In Chinook salmon Redds During Spring Tests, 2013.



2.4 Steelhead Redd Protection Flows

Since there have not been any steelhead redds in the tailrace that are dependent on powerhouse flows, there has been no need to provide powerhouse flows during the steelhead incubation period. The only redd that was observed adjacent to the shoreline above the Chelan Falls highway bridge was in flowing water coming from the Habitat Channel.

2.5 Chinook salmon Egg to Emergence Survival

Studies of Chinook salmon egg to emergence survival were also initiated in 2011, in conjunction with the IGDO studies. A recent set of studies conducted in the Columbia River, Hanford Reach, measured egg to emergence survival for Chinook salmon, using a technique they developed suitable for placing a known number of eggs in a container with local substrate in a manner that can be done by divers in relatively deep, flowing water (Oldenburg et al. 2012). The Hanford Reach studies used cylindrical egg tubes (CET) to place 100 eyed eggs in the tube, then manually excavated an area to simulate a redd, and burying the CET at the same depth as found in the egg pockets of nearby, natural redds. At the end of the study, the CETs are retrieved and the number of live Chinook salmon fry counted in the CET provides an estimate of egg to emergence survival. Chelan PUD adapted this study methodology to address the CRBEIP biological objective that egg to emergence survival be either greater than 80 percent of the average egg to emergence survival in good quality spawning areas in the Methow River or meet 70 percent survival outright, whichever is less.

The 2011-2012 study was designed to evaluate egg-emergence survival in four different areas, including: (1) the tailrace in the area filled with gravel to create more spawning habitat; (2) the area at the confluence of the tailrace and Reach 4 of the Chelan River, where the spawning gravel has accumulated as a result of natural processes; (3) in the Columbia River on the alluvial fan formed below the confluence of the Chelan and Columbia rivers; and (4) in the Chelan River Habitat Channel. The new spawning gravels placed in the tailrace and the spawning areas in the Habitat Channel are the areas being tested to determine if the biological objective for egg-emergence survival is being met in these constructed areas. The naturally occurring spawning areas at the confluence of the tailrace and Reach 4 and on the alluvial fan in the Columbia River are meant to serve as a natural control for comparison. In addition, a number of CETs were placed in open water to serve as controls to determine the survival with the influence of only handling and other experimental factors unrelated to spawning gravel quality. Controls for the tailrace were unsuccessful and had 100 percent mortality due to algae and periphyton plugging the mesh. Controls in the Habitat Channel were hanging under a log structure and apparently were shaded enough to prevent algae growth.

The 2011-2012 study gave mixed results, with a number of the CETs having complete mortality of the eggs. However, the results were odd in that some of the CETs with good survival were placed very near the CETs with few or no survival. All the mortality appeared to be prior to hatch of the eggs, in that few dead sac-fry and no dead button-up fry were found in the CETs. The majority of dead eggs that were in CETs with little or no fry appeared to have died relatively close to hatching. This could be because the level of oxygen needed for egg/embryo survival just prior to hatching has been estimated to be near 7.0 mg/l (Alderdice, et al. (1958)).[1] The estimated date of hatching for the CETs, based on accumulated temperature units, was about January 6, 2012. The dissolved oxygen levels recorded during powerhouse tests in late December and early January generally remained well above 8.0 mg/l for three of the four Minisondes that were in operation during that time period. Additional tests later in January, with 7-9 functional Minisondes, also had dissolved oxygen levels generally well above 8.0 mg/l, with the exception of the same redd that had previously shown lower dissolved oxygen levels. The CETs were placed in similar substrate to the locations of the redds, but not in Chinook salmon redds. It is possible that the CETs were placed in substrate somewhat less permeable than that used in the nearby redds, but this seems unlikely. The CETs placed in the Habitat Channel had better survival, which ranged from 43 live fry to 96 live fry. The results of the 2011-2012 CET study are summarized in Table 2-4.

---

[1] From Alderdice et al. (1958) as summarized by Hillman, T.W. (personal communication 12/9/2011) "The DO requirements of embryos increase as they grow, reaching a peak just before hatching. After hatching, the alevins can deal with low DO by pumping water with their gills, moving to areas of higher DO, and also by circulating water around themselves with their fins. Alderdice et al. (1958) estimated that the critical levels of DO (defined as "those at which respiratory demand is just satisfied," p. 248) went from about 1 mg/L just after fertilization to 7 mg/L before hatching. Between these "critical levels" and the DO levels at which 50% of the embryos died (about 0.5-1.5 mg/L, depending on the stage at which the reduction in DO took place), there were levels at which embryos survived but did not thrive and were judged to have been unviable under natural conditions."

Table 2-4. Chelan River Chinook Egg to Emergence Survival in CETs, 2011-2012

Location	CET #	Live Fry	Dead Fry	Dead Eggs	Notes
Tailrace In Gravel Fill	1	0	0	-	Too much fungus to count
	2	18	5	-	Too much fungus to count
	3	90	0	8	
	4	0	0	-	Too much fungus to count
	5	71	0	20	
Tailrace Natural Gravel	6	0	0	-	Too much fungus to count
	7	96	0	0	
	8	27	0	-	Too much fungus to count
	9	0	0	-	Too much fungus to count
	10	90	0	8	
Columbia River	11	0	0	68	
	12	86	0	14	
	13	0	0	30	
	14	90	0	8	
	15	71	0	13	
Habitat Channel	16	94	0	6	
	17	53	0	-	Too much fungus to count
	18	59	0	-	Too much fungus to count
	19	43	0	-	Too much fungus to count
	20	96	0	4	
Habitat Channel Control	21	85	2	11	
	22	93	1	2	
	23	75	0	16	

*Starting with 100 Eggs Per CET

This study was repeated in 2012-2013, using the same methodology except that the control CETs were placed differently than during the previous study. The controls (five in the tailrace and four in the habitat channel) were placed on the surface of clean substrate, oriented perpendicular to the direction of flow and covered loosely with large cobble to prevent periphyton growth on the CET mesh. The concept for the controls was to allow water circulation uninhibited by the sand and small grain materials that cover the CETs placed in artificial redds, thus the expectation was that control survival would be high in the tailrace even with no flow from the powerhouse. Surprisingly, all the control CETs and all the CETs placed in the tailrace, except one, experienced 100 percent mortality (Table 2-5). This mortality apparently occurred within a week or two of the CET placements because the dead eggs showed little evidence of development beyond the eyed-egg stage. However, the powerhouse operated continuously at full flow from the evening of December 20, 2012, when CET installation was completed, until late January 2013. During CET installation, the powerhouse was operated at full flow at night, then at a minimum of about 800 cfs during scheduled diving periods. The only time the powerhouse had no flow was during one period of less than two hours that was needed for divers to install two CETs at the narrow area upstream of the highway bridge where currents were too swift at 800 cfs flow for the work to be accomplished. Contrary to the results for the CETs in the tailrace, all the CETs in the Habitat Channel and most of those in the Columbia River below the bridge had high survivals.

The only CET in the tailrace that had live fry was in a location at the boundary zone where flow from the Habitat Channel converges with the tailrace. The results of the CET studies in the tailrace are puzzling, especially under the 2012-2013 powerhouse operations where the powerhouse operated at full flow for over a month immediately following the installation of the CETs. Since the egg-fry survival in the CETs in the Habitat Channel exceeded 90 percent and averaged about 80 percent for the CETs in the Chelan River flow below the bridge, the potential sources of experimental bias (egg quality, packing and handling of CETs, substrate quality and healthy dissolved oxygen levels in natural Chinook salmon redds) have largely been eliminated. There may be some experimental flaw associated with the design of the CETs and the exchange of water under low flow conditions that could account for these results. The next study should include a sampling protocol for examination of egg survival in the naturally spawned Chinook salmon redds, as well as possibly using a different type of egg container for planted eggs.

Table 2-5. Chelan River Chinook salmon Egg to Emergence Survival in CETs, 2012-2013.

Location	CET #	Live Fry	Dead Fry	Dead Eggs	Notes
Tailrace In Gravel Fill	1	0	0	Few	Too much fungus to count
	2	0	0	Few	Too much fungus to count
	3	0	0	Few	Too much fungus to count
	4	0	0	Many	Too much fungus to count
	5	0	0	Many	Too much fungus to count
Tailrace Natural Gravel	6	0	1	Many	Too much fungus to count
	7	0	0	Many	Too much fungus to count
	8	53	0	Many	Too much fungus to count
	9	0	0	Many	Too much fungus to count
	10	0	0	Many	Too much fungus to count
Columbia River	11	93	0	7	
	12	83	0	12	Some eggs not countable
	13	74	0	18	Some eggs not countable
	14	93	0	5	Some eggs not countable
	15	64	0	Many	Too much fungus to count
Habitat Channel	16	91	0	9	
	17	98	0	4	
	18	95	0	5	
	19	90	1	10	
	20	98	0	2	
Habitat Channel Control	21	0	0	Many	
	22	0	0	Many	
	23	0	0	Many	
	24	0	0	Many	
	25	0	0	Many	
Habitat Channel Control	26	91	0	8	
	27	93	0	6	
	28	88	0	11	
	29	95	0	6	

*Starting with 100 Eggs Per CET

2.6 Steelhead Egg to Emergence Survival

Thus far, Chelan PUD has not attempted to measure egg to emergence survival for steelhead. Since spawning occurs in April and early May, the timing of emergence for steelhead from redds in the Habitat Channel would range from late May – mid June (600 – 650 temperature units to emergence). For all three years (2010-2012), the good mountain snowpacks have led to spill from Lake Chelan by early June, resulting in flows well above 1,000 cfs in Reach 4 during the emergence period. No steelhead fry have been observed during surveys. Use of CETs or other controlled means to incubate steelhead eggs in the substrate appear to be feasible, but would require a source of steelhead eggs with accumulated temperature units in April that would be comparable to naturally spawned steelhead eggs in the Habitat Channel. The local steelhead hatcheries typically finish their egg take by early March, which would be much earlier than natural spawning. Use of eyed eggs from a hatchery is likely the most practical means to measure steelhead egg-emergence survival, but it will require special arrangements for a late spawning at one of the local hatcheries and ESA clearance since steelhead are a listed species.

SECTION 3: CHINOOK AND STEELHEAD REARING

3.1 Chinook salmon rearing

Snorkel surveys have been conducted in the tailrace and Reach 4 in 2010 (one survey) and in 2012, with surveys in April, May, June, August, September and November. A survey scheduled for July 2012 was cancelled due to high spill levels. In addition to snorkel surveys, Chinook salmon fry have been observed in Reach 4 during steelhead spawning surveys and other activities. Some of the surveyors have attempted to distinguish Chinook salmon fry from coho fry and have given separate counts for each species, however it is very difficult to make that determination without actually having the fish in hand. Chinook salmon and coho counts have been combined in Table 3-1, but separate counts are provided in the survey data spreadsheet in Appendix A. Snorkel survey data collected in 2013 will be available at the Chelan PUD web site under Biological Objectives (http://www.chelanpud.org/documents/40558_Snorkel_Fish_Survey_2013.pdf).

Table 3-1. Chelan River Chinook and Coho Salmon Fry Counts.

Year	Location	Mar	Apr	May	Jun	Jul	Aug.	Sept	Nov
2010	Tailrace	-	-	0	-	-	-	-	-
2010	Channel	-	-	3945	-	-	-	-	-
2010	Pool	-	-	845	-	-	-	-	-
2012	Tailrace	0	0	2670	85	-	0	0	0
2012	Channel	0	0	2312	0	-	0	0	0
2012	Pool	0	8	0	-	-	0	0	0

The snorkel survey data for 2012 was compromised by high flows in June (3,261 cfs in Reach 4), thus the failure to observe any Chinook salmon fry in the Habitat Channel may not indicate that Chinook salmon fry have left Reach 4 by this time. However, the lower count in the tailrace would support a hypothesis that Chinook salmon fry begin to move downstream into rearing habitat in the Columbia River as they reach larger size. This is consistent with the behavior of summer Chinook salmon in the Wenatchee River and Methow River and with offshore and downstream movement noted for fall Chinook salmon in the Hanford Reach of the Columbia River. The surveys in August were past the date when any Chinook salmon would be expected to remain in shallow water habitats.

During the April survey (4/17/2012) no Chinook salmon fry were counted in either the Habitat Channel or tailrace, although the accumulated temperature units had passed 1000 degree-days (°C) for more than 80 percent of the redds in the tailrace. However, with the water temperature of about 11 °C on that survey, the fish may have been down in the cobbles and in other types of cover. Casual observations around the large wood structures in the Habitat Channel have typically not observed Chinook salmon fry in these areas until late April and May, when water temperatures are around 15 °C.

3.2 Steelhead rearing

The snorkel surveys have not counted any steelhead fry, parr or pre-smolts in either Reach 4 or in the tailrace, however, larger rainbow trout have been observed, as have adult steelhead, in March, April, and May, and larger rainbow (considered rainbow, not steelhead, based on body shape) were also observed in August, September and November. Water temperatures in August exceeded 19 °C.

Water temperatures were favorable during May and June for steelhead fry to rear in the Habitat Channel, however, high flows in June and July prevented effective snorkel surveys and also may have been high enough to push emergent steelhead fry out into the Columbia River. Future surveys in years without high spill levels during steelhead emergence are expected to find steelhead fry present in June.

SECTION 4: FISH COMMUNITY REACHES 1-3, REACH 4

4.1 Snorkel Surveys Reaches 1-3

Snorkel surveys were completed in 2012 in Reach 1 during April and November and in Reaches 2 and the uppermost pool of Reach 3 in April. Surveys scheduled for August were cancelled due to safety concerns. Although these surveys were originally scheduled to only occur every two years, the surveys will be repeated in 2013 due to failure to conduct a survey in August of 2012. Surveys of Reach 3 present some safety and logistical constraints due to the inability of snorkel crews to find a safe route past the falls and snow and ice in November. Alternative access to the pools below the falls will be explored in 2013.

Snorkel surveys in April found 7 adult rainbow and one sucker in the first 2-3 pools below the low level outlet. No fish were observed present in any other sections of Reach 1, although several pool areas at the lower end of that reach appeared to have adequate depth and cover for fish to overwinter. No fish were observed in Reach 2, which is a relatively short section of mostly continuous riffle and glide. The pool below the uppermost falls in Reach 3 also had 5 adult rainbow, 8 adult cutthroat, one adult Chinook salmon and one smallmouth bass. All these fish, including the Chinook salmon, are typical of the size and type of fish present in Lake Chelan. We assume that these fish moved through the spillway into the Chelan River during the previous spring and summer. Since spill in 2011 ended on August 11, then these fish would have been present in the Chelan River during minimum flows at least from August and more likely during July, due to spill volumes being highest during the first half of July. Daily average water temperatures in reaches 1-3 exceeded 20 °C during most of August and the first half of September, 2011. The maximum daily average water temperatures from the beginning of Reach 1, end of Reach 1 and end of Reach were 21.7 °C, 21.4 °C and 21.6 °C, respectively. The highest hourly temperatures recorded were 22.1 °C, 23.2 °C, and 23.8 °C, respectively for the same locations. The fish present in April of 2012 apparently survived under these water temperature conditions.

The snorkel survey of Reach 1 in November found 12 rainbow present, which probably entered from Lake Chelan during the 2012 spill season. Reach 2 and the upper pool of Reach 3 were not surveyed in November due to safety concerns because of ice and snow on rocks in these steep gradient sections.

4.2 Snorkel Surveys in Reach 4 Pool and Habitat Channel.

The Reach 4 pool and Habitat Channel were both heavily used by several other species of fish that migrated in from the Columbia River for spawning. Chiselmouth, northern pikeminnow and suckers all used the Habitat Channel and gravel deposits in the pool for spawning. Although snorkel survey observers did not count many chiselmouth or pikeminnow adults, several hundred were observed spawning during steelhead spawning surveys in early June, and a ripe male northern pikeminnow were readily captured by angling in the pool. The June timing of these species corresponded to the high spill period and the June snorkeling survey was not very effective due to the high flow. During snorkel surveys in May, large suckers were quite active, with 324 counted in 2010 and 1324 counted in 2012.

Smallmouth bass were observed guarding nests near the wood structures in the Habitat Channel during May, with 32 smallmouth bass greater than 6 inches in length observed in the Habitat Channel and pool. Smallmouth bass were also observed in the pool in April and August, presumably rearing in this area.

In November, six bull trout (12”- 18”) were present in the Habitat Channel, concurrent with Chinook salmon spawning activity. Also present were ten rainbow (8” – 14”). We presume that the bull trout and rainbow were present to feed on Chinook salmon eggs.

Other fish species observed in the Reach 4 pool and Habitat Channel include mountain whitefish, redside shiner, peamouth, stickleback and bluegill. All these species are common in the Columbia River. In the tailrace and below the last riffle in the Habitat Channel, the snorkel observations have included carp, walleye, juveniles of northern pikeminnow, chiselmouth and peamouth (collectively counted as cyprinid fry), and juvenile smallmouth bass.

SECTION 5: FUNCTIONAL AQUATIC ECOSYSTEM

5.1 Water Quantity and Quality

The Lake Chelan Hydroelectric Project has been operated to meet minimum flows to the Chelan River, avoid high spill flows that could damage developing riparian zones and the features in the Habitat Channel, and to meet lake level targets. The most challenging operation has been to avoid high spill flows while meeting spring and summer lake levels during two years with high runoff levels and late timing of runoff. The goal has been to avoid spill levels in excess of 6,000 cfs, which has thus far been accomplished with the exception of a short period in 2012 when spill reached 7,000 for a few hours. Ramping rates were also instituted during decreases in flow to prevent fish stranding. Through the first three years of operation, no damage has been observed to developing riparian zones or wood/boulder features in the Habitat Channel due to high spill. Nor have any fish strandings due to sudden flow reductions been observed. The desired ratio of maximum flow to minimum flow (6,000 cfs to 80 cfs) is 75 to 1, which is similar to the ratio for the Entiat River, a nearby Columbia River tributary of similar size. The Entiat River often has minimum winter flows of 50 – 60 cfs and peak flow during the year has exceeded 4,000 cfs in 6 of the past 53 years, for a peak flow to minimum flow ratio of about 70 – 80. Over time, management to generally restrain spill flows to 6,000 cfs or less should allow the development of a stable riparian zone in Reach 1 and protect the riparian zone and wood/boulder features in the Habitat Channel.

The annual temperature regime for the Chelan River has been reported in annual flow and temperature reports, available at http://www.chelanpud.org/lc-Resource-Documents-WaterQuality.cfm. The water temperatures from November - May have been within the water quality criteria for a designated use of salmonid spawning, migration and rearing and winter temperatures are relatively mild due to the effect of Lake Chelan. Water temperatures in December and January generally average from 3-5 °C and have not been observed to reach the very cold temperatures that can result in frazil and anchor ice formation (Figure 5-1).

Water temperatures in summer and early fall, however, significantly exceed criteria for salmonid spawning, rearing and migration (7-DADMax<=17.5 °C). The water temperature exceeds the criteria even as it leaves Lake Chelan, drawn off the bottom of the forebay at the Low Level Outlet. The 7-DADMax for the months of May – October are shown (Figures 5-2,3,4,5) at four locations in the Chelan River for the three years since minimum flows were initiated. The UUILT for westslope cutthroat trout is variously reported as ranging from 20 °C to 22 °C, depending on the strain of cutthroat used in the experiments, the age of the fish, the degree of daily fluctuation in temperature and the level of thermal acclimation that took place prior to exposing the fish to temperature stress. The 7-DADMax of water leaving Lake Chelan exceeded 22 °C in both 2010 and 2012 (Figure 5-2). The 7-DADMax water temperature was about 2 °C higher at the bottom of Reach 3 and at the end of the Habitat Channel.

The water temperature regime of the Chelan River, as expected, is warm compared to other Columbia River tributaries in the Chelan area. However, the other lake-fed tributary, the Okanogan River, has a similar temperature regime to that observed in the Chelan River. The mean of daily average values for temperature at Malott during July and August range from 21 °C

– 24 °C (USGS data[2]). The peak daily mean temperatures recorded in 2010 – 2012 also ranged from 21 °C – 24 °C.

Figure 5-1. Chelan River Reaches 1-3 Daily Average Water Temperatures, 2012.

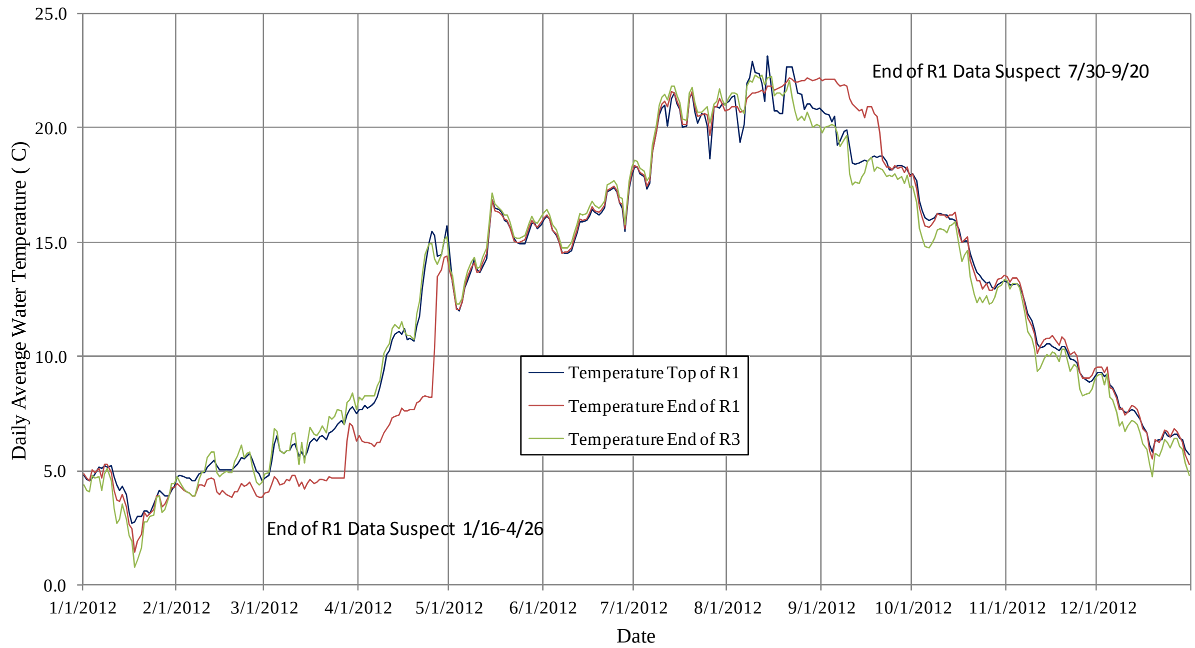
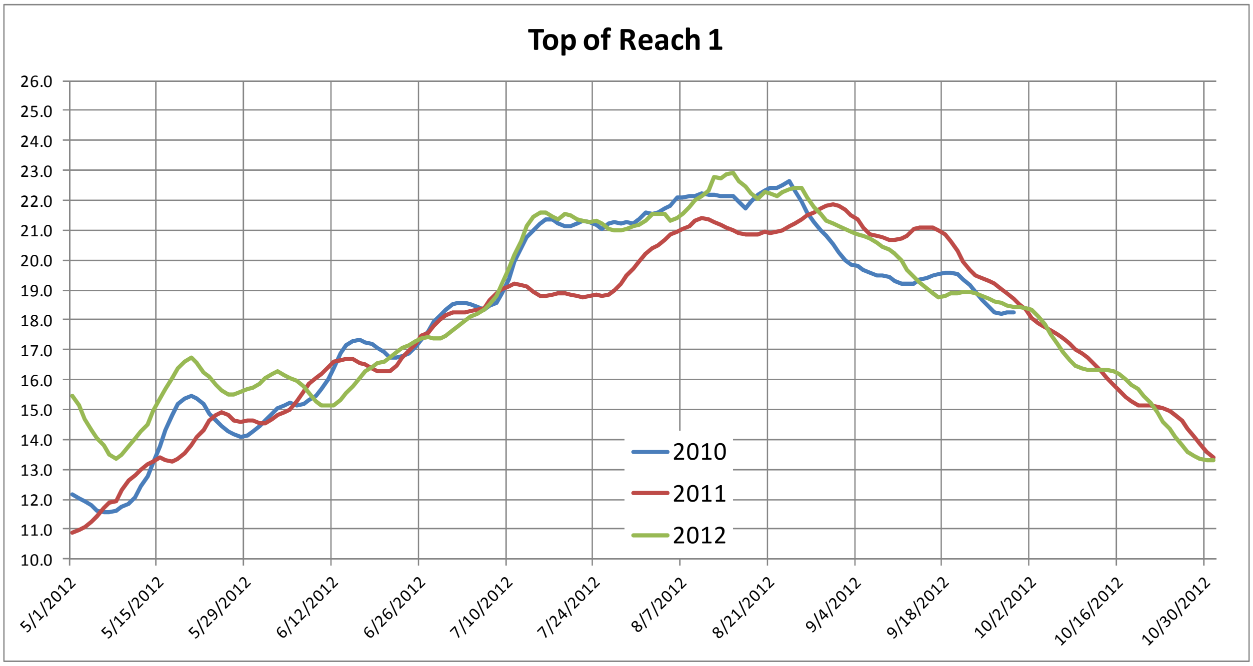


Figure 5-2. Chelan River Top of Reach 1 – 7DADMax May - October.



2 http://waterdata.usgs.gov/usa/nwis/uv?site_no=12447200

Figure 5-3. Chelan River Bottom of Reach 1 – 7DADMax May - October.

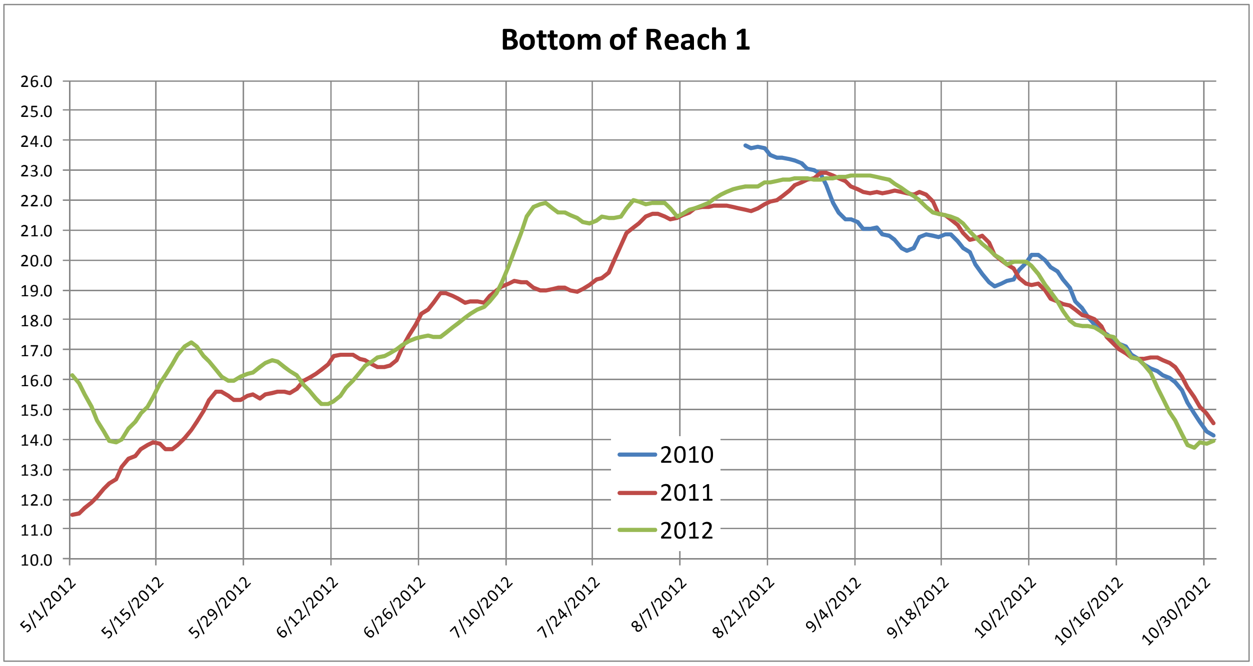


Figure 5-4. Chelan River Bottom of Reach 3 – 7DADMax May - October.

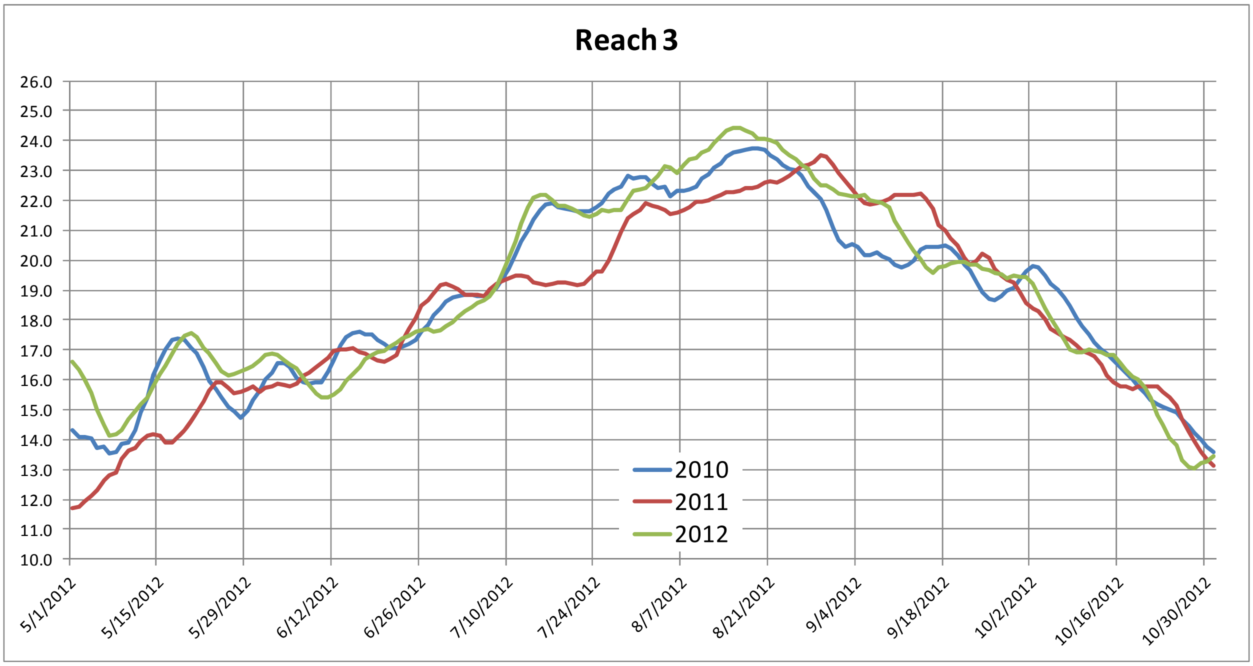
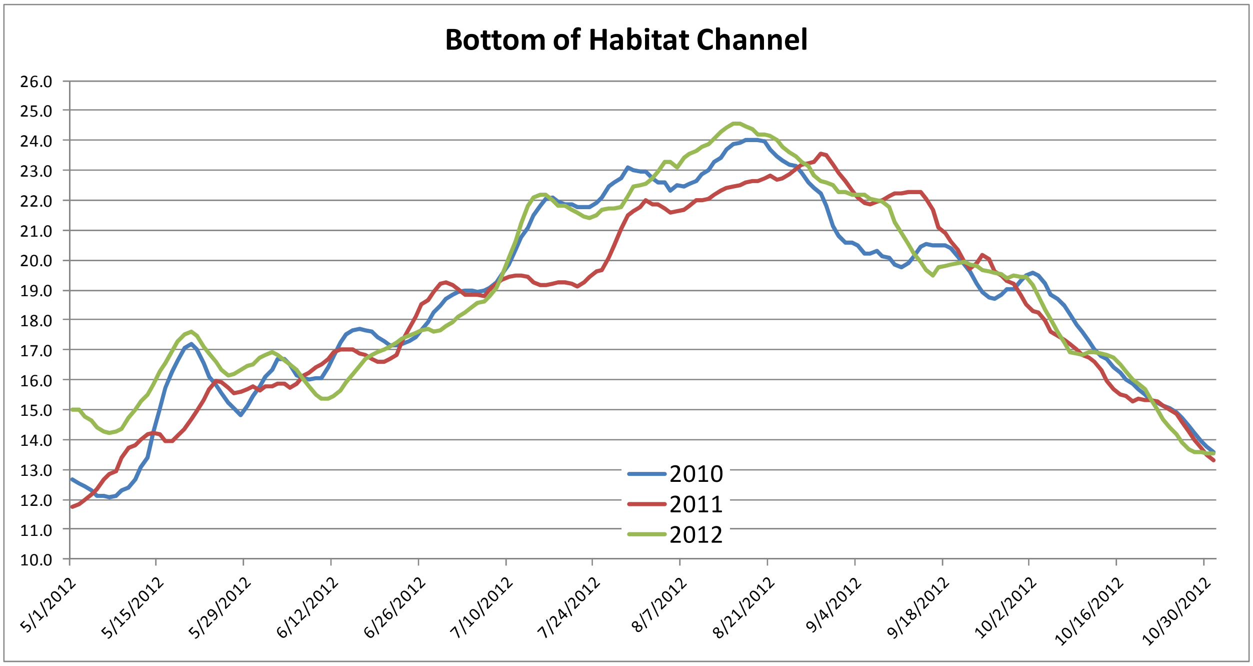


Figure 5-5. Chelan River Bottom of Habitat Channel – 7DADMax May - October.



Water quality, other than temperature, has not yet been fully evaluated. Limited sampling in September and October for pH and dissolved oxygen in the Habitat Channel found dissolved oxygen ranged from 8.1 to 10.3, even though water temperatures exceeded 23 °C during the August sampling, and pH from 7.4 to 8.1. These values for dissolved oxygen and pH are within the criteria for salmonid spawning, rearing, and migration.

5.2 __Macroinvertebrates__

Benthic macroinvertebrates were collected from the Habitat Channel in the summer of 2011 and 2012. These samples have not yet been analyzed for species composition. However, observation during sample collection indicated that species diversity is limited with most common organisms being leeches, small unidentified larvae of the same type, some chironomids, and polychaete worms. These collections were qualitative, moving upstream in a zigzag manner and kicking the substrate vigorously. The goal was to collect over a broad section of substrate because macroinvertebrate density was low. These samples also included a significant amount of Didymo, a nuisance diatom.

Additional samples will be collected in 2013, using a quantitative methodology. Samples will also be collected in Reach 1. The samples will be sent to a lab for analysis in 2013.

5.3 __Riparian Zone Establishment__

The willows and other riparian species planted in the Habitat Channel have thrived and are expanding beyond the initial planting zone. However, beaver eliminated most of the cottonwoods, so additional live stakes with beaver protection should be added in the future.

The riparian zone in Reach 1 is meager due to the past history of very high spillway flows scouring the shoreline, followed by annual dewatering with no minimum flow from

August–April. A series of aerial photographs were taken in November 2009 to document the initial status of riparian zone at the time minimum flows were established. Representative of Reach 1 and before/after photographs of riparian vegetation in the Habitat Channel after three growing seasons can be viewed at the Chelan PUD web site (http://www.chelanpud.org/departments/licensingCompliance/OtherDocuments/40560.pdf).

Chelan PUD is required to conduct a riparian feasibility study to better characterize the opportunities for the establishment of riparian vegetation on the banks of the Chelan River (401 Water Quality Certification, X.E.). The success of the live stake plantings in the Habitat Channel are instructive of what could be accomplished in Reach 1. Chelan PUD intends to revisit the status of riparian vegetation in Reach 1 in summer of 2013, with an initial assessment of natural riparian generation and feasibility of use of live stakes for areas lacking in natural riparian regeneration.

5.4 Stream Channel Characteristics

The Habitat Channel, which is a constructed stream channel with large wood, boulders, riffles, pools, sinuosity, a hardened width to depth relationship and flow control, has so far maintained its design characteristics and is providing spawning and rearing habitat for Chinook salmon, steelhead, and other fish species. A substantial amount of mixed gravel and sand has entered into the pool above the hydraulic control structure and is also providing spawning habitat, which is an unplanned benefit. The bed load material entering Reach 4 likely originates from a natural slide zones on the south side of the river in Reach 2. This material consists of glacial deposits that do not appear to include much cobble. There has been enough movement of this smaller riverbed material into the Habitat Channel that the interstitial spaces in the larger cobble and boulder "riffle mix" used to define the hydraulic breaks between the pool sections of the Habitat Channel have partially filled in and that has further stabilized the tail outs of the pools. Small accumulations of this finer material have been deposited in areas around the large wood structures and some sandy areas have formed behind the large wood, which has increased the diversity of the riverbed. However, the flow velocities in the main channel and pools have been adequate to move excess bed load material on through the Habitat Channel and there is no evidence that the pools are filling in with sediments. Overall, the Habitat Channel has maintained its desired stream channel diversity through three years since construction, with fairly high flows during summer in each of those years. The movement of gravels and sand through the Habitat Channel during low flow years has not yet been observed.

Steelhead have shown a preference for the smaller gravel and sand substrates in their selection of spawning sites. Accumulations of this substrate type are still limited in most sections of the Habitat Channel, possibly due to a limited supply of this type of bed load moving into the Habitat Channel from upstream sources. A large accumulation of smaller gravel and sand substrate has built up in the pool at the upstream end of the Habitat Channel and permitting is in progress to manage this accumulation, with the intent to release some of it downstream into the Habitat Channel sections that have a limited supply of this substrate size that is preferred by spawning steelhead.

Reach 1 does not have a diverse stream channel structure, with most of its length consisting of continuous riffle with a streambed consisting of very large cobble and small boulders. Although unstable areas of glacial deposits border the riverbed, these areas have been largely cut off as sources of small streambed material due to bank armoring done to prevent major landslides. The river bed has mostly been scoured of its smaller cobbles and gravels during very high spill flows in the past. There are some large bars terraced above the current ordinary high water line, which is determined by management of the spill operations to avoid spill levels exceeding 6,000 cfs. The bars and side channels that in what would have been the original channel migration zone are probably activated only at flows exceeding 10,000 cfs. Under present flow management, the Reach 1 river channel is effectively hardened in its present state and is unlikely to change without mechanical intervention. Although small driftwood is spilled into Reach 1 from the dam, there is no significant source of large wood that could catch and hold the smaller wood in the channel. Consequently, there is very little cover and only minimal pool habitat for cutthroat trout or other fish species in Reach 1. The lack of fine gravel and sand also likely limits production of benthic organisms to only those species that can attach to large cobbles and boulders.

5.5 Next Steps For Reaches 1-3

The 401 Certification, which was incorporated into the Project License, includes language in sections V.B.iv (page 121) and X.E (page 127) that directs Chelan PUD to study "… geomorphic influences on water temperatures in the Chelan River in order to address temperature, velocity, depth and substrate to determine best methods to achieve biological objectives for cutthroat trout." and to conduct a "riparian feasibility study…" respectively. In 2013, the CRFF initiated discussions regarding stocking cutthroat trout of various sizes in Reach 1 to investigate the potential of meeting Chelan River biological objectives for cutthroat trout in a more timely manner. In addition, there are several actions for adaptive management in IV.D (Page 118) that "…Chelan PUD may implement to address how to meet the biological objectives. ….and temperature reduction actions for Reaches 1 through 3, including increasing shade, refugia enhancement, and flow increases during hot weather or daytime." The potential of such actions to reduce temperatures can be evaluated through modeling prior to making decisions to implement. To assist the Chelan River Fisheries Forum in evaluating the utility of modeling, Chelan PUD initiated a contract in 2012 to WEST Consultants for an analysis of potential models that could be used in this effort. That contract includes provision for a presentation to the Chelan River Fisheries Forum, which will occur in 2013.

SECTION 6: SUMMARY

The biological objectives for the Chelan River cover four main categories; (1) Chinook salmon and steelhead spawning and incubation, (2) Chinook salmon and steelhead rearing, (3) Reaches 1-3 fish community with emphasis on cutthroat trout and use of Reach 4 by other species, and (4) monitoring of factors that meet or limit achievement of a functional aquatic ecosystem. The achievement of biological objectives will take more time for some objectives, such as establishment of a fish community and functional aquatic ecosystem in Reaches 1-3, because this area has to develop a stream channel structure and riparian zone that matches the minimum and maximum flow regime established in 2009. Many natural processes necessary to support these objectives for Reaches 1-3 will require years to develop. On the other hand, the objectives for Chinook salmon and steelhead spawning and incubation have advanced rapidly, with immediate response to the creation of new spawning habitat and, because the Habitat Channel and tailrace spawning gravel additions were done with mechanical intervention, these areas are already functioning to a high degree.

The Chinook salmon spawning surveys have shown that the habitat created in the tailrace and Habitat Channel are functioning, with the number of Chinook salmon redds having increased each year since 2008. The number of Chinook salmon redds in the Chelan River in 2012, 426 redds, was over 150 redds greater than the highest count (253) prior to the creation of the additional spawning habitat in the tailrace and Habitat Channel. The number of steelhead redds has fluctuated, but no previous record of steelhead spawning use on a regular basis exists. The development of guidelines for powerhouse operations to assure that intragravel-dissolved oxygen levels remain above 6.0 mg/l in Chinook salmon redds and measurement of Chinook salmon egg-emergence survival is completing a second year of study. Protocols for minimum powerhouse operation scheduling will be in place prior to the 2013 Chinook salmon spawning season.

Use of the Habitat Channel as rearing habitat for Chinook salmon fry has now been documented during May, but high spill flows interfered with effective snorkel surveys in June and no steelhead fry have been observed rearing in the Habitat Channel. Other native and non-native fish common to the Columbia River have also been documented to use the Habitat Channel for spawning and rearing.

Snorkel surveys in Reaches 1-3 have documented some limited use by adult rainbow and cutthroat trout, with indications that cutthroat trout can survive through the summer in Reach 3. Snorkel surveys in this area have been hampered by safety concerns, but those issues have been resolved and additional surveys are scheduled for 2013. However, the stream channel diversity and lack of a riparian zone in Reach 1 have the potential to limit establishment of a fish community in that section of the Chelan River for many years into the future.

Water quantity and quality appears suitable for meeting the biological objectives in all sections of the Chelan River, although further study is needed for dissolved oxygen, pH, total dissolved gas and turbidity. The temperature regime, as expected, is much warmer in August and September than the Washington State Water Quality Criteria for salmonid spawning, rearing, and migration. However, the water temperatures are no worse than those observed in the Okanogan, a major salmon producing tributary to the Columbia River. The Chelan River and Okanogan River are both fed by large lakes, which have a strong influence on the water temperature regime of these rivers.

SECTION 7: LITERATURE CITED

Alderdice, D. F., W. P. Wickett, and J. R. Brett. 1958. Some effects of temporary exposure to low dissolved oxygen levels on Pacific salmon eggs. J. Fish. Res. Board Can. 15:229-249.

Bickel, T. O., and Closs, G. P. (2008). Impact of Didymosphenia geminata on hyporheic conditions in trout redds: reason for concern?. Marine and Freshwater Research 59, 1028–1033.

BioAnalysts, Inc. 2003. Effects of powerhouse operations on intragravel flows and water quality within Chinook redds. Prepared for Public Utility District No.1 of Chelan County, Wenatchee, Washington.

Oldenburg, E. W., B. J. Goodman, G. A. McMichael, and R. B. Langshaw. 2012. Forms of production loss during the early life history of fall Chinook salmon. Battelle–Pacific Northwest Division Report prepared for Public Utility District No. 2 of Grant County, PNWD-4314, Richland, Washington.

APPENDIX A: CHINOOK SALMON AND STEELHEAD REDD COUNTS

2010 Chelan River Chinook Spawning Surveys				
DATE	**SECTION**	**NEW REDDS**	**OLD REDDS**	**TOTAL REDDS**
10/15/2010	Powerhouse Tailrace	3	0	3
10/21/2010	Powerhouse Tailrace	36	3	39
10/27/2010	Powerhouse Tailrace	111	39	150
11/3/2010	Powerhouse Tailrace	46	150	196
11/10/2010	Powerhouse Tailrace	27	196	223
11/17/2010	Powerhouse Tailrace	11	223	234
12/1/2010	Powerhouse Tailrace	0	234	234
10/15/2010	Columbia River Tailrace	0	0	0
10/21/2010	Columbia River Tailrace	13	0	13
10/27/2010	Columbia River Tailrace	11	13	24
11/3/2010	Columbia River Tailrace	17	24	41
11/10/2010	Columbia River Tailrace	7	41	48
11/17/2010	Columbia River Tailrace	1	48	49
12/1/2010	Columbia River Tailrace	0	49	49
10/15/2010	Pool	1	0	1
10/21/2010	Pool	1	1	2
10/27/2010	Pool	4	2	6
11/3/2010	Pool	1	6	7
11/10/2010	Pool	0	7	7
11/17/2010	Pool	0	7	7
12/1/2010	Pool	0	7	7
10/15/2010	Habitat Channel	6	0	6
10/21/2010	Habitat Channel	32	6	38
10/27/2010	Habitat Channel	19	38	57
11/3/2010	Habitat Channel	38	57	95
11/10/2010	Habitat Channel	11	95	106
11/17/2010	Habitat Channel	2	106	108
12/1/2010	Habitat Channel	0	108	108
Grand Total for Season				*398*

2011 Chelan River Chinook Spawning Surveys

DATE	SECTION	NEW REDDS	OLD REDDS	TOTAL REDDS
10/13/2011	Powerhouse Tailrace	5	0	5
10/20/2011	Powerhouse Tailrace	52	5	57
10/26/2011	Powerhouse Tailrace	58	57	115
11/2/2011	Powerhouse Tailrace	15	115	130
11/9/2011	Powerhouse Tailrace	29	130	159
11/16/2011	Powerhouse Tailrace	31	159	190
11/28/2011	Powerhouse Tailrace	2	190	192
10/13/2011	Columbia River Tailrace	3	0	3
10/20/2011	Columbia River Tailrace	16	3	19
10/26/2011	Columbia River Tailrace	13	19	32
11/2/2011	Columbia River Tailrace	7	32	39
11/9/2011	Columbia River Tailrace	5	39	44
11/16/2011	Columbia River Tailrace	4	44	48
11/28/2011	Columbia River Tailrace	0	48	48
10/13/2011	Pool	5	0	5
10/20/2011	Pool	16	5	21
10/26/2011	Pool	5	21	26
11/2/2011	Pool	1	26	27
11/9/2011	Pool	1	27	28
11/16/2011	Pool	0	28	28
11/28/2011	Pool	0	28	28
10/13/2011	Habitat Channel	6	0	6
10/20/2011	Habitat Channel	38	6	44
10/26/2011	Habitat Channel	48	44	92
11/2/2011	Habitat Channel	38	92	130
11/9/2011	Habitat Channel	8	130	138
11/16/2011	Habitat Channel	7	138	145
11/28/2011	Habitat Channel	0	145	145
Grand Total for Season				*413*

2012 Chelan River Chinook Spawning Surveys				
DATE	SECTION	NEW REDDS	OLD REDDS	TOTAL REDDS
10/8/2012	Powerhouse Tailrace	0	0	0
10/11/2012	Powerhouse Tailrace	3	0	3
10/17/2012	Powerhouse Tailrace	83	3	86
10/25/2012	Powerhouse Tailrace	89	86	175
10/31/2012	Powerhouse Tailrace	11	175	186
11/7/2012	Powerhouse Tailrace	35	186	221
11/13/2012	Powerhouse Tailrace	1	221	222
11/16/2012	Powerhouse Tailrace	6	222	228
12/4/2012	Powerhouse Tailrace	3	228	231
10/8/2012	Columbia River Tailrace	0	0	0
10/11/2012	Columbia River Tailrace	0	0	0
10/17/2012	Columbia River Tailrace	14	0	14
10/25/2012	Columbia River Tailrace	26	14	40
10/31/2012	Columbia River Tailrace	9	40	49
11/7/2012	Columbia River Tailrace	6	49	55
11/13/2012	Columbia River Tailrace	1	55	56
11/16/2012	Columbia River Tailrace	0	56	56
12/4/2012	Columbia River Tailrace	0	56	56
10/8/2012	Pool	5	0	5
10/11/2012	Pool	2	5	7
10/17/2012	Pool	2	7	9
10/25/2012	Pool	7	9	16
10/31/2012	Pool	2	16	18
11/7/2012	Pool	0	18	18
11/13/2012	Pool	0	18	18
11/16/2012	Pool	1	18	19
12/4/2012	Pool	0	19	19
10/8/2012	Habitat Channel	1	0	1
10/11/2012	Habitat Channel	5	1	6
10/17/2012	Habitat Channel	22	6	28
10/25/2012	Habitat Channel	68	28	96
10/31/2012	Habitat Channel	13	96	109
11/7/2012	Habitat Channel	6	109	115
11/13/2012	Habitat Channel	2	115	117
11/16/2012	Habitat Channel	3	117	120
12/4/2012	Habitat Channel	0	120	120
Grand Total for Season				*426*

2011 Chelan River Steelhead Spawning Surveys			
Date	*New Redds*	*Total Redds*	*Sections*
16-Mar	0	0	
25-Mar	0	0	
1-Apr	5	5	2,4
6-Apr	1	6	2
14-Apr	2	8	2,TR
22-Apr	8	16	2,3,6,Pool- lower end
3-May	4	20	3,5,6
10-May	0	20	
18-May	0	20	
24-May	0	20	
1-Jun	1	21	Pool- lower end
High Spill - no more surveys			

2012 Chelan River Steelhead Spawning Surveys			
Date	*New Redds*	*Total Redds*	*Sections*
29-Mar	2	2	2,3
6-Apr	2	4	6
13-Apr	1	5	3
17-Apr	1	6	Pool – upper end
25-Apr	0	6	
3-May	0	6	
8-May	0	6	
16-May	1	7	2
High Spill - no more surveys			

APPENDIX B: SNORKEL SURVEY DATA FOR THE CHELAN RIVER

Chelan River Habitat Channel Snorkel Fish Survey

5/20/2010 Flow/Temperature in Channel - 200 cfs/14.0 C Flow/Temperature in Tailrace (powerhouse) - 0 cfs/14.7 C

Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	0	0	0	75		2	0		0	20	0	0	0	0	0	0
Habitat Channel	0	0	0	0	0	0	0	3945	105	0	255		9	6		4	0	0	0	0	0	0	0
Pool	0	0	0	0	0	0	0	845	0	0	69		11	0		1	0	0	0	0	0	0	0
Total	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***4790***	***105***	***0***	***399***		***22***	***6***		***5***	***20***	***0***	***0***	***0***	***0***	***0***	***0***

3/29/2012 Flow/Temperature in Channel - 338 cfs/7.5 C Flow/Temperature in Tailrace (powerhouse) - 800 cfs/7.5 C

Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	5	0	1	0	0	0	0	0	0	8		1	0		0	0	0	0	0	0	0	0
Habitat Channel	0	0	0	1	0	0	2	0	0	0	0		2	0		0	0	0	0	0	0	0	0
Total	***0***	***5***	***0***	***2***	***0***	***0***	***2***	***0***	***0***	***0***	***8***		***3***	***0***		***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***

4/17/2012 Flow/Temperature in Channel - 342 cfs/10.5 C Flow /Temperature in Tailrace (powerhouse) - 800 cfs/11.2 C

Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	0	0	0	0		9	0		0	0	0	0	0	0	0	0
Habitat Channel	0	3	0	2		1	0	0	0	0	49		2	0		3	0	0	0	0		0	
Pool	0	0	0	0	0	0	0	8	0	0	35		3	0		3	0	0	0	0		0	
Total	***0***	***3***	***0***	***2***	***0***	***1***	***0***	***8***	***0***	***0***	***84***		***14***	***0***		***6***	***0***	***0***	***0***	***0***	***0***	***0***	***0***

5/16/2012 Flow/Temperature in Channel - 393 cfs/17.3 C Flow/Temperature in Tailrace (powerhouse) - 2230 cfs/16.8 C

Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	2660	10	0	14	0	3	0		4	0	0	3	75	0	0	0
Habitat Channel				6 (12", Tripl)			7	1962	350		644		22			6		1	0	1	4	4	4
Pool	0	0	0	3	0	0	0	0	0	0	680	0	10	0		6	0	0	0	0	0	0	0
Total	***0***	***0***	***0***	***9***	***0***	***0***	***7***	***4622***	***360***	***0***	***1338***	***0***	***35***	***0***		***16***	***0***	***1***	***3***	***76***	***4***	***4***	***4***

6/20/2012 Flow/Temperature in Channel - 3261 cfs/16.8 C Flow/Temperature in Tailrace (powerhouse) - 2300 cfs/16.6 C

Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	239	46	0	24		20	0		11	0	3	2	40	0	25	400
Habitat Channel	0	0	0	0	0	0	0	0	0	0	0		7	0		55	0	0	0	0	0	0	0
Total	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***239***	***46***	***0***	***24***		***27***	***0***		***66***	***0***	***3***	***2***	***40***	***0***	***25***	***400***

8/24/2012 Flow/Temperature in Channel - 83 cfs/19.7 C Flow/Temperature in Tailrace (powerhouse) - 2410 cfs/21.7 C

Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	1	0	0	0	0	0	0	0	0	0	1	111	23	0	1005	0	0	0	1 (20")	0	0	0	0
Habitat Channel	1	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
Pool	1	0	0	3 (18")	0	0	0	0	0	0	16	0	6	0	0	0	0	0	0	0	0	0	0
Total	***3***	***0***	***0***	***3***	***0***	***0***	***0***	***0***	***0***	***0***	***21***	***111***	***29***	***0***	***1005***	***0***	***0***	***0***	***1***	***0***	***0***	***0***	***0***

9/12/2012 Flow/Temperature in Channel - 84 cfs/16.9 C Flow/Temperature in Tailrace (powerhouse) - 2420 cfs/18.8 C

Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Habitat Channel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pool	0	0	0	1 (12"-15")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	***0***	***0***	***0***	***1***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***

11/15/2012 Flow/Temperature in Channel - 338 cfs/10.8 C Flow/Temperature in Tailrace (powerhouse) - 2460 cfs/11.5 C

Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >6	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
Habitat Channel	36	0	3	10 (8"-14")	0	6 (12"-18")	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0
Pool	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	***36***	***0***	***3***	***10***	***0***	***6***	***0***	***0***	***0***	***0***	***25***	***1***	***0***	***1***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***

Chelan River Reach 1-3 Snorkel Fish Survey

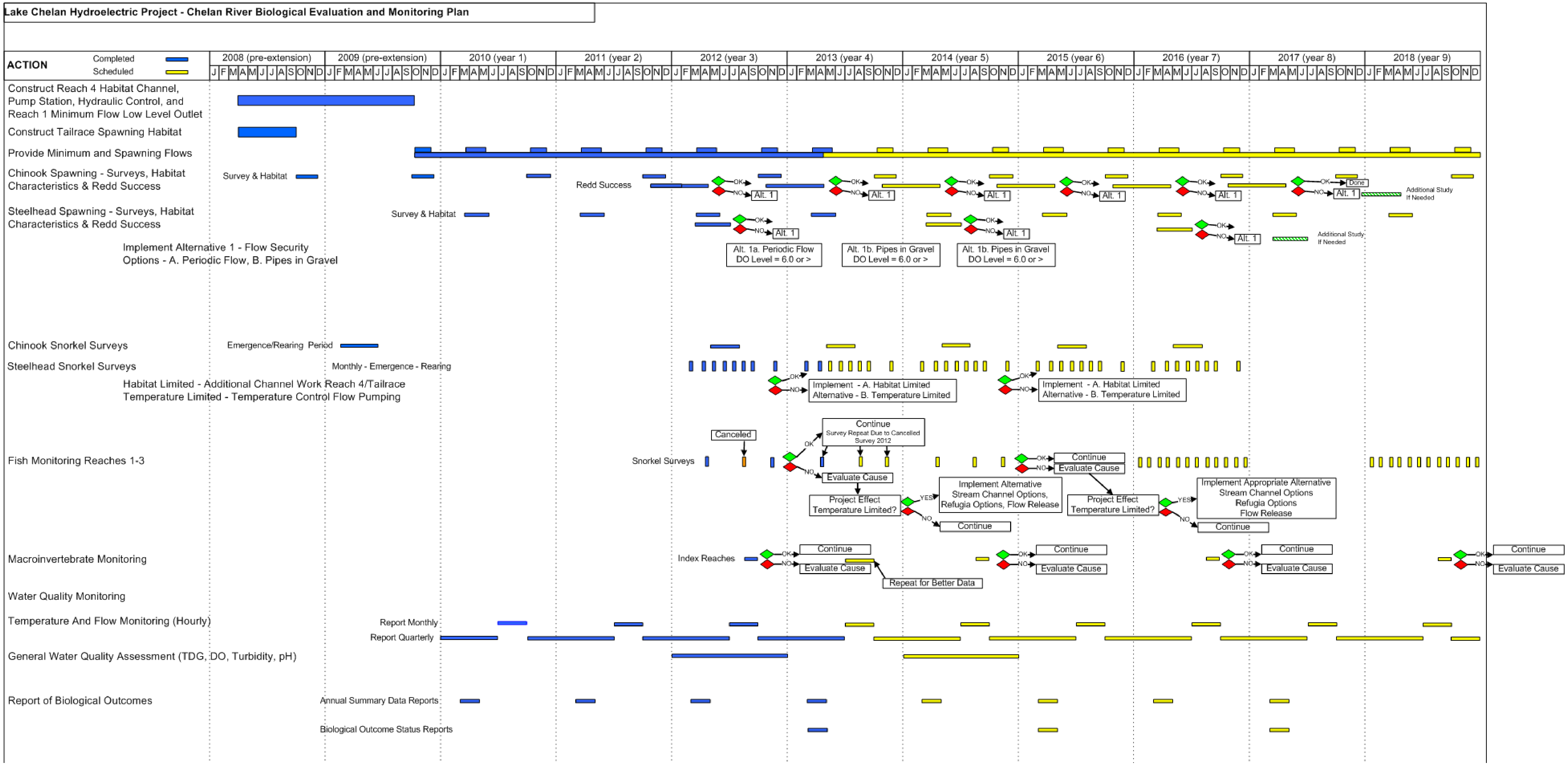
3/20/2012 Flow/Temperature in River - 83 cfs/6.5 C

Stream Section	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth	Shiner	Pikeminnow <6"	Pikeminnow	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Reach 1	0	0	0	7	0	0	0	0	0	0	1		0	0		0	0	0	0	0	0	0	0
Reach 2	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0	0	0	0	0
Reach 3	1	0	0	5	8	0	0	0	0	0	0		1	0		0	0	0	0	0	0	0	0
Total	***1***	***0***	***0***	***12***	***8***	***0***	***0***	***0***	***0***	***0***	***1***		***1***	***0***		***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***

11/13/2012 Flow/Temperature in River - 84 cfs/10.9 C

	Adult Chinook	Adult Steelhead	Adult Coho	Rainbow	Cutthroat	Bull Trout	Whitefish	Chinook Fry	Coho Fry	Rainbow Fry/Parr	Sucker	Smallmouth <6"	Smallmouth >6"	Shiner	Pikeminnow <6"	Pikeminnow >	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Reach 1	0	0	0	12 (10"-15")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reach 2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Reach 3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Total	***0***	***0***	***0***	***12***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***

APPENDIX C: CHELAN RIVER MONITORING AND EVALUATION SCHEDULE


Lake Chelan Hydroelectric Project - Chelan River Biological Evaluation and Monitoring Plan
ACTION
Completed
Scheduled
2008 (pre-extension)
2009 (pre-extension)
2010 (year 1)
2011 (year 2)
2012 (year 3)
2013 (year 4)
2014 (year 5)
2015 (year 6)
2016 (year 7)
2017 (year 8)
2018 (year 9)
J F M A M J J A S O N D
Construct Reach 4 Habitat Channel, Pump Station, Hydraulic Control, and Reach 1 Minimum Flow Low Level Outlet
Construct Tailrace Spawning Habitat
Provide Minimum and Spawning Flows
Chinook Spawning - Surveys, Habitat Characteristics & Redd Success
Survey & Habitat
Redd Success
OK
NO
Alt. 1
Done
Additional Study If Needed
Steelhead Spawning - Surveys, Habitat Characteristics & Redd Success
Survey & Habitat
Implement Alternative 1 - Flow Security Options - A. Periodic Flow, B. Pipes in Gravel
Alt. 1a. Periodic Flow DO Level = 6.0 or >
Alt. 1b. Pipes in Gravel DO Level = 6.0 or >
Alt. 1b. Pipes in Gravel DO Level = 6.0 or >
Chinook Snorkel Surveys
Emergence/Rearing Period
Steelhead Snorkel Surveys
Monthly - Emergence - Rearing
Habitat Limited - Additional Channel Work Reach 4/Tailrace
Temperature Limited - Temperature Control Flow Pumping
Implement - A. Habitat Limited Alternative - B. Temperature Limited
Implement - A. Habitat Limited Alternative - B. Temperature Limited
Fish Monitoring Reaches 1-3
Snorkel Surveys
Canceled
Continue
Survey Repeat Due to Cancelled Survey 2012
Evaluate Cause
Project Effect Temperature Limited?
YES
Implement Alternative Stream Channel Options, Refugia Options, Flow Release
Implement Appropriate Alternative Stream Channel Options Refugia Options Flow Release
Macroinvertebrate Monitoring
Index Reaches
Repeat for Better Data
Water Quality Monitoring
Temperature And Flow Monitoring (Hourly)
Report Monthly
Report Quarterly
General Water Quality Assessment (TDG, DO, Turbidity, pH)
Report of Biological Outcomes
Annual Summary Data Reports
Biological Outcome Status Reports

APPENDIX D: CONSULTATION RECORD

Chelan PUD provided a draft of the 2013 Chelan River Biological Objectives Status Report to Ecology and members of the CRFF in accordance with the requirements of the May 19, 2010, FERC Order granted a time extension, which set the date for the first report to be due April 30, 2013. The draft was sent out for review, as described in an email notification dated February 6, 2013 (see below).

The following individuals were sent draft copies for review:

NAME	***AGENCY***
Irle, Pat	Washington State Department of Ecology
McKinney, Charlie	Washington State Department of Ecology
Caldwell, Brad	Washington State Department of Ecology
Pacheco, Jim	Washington State Department of Ecology
Korth, Jeffrey	Washington State Department of Fish and Wildlife
Simon, Graham	Washington State Department of Fish and Wildlife
Maitland, Travis	Washington State Department of Fish and Wildlife
McCoy, Gina	Washington State Department of Fish and Wildlife
Willard, Catherine	United States Department of Agriculture – Forest Service
Martinez, Alex	United States Department of Agriculture – Forest Service
Glesne, Reed	National Park Service
Lewis, Steve	United States Fish and Wildlife Service
Domingue, Rich	National Marine Fisheries Services
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
Goedde, Robert	City of Chelan
Archibald, Phil	Lake Chelan Sportsman Association

Commenting Agency	Agency Comment	Chelan PUD Response
CRFF 4/3/13 Review Meeting	Table 1-1. Change verbiage from "Will achieve" to "Expect to achieve"; add space or dash between "Achieved" and "2 acres…:" for Chinook and steelhead spawning habitat categories.	These changes were made in revised Table 1-1.
CRFF 4/3/13	Section 2.2: Add discussion describing that small gravel is a limiting factor for steelhead spawning and there appears to be a limited supply of smaller gravels in the Habitat Channel. Mentioning it in Section 2.2, but have the full discussion in Section 5.4, which would be a location that is more appropriate.	A statement regarding the limited amount of small gravel in the habitat channel was added to Section 2.2. A discussion of this topic was added to Section 5.4.
CRFF 4/3/13	Section 2.3: Condense discussion in this document since a separate detailed report will be produced on tailrace redd dissolved oxygen studies and egg-fry survival.	Description of tests was condensed by removing unnecessary detail.
CRFF 4/3/13	Page 9: Add table of Chelan powerhouse operations and changes in dissolved oxygen. Add labels (mg/L, Flow) to axes in Figure 2-1.	The table of powerhouse operations was added, but there was no concise way to include dissolved oxygen data in the table. The axis labels were added to figure 2-2.
CRFF 4/3/13	Page 10: Add summary of next steps and reference new study plan for intra-gravel DO investigation that will be developed for 2013-14.	A statement was added regarding further study to refine powerhouse operations and confirm objectives are achieved.
CRFF 4/3/13	Section 2.5: Add 100 eggs per cylindrical egg tube (CET) in text.	The 100 eggs per CET was added to the title of each table.
CRFF 4/3/13	Table 2-3: Add 2012-2013 data.	A second table and discussion of 2012-13 results was added
CRFF 4/3/13	Section 3: Add link to this years' snorkel survey data.	This link was added.
CRFF 4/3/13	Section 5.3: Include before and after photos of Habitat Channel and riparian vegetation. Reach 1, too? Add link to photos?	A suite of photos will be added to the Chelan PUD web site and a link has been provided in this report.
CRFF 4/3/13 Ecology	Section 2.1. Add graph showing Chinook redd count per year with arrows indicating year in which gravel was added to tailrace and year that habitat channel was completed.	A Figure was added with text boxes denoting year in which each of these habitat expansions was created.
CRFF 4/3/13 Ecology	Add a sentence that Wells stock Chinook use deep spawning habitat	This statement was added at the conclusion of Section 2.1.
CRFF 4/3/13 Ecology	Include temperature data in report in section 5.1. Insert graph for comparison of actual temperature daily maximum versus numeric standard. Use one station below the dam and one in Reach 4. Include cutthroat temperature tolerance reference from literature.	Five graphs of temperature data were added to Section 5.1. A general statement regarding reported literature values for the UUILT for westslope cutthroat trout was added to the discussion.
CRFF 4/3/13 Ecology	Provide better description in text of why we expect to achieve Biological Objectives in table 1.1.	Discussion of reason why achievement of biological objectives is expected was added to the discussions at various sections.

Commenting Agency	Agency Comment	Chelan PUD Response
CRFF 4/3/13 Ecology	Add in report that we may want to test altering spawning flows – reduce pumped flow for steelhead spawning.	A discussion of a potential to test lower flow in 2014 was added to the end of Section 2.2.
CRFF 4/3/13 Ecology	Include updated Monitoring and Evaluation foldout diagram from Chapter 7 in an Appendix.	This diagram was added to the report as Appendix C
CRFF 4/3/13 WDFW	Mention spawning survey frequency (1 per week). Describe methods. Add the weekly survey data to the appendix.	The survey methods were added to the text and individual survey data to the appendices.
Email 4/5/13 Ecology	Add a 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)	Four graphs of the 7-DADMax water temperatures from May through October, for 2010 – 2012, were added for these locations and also the end of Reach 1.
Email 4/17/13 USFWS	Add a section "Next Steps," which should entail a close look at addressing the width-depth ratio, lack of habitat complexity, and cover in Reach 1-3. Ecology, WDFW and USFS endorsed this comment.	Section 5.5 – Next steps for Reaches 1-3 was added to the report
Email 4/23/13 USFS	Figure 1-1. Statements below cutthroat trout, Chinook salmon and steelhead are unclear.	The figure is for illustrative purposes showing the extent of the Chelan River and location of key species with biological objectives. It would be difficult to elaborate on the specific indicators without cluttering the figure with too much detail.
Email 4/23/13 USFS	Table 1-1. Add column to table to include limiting factors that are still present, for example: Chinook salmon habitat quality, location, status, dissolved oxygen, proposed actions to address limiting factors, etc.	Adding a column to the table to convey this level of additional information would make the table too large to be easily viewed. These points are being addressed in the text (see reponse to CRFF 4/3/13 – Ecology regarding similar comment Table 1-1.
Email 4/23/13 USFS	Several small editorial changes and comments provided in tracked changes in MSWORD document.	The edits were incorporated and comments addressed in the final report.

Bitterman, Deborah

From: Smith, Michelle
Sent: Tuesday, February 26, 2013 12:43 PM
To: 'Alex Martinez (ramartinez@fs.fed.us)'; 'Bob Rose (rosb@yakamafish-nsn.gov)'; 'Brad Caldwell (brca461@ecy.wa.gov)'; 'Carl Merkle (carlmerkle@ctuir.com)'; 'Gina McCoy (Gina.McCoy@dfw.wa.gov)'; 'Jim Pacheco (jpac461@ecy.wa.gov)'; 'Justin Yeager (Justin.Yeager@noaa.gov)'; 'Korth, Jeffrey '; 'Maitland Travis (travis.maitland@dfw.wa.gov)'; 'McKinney Charlie (cmck461@ECY.WA.GOV)'; 'Pat Irle'; 'Phil Archibald (kim.l.lohse@gmail.com)'; 'Reed Glesne (Reed_Glesne@nps.gov)'; 'Robert Goedde (bgoedde@cityofchelan.us)'; 'Simon Graham (graham.simon@dfw.wa.gov)'; 'Steve Lewis (Stephen_Lewis@fws.gov)'; 'Willard Catherine (cwillard@fs.fed.us)'
Cc: Hays, Steve; Osborn, Jeff; Miller, Joseph; Truscott, Keith; Bitterman, Deborah; Sokolowski, Rosana
Subject: Chelan River Fishery Forum: draft and final Biological Objectives Status Report schedule

Dear Chelan River Fishery Forum,

FYI -- We expect to have the (Draft) Biological Objectives Status Report emailed to you for review on March 15. Recall that these reports are due in years 4, 6, 8, and 10 from the date of initiation of the Chelan River minimum flow and Reach 4 habitat enhancements (which was Oct 2009). I've included the language from our 401 Certification below. Our required date for providing the Draft for Ecology and forum review is February 28. However, with current work loads, finalizing data analysis and completing internal review is taking a bit longer than anticipated. We apologize for this delay. The Final report is due to Ecology, CRFF, and the FERC by April 30. This provides approximately 45 days to review, discuss, and make changes. To help facilitate this review, we would like to propose a CRFF meeting/conf call for mid-to-late March to discuss the Draft report. Jeff Osborn will be notifying you soon to organize this meeting.

Regards,

Michelle

Michelle Smith
License and Compliance Manager
Chelan County Public Utility District
Wenatchee, WA
509-661-4180

401 Water Quality Certification:

IV. E. Biological Objectives Status Reports: By no later than April 30, in each of years 4, 6, 8, and 10 following the effective date of the license, Chelan PUD shall provide to Ecology and other members of the CRFF a final Biological Objectives Status Report that (1) summarizes the results of monitoring and evaluation program, and evaluates the need for modification of the program, (2) describes the degree to which the biological objectives have been achieved, and the prospects for achieving those objectives in the next reporting period, (3) reviews management options taken to meet those biological objectives, and (4) recommends any new or modified restoration and/or monitoring and evaluation measures that are needed to meet, to the extent practicable, the biological objectives. Such recommendations shall contain a schedule for timely implementation. No later than February 28 of each year, Chelan PUD shall provide a draft of such final report to the CRFF and consult with its members prior to issuing the final report. If a CRFF member is not in agreement with the draft report or recommendations and has an alternative evaluation or recommendation, Chelan PUD shall include a discussion of that alternative or recommendation in the final report.