

PUBLIC UTILITY DISTRICT NO. 1 *of* CHELAN COUNTY
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April 29, 2015

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) – 2015 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]

On September 2, 2010, the Commission issued the "*Order Revising Quality Assurance Project Plan Filing Schedule under Article 401 and Water Quality Certification Condition V.B,*"[4] ordering paragraph (C), requiring that Chelan PUD shall include its revised Quality Assurance Project Plan for its Chelan River Water Temperature Modeling Study with the submittal of the 2015 Final Biological Objectives Status Report. In addition, the Commission issued the "*Order Approving Chelan River Water Temperature Modeling Study Quality Assurance Project Plan*"[5]

[1] 121 FERC ¶ 62,143 (2007)
[2] 117 FERC ¶ 62,129 (2006)
[3] 131 FERC ¶ 62,151 (2010)
[4] 132 FERC ¶ 62,147 (2010)
[5] 148 FERC ¶ 62,177 (2014)

on September 4, 2014, footnote 5, reiterating this same filing date. Chelan PUD will concurrently file this revised plan as a separate document.

Chelan PUD hereby files the 2015 Final Biological Objectives Status Report. On March 16, 2015, a final draft of this report was provided to the resource agencies, Tribes and non-governmental organizations specified for review. Please refer to Appendix C for the consultation documentation.

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

Sincerely,

Jeffrey G. Osborn
Compliance Program Supervisor
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cc: Erich Gaedeke, FERC Portland Regional Office
Chris Coffin, Washington Department of Ecology
Chelan River Fishery Forum

Enclosure: 2015 Final Biological Objectives Status Report

CHELAN RIVER BIOLOGICAL OBJECTIVES 2015 STATUS REPORT

LICENSE ARTICLE 408

Final Report

LAKE CHELAN HYDROELECTRIC PROJECT
FERC Project No. 637

April 29, 2015

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

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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. This second Biological Objectives Status is due April 30, 2015.

The purpose of this 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.

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 three sections that pertain to specific biological objectives described in the CRBEIP: (1) biological objectives for Chinook salmon; (2) biological objectives for steelhead trout; and (3) biological objectives for cutthroat trout. There are specific measurement objectives for Chinook Salmon and steelhead trout in this report, including spawning survey counts, distribution of redds, intragravel dissolved oxygen levels, egg to fry emergence survival rates and presence of rearing juveniles. The measurement objective for cutthroat trout is the presence of 200 fish at various age classes.

Table 1-1. Criteria for achievement of biological objectives in the Chelan River.

Fish Species and Use	Biological Objective	Measured Parameters	Evaluation Timeframe	Actions if Biological Objective Achieved	Actions if Biological Objective Not Achieved
Chinook Spawning Habitat Reach 4 and Tailrace	Areas developed to support spawning meet design habitat characteristics (depth, velocity, and substrate) at the design flow (as-built functionality)	Field measurement to confirm achievement of physical parameters. The presence and success of spawning fish will also be considered in the determination of achievement.	Years 1 – 10, as needed to set flows or further modify channel	Must be met	Must be met
Chinook Spawning Habitat Use Reach 4 and Tailrace	Distribution of spawning use should reflect distribution of constructed spawning habitat	Spawning use, numbers, distribution and habitat characteristics of selected redds. Qualitative judgment	Years 1 – 10, as needed to set flows	Maintain Actions. No additional actions needed	Determine if Project effect. Continue until all feasible and reasonable habitat measures to achieve this objective are implemented. When no further feasible and reasonable actions exist, CRFF will recommend whether or not Chelan PUD should continue measures implemented

Fish Species and Use	Biological Objective	Measured Parameters	Evaluation Timeframe	Actions if Biological Objective Achieved	Actions if Biological Objective Not Achieved
Chinook Spawning Habitat Quality, Reach 4/Tailrace, Conditions suitable for survival from egg to emergence	Intragravel Dissolved Oxygen ≥ 6.0 mg/l	During all scheduled (non-emergency) powerhouse shutdowns, tailrace intragravel DO monitored hourly. During egg incubation, tailrace and Reach 4 intragravel DO monitored each week hourly for at least one 24-hour period	Years 1-5. Extend if additional measures needed or as recommended by CRFF	Must be met unless determined not a Project effect	Must be met unless determined not a Project effect
Chinook Spawning Success, Reach 4/Tailrace, Conditions suitable for survival from egg to emergence	Egg to emergence success equal to > 80% of Methow River average or 70% survival, whichever is less	At least 10% of redds capped and studied for egg to emergence success or other method recommended by CRFF	Years 1-5	Maintain Actions. No additional actions needed	Determine if Project effect. Continue until all feasible and reasonable habitat measures to achieve this objective are implemented. When no further feasible and reasonable actions exist, CRFF will recommend whether or not Chelan PUD should continue measures implemented

Fish Species and Use	Biological Objective	Measured Parameters	Evaluation Timeframe	Actions if Biological Objective Achieved	Actions if Biological Objective Not Achieved
Chinook Juvenile Rearing Habitat Use, Reach 4/Tailrace	Presence and use of available habitat	Snorkel surveys from emergence until fish move into Columbia River (emergence – June). Qualitative judgment	Years 1-5. Extend for next 5 years if fry use is low	Maintain Actions. No additional actions needed	Determine if Project effect. Continue until all feasible and reasonable habitat measures to achieve this objective are implemented. When no further feasible and reasonable actions exist, CRFF will recommend whether or not Chelan PUD should continue measures implemented
Chinook Adult Use of Habitat, Reach 4/Tailrace	Adult production of fish produced in Chelan River	Ratio of Chelan River origin/other origin adult carcasses in spawning population	Years 1-10	Maintain Actions. No additional actions needed	Continue until all feasible and reasonable habitat measures to achieve the objectives identified in 7-10 are implemented. When no further feasible actions exist and objectives not attained or the goal not achieved,the CRFF will recommend whether or not Chelan PUD should continue measures implemented

Fish Species and Use	Biological Objective	Measured Parameters	Evaluation Timeframe	Actions if Biological Objective Achieved	Actions if Biological Objective Not Achieved
Steelhead Spawning Habitat Reach 4 and Tailrace	Areas developed to support spawning meet design habitat characteristics (depth, velocity, and substrate) at the design flow (as-built functionality)	Field measurement to confirm achievement of physical parameters. The presence and success of spawning fish will also be considered in the determination of achievement.	Years 1 – 10	Must be met	Must be met
Steelhead Spawning Habitat Use Reach 4 and Tailrace	Distribution of spawning use should reflect distribution of constructed spawning habitat	Spawning use, numbers, distribution and habitat characteristics of selected redds. Qualitative judgment. Spawning surveys years 1-2 biweekly, weekly years 3-10, March – May or as needed to set flows	Years 1 – 10, extend if additional measures needed	Maintain Actions. No additional actions needed	Determine if Project effect. Continue until all feasible and reasonable habitat measures are implemented. If can't reach use objective, maintain habitat achieved
Steelhead Spawning Habitat Quality, Reach 4/Tailrace, Conditions suitable for survival from egg to emergence	Intragravel Dissolved Oxygen ≥ 6.0 mg/l	During all scheduled (non-emergency) powerhouse shutdowns, tailrace intragravel DO monitored hourly. During egg incubation, tailrace and Reach 4 intragravel DO monitored each week hourly for at least one 24-hour period	Years 1-5. Extend if additional measures needed or as recommended by CRFF	Must be met unless determined not a Project effect	Must be met unless determined not a Project effect
Steelhead Spawning Success, Reach 4/Tailrace, Conditions suitable for survival from egg to emergence	Egg to emergence success equal to > 80% of Methow River average or 70% survival, whichever is larger	At least 10% of redds capped and studied for egg to emergence success or other method recommended by CRFF	Years 1-5	Maintain Actions. No additional actions needed	Determine if Project effect. Continue until all feasible and reasonable habitat measures are implemented. If can't reach use objective, maintain best habitat achieved

Fish Species and Use	Biological Objective	Measured Parameters	Evaluation Timeframe	Actions if Biological Objective Achieved	Actions if Biological Objective Not Achieved
Steelhead Juvenile Rearing Habitat Use, Reach 4/Tailrace	Fry presence and use of available habitat	Snorkel surveys from emergence until fish move into Columbia River. 8 times per year, only when redds observed in area. Qualitative judgment	Years 3-10	Maintain Actions. No additional actions needed	Determine if Project effect. Continue until all feasible and reasonable habitat are implemented. When no further feasible actions exist and objectives not attained or the goal not achieved, the CRFF will recommend whether or not Chelan PUD should continue measures implemented.
Steelhead Outmigrant success	Adult production of fish produced in Chelan River – net benefit to ESU	Best professional judgment of CRFF and/or new technology showing adult origin	Years 5-10	Maintain Actions. No additional actions needed	Continue until all feasible and reasonable habitat measures to achieve the objectives identified in 7-10 are implemented. When no further feasible actions exist and objectives not attained or the goal not achieved,the CRFF will recommend whether or not Chelan PUD should continue measures implemented

Fish Species and Use	Biological Objective	Measured Parameters	Evaluation Timeframe	Actions if Biological Objective Achieved	Actions if Biological Objective Not Achieved
Cutthroat Habitat, Reaches 1-3	Presence of 200 fish including various age classes. Habitat improvements for cutthroat, as related to water temperature may include: new, naturally evolved stream channel; riparian shade; thermal refugia/pumping studies; increased flows	Snorkeling surveys, number, distribution, age of resident fish. Cross-sectional and average stream temperature measurements. Flow measurements.	Years 1-5 will serve as establishment. If 200 fish not achieved in year 5, then either continue studies for: A-10 years beyond year 5 of New License to allow natural cutthroat colonization from Lake Chelan; or B-5 years beyond year 5 of New License if no natural colonization is evident and test sample of cutthroat is deemed necessary by CRFF	Maintain actions	Determine if Project effect. Continue until all feasible and reasonable habitat measures are implemented. When no further feasible actions exist and objectives not attained or the goal not achieved, the CRFF will recommend whether or not Chelan PUD should continue measures implemented.

Fish Species and Use	Biological Objective	Measured Parameters	Evaluation Timeframe	Actions if Biological Objective Achieved	Actions if Biological Objective Not Achieved
Cutthroat Create habitat to support a viable population of cutthroat trout in Reaches 1-3	200 resident fish	Number of fish via snorkeling surveys as specified in Table 7-10	Years 5-10	Maintain Actions. No additional actions needed	Continue until all feasible and reasonable habitat measures to achieve the objectives identified in 7-10 are implemented. When no further feasible actions exist and objectives not attained or the goal not achieved, the CRFF will recommend whether or not Chelan PUD should continue measures implemented

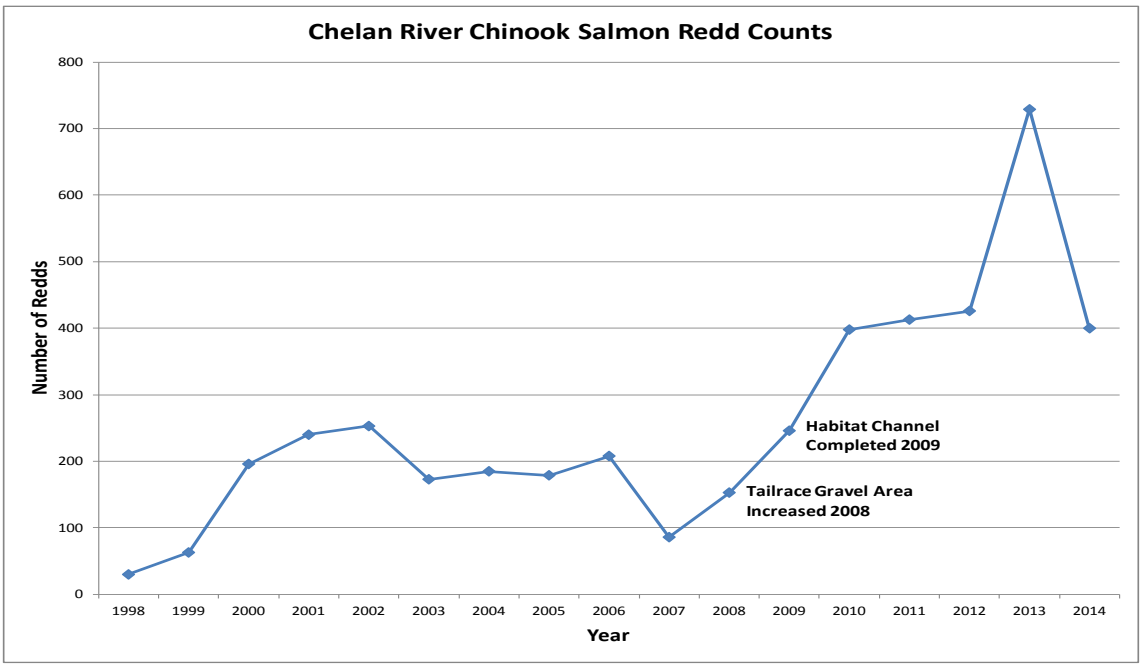
SECTION 2: BIOLOGICAL OBJECTIVES FOR CHINOOK SALMON

2.1 Spawning Habitat for Chinook Salmon Meets Design Characteristics

The CRBEIP states that "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, et al. 2014) 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 (Figure 2-1). The fish per redd (FPR) and escapement estimates in Table 2-1 are based on the male:female sex ratio of summer Chinook sampled at Wells Dam (Hillman, et al. 2014).

Figure 2-1. Chelan River Historical Redd Counts.



The tailrace spawning habitat was created in 2008, with fish use observed in that year. Additional Chinook and steelhead spawning habitat was created in 2009, with the habitat available for use by Chinook in that year. The design parameters (depth, cover, velocity, substrate) defined in the CRBEIP were successfully constructed according to 30%, 60%, 90% and final design plans that were reviewed and approved by the CRFF (Appendix A). Confirmation that suitable spawning habitat for Chinook was created in the tailrace and in Reach 4 did not require post-construction physical measurements because both areas of new habitat were immediately colonized by Chinook salmon in the first year following construction.

Table 2-1. Chelan River Chinook 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
2013	2.31	729	1684
2014	2.75	400	1100

2.2 Chinook Salmon Use of Spawning Habitat Throughout Constructed Habitat

The achievement of this biological objective has been documented through spawning survey redd counts, which show use by Chinook salmon has increased since the construction of this habitat. Since gravel placement in the tailrace and construction in Reach 4 of the Habitat Channel, the combined Chinook 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 400 in 2014, with a high count of 729 in 2013 (Table 2-1). Prior to 2008, the highest redd count was 253. Spawning has also been distributed throughout the available habitat created in the tailrace and in the Reach 4 Habitat Channel (Table 2-2), with all areas being used.

Table 2-2. Chelan River Chinook and Coho 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
2013	320	269	140	729
2014	246	78	76	400

2.2.1 Temporary Habitat Channel Flow Reduction and Chinook Salmon Spawning Habitat Availability

Flow provided in the Chelan River Habitat Channel for steelhead and Chinook salmon is a minimum of 320 cfs by a combination of spill and pumping, per the Chelan River Biological Evaluation and Implementation Plan (CRBEIP). Currently, 5 pumps are used to meet the minimum spawning flow requirement in the Habitat Channel. Due to the complexity and, according to PUD engineers, reduced reliability of variable speed pumps, the pump station was designed to provide 240 cfs at minimum tailwater elevations (maximum "lift" from intake screen to canal, which means minimum discharge per pump). This assures that the 320 cfs minimum flow would always be provided when the minimum instream flow from the lake matches the 80 cfs minimum flow from that source. However, at normal tailwater elevations, the 5 pumps actually discharge from 250-260 cfs (about 50-55 cfs each), and the total Habitat Channel flows during both the Chinook and steelhead spawning periods have been 340-350 cfs.

Washington Department of Ecology (Ecology), Washington Department of Fish and Wildlife (WDFW), and Chelan PUD staff have commented that water velocities being provided in the Habitat Channel currently, particularly for steelhead, may be too high, based on Habitat Suitability Index (HSI) measurements, flow observations in stream margin habitat and log structures during early rearing of Chinook salmon fry, and best professional judgment that the Habitat Channel “just looks better” at lower flows. A remedy for reducing flows in the Habitat Channel for Chinook salmon and steelhead spawning and Chinook salmon fry early rearing is to reduce the number of pumps operated during the March 15 through May 15 steelhead spawning period. Lower flows can be provided by reducing pump operations from 5 pumps to 4 pumps (200-208 cfs) and adjusting the Low level Outlet (LLO) output, if desired, to be greater than 80 cfs to provide a total flow in the Habitat Channel in the range of 280 cfs – 320 cfs.

A proposed temporary change in pumped flow operation, developed by the Chelan River Fishery Forum (CRFF), is a follows:

Proposal

1. Conduct a pump station reduced flow operation during the Chinook spawning period in 2013
2. Operate 4 pumps instead of 5 pumps from October 15 through November 30, 2013
3. Conduct Chinook salmon spawning ground surveys, as required by the Lake Chelan comprehensive Settlement Agreement (SA)
4. Compare Chinook salmon redd distribution in the Habitat Channel in 2013 to redd distribution from spawning ground survey redd mapping from 2009 through 2012
5. If Chinook salmon redd distribution in the Habitat Channel appears to be similar in 2013 to previous years, then conduct the same pump station operation (4 pumps versus 5) during the steelhead spawning period, March 15 through May 15, in 2014
6. If Chinook salmon redd distribution in the Habitat Channel appears to be significantly different in 2013 to previous years, then return to 5 pump operation for the steelhead spawning period in 2014.

Operation of 4 pumps, instead of 5 pumps, was implemented during the 2013 and 2014 Chinook salmon spawning periods (October 15-November 30) and 2014 steelhead spawning period (March 15-May 15). Results for the 2013 Chinook salmon and 2014 steelhead are reported in this report. Data from Chinook salmon 2014 are still being analyzed at the writing of this report and 2015 steelhead data have yet to be collected. These results will be reported in the next Biological Objectives Status Report.

Information displayed in Table 2-3 show comparison of Chinook salmon redd locations and proportions in the various subsections of the Chelan River Habitat Channel from 2009 through 2013. Five pumps were used to provide spawning flows in 2009 through 2012, and four pumps were used in 2013. Section 1 is the section immediately below the bottom-end riffle in the Habitat Channel, very close to the confluence with the Chelan tailrace, working upstream to Section 7 that is located immediately below the pump station canal discharge pool. The Pool section includes the pump station discharge pool and large pool upstream to the first rapids at the bottom end of the Chelan River Gorge.

Table 2-3. Comparison of Chelan River Habitat Channel Chinook Salmon Spawning Under 4 Pump versus 5 Pump Operation

	2013		2012		2011		2010		2009	
	4 pump operation		5 pump operation		5 pump operation		5 pump operation		5 pump operation	
	No. Redds	Prop.	No. Redds	Prop.	No. Redds	Prop.	No. Redds	Prop.	No. Redds	Prop.
Section 1	10	0.04	2	0.01	5	0.03	5	0.04	4	0.05
Section 2	67	0.25	48	0.35	54	0.30	38	0.33	22	0.28
Section 3	39	0.14	13	0.09	19	0.11	13	0.11	8	0.10
Section 4	55	0.20	19	0.14	25	0.14	25	0.22	14	0.18
Section 5	32	0.12	19	0.14	25	0.14	13	0.11	11	0.14
Section 6	24	0.09	19	0.14	22	0.12	14	0.12	13	0.16
Section 7	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Pool	42	0.16	19	0.14	28	0.16	7	0.06	7	0.09
Total	269	1.00	139	1.00	178	1.00	115	1.00	79	1.00

Information displayed in Table 2-4 highlight the sections of the Habit Channel ranked in order of proportion of redds constructed, which could be interpreted as preference, by Chinook salmon from 2009 through 2013. As stated previously, five pumps were used to provide spawning flows in 2009 through 2012, and 4 pumps were used in 2013.

Table 2-4. Comparison of Chelan River Habitat Channel Chinook Salmon Redd Distribution Under 4 Pump versus 5 Pump Operation

	2013	2012	2011	2010	2009
	4 pump operation	5 pump operation	5 pump operation	5 pump operation	5 pump operation
	Total redds = 269	Total redds = 139	Total redds = 178	Total redds = 115	Total redds = 79
Rank					
1	Section 2	Section 2	Section 2	Section 2	Section 2
2	Section 4	Section 4 (tie)	Section 4	Section 4	Section 4
3	Section 3	Section 5 (tie)	Section 5	Section 6	Section 6
4	Section 5	Section 6 (tie)	Section 6	Section 3/5 (tie)	Section 5

Degree of Achievement of Objective

This objective has been fully achieved. The Project is being operated to maintain the achievement of this objective by managing Lake Chelan spill levels to protect the Reach 4 Habitat Channel from damage due to high flows and to limit bed load accumulations in the tailrace spawning habitat at the Reach 4 confluence. In the summer of 2014, bed load accumulations of river cobble at the confluence of the Reach 4 high flow channel were excavated to reduce the potential of Chinook redd dewatering during low water conditions in the Columbia River. The river cobbles removed were suitable spawning gravel material and were stockpiled on the shoreline at the site for potential future use. Redd surveys in the fall of 2014 documented

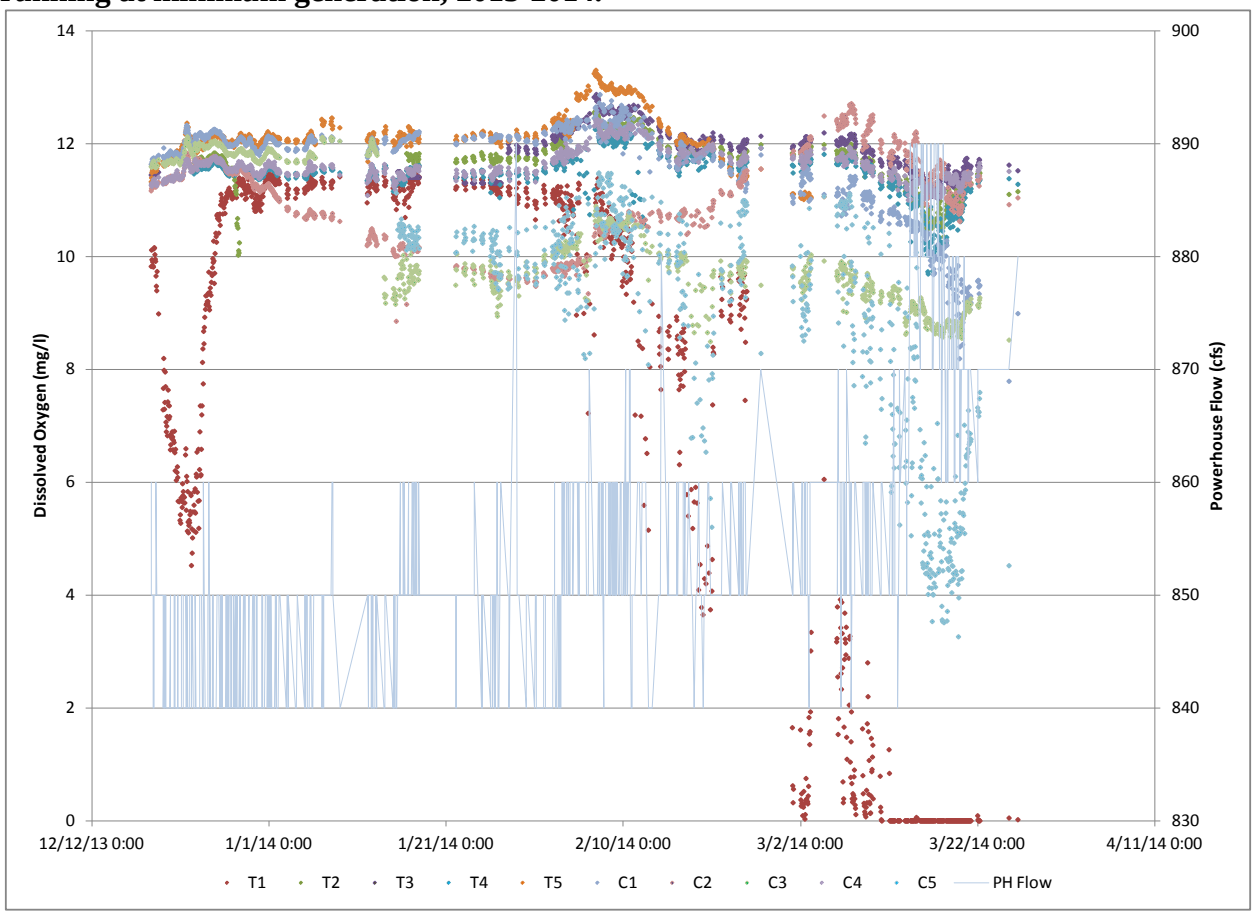
Chinook spawning use in the excavated area, demonstrating that the maintenance operation maintained the depth, velocity and substrate characteristics suitable for Chinook spawning.

2.3 Chinook Salmon Tailrace Intragravel Dissolved Oxygen ≥ 6.0 mg/l

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.

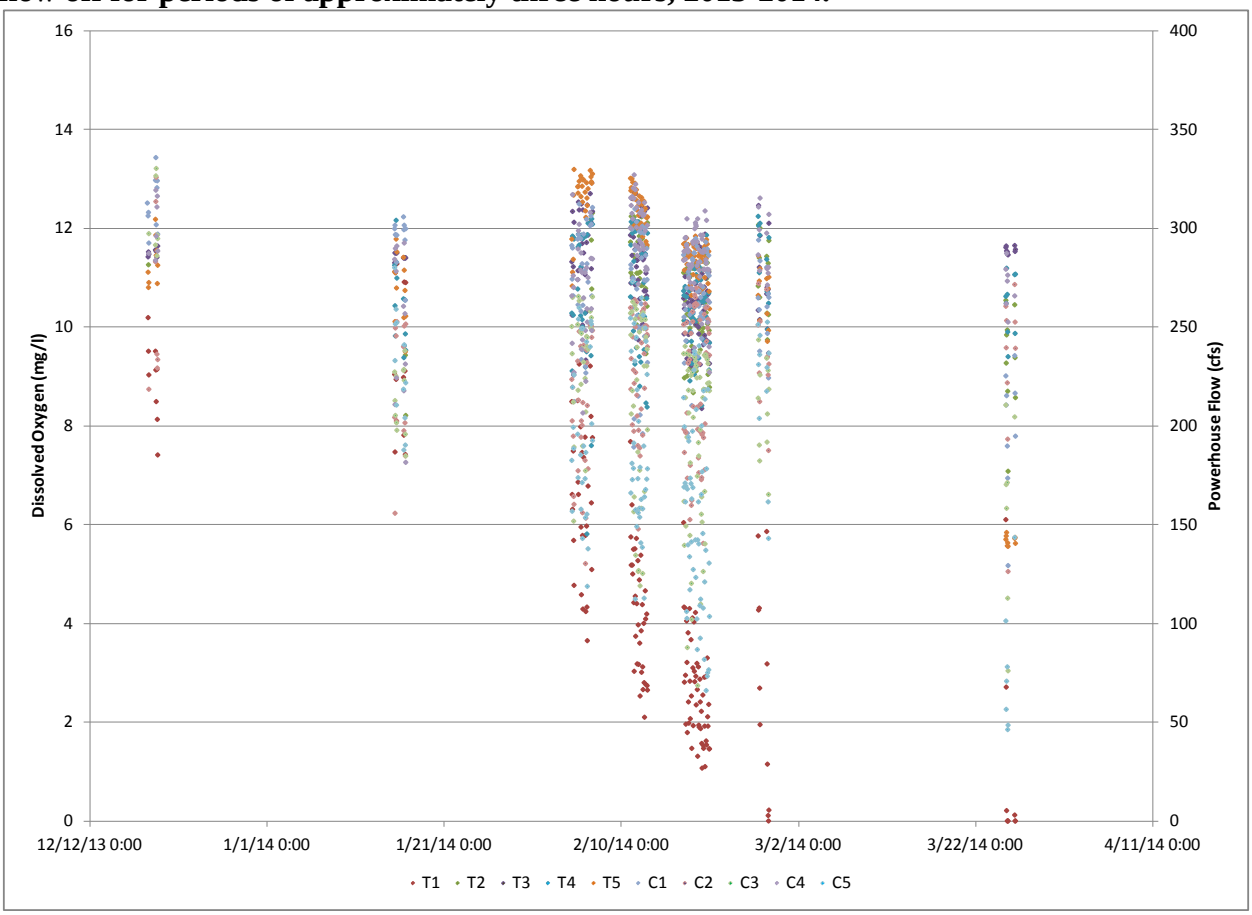
Studies to determine the level of powerhouse operation needed to meet IGDO requirements were initiated in the fall of 2011. Three years of study, with dissolved oxygen meters taking hourly IGDO readings in the egg pockets of 10 redds, tested different periods of powerhouse outages and powerhouse flow levels. These tests indicated that operation of the powerhouse with one turbine at minimum generation (approximately 850 cfs) generally maintains intragravel dissolved oxygen levels above 6.0 mg/l (Figure 2-2). There were two redds that did show lower IDGO levels during minimum generation (T1 and C5), however live fry were found at both locations when the IGDO sensors were removed in late March. The sensors are inserted into PVC pipe housings with the end in the egg pocket perforated with numerous small drill holes. These holes and the sensors inside the pipe can become fouled over the long deployment period, which may contribute to the decline in IGDO levels measured in these redds late in the study. Also, the permeability of salmon redds declines over time as periphyton recolonizes the surface of the redd, while biological oxygen demand increases over time as eggs hatch and dead eggs decay.

Figure 2-2. Dissolved oxygen levels in Chinook salmon redd egg pockets with one turbine running at minimum generation, 2013-2014.



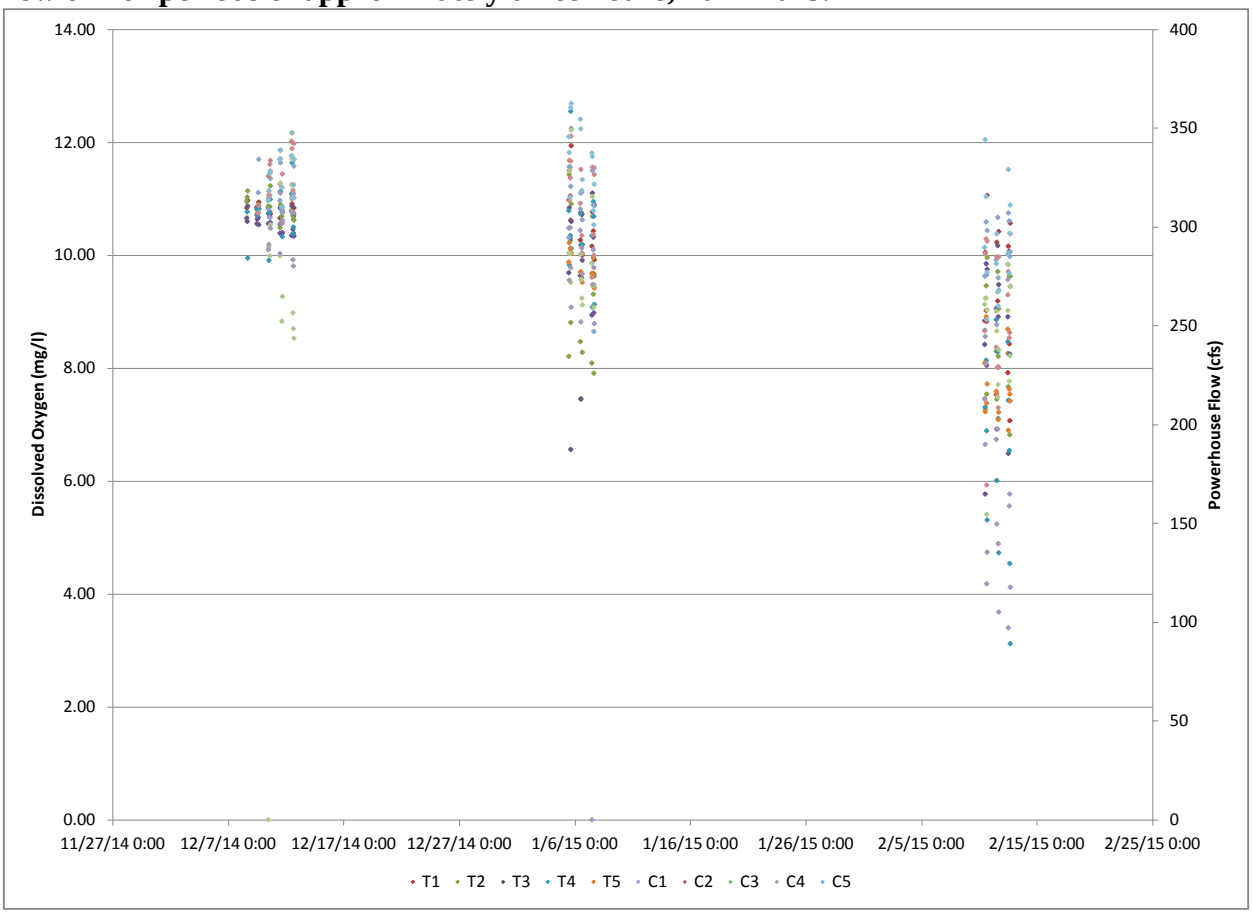
The 2013 results also indicated that IGDO levels above 6.0 mg/l can be maintained in the majority of redds with periods of two or three hours with no powerhouse flow, even over repeating cycles, when followed by at least one hour of operation with one turbine at minimum generation. However, some redds will not maintain IGDO levels above 6.0 mg/l with no powerhouse flow for three hour periods, particularly later in the incubation period in February and March. Three of the ten redds (T1, C3 and C5) monitored in the 2013-14 incubation period had a number of IGDO readings below 6.0 mg/l, while some of the other redds occasionally dipped below that level (Figure 2-3).

Figure 2-3. Dissolved oxygen levels in Chinook salmon redd egg pockets with powerhouse flow off for periods of approximately three hours, 2013-2014.



Monitoring of IGDO levels in ten redds in the tailrace is currently in progress for a fourth year to confirm these results. Due to high fall and winter inflows into Lake Chelan, there have not been any minimum generation studies this year. However, there have been some periods of three hours with no powerhouse flow during diver operations to sample redds for egg-to-emergence survival studies. The results are similar to the previous studies, further confirming the level of IGDO protection provided with intermittent operation of the powerhouse (Figure 2-4). As in the previous year, IGDO levels remained well above 6.0 mg/l during intermittent periods with no powerhouse flow during the months of December and January, but in February there were two redds with IGDO levels below 5 mg/l and three others with IGDO that dipped below 6.0 mg/l. Two more dive operations are scheduled for March, 2015.

Figure 2-4. Dissolved oxygen levels in Chinook salmon redd egg pockets with powerhouse flow off for periods of approximately three hours, 2014-2015.



Degree of Achievement of Objective

The objective of providing minimum IDGO levels of 6.0 mg/l can be met by maintaining powerhouse flows with one turbine operating at minimum generation flows. Over the past two years, extensive modeling work has been undertaken by Chelan PUD to develop operating procedures that will manage power generation operations to best meet both the tailrace IDGO requirements and refill timing requirements for recreational use in Lake Chelan. These operating procedures incorporate, at a minimum, operation of one turbine at minimum generation throughout the incubation period to maintain IDGO levels.

2.4 Egg to emergence success equal to > 80% of Methow River average or 70% survival

Studies of Chinook 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 fry counted in the CET provides an estimate of egg to emergence survival. Chelan PUD adapted this study methodology to address the 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 to 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 were the areas being tested to determine if the biological objective for egg to 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 were meant to serve as a natural control for comparison.

The CET studies were repeated for three years, but the use of CETs was only successful in the Habitat Channel. In the tailrace and in the Columbia River, most of the eggs in CETs died prior to hatching or shortly after hatching, as also happened with CET control sites placed in the tailrace with just a light covering of cobble. This was contrasted with apparently successful incubation and fry survival observed in natural Chinook redds by divers when replacing or removing dissolved oxygen sensors. However, the CETs did function well in the shallower water and higher velocities of the Habitat Channel. The CET methodology in the tailrace was replaced with monthly direct sampling of Chinook redds by divers to determine egg to emergence survival. These redd sampling studies were conducted during the 2013-2014 incubation period and are currently in progress for the 2014-2015 incubation period.

The CET studies in the Habitat Channel have demonstrated that egg to emergence survival exceeds 70 percent. The average survival of eggs to emergent fry in the CETs placed in the Habitat Channel was 81percent, while control CETs in the Habitat Channel had 90 percent survival. The CET survival data in the Habitat Channel, from upper (A) to lower (E) spawning sections, is in Table 2-3.

Table 2-5. Habitat Channel CETs Egg – Emergent Fry Survival.

Location/year	Section	Live Fry	Dead Fry	Dead Eggs	Notes
Habitat Channel	A	94	0	6	
2011-2012	B	53	0	-	Eggs not countable
	C	59	0	-	Eggs not countable
	D	43	0	-	Eggs not countable
	E	96	0	4	
Habitat Channel	A	91	0	9	
2012-2013	B	98	0	4	
	C	95	0	5	
	D	90	1	10	
	E	98	0	2	
Habitat Channel	A	40	34	4	Tube Washed Out
2013-2014	B	89	0	-	Eggs not countable
	C	94	0	2	
	D	77	0	6	
	E	97	0	2	
Habitat Channel	Control	85	2	11	
2011-2012	Control	93	1	2	
	Control	75	0	16	
Habitat Channel	Control	91	0	8	
2012-2013	Control	93	0	6	
	Control	88	0	11	
	Control	95	0	6	
Habitat Channel	Control	99	0	0	
2013-2014	Control	92	1	3	
	Control	94	0	0	
	Control	86	0	4	

Survival of Chinook eggs and pre-emergent fry in redds in the tailrace has been measured for the past two incubation periods, 2013-2014 and 2014-2015, by hand excavating into egg pockets of redds. Active egg pockets have been excavated by divers until either eggs or hatched fry are located, at which time an underwater airlift tube is used to collect approximately 80-100 embryos. The contents of each sample were enumerated as either live or dead, eggs or fry, to estimate the survival rate for that redd. At the conclusion of each sample, the excavated egg pocket and surrounding area was refilled with the excavated material to prevent further disturbance to the redd. The sampling design was to sample one redd in each zone of the tailrace, from upstream to downstream, in the vicinity of each of the 10 dissolved oxygen probes. The sampling events were scheduled to occur five times over the course of the incubation period. These events have been in December at time of oxygen probe placement, once in January, once in early February, once late February or early March and at time of oxygen probe removal in late March.

The redd samples in 2013-2014 had an overall survival rate of 87 percent (Table 2-4). Redd sampling during the 2014-2015 incubation period is still in progress at the time of this report, but the results from the first three sampling events are similar to the survival rates observed in 2013-2014. Should survival rates for the remaining redd samples remain similar, the results will confirm that the egg-emergence survival rate in the tailrace has met the biological objective of 70 percent survival. It is noteworthy that these survival rates were reached despite having a number of periods with no powerhouse flow for oxygen probe installation in December and later redd sampling events and, in 2013-2014, extensive periods of time with only minimum generation flows from the powerhouse.

The other finding of the tailrace redd sampling is that most Chinook fry had completely absorbed the yolk sac by the time of the March 25, 2014 sampling. This level of development is consistent with the accumulated temperature units from surface water temperatures, which predicts that over 1000 temperature units would have been accumulated by that date for 95 percent of the redds that year. Accumulation of 1000 temperature units is commonly considered to be the average incubation period for emergence timing of Chinook salmon. In the final sampling event, many of the fry were actively swimming away when the redd was excavated and had to be counted or netted because they were too quick for capture with the airlift tube.

Degree of Achievement of Objective

The objective of providing conditions suitable for to meet 70 percent survival from egg to emergence in the tailrace and Habitat Channel has been met, provided that final results of the 2014-2015 study do not change this conclusion. The quality of the spawning substrate provided in both the tailrace and in the Habitat Channel has provided good intragravel flow rates and the IGDO levels necessary for incubation of Chinook eggs. The 80 cfs minimum flow rate has also been observed to be sufficient since no dewatered redds have been observed in the Habitat Channel. An accumulation of gravel and cobble in the tailrace below the confluence with the high flow channel in Reach 4 was removed in 2014 because some Chinook redds on that deposition zone were observed to be dewatered during lower than normal water levels in the Columbia River during March of 2014. Those low water levels were due to initial measures taken in response to an emergency reduction in the Wanapum Project's reservoir elevation. Future Project operations provide for continuation of minimum generation flows during the October – March spawning and incubation period to ensure that favorable survival conditions are maintained.

Table 2-6. Tailrace Redd Excavation Egg – Emergent Fry Survival, 2013-2014.

Date	Location	Live Egg	Dead Egg	Live Fry	Dead Fry	% Survival	Mean of Samples
12/15/2013	T1	130	1	0	0	99%	
12/15/2013	T2	88	2	0	0	98%	
12/15/2013	T3	83	13	7	0	87%	
12/15/2013	T4	0	0	118	4	97%	
12/15/2013	T5	118	21	0	0	85%	
12/15/2013	C1	186	3	0	0	98%	
12/15/2013	C2	11	2	96	2	96%	
12/15/2013	C3	62	0	0	0	100%	
12/15/2013	C4	104	2	1	0	98%	
12/16/2013	C5	1	0	36	26	59%	
	Total	783	44	258	32	93.2%	91.8%
1/16/2014	T1	113	3	3	2	96%	
1/16/2014	T2	0	6	97	1	93%	
1/16/2014	T3	150	3	1	1	97%	
1/16/2014	T4	7	2	1	0	80%	
1/16/2014	T5	153	1	8	1	99%	
1/15/2014	C1	0	4	64	2	91%	
1/15/2014	C2	123	3	0	0	98%	
1/15/2014	C3	16	2	44	4	91%	
1/15/2014	C4	0	4	61	10	81%	
1/15/2014	C5	5	0	45	1	98%	
	Total	454	25	321	20	94.5%	92.5%
2/4/2014	T1	0	2	81	2	95%	
2/4/2014	T2	54	4	14	3	91%	
2/4/2014	T3	0	0	78	6	93%	
2/4/2014	T4	0	0	98	3	97%	
2/4/2014	T5	0	0	64	2	97%	
2/4/2014	C1	0	0	97	0	100%	
2/5/2014	C2	0	2	73	1	96%	
2/5/2014	C3	2	2	65	1	96%	
2/5/2014	C4	0	1	70	2	96%	
2/5/2014	C5	0	1	119	2	98%	
	Total	56	10	678	20	96.1%	95.8%
2/25/2014	T1	0	2	108	0	98%	
2/25/2014	T2	0	2	139	0	99%	
2/25/2014	T3	0	4	99	0	96%	
2/25/2014	T4	0	59	3	0	5%	
2/25/2014	T5	0	2	95	0	98%	
2/25/2014	C1	0	86	4	0	4%	
2/25/2014	C2	0	79	32	0	29%	
2/26/2014	C3	0	0	1	133	1%	
2/26/2014	C4	0	0	144	2	99%	
2/26/2014	C5	0	0	84	5	94%	
	Total	0	232	601	140	61.8%	62.3%
3/25/2014	T1	0	3	87	0	97%	
3/25/2014	T2	0	4	100	0	96%	
3/25/2014	T3	0	1	127	0	99%	
3/25/2014	T4	0	3	69	0	96%	
3/25/2014	T5	0	14	73	0	84%	
3/25/2014	C1	0	13	115	1	89%	
3/25/2014	C2	0	0	114	0	100%	
3/25/2014	C3	0	3	104	0	97%	
3/26/2014	C4	0	0	92	6	94%	
3/26/2014	C5	0	0	97	3	97%	
	Total	0	38	891	10	94.9%	94.9%

2.5 Juvenile Rearing Habitat – Chinook Use Available Habitat From Emergence - June

The Biological Objective to provide early rearing habitat for Chinook fry is that the available habitat, particularly habitat constructed in Reach 4, is used by Chinook salmon fry from time of emergence until they move out into the Columbia River. Snorkel surveys have been conducted in the tailrace and Reach 4 in 2010 (May only), and with surveys in April, May, June, August, September and November from 2012 - 2014. A survey scheduled for July 2012 was cancelled due to high spill levels. In addition to snorkel surveys, Chinook fry have been observed in Reach 4 during steelhead spawning surveys and other activities. Some of the surveyors have attempted to distinguish Chinook 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 and coho counts have been combined in Table 3-1, but separate counts are provided in the survey data spreadsheet in Appendix B.

Table 2-7. Chelan River Chinook and Coho Fry Counts.

Year	Location	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Nov.
2010	Tailrace	-	-	0	-	-	-	-	-
2010	Channel	-	-	3945	-	-	-	-	-
2010	Pool	-	-	845	-	-	-	-	-
2012	Tailrace	0	0	2670	285	-	0	0	0
2012	Channel	0	0	2312	0	-	0	0	0
2012	Pool	0	8	0	-	-	0	0	0
2013	Tailrace	0	25	9000	5	0	0	0	0
2013	Channel	0	0	3845	1	1	0	0	0
2013	Pool	0	5	30	1	1	0	0	0
2014	Tailrace	0	4090	3000	0	0	0	0	0
2014	Channel	0	11035	4710	0	0	0	0	0
2014	Pool	0	2600	22	0	0	0	0	0

Chinook fry have been observed using the available habitat in each year surveyed. The observation of few Chinook fry in April of 2012 and 2013 was likely due to the surveys being earlier in the month with lower water temperatures (<12 °C). The survey in April 2014 was later in the month (4/24) and water temperatures had been warmer for over a week prior to the survey (>12 °C). Chinook fry have moved out of the pool, Habitat Channel and tailrace by the June surveys, which have been conducted in Mid June. Water temperatures during the June surveys have ranged from 17 °C – 19 °C. Water temperatures from late April – May range from 12 °C – 17 °C, which results in rapid growth for Chinook fry in the Chelan River and tailrace. The larger members of the population have been observed in deeper and swifter water on the outside edge of the log structures during May surveys.

Degree of Achievement of Objective

The objective to provide early rearing habitat for Chinook fry has been met, as evidenced by the snorkel survey results. Surveys have found that all low velocity habitat is populated with Chinook fry, including the large wood structures, inundated willows and the cobble areas with low velocity.

2.6 Evidence of Adult Production from Chinook Produced in Chelan River

Chinook salmon from the Upper Columbia summer Chinook stock that spawns in the tailrace and Reach 4 Habitat Channel are adapted to simultaneously rear and migrate downstream toward the ocean as they grow. However, to be certain that the spawning and rearing habitat created in the tailrace and Reach 4 of the Chelan River is providing suitable conditions to support this life history, the CRBEIP contains the Biological Objective that there be evidence of naturally produced adult Chinook returning to this habitat as an indication of achievement. In addition to spawning surveys, the carcasses of Chinook salmon that died after spawning are collected and examined for marks, primarily a clipped adipose fin indicating the presence of a coded wire tag (CWT) in the snout. The snouts of marked carcasses are collected and processed for extraction and identification of the CWT, which identifies fish from hatchery releases and other programs. In addition, a sample of scales is also taken, if possible, and the scales are analyzed to determine the age of the fish and whether of natural or hatchery origin. The information from both sources is combined to produce an estimate of the composition of the spawning population by origin and brood year.

Prior to construction of the tailrace spawning habitat and Habitat Channel spawning and rearing channel, carcasses had been collected from the summer Chinook that were spawning in the gravel deposits below the confluence of the Chelan and Columbia rivers. These fish historically were a mix of natural and hatchery origin fish. The marked hatchery fish were predominately produced by the Turtle Rock and Wells hatchery programs, while the unmarked fish could be a combination of natural production from the existing habitat and unmarked fish from both these hatcheries and other sources. Over time, an increase in either the ratio of natural origin Chinook carcasses or in the total number of unmarked Chinook using the tailrace and Habitat Channel would indicate that adult production has increased following creation of this habitat. Since the number of spawners is variable due to different survival between years, the ratio of natural to hatchery origin spawners might be expected to be the least variable, provided that hatchery release numbers, locations and stray rates remained constant from year to year. However, that has not been the case. Since 2007 part of the Turtle Rock fish production was released directly into the Chelan tailrace. The Turtle Rock program was relocated in fall of 2011 to a new rearing facility at the Chelan tailrace and all fish are now released at that location. The release of yearling summer Chinook smolts into the Chelan tailrace went from about 100,000 in 2008 and 2009, to 200,000 in 2010 and 2011, and 570,000 in 2012 and 2013 (Hillman et al, 2014). These

direct releases have affected the historical ratio of natural to hatchery origin spawning population since 2010 and will continue to increase the return of hatchery origin fish in future brood years.

The production of natural origin adult Chinook from the Chelan tailrace and Habitat Channel can be estimated by comparing historical to current and future numbers of natural origin fish using that spawning area. The total number of spawners is estimated from redd counts using a fish per redd factor (Table 2-1). The proportion of natural origin fish in the spawning population for that year can be estimated from carcass surveys, as discussed above. The product of that proportion and the total number of spawners yields an estimate of natural origin Chinook in the spawning population. If the rate of natural origin Chinook straying into the Chelan River from other spawning populations is relatively constant, then an increase in the natural origin spawning population in the Chelan tailrace and Habitat Channel would be evidence of adult production from this habitat.

The number of natural origin Chinook using the Chelan tailrace and Habitat Channel has been higher the past four years than prior to construction of these habitat areas (Table 2-6; Figure 2-5). However, the first two years of higher returns were prior to the year that the first adults (four year old) could return from fish that spawned in the expanded tailrace habitat in 2008. High survivals and increased spawning escapements of summer Chinook have been observed in both natural and hatchery origin populations for the past several years. Thus, although the increase in natural origin Chinook spawning in the tailrace and Habitat Channel is encouraging, it is too early to be certain that the additional spawning habitat has significantly increase natural origin production in the Chelan River. However, it is almost certain, based on the distribution of the Chinook redds (Table 2-2), that a high proportion of the returning Chinook adults were produced from redds in the expanded tailrace habitat and in the Habitat Channel.

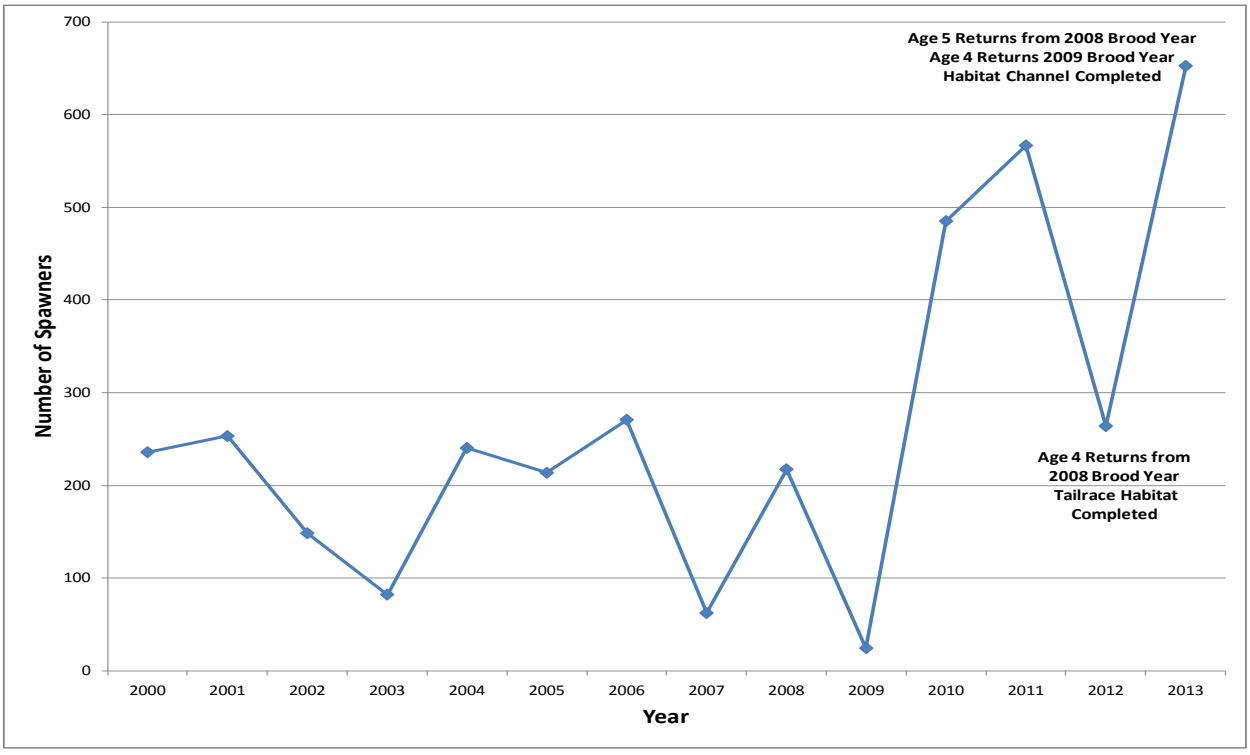
Degree of Achievement of Objective

The objective that adult Chinook production result from the spawning and rearing habitat created in the tailrace and Habitat Channel has probably been achieved. Since data are only available for two years of returning adult production, the certainty that this objective has been achieved will increase in the future.

Table 2-8. Natural and Hatchery Origin Chinook Spawning in the Chelan Tailrace and Habitat Channel.

Return Year	Hatchery	Wild	Hatchery	Wild
Return Year	Proportion		Number of Fish	
	Hatchery	Wild	Hatchery	Wild
2000	0.65	0.35	430	236
2001	0.74	0.26	731	253
2002	0.74	0.26	433	149
2003	0.80	0.20	337	82
2004	0.43	0.57	180	240
2005	0.59	0.41	310	214
2006	0.36	0.64	149	271
2007	0.67	0.33	127	62
2008	0.56	0.44	280	217
2009	0.96	0.04	600	25
2010	0.57	0.43	633	485
2011	0.56	0.44	713	567
2012	0.80	0.20	1044	264
2013	0.61	0.39	1031	653

Figure 2-5. Chelan River Natural Origin Spawners.



SECTION 3: BIOLOGICAL OBJECTIVES FOR STEELHEAD

3.1 Spawning Habitat for Steelhead Meets Design Characteristics

The CRBEIP states that "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."

Steelhead spawning has been observed in the Habitat Channel in four of the five 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, 7 redds in 2012, 21 redds in 2013 and no redds in 2014. The steelhead redd surveys since 2011 were made weekly, beginning in late March and continuing into June or until high flows precluded further observations. Surveys are conducted by observing from high points overlooking the tailrace and pool area and walking both shores of the Habitat Channel. Steelhead redds have not been observed in the tailrace, except for the shoreline margin in flow exiting the Habitat Channel (one redd each in 2011 and 2013). The lack of redds in 2014 may have been due to the combination of a low steelhead return that year and potential delay of spring migrating steelhead due to interruption of fish passage at Wanapum Dam.

The first redds have been observed in late March, with the majority of spawning initiated in mid to late April. In 2011, one redd was initiated at the end of May. Steelhead redds were distributed throughout the Habitat Channel and a few redds were also in the pool formed by the hydraulic control structure. Most of the redds have been in the vicinity of cover from either boulders or log structures. Steelhead redds were 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 and 2013 at steelhead redds were often greater than the expected preference for this species, with some redds deeper than 30 inches and in velocities exceeding three feet per second. Also, the higher flows reduce the available low velocity habitat preferred by Chinook fry, which are rearing in the Habitat Channel from April – June.

The Chelan River Fishery Forum has approved testing a lower flow during the steelhead spawning period, which is discussed in Section 3.2.1.

Degree of Achievement of Objective

The Habitat Channel was constructed to provide spawning and rearing habitat for Chinook salmon and steelhead, with an expectation that the wood and boulder cover and riffle habitat would provide suitable conditions for steelhead spawning and early rearing. It appeared that the availability of suitable small gravel substrate has diminished over time in some of the areas of the Habitat Channel where steelhead redds had been observed. To provide more small gravel substrate, the CRFF approved the addition of 70 cubic yards of small gravel to various locations in the Habitat Channel. This gravel was placed in late summer of 2014. The first opportunity to observe whether steelhead make use of that gravel will be in spring, 2015.

The Washington Departments of Ecology and Fish and Wildlife have been measuring Habitat Channel cross-sections for depth, velocity, substrate and cover. These data have been modeled to estimate weighted useable area for steelhead spawning, with 15 transects extrapolated to predict the percent of the channel suitable for steelhead spawning conditions based on current Washington State preference curves for steelhead spawning. The modeling study evaluated the percent of the channel with suitable substrate, combined depth/velocity, and overall useable area for steelhead spawning (Jim Pacheco, CRFF presentation 2015). The addition of gravel in 2014 improved the proportion of channel bed from 37.6% useable to 41.4% useable substrate. Evaluation of depth/velocity suitability at different flows showed that lower flows would increase suitable spawning area in the Habitat Channel. The overall useable area estimates, with the 2014 gravel addition, were 13.5% useable area at 300 cfs flow and 16.0% useable area at 250 cfs flow.

At this time, the CRFF has not made a recommendation regarding whether the Habitat Channel, as currently operated, is providing a suitable balance between spawning habitat for steelhead, rearing habitat for both Chinook and steelhead, and spawning habitat for Chinook. The fact that steelhead spawned in the Habitat Channel in four of five years meets, at least partially, the criteria for achievement. However, the appropriate number of steelhead redds for the Habitat Channel is an open question. Operation of the Habitat Channel at reduced flow during the steelhead spawning season is scheduled for testing in 2015. The Habitat Channel weighted useable area for Chinook fry rearing, which is concurrent with the steelhead spawning season, has not been evaluated.

3.2 Steelhead Use of Spawning Habitat Throughout Constructed Habitat

The distribution of steelhead redds within the Habitat Channel was fairly even between the upper and lower parts of the channel in 2010 and 2011. However, by 2013 the preponderance of redds was in the lower channel areas, while the upper part of the channel had only two of the 21 redds observed. This observation is concurrent with the observation that some of the small gravel patches in the upper Habitat Channel that were previously used by spawning steelhead appeared to have diminished. The Habitat Channel has changed over time, with a more pronounced thalweg and some shallow shoreline areas now growing willows and trapping sand. This is a natural evolution of the stream channel in response to annual flow cycles. As previously mentioned, 70 cubic yards of small gravel was placed in the upper and middle sections of the Habitat Channel. The gravel additions were focused on areas where steelhead redds had been observed in 2011, but not present in 2013, as well as in other areas with suitable cover that appeared to have the preferred depths and velocities but lacked suitable substrate for steelhead spawning.

3.2.1 Temporary Habitat Channel Flow Reduction and Steelhead Spawning Habitat Availability

As stated in Section 2.2.1, 4 pumps were operated during the 2014 steelhead spawning period, March 15 through May 15 to investigate steelhead habitat suitability and use at reduced flows in the Habitat Channel.

No steelhead redds were observed in the Habitat Channel during weekly spawning ground surveys conducted between March 15 and May 15, 2014. Participants noted during the August 20, 2014, CRFF meeting that the lack of steelhead spawning in the habitat channel in 2014 was probably related to a Columbia River-wide incidence of low adult steelhead returns. Additionally, the CRFF speculated, and agreed, that the lack of steelhead may have been due also to the Wanapum dam crack incident delaying steelhead upstream migration in 2014.

The CRFF recommended that 4 pump operation be repeated in 2015 during the March 15 through May 15 steelhead spawning to gather another year of data to assess the affect of reduced flow on steelhead spawning habitat availability and use. Results of the 2015 investigation will be reported in the next Biological Objectives Status Report.

Degree of Achievement of Objective

The achievement of this objective will require further work to evaluate the limiting factors and suitable management actions to restore and improve steelhead spawning distribution in the Habitat Channel. In natural rivers, small substrate moves downstream during annual spring/summer high flows, but it is also continuously replaced by new gravel coming in from upstream. The Habitat Channel does not have the same opportunity for gravel recruitment and

periodic gravel supplementation may be needed to replenish the small substrate favored by steelhead for spawning. Also, further work to determine the flows that provide the best conditions for spawning steelhead and rearing Chinook fry should proceed.

3.3 Steelhead Tailrace/Reach 4 Intragravel Dissolved Oxygen ≥ 6.0 mg/l

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 redds observed were adjacent to the shoreline above the Chelan Falls highway bridge in flowing water coming from the Habitat Channel. Although suitable substrate and velocities exist in some parts of the tailrace, no steelhead have used it for spawning, possibly due to lack of any boulder, wood or vegetative cover. Also, the substrate in the Habitat Channel spawning area is porous and free of sediments, thus steelhead redds would not lack intragravel flow. Since the Habitat Channel is never without sufficient flow to maintain intragravel dissolved oxygen, there is no need to monitor intragravel dissolved oxygen.

Degree of Achievement of Objective

This objective has been met by nature of maintaining continuous flow and by design of the clean substrate in the Habitat Channel. If in the future a landslide or other natural disaster were to cause heavy deposition of fine sediments into the Habitat Channel, then the suitability of substrate for survival from egg to emergence would need to be evaluated.

3.4 Egg to emergence success equal to > 80% of Methow River average or 70% survival

The survival from egg to emergence of steelhead has not been evaluated due to technical issues that make such evaluation difficult. Since steelhead are listed as threatened under the Endangered Species Act (ESA), actions to disturb redds such as redd capping or excavation are considered a "take" and prohibited except under permits. An experiment using CETs or other egg baskets could be designed using a surrogate, such as hatchery steelhead eggs from a stock not listed under the ESA. However, it would be difficult to find hatchery steelhead eggs that match the timing of steelhead spawning in the Habitat Channel. The results of the Chinook egg – emergence survival studies in the Habitat Channel could be considered as a surrogate for steelhead survival. These studies demonstrated survival of 81 percent from eyed egg to emergent fry.

Degree of Achievement of Objective

This objective has not been evaluated, although there is no apparent reason why the objective would not be achieved. The CRFF needs to either recommend a suitable method for measurement of this parameter or seek concurrence that the objective is likely to have been achieved.

3.5 Juvenile Rearing Habitat – Steelhead Use Available Habitat Until Enter Columbia River

Steelhead emergence timing in the Chelan River is predicted to occur in June, based on spawning timing and accumulated temperature units. There were no steelhead fry or parr observed during snorkel surveys in 2012 because high spill flows began prior to emergence of steelhead, which made the snorkel survey ineffective and may also have flushed emerging steelhead fry out of the Habitat Channel. However, in 2013 the snorkel surveys in June and July found steelhead fry in the Habitat Channel and upstream in the pool (Appendix 2). Steelhead fry (mostly 40 mm size range) were observed on June 15 in very shallow boulder/cobble areas of the stream margin. In July, the steelhead were larger and flow was lower (82 cfs), with the parr inhabiting midstream areas behind large boulder/cobbles. Only a few parr were observed in August. Since there were no steelhead redds in 2014, there were no steelhead fry observed.

Degree of Achievement of Objective

The observations in 2013 were encouraging since steelhead fry were well distributed in the Habitat Channel and up into the pool. Also, presence of larger fry in July indicated that fish were able to rear in the Habitat Channel up to that time. Further observations are needed to evaluate if the Habitat Channel is providing suitable rearing habitat for steelhead fry and parr.

3.6 Evidence of Adult Production from Steelhead Produced in Chelan River

This objective has not been evaluated due to lack of a suitable method. Since steelhead do not die after spawning, there are no carcasses to evaluate. The CRBEIP recognized that measurement of this objective would require either new technology or best professional judgment of the CRFF regarding whether steelhead spawning in the Chelan River would be successful in producing smolts and adults.

SECTION 4: BIOLOGICAL OBJECTIVES FOR CUTTHROAT TROUT

4.1 Cutthroat Trout Presence of 200 Fish of Various Age Classes

The CRBEIP provided for restoring flows to Reaches 1-3 of the Chelan River with the objective that a population of 200 cutthroat trout, of various age classes, would become established in the river. The initial five years following reestablishment of flows was set to wait and see if 200 cutthroat trout would recruit to the Chelan River from Lake Chelan during the annual spill period. If, after year 5, a population of 200 fish has not been achieved, then the CRBEIP provided for either extending the evaluation for another ten years to allow natural colonization from Lake Chelan or to stock cutthroat into the Chelan River to determine if they could survive and persist. If cutthroat failed to survive and persist, then habitat improvements directed toward reducing water temperatures were to be pursued.

Snorkel surveys have determined that some cutthroat trout have been slowly colonizing from Lake Chelan, but there have been more rainbow trout coming out of the lake than cutthroat. This is probably a result of there being more rainbow than cutthroat present in Lake Chelan (Table 4-1). The number of both species apparently increased in 2014, although there is reason to believe that cutthroat may have been present but not observed in November 2013 because there were no spill events between that survey and April 2014 when fish could have passed out of Lake Chelan. It is encouraging that between the 2014 August and November surveys, during which time the water temperatures were high, the number of rainbow and cutthroat did not greatly decline.

Table 4-1. Cutthroat and rainbow trout counted in snorkel surveys in Chelan River Reachs 1-3.

		2012			2013			2014		
		March	August	November	April	August	November	April	August	November
Cutthroat	R1	0	NS	0	5	0	0	19	11	20
	R2	0	NS	NS	0	0	0	2	2	1
	R3	8	NS	NS	3	2	0	NS	NS	NS
Rainbow	R1	7	NS	12	5	0	1	5	58	51
	R2	0	NS	NS	0	11	7	5	39	32
	R3	5	NS	NS	5	0	0	NS	NS	NS

The snorkel surveys did find cutthroat of more than one age class in 2014. The November survey found cutthroat as small as 7 inches and as large as 15 inches, which probably represents at least two age classes. However, thus far there have been no young of year or yearling sized cutthroat or rainbow observed in Reaches 1-3. In order to determine if younger age classes of cutthroat can survive and persist in Reaches 1-3, the CRFF agreed that cutthroat fry and fingerlings should be planted in Reach 1 in prior to surveys in 2015. Approximately 2,000 cutthroat about one inch in length were planted below the Low Level Outlet in October, 2014. None of these fish were observed during the November survey, but water temperature was cold enough that such small fish were likely hiding in the substrate.

Degree of Achievement of Objective

The snorkel surveys have determined that some colonization of adult cutthroat has occurred, but no young age classes have been observed thus far in either cutthroat or rainbow. Planting of test fish for these younger age classes was initiated in the fall of 2014 to provide a means to evaluate the suitability of the Reach 1 habitat for these smaller fish. Surveys of Reach 3 have proven to not be feasible due to safety concerns. Also, a number of large rocks recently fallen into Reach 2 were noted during the November 2014 survey. The frequency of rock fall is sufficient to warrant suspension of snorkel surveys in Reach 2 for safety reasons. Future surveys will be limited to Reach 1. However, sufficient habitat area exists in Reach 1 to support a cutthroat trout population of 200 fish, thus future measurement of progress toward meeting this objective should not be affected by reducing the survey area.

4.2 Create Habitat to Support a Viable Population of Cutthroat Trout in Reaches 1-3

The CRBEIP has the objective of taking reasonable and feasible actions to improve habitat in Reaches 1-3 if necessary to establish a viable population of cutthroat trout. The primary measures envisioned as potentially necessary were related to management of high summer water temperatures. In addition to temperature monitoring for the past five years, a temperature modeling study is in progress that will be able to evaluate the potential of different actions to moderate peak summer water temperatures. These actions could include river channel narrowing, establishment of riparian vegetation and short-term flow increases during hot weather. In support of this study, a riparian feasibility study is also in progress to evaluate the rate of natural establishment of riparian vegetation, feasible actions to increase the rate of riparian establishment, and an evaluation of the potential height and shade that could be provided to the river channel once mature riparian vegetation is present.

At this time, there is no evidence that summer water temperatures or other limiting factors are preventing the establishment of a viable population of cutthroat in Reaches 1-3. Snorkel surveys and other techniques, as necessary, will be undertaken to determine the fate of juvenile cutthroat planted into Reach 1 in 2014 and 2015. The time frame for these evaluations in the CRBEIP is years 5 – 10, with the results of the temperature model and riparian feasibility study becoming available in 2015 concurrent with the snorkel survey results for the juvenile cutthroat plants.

SECTION 5: LITERATURE CITED

Chelan PUD. 1991 Application for raising the pool elevation from 707 feet to 710 feet, Rocky Reach Hydroelectric Project No. 2145.

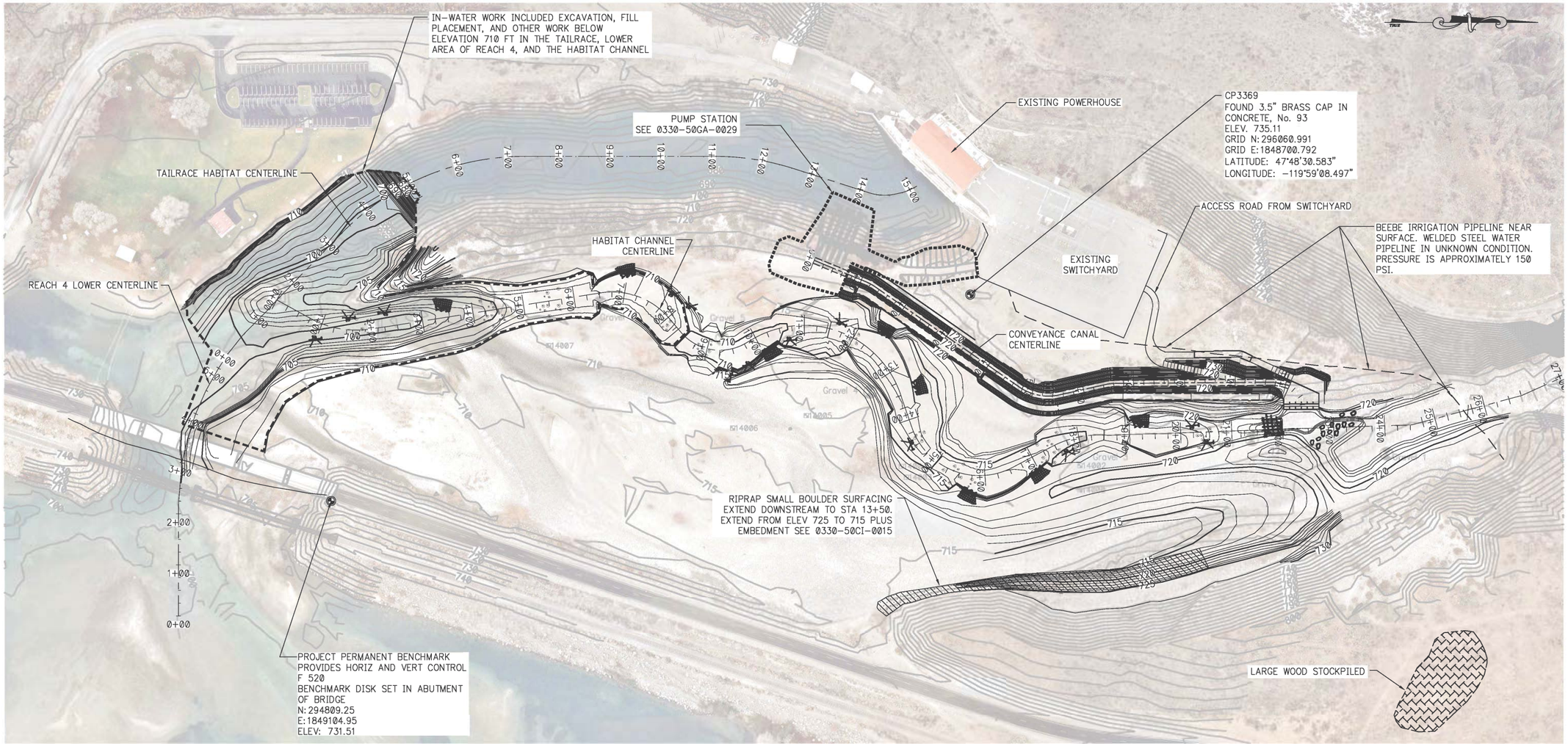
Hillman, T., M. Miller, C. Moran, M. Tonseth, M. Hughes, A. Murdoch, L. Keller, C. Willard, B. Ishida, C. Kamphaus, T. Pearsons, and P. Graf. 2014. Monitoring and evaluation of the Chelan and Grant County PUDs hatchery programs: 2013 annual report. Report to the HCP and PRCC Hatchery Committees, Wenatchee, WA.

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.

Pacheco, J. 2015. Chelan fish channel habitat study: Events since mid 2012. A powerpoint presentation to the Chelan River Fish Forum, February 4, 2015.

APPENDIX A: AS-BUILT DRAWINGS OF CHELAN RIVER HABITAT

As-built drawings will be included in the final report filed with the FERC on April 30, 2015.



LEGEND

- LOG JAM
- V-LOG JAMS
- BOULDERS
- TI4005 TEST PIT LOCATION
- GRAVEL PAINT TEST LOCATIONS

NOTE:

HORIZONTAL DATUM: NAD 83 SP WA NORTH
VERTICAL DATUM: NGVD-29
SURVEY BASE TOPOGRAPHY PROVIDED BY CHELAN PUD

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DESIGNER C. REYNOLDS	2ND ENG.	3	3/25/2015	AS BUILT			SBT	MPS
APPROVAL J. KIDDER	PROJ. MGR.	REV	DATE	REVISION			REQ. BY	DRFT

PUBLIC UTILITY DISTRICT NO. 1 OF CHELAN COUNTY
WENATCHEE, WASHINGTON

Chelan Hydro
OVERALL SITE PLAN DESIGN
TOPOGRAPHY AND ALL ALIGNMENTS

BID 08-01

SHEET R1 OF R50
REVISION 3
DATE 3/25/2015
DWG. **0330-50GA-0028**

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ORIG. DATE 8/31/2007

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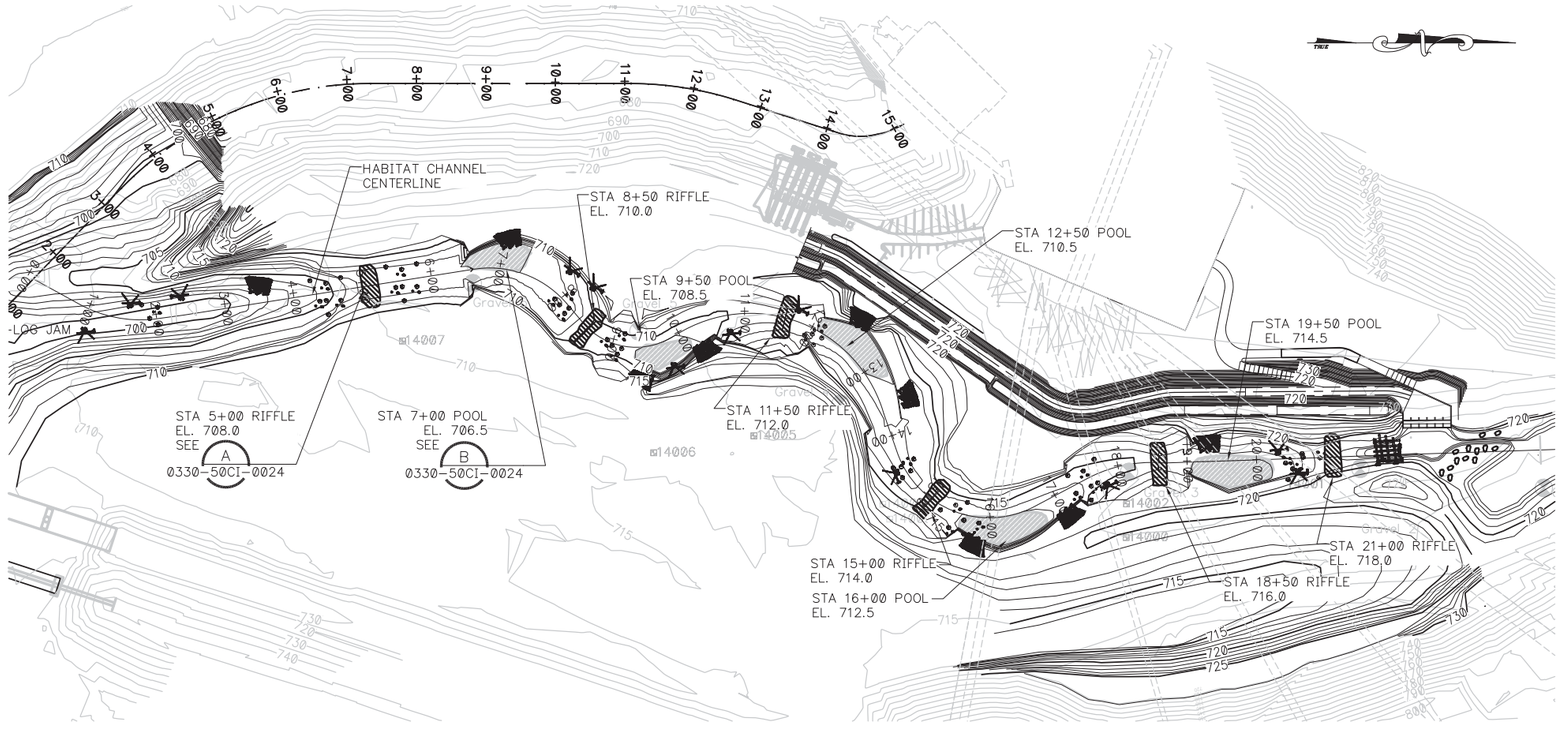

HABITAT CHANNEL PLAN

1" = 100'

HABITAT CHANNEL CENTERLINE STATIONING TABLE			
STA	NORTHING	EASTING	FINISHED ELEVATION
0+00.00	294702.84	1848711.32	705.20
0+50.00	294746.69	1848735.35	703.70
1+00.00	294791.53	1848758.05	701.10
1+50.00	294840.69	1848769.51	700.00
2+00.00	294890.95	1848767.26	700.00
2+50.00	294940.42	1848760.04	700.00
3+00.00	294989.81	1848752.23	700.21
3+50.00	295039.20	1848744.42	702.29
4+00.00	295088.58	1848736.62	703.67
4+50.00	295137.97	1848728.81	705.16
5+00.00	295187.36	1848721.00	707.00
5+50.00	295236.74	1848713.20	707.00
6+00.00	295286.13	1848705.39	707.00
6+50.00	295335.52	1848697.58	707.00
7+00.00	295386.26	1848697.91	707.00
7+50.00	295433.84	1848715.63	707.74
8+00.00	295472.44	1848748.55	708.00
8+50.00	295506.30	1848786.28	710.00
9+00.00	295553.20	1848808.20	709.46
9+50.00	295604.77	1848803.73	708.50
10+00.00	295649.90	1848780.01	709.18
10+50.00	295697.82	1848764.41	709.94
11+00.00	295748.13	1848761.27	710.64
11+50.00	295797.62	1848770.81	712.00
12+00.00	295843.15	1848792.42	711.01
12+50.00	295881.84	1848824.72	711.00
13+00.00	295911.24	1848865.66	711.09

HABITAT CHANNEL CENTERLINE STATIONING TABLE			
STA	NORTHING	EASTING	FINISHED ELEVATION
13+50.00	295929.94	1848912.42	711.70
14+00.00	295946.30	1848959.67	712.28
14+50.00	295970.93	1849004.12	712.83
15+00.00	296009.83	1849036.87	714.00
15+50.00	296057.85	1849053.56	713.01
16+00.00	296108.67	1849052.01	713.00
16+50.00	296155.62	1849033.03	713.09
17+00.00	296199.80	1849009.61	713.69
17+50.00	296245.01	1848987.71	714.27
18+00.00	296294.14	1848976.45	714.83
18+50.00	296344.48	1848975.85	716.00
19+00.00	296394.45	1848974.17	715.00
19+50.00	296444.42	1848972.49	715.00
20+00.00	296494.39	1848970.77	715.18
20+50.00	296544.36	1848968.95	716.84
21+00.00	296594.32	1848967.02	718.00
21+50.00	296644.29	1848965.25	716.10
22+00.00	296694.26	1848963.57	716.10
22+50.00	296744.23	1848961.89	715.90
23+00.00	296794.20	1848960.21	719.00
23+50.00	296844.18	1848958.54	717.50
24+00.00	296894.15	1848956.86	715.97
24+50.00	296943.52	1848951.11	715.97
25+00.00	296991.83	1848938.23	715.90
25+50.00	297040.14	1848925.35	715.90
26+00.00	297088.46	1848912.48	N/A

LEGEND

- LOG JAM
- V-LOG JAMS
- BOULDERS
- 14007 TEST PIT LOCATION
- GRAVEL PAINT TEST LOCATIONS
- POOLS
- RIFFLES

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ORIG. DRAWN ANC
ORIG. DATE 4/26/2007

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2ND ENG. P. POWERS	PRIM. ENG.		
DESIGNER C. REYNOLDS	2ND ENG.		
APPROVAL J. KIDDER	PROJ. MGR.		

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Chelan Hydro
HABITAT CHANNEL PLAN
BID 08-01

SHEET R3 OF R50
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DWG. 0330-50CI-0018

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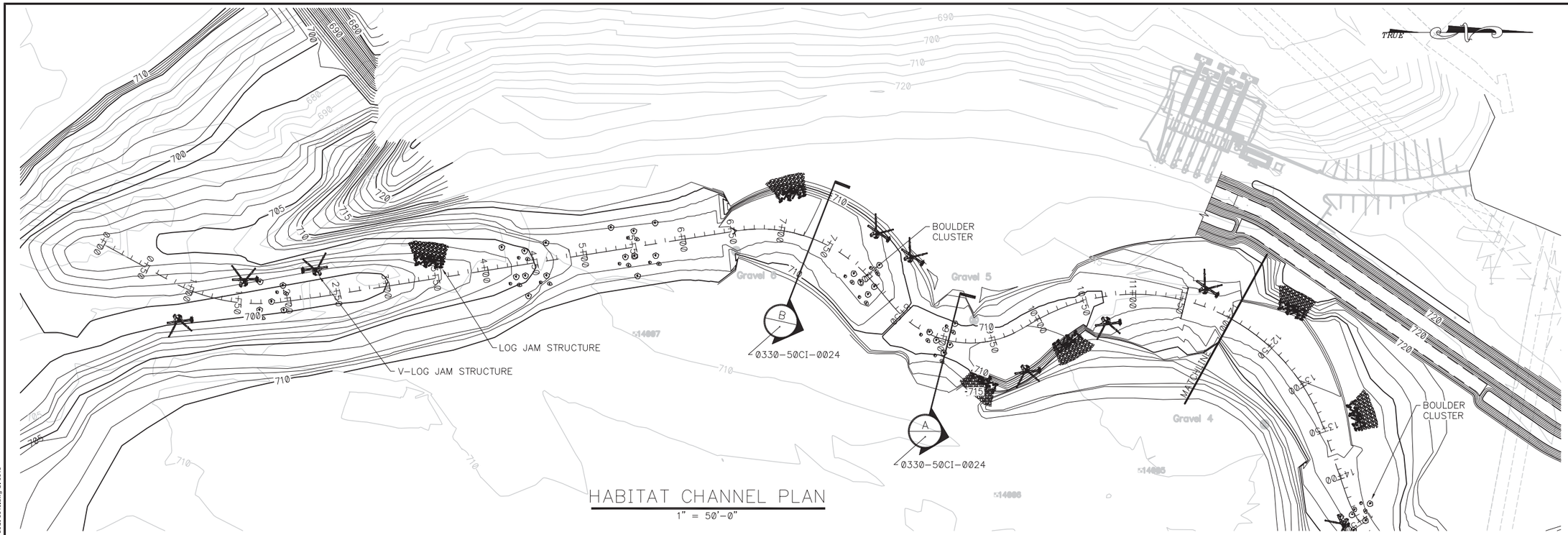
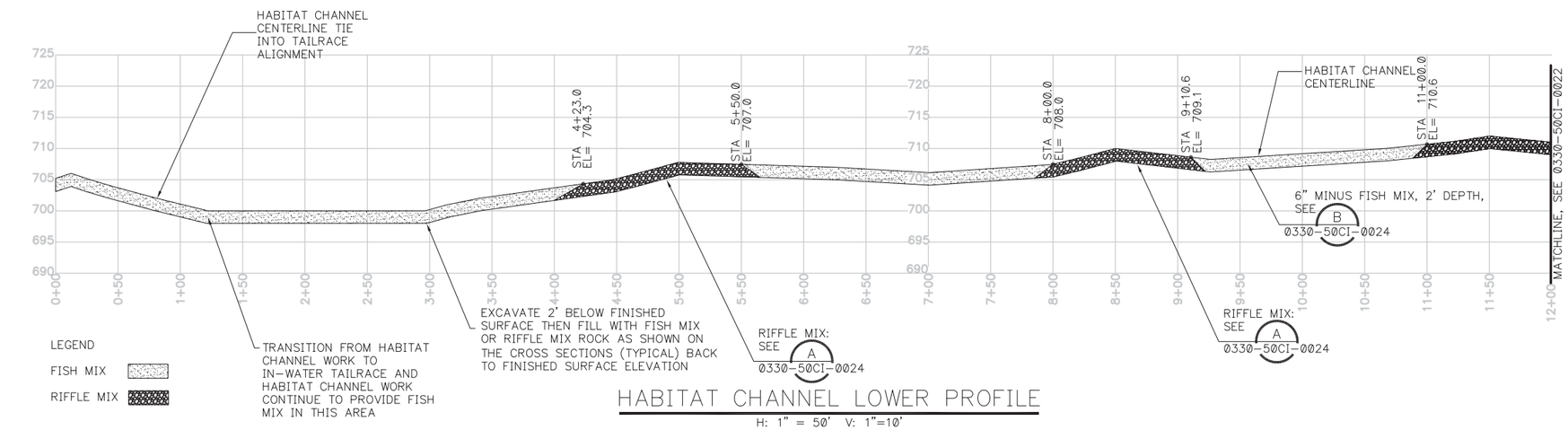


HABITAT CHANNEL PLAN

1" = 50'-0"



HABITAT CHANNEL LOWER PROFILE

H: 1" = 50' V: 1"=10'

LEGEND

- LOG JAM
- V-LOG JAMS
- BOULDERS
- 14007 TEST PIT LOCATION
- 2 GRAVEL PAINT TEST LOCATIONS

JAY S. KIDDER STATE OF WASHINGTON 25405 REGISTERED PROFESSIONAL ENGINEER
EXPIRES: 5-1-2008

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DATE ORIGINAL SIGNED:
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HABITAT CHANNEL PLAN AND PROFILE LOWER
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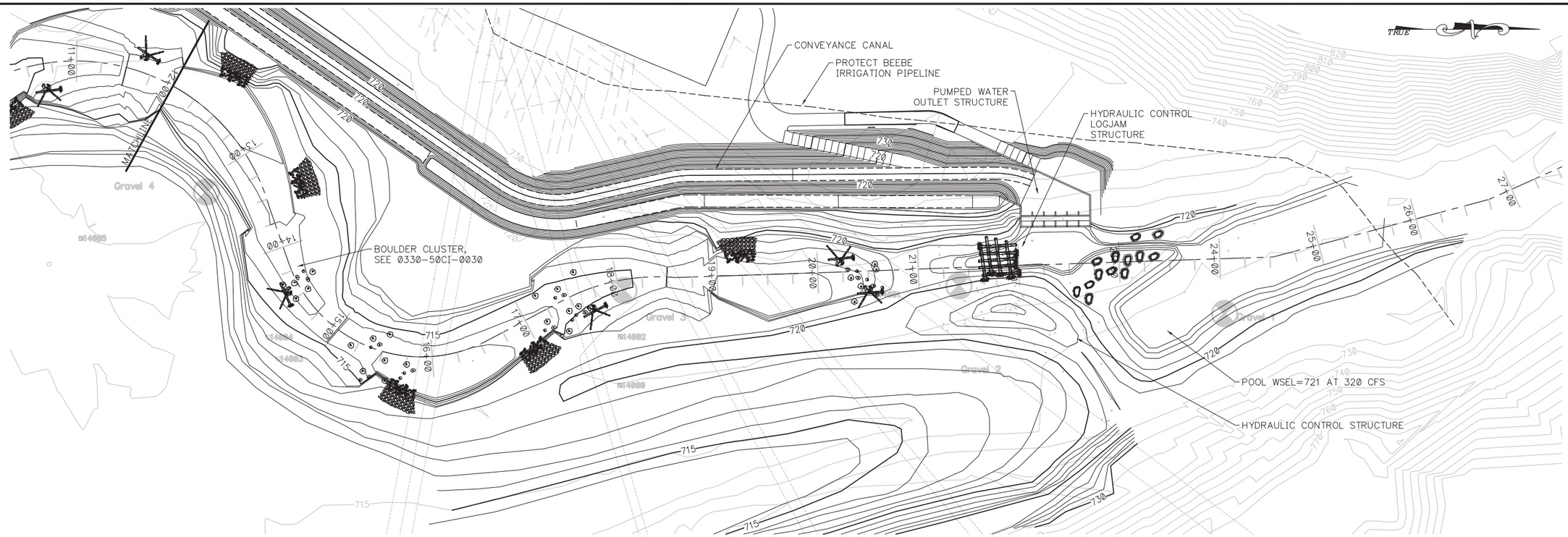
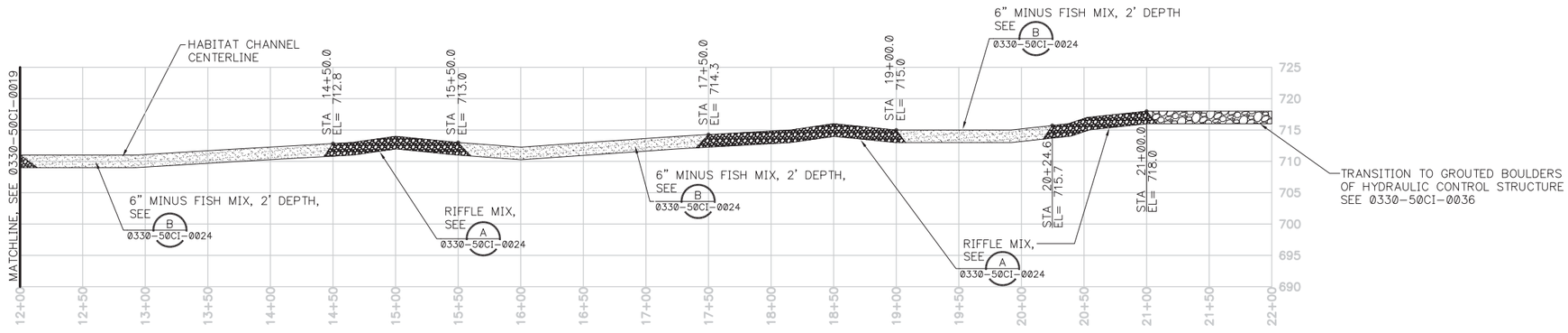


HABITAT CHANNEL PLAN

1" = 50'

LEGEND

- LOG JAM
- V-LOG JAMS
- BOULDERS
- TEST PIT LOCATION
- GRAVEL PAINT TEST LOCATIONS



HABITAT CHANNEL UPPER PROFILE

H: 1" = 50' V: 1"=10'

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WENATCHEE, WASHINGTON

Chelan Hydro
HABITAT CHANNEL PLAN AND PROFILE UPPER
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REVISION	3
DATE	3/25/2015
DWG.	0330-50CI-0022

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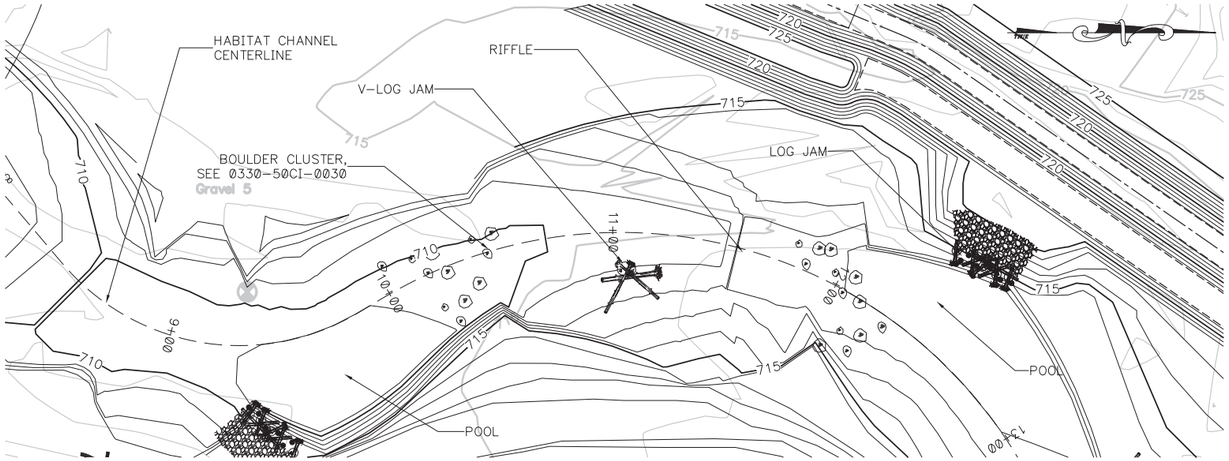


LEGEND

- LOG JAM
- V-LOG JAMS
- BOULDERS
- ×14005 TEST PIT LOCATION
- 2 GRAVEL PAINT TEST LOCATIONS

DETAILED PLAN
1" = 30'

FIVE-BOULDER NATURALLY OCCURRING BOULDER CLUSTER

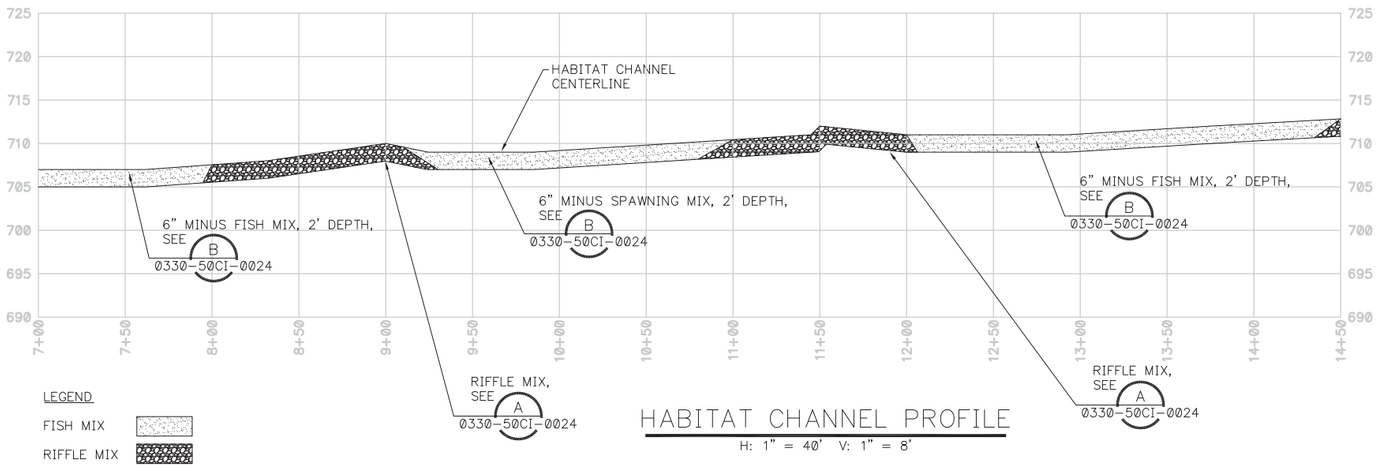
POOL

POOL AND RIFFLE AREAS SHOWING BOULDER CLUSTERS

EXAMPLE PHOTOS 1
NTS

NATURAL BOULDER CLUSTERS AND RIFFLES

EXAMPLE PHOTOS 2
NTS



LEGEND

- FISH MIX
- RIFFLE MIX

HABITAT CHANNEL PROFILE
H: 1" = 40' V: 1" = 8'

NOTES;

1. THESE PHOTOS ARE PRESENTED AS EXAMPLES OF NATURALLY OCCURRING RIVER BEDS WITH POOLS AND RIFFLES.
2. BOULDER CLUSTERS ARE PRESENTED IN THE PHOTO.
3. RIFFLE EXAMPLE PHOTOS.
4. THESE PHOTOGRAPHS ARE SHOWN FOR EXAMPLE ONLY.

JAY S. KIDDER — STATE OF WASHINGTON — 25485 — REGISTERED PROFESSIONAL ENGINEER — EXPIRES: 5-1-2008

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ORIG. DATE 8/31/2007

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DESIGNER C. REYNOLDS	2ND ENG.	3	3/25/2015	AS BUILT	SBT	MPS	
APPROVAL J. KIDDER	PROJ. MGR.	REV	DATE	REVISION	REQ. BY	DRFT	

PUBLIC UTILITY DISTRICT NO. 1 OF CHELAN COUNTY
WENATCHEE, WASHINGTON

Chelan Hydro
HABITAT CHANNEL POOL AND RIFFLE DETAILS
BID 08-01

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DWG. 0330-50CI-0023

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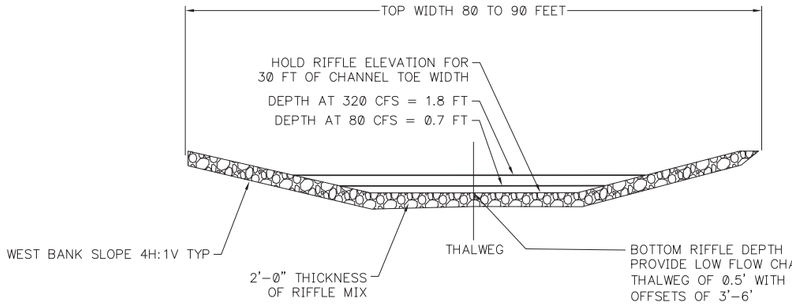


NOTE:

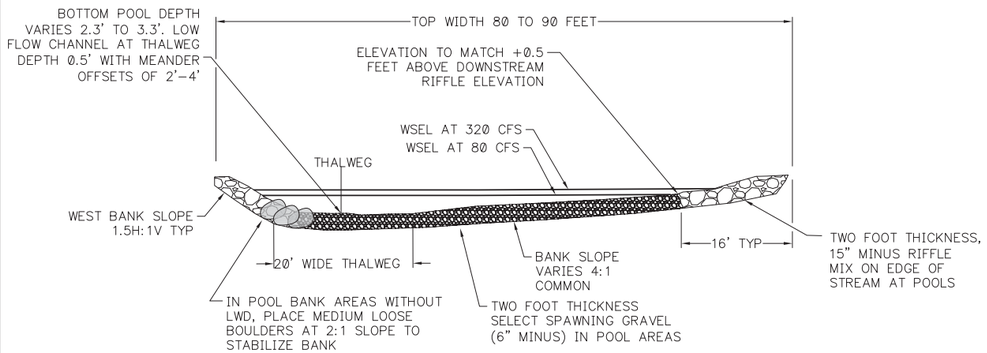
1. CROSS-SECTIONS ARE CUT LOOKING UP-STATION.

TYPICAL RIFFLE

HABITAT CHANNEL SECTION

1" = 10'

A 0330-50CI-0019



NOTE:

1. CROSS-SECTIONS ARE CUT LOOKING UP-STATION.

TYPICAL POOL

HABITAT CHANNEL SECTION

1" = 10'

B 0330-50CI-0019

CHANNEL LAYOUT

STATION	DESCRIPTION	ELEV	LOCATION	BOTTOM WIDTH FT	EAST BANK SLOPE (H:V)	WEST BANK SLOPE (H:V)	KEY PIECES NUMBER	SHORT KEY LOGS NUMBER	FILLER RACKING NUMBER	BOULDERS NUMBER
1+00	V-LOG JAM	SEE SHEET 0330-50CI-0028	EAST BANK				3		15	1
1+50	V-LOG JAM	SEE SHEET 0330-50CI-0028	WEST BANK				3		15	1
2+00	BOULDER CLUSTERS	SEE SHEET 0330-50CI-0030								16
2+20	V-LOG JAM	SEE SHEET 0330-50CI-0028	WEST BANK				3		15	1
3+50	LOG JAM	SEE SHEET 0330-50CI-0028	WEST BANK				6	9	12	3
3+80	BEGIN CHANNEL EXCAVATION	705.0								
4+50	BOULDER CLUSTERS	SEE SHEET 0330-50CI-0030								16
5+00	RIFFLE	708.0	CENTERLINE	30	10:1	10:1				
5+50	BOULDER CLUSTERS	SEE SHEET 0330-50CI-0030								16
6+80	POOL	706.5	30 FT WEST OF CENTERLINE	20	4:1	1.5:1				
7+00	LOG JAM	SEE SHEET 0330-50CI-0028	WEST BANK				6	9	12	3
7+80	V-LOG JAM	SEE SHEET 0330-50CI-0028	WEST BANK				3		15	1
8+00	BOULDER CLUSTERS	SEE SHEET 0330-50CI-0030								16
8+20	V-LOG JAM	SEE SHEET 0330-50CI-0028	WEST BANK				3		15	1
8+50	RIFFLE	710.0	CENTERLINE	30	10:1	10:1				
9+00	BOULDER CLUSTERS	SEE SHEET 0330-50CI-0030								16
9+30	LOG JAM	SEE SHEET 0330-50CI-0028	EAST BANK				6	9	12	3
9+60	V-LOG JAM	SEE SHEET 0330-50CI-0028	EAST BANK				3		15	1
10+00	POOL	708.5	30 FT EAST OF CENTERLINE	20	1.5:1	4:1				
10+30	LOG JAM	SEE SHEET 0330-50CI-0028	EAST BANK				6	9	12	3
10+80	V-LOG JAM	SEE SHEET 0330-50CI-0028	EAST BANK				3		15	1
11+50	RIFFLE	712.0	CENTERLINE	30	10:1	10:1				
11+80	V-LOG JAM	SEE SHEET 0330-50CI-0028	WEST BANK				3		15	1
12+50	LOG JAM	SEE SHEET 0330-50CI-0028	WEST BANK				6	9	12	3
12+50	POOL	710.5	30 FT WEST OF CENTERLINE	20	4:1	1.5:1				
13+50	LOG JAM	SEE SHEET 0330-50CI-0028	WEST BANK				6	9	12	3
14+50	BOULDER CLUSTERS	SEE SHEET 0330-50CI-0030								16
14+50	V-LOG JAM	SEE SHEET 0330-50CI-0028	WEST BANK				3		15	1
15+00	RIFFLE	714.0	CENTERLINE	30	10:1	10:1				
15+50	BOULDER CLUSTERS	SEE SHEET 0330-50CI-0030								16
15+70	LOG JAM	SEE SHEET 0330-50CI-0028	EAST BANK				6	9	12	3
16+00	POOL	712.5	30 FT EAST OF CENTERLINE	20	1.5:1	4:1				
17+00	LOG JAM	SEE SHEET 0330-50CI-0028	EAST BANK				6	9	12	3
17+50	BOULDER CLUSTERS	SEE SHEET 0330-50CI-0030								16
17+80	V-LOG JAM	SEE SHEET 0330-50CI-0028	EAST BANK				3		15	1
18+50	RIFFLE	716.0	CENTERLINE	30	10:1	10:1				
19+20	LOG JAM	SEE SHEET 0330-50CI-0028	WEST BANK				6	9	12	3
19+50	POOL	714.5	30 FT EAST OF CENTERLINE	20	4:1	1.5:1				
20+20	V-LOG JAM	SEE SHEET 0330-50CI-0028	EAST BANK				3		15	1
20+50	V-LOG JAM	SEE SHEET 0330-50CI-0028	WEST BANK				3		15	1
20+50	BOULDER CLUSTERS	SEE SHEET 0330-50CI-0030	CENTERLINE							16
21+00	RIFFLE	718.0	CENTERLINE	30	4:1	4:1				
21+50	ENTRANCE LOG JAM	SEE SHEET 0330-50CI-0039	CENTERLINE				46			6
						TOTAL	136	81	288	189

TABLE NOTES:

1. CENTERLINE ALIGNMENT (STA 0+00 TO 22+00).
2. CHANNEL BOTTOM WIDTH, ELEVATION, BANK SLOPE AND ALIGNMENT TO TRANSITION BETWEEN STATIONS AS SHOWN BY CONTOURS ON PLAN VIEW.
3. STATION FOR BOULDER CLUSTER PLACEMENT REPRESENTS CENTER OF OVERALL PLACEMENT.
4. KEY LOGS: 20 TO 30 FT LONG, 18 TO 30" DIAM WITH ROOTWADS.
5. SHORT KEY LOGS: 10 TO 15 FT LONG, 15 TO 30" DIAM WITH ROOTWADS.
6. FILLER ROOTWADS/RACKING MATERIAL: 10 TO 15 FT LONG, 8 TO 15" DBH WITH ROOTWADS.
7. POOL LOCATION REFERS TO OFFSET FROM CENTERLINE TO THALWEG.

JAY S. KIDDER STATE OF WASHINGTON 25485 REGISTERED PROFESSIONAL ENGINEER
EXPIRES: 5-1-2008

ORIGINAL SIGNED BY: JAY S. KIDDER, P.E.
DATE ORIGINAL SIGNED:
DOCUMENTS STORED AT PUD NO. 1 OF CHELAN COUNTY, WENATCHEE, WA

ORIG. DRAWN ANC
ORIG. DATE 8/31/2007

CONSULTANT								
PRIM. ENG. J. KIDDER	CHELAN PUD NO.1	SCALE SEE DWG	BAR IS ONE INCH ON ORIGINAL DRAWING. VERIFY SCALE 0 1" IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.					
2ND ENG. P. POWERS	PRIM. ENG.							
DESIGNER C. REYNOLDS	2ND ENG.	3	3/25/2015	AS BUILT		SBT	MPS	
APPROVAL J. KIDDER	PROJ. MGR.	REV	DATE	REVISION		REQ. BY	DRFT	

PUBLIC UTILITY DISTRICT NO. 1 OF CHELAN COUNTY
WENATCHEE, WASHINGTON

P.U.D. CHELAN COUNTY

Chelan Hydro
HABITAT CHANNEL SECTIONS AND DETAILS

BID 08-01

SHEET R7 OF R50
REVISION 3
DATE 3/25/2015
DWG. 0330-50CI-0024

DOCUMENT CLASS: ID: ORIGINAL DWG. #: R7

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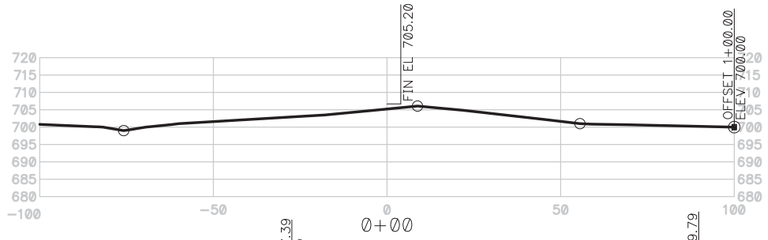

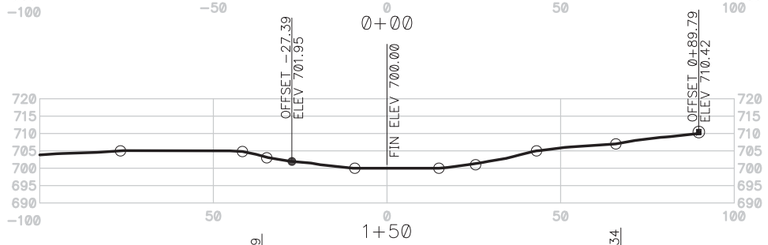

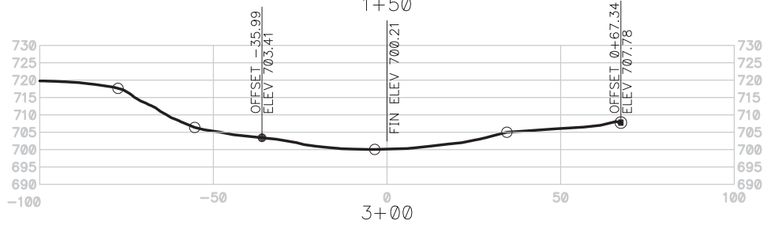

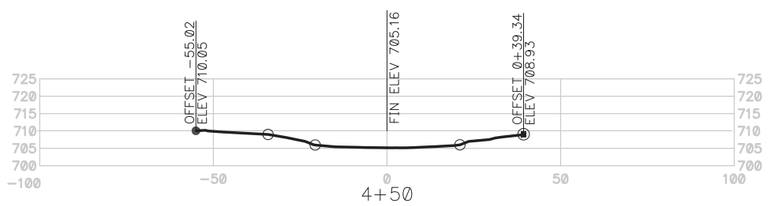

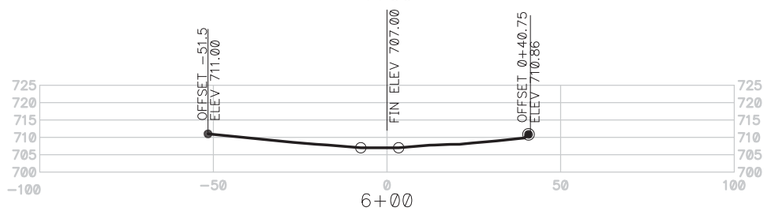

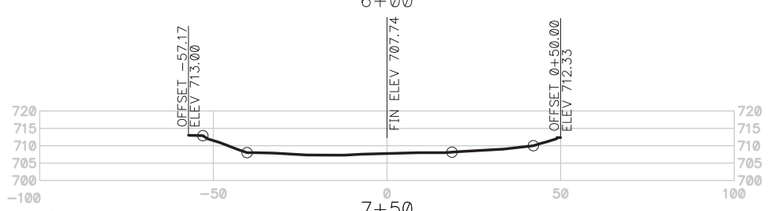

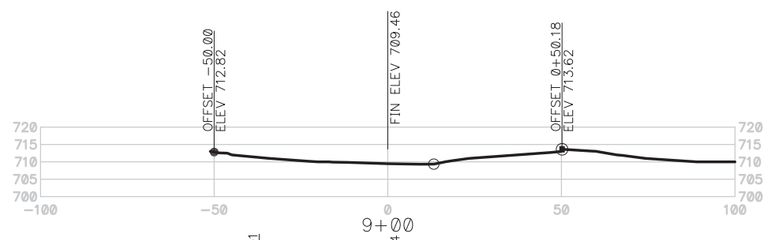

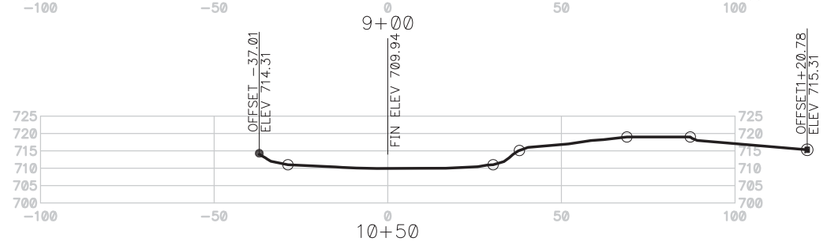

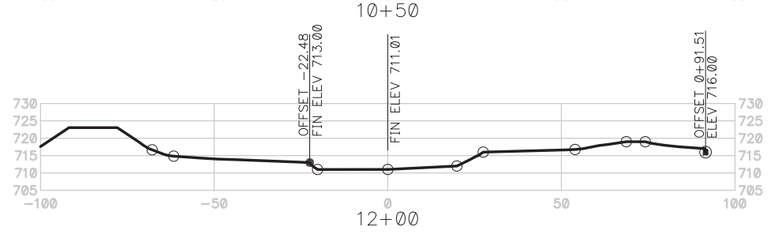

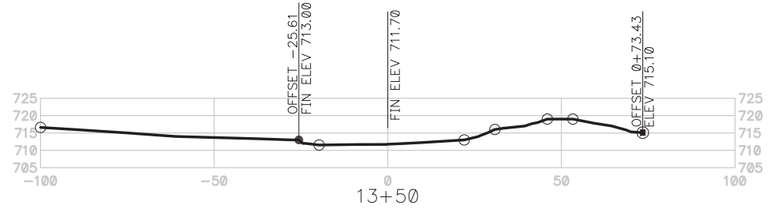

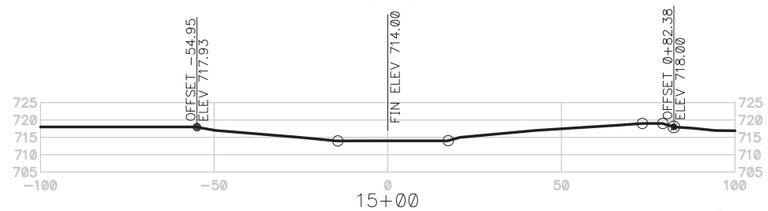

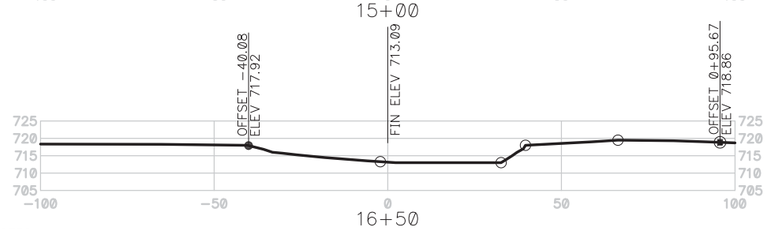

◉ EAST BANK/CATCH POINT

● WEST BANK/CATCH POINT

○ GRADE BREAK
(SEE TABLE 0330-50CI-0026)

FINISHED SURFACE

NOTES:

1. CROSS-SECTIONS ARE CUT LOOKING UP-STATION FROM HABITAT CHANNEL CENTERLINE

JAY S. KIDDER
STATE OF WASHINGTON
25405
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES: 5-1-2008

ORIGINAL SIGNED BY: JAY S. KIDDER, P.E.
DATE ORIGINAL SIGNED:
DOCUMENTS STORED AT PUD NO. 1 OF CHELAN COUNTY, WENATCHEE, WA

ORIG. DRAWN ANC
ORIG. DATE 8/31/2007

CONSULTANT			SCALE SEE DWG		BAR IS ONE INCH ON ORIGINAL DRAWING. VERIFY SCALE 0 1" IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.		
PRIM. ENG. J. KIDDER	CHELAN PUD NO.1						
2ND ENG. P. POWERS	PRIM. ENG.						
DESIGNER C. REYNOLDS	2ND ENG.	3	3/25/2015	AS BUILT	SBT	MPS
APPROVAL J. KIDDER	PROJ. MGR.	REV	DATE	REVISION	REQ. BY	DRFT

PUBLIC UTILITY DISTRICT NO. 1 OF CHELAN COUNTY
WENATCHEE, WASHINGTON

P.U.D. CHELAN COUNTY

Chelan Hydro
HABITAT CHANNEL SECTIONS

BID 08-01

SHEET R8 OF R50
REVISION 3
DATE 3/25/2015
DWG. 0330-50CI-0025

DOCUMENT CLASS: ID: ORIGINAL DWG. #: R8

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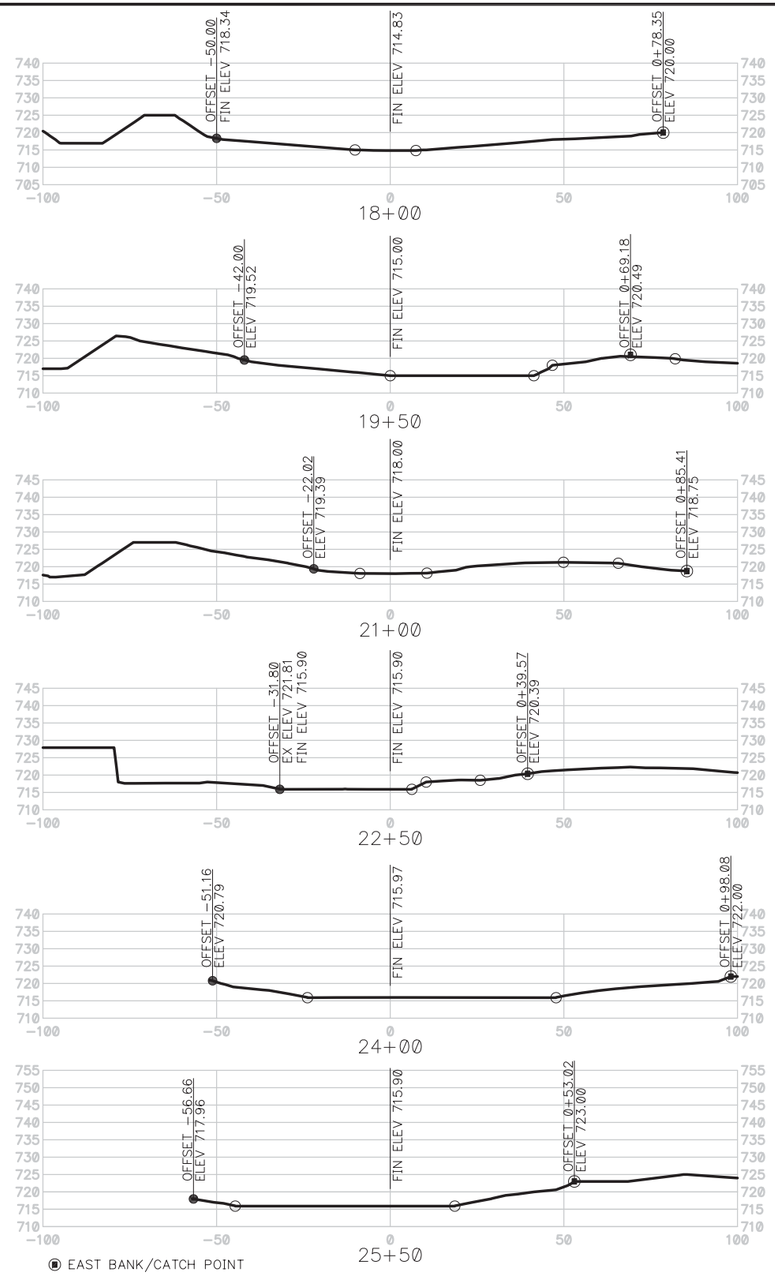

HABITAT CHANNEL SECTION GRADE BREAK TABLE

STATION	OFFSET	FINISHED ELEVATION
0+00	−98.63	700.72
	−75.81	699.00
	−70.19	699.88
	−57.17	701.16
	−34.25	702.53
	−4.27	704.79
	8.79	706.06
	20.26	705.00
	55.56	701.00
	89.32	700.24
1+50	−99.25	703.88
	−76.75	705.00
	−55.53	705.02
	−41.63	704.81
	−34.62	703.16
	−9.27	700.00
	14.95	700.00
	25.51	701.35
	43.07	705.00
	64.65	706.92
	65.90	707.00
3+00	−97.68	719.72
	−77.45	717.63
	−68.98	713.15
	−55.37	706.38
	−45.73	704.57
	−8.82	700.12
	−3.53	700.05
	1.84	700.20
	34.52	705.00
	39.85	705.36
4+50	−34.25	709.00
	−20.67	705.96
	21.00	706.00
6+00	−32.59	709.09
	−7.55	707.00
	3.35	707.00
	18.51	707.98
7+50	−53.02	712.89
	−40.28	708.00
	−13.90	707.28
	9.76	707.99
	14.90	708.00
	18.71	708.14
	42.15	710.00
9+00	13.25	709.34
	19.02	710.40

STATION	OFFSET	FINISHED ELEVATION
10+50	−28.75	711.00
	0.35	709.94
	30.33	711.03
	37.90	715.11
	68.84	719.00
	87.11	719.00
12+00	−67.86	716.66
	−61.65	714.84
	−35.23	713.49
	−27.83	713.21
	−20.22	711.00
	0.00	711.01
	19.89	712.00
	24.09	714.06
	27.48	715.99
	53.94	716.76
	68.68	719.00
	74.15	719.00
13+50	−100.00	716.59
	−19.78	711.53
	22.02	713.00
	30.85	716.01
	45.93	719.00
	53.30	719.00
15+00	−14.39	713.97
	17.41	714.04
	73.31	719.00
	79.18	719.00
16+50	−2.14	713.27
	17.84	713.00
	32.64	713.00
	39.65	718.00
	66.28	719.47
	76.06	719.38
18+00	−20.42	715.82
	−10.14	715.00
	7.34	714.82
19+50	0.00	715.00
	35.55	715.00
	41.35	715.00
	46.68	718.00
	75.91	720.23
	82.06	719.86
21+00	−16.68	718.56
	−8.74	718.06
	−6.36	718.06
	10.57	718.15
	37.69	721.04
	49.88	721.27
	53.15	721.22
	65.67	721.00
	73.42	719.87

STATION	OFFSET	FINISHED ELEVATION
22+50	6.22	715.90
	10.35	718.00
	17.61	718.45
	25.92	718.51
24+00	−25.82	716.36
	−23.83	715.90
	−12.04	715.90
	46.80	715.90
	47.75	715.90
25+50	−44.64	715.90
	−38.47	715.90
	−16.89	715.90
	4.92	715.90
	18.59	715.90

NOTES:

1. CROSS−SECTIONS ARE CUT LOOKING UP−STATION FROM HABITAT CHANNEL CENTERLINE

JAY S. KIDDER — STATE OF WASHINGTON — 25485 — REGISTERED PROFESSIONAL ENGINEER
EXPIRES: 5-1-2008

ORIGINAL SIGNED BY: JAY S. KIDDER, P.E.
DATE ORIGINAL SIGNED:
DOCUMENTS STORED AT PUD NO. 1 OF CHELAN COUNTY, WENATCHEE, WA

ORIG. DRAWN ANC
ORIG. DATE 8/31/2007

CONSULTANT

PRIM. ENG. J. KIDDER	CHELAN PUD NO.1	SCALE SEE DWG		BAR IS ONE INCH ON ORIGINAL DRAWING.	VERIFY SCALE 0 — 1" IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.		
2ND ENG. P. POWERS	PRIM. ENG.						
DESIGNER C. REYNOLDS	2ND ENG.	3	3/25/2015	AS BUILT		SBT	MPS
APPROVAL J. KIDDER	PROJ. MGR.	REV	DATE	REVISION		REQ. BY	DRFT

PUBLIC UTILITY DISTRICT NO. 1 OF CHELAN COUNTY
WENATCHEE, WASHINGTON

P.U.D. CHELAN COUNTY

Chelan Hydro
HABITAT CHANNEL SECTIONS
BID 08−01

SHEET R9 OF R50
REVISION 3
DATE 3/25/2015
DWG. 0330−50CI−0026

DOCUMENT CLASS: ID: ORIGINAL DWG. #: R9

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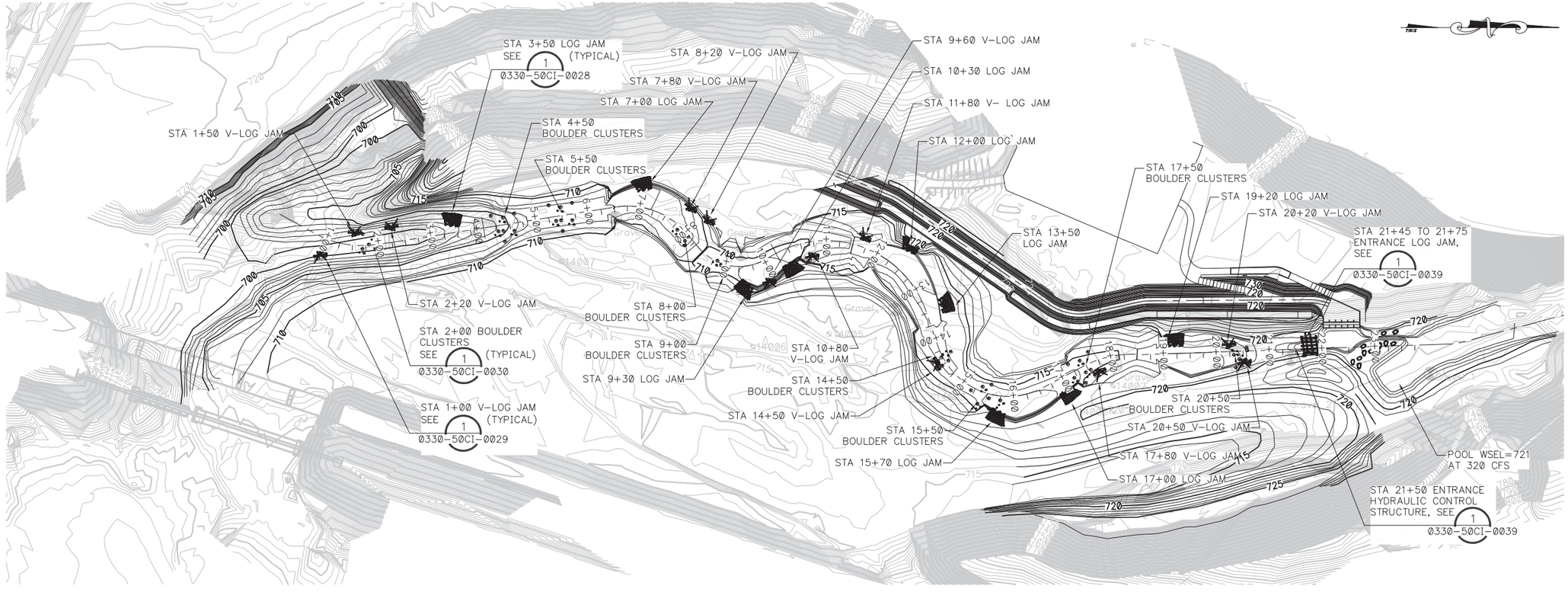

NOTE;

1. THIS DRAWING SHOWS THE LOCATION, CALLOUT AND TYPE AND QUANTITY OF LOG STRUCTURES AND BOULDER CLUSTERS FOUND IN THE HABITAT CHANNEL. SEE SHEET 0330-50CI-0024
2. THE ENTRANCE LOG JAM IS SHOWN FOR LOCATION ON THIS SHEET.
3. STRUCTURES ARE IDENTIFIED WITH THIS SHEET FOR THEIR PRIMARY LOCATION.

LEGEND

- LOG JAM
- V-LOG JAMS
- BOULDERS
- 14005 TEST PIT LOCATION
- 2 GRAVEL PAINT TEST LOCATIONS

JAY S. KIDDER STATE OF WASHINGTON 25485 REGISTERED PROFESSIONAL ENGINEER
EXPIRES: 5-1-2008

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CONSULTANT								
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APPROVAL J. KIDDER	PROJ. MGR.	REV	DATE	REVISION		REQ. BY	DRFT	

PUBLIC UTILITY DISTRICT NO. 1 OF CHELAN COUNTY
WENATCHEE, WASHINGTON

Chelan Hydro
LOG STRUCTURES PLAN
BID 08-01

SHEET R10 OF R50
REVISION 3
DATE 3/25/2015
DWG. 0330-50CI-0027

ORIG. DRAWN ANC
ORIG. DATE 8/31/2007

DOCUMENT CLASS: ID: ORIGINAL DWG. #: R10

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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	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
#1	0	0	0	0	0	0	0	66	0	0	36		1	0		4	0	0	0	0	0	0	0
#2	0	0	0	0	0	0	0	135	0	0	92		1	0		0	0	0	0	0	0	0	0
#3	0	0	0	0	0	0	0	293	0	0	3		0	5		0	0	0	0	0	0	0	0
#4	0	0	0	0	0	0	0	1300	0	0	17		1	0		0	0	0	0	0	0	0	0
#5	0	0	0	0	0	0	0	402	0	0	66		1	1		0	0	0	0	0	0	0	0
#6	0	0	0	0	0	0	0	1748	75	0	40		5	0		0	0	0	0	0	0	0	0
#7	0	0	0	0	0	0	0	1	30	0	1		0	0		0	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	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	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
#1	0	0	0	1	0	0	0	0	0	0	4		0	0		0	0	0	0	0	0	0	0
#2	0	0	0	0	0	0	0	0	0	0	27		0	0		0	0	0	0	0	0	0	0
#3	0	2	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0	0	0	0	0
#4	0	0	0	0	0	0	0	0	0	0	0		0	0		0	0	0	0	0	0	0	0
#5	0	1	0	0	0	1	0	0	0	0	8		0	0		1	0	0	0	0	0	0	0
#6	0	0	0	1	0	0	0	0	0	0	10		2	0		2	0	0	0	0	0	0	0
#7	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	0	0	0	0	845	0	0	69		11	0		1	0	0	0	0	0	0	0
Total	0	3	0	2	0	1	0	845	0	0	118		22	0		4	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
#1	0	0	0	0	0	0	0	0	0	0	14	0	3	0		0	0	1	0	1	0	0	0
#2	0	0	0	2	0	0	0	0	0	0	343	0	1	0		5	0	0	0	0	4	4	4
#3	0	0	0	2 (12", Tripl.)	0	0	0	287	50	0	28	0	4	0		0	0	0	0	0	0	0	0
#4	0	0	0	2 (12", Tripl.)	0	0	3	228	0	0	52	0	1	0		0	0	0	0	0	0	0	0
#5	0	0	0	0	0	0	4	660	200	0	100	0	4	0		1	0	0	0	0	0	0	0
#6	0	0	0	0	0	0	0	787	100	0	107	0	9	0		0	0	0	0	0	0	0	0
#7	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	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

JULY SURVEY CANCELLED - HIGH SPILL

Chelan River Habitat Channel Snorkel Fish Survey

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

3/11/2013 **Flow/Temperature in Channel - 84 cfs/6.2 C** **Flow/Temperature in Tailrace (powerhouse) - 843 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 >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Tailrace	0	1	0	0	0	0	0	0	0	0	41	0	0	0	0	0	0	0	0	0	0	0	0
Habitat Channel	0	3	0	2 (14",18")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pool	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	4	0	2	0	0	0	1	0	0	41	0	0	0	0	0	0	0	0	0	0	0	0

4/10/2013 **Flow/Temperature in Channel - 342 cfs/10.4 C** **Flow/Temperature in Tailrace (powerhouse) - 2368 cfs/10.7 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	1	0	0	0	0	0	25	0	0	54	1	0	0	0	0	0	0	0	0	0	0	0
#1	0	2	0	1 (12"-16)	0	0	0	0	0	0	110	0	0	0	0	0	0	0	0	0	0	0	0
#2	0	2	0	0	0	0	0	0	0	0	72	1	0	0	0	0	0	0	0	0	0	0	0
#3	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
#4	0	1	0	1 (12"-16)	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0
#5	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	1 (12"-16)	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0
#7	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	3	0	4 (12"-16)	0	0	0	5	0	0	158	1	1	0	1	1	0	0	0	0	0	0	0
Total	0	10	0	7	0	0	0	30	0	0	418	3	1	0	1	1	0	0	0	0	0	0	0

5/15/2013 **Flow/Temperature in Channel - 240 cfs/16.9 C** **Flow/Temperature in Tailrace (powerhouse) - 2281 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	9000	0	0	55	0	15	0	0	3	0	0	8	229	0	0	0
#1	0	0	0	2 (12"-16)	0	0	0	0	0	0	200	0	0	0	0	5	0	0	0	30	0	0	0
#2	0	0	0	1 (12"-16)	0	0	0	980	10	0	425	0	0	0	0	1	0	0	0	0	0	0	0
#3	0	0	0	2 (Notes)	0	0	0	940	0	0	90	0	1	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	5 (Notes)	0	0	0	1294	1	0	150	0	0	0	1	0	0	0	0	0	0	0	0
#5	0	0	0	2 (12"-16)	0	0	0	380	1	0	100	1	1	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	0	2 (12"-16)	0	0	225	13	0	225	0	7	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	1 (12"-16)	0	0	0	1	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0
Pool	0	0	0	2 (12"-16)	1 (12"-16)	0	0	21	9	0	825	0	18	0	0	18	0	0	0	0	0	9	0
Total	0	0	0	15	3	0	0	12841	34	0	2076	1	42	0	1	27	0	0	8	259	0	9	0

*Notes 3845

Rainbow Notes - Section3 = 1 Triploid 18", 1 RB 12"-16"; Section 4 = 2 Triploid 18", 1 possible Steelhead presmolt < 6", 2 RB 12"-16"

Chinook Fry Notes - Salmonid fry (assumed Chinook) have been using the leakage water and tailrace backwater in the spill overflow since early April. This area is too shallow to snorkel

Chelan River Habitat Channel Snorkel Fish Survey

6/14/2013 **Flow/Temperature in Channel - 203 cfs/19.1 C** **Flow/Temperature in Tailrace (powerhouse) - 2387 cfs/18.4 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	5	0	0	81	0	25	0	0	40	0	0	3	0	0	0	0
#1	0	0	0	1 (12"-16)	0	0	0	0	0	0	20	0	0	0	0	30	0	0	0	0	0	0	0
#2	0	0	0	1 (12"-16)	0	0	0	0	0	0	250	0	0	0	0	700	0	0	0	0	0	0	0
#3	0	0	0	4 (12"-16)	0	0	0	0	0	10	20	0	0	0	0	100	30	0	0	0	0	0	0
#4	0	0	0	1 (12"-16)	0	0	0	0	0	20	130	0	0	0	0	110	40	0	0	0	0	0	0
#5	0	0	0	2 (12"-16)	1 (12"-16)	0	0	0	0	50	125	0	2	0	0	110	30	0	0	0	0	0	0
#6	0	0	0	3 (12"-16)	1 (12"-16)	0	0	0	0	13	70	0	3	0	0	50	20	0	0	0	0	0	0
#7	0	0	0	0	0	0	0	1	0	24	335	2	0	0	0	753	0	0	0	0	0	0	0
Pool	0	0	0	1 (12"-16)	3 (12"-16)	0	0	1	0	139	236	10	14	0	0	202	0	0	0	0	0	4	0
Total	0	0	0	13	5	0	0	7	0	256	1267	12	44	0	0	2095	120	0	3	0	0	4	0

Notes: 1 Tench in Pool, numerous smallmouth fry in pool and throughout Habitat Channel

Rainbow/steelhead Fry - 40mm-80mm size range with most near the 40mm part of range - inhabiting very shallow cobble/boulder habitat at stream margins

Pikeminnow on Section 7 were moving back and forth between pool, under log structure and Section 7 - may have double counted

7/18/2013 **Flow/Temperature in Channel - 82 cfs/20.1 C** **Flow/Temperature in Tailrace (powerhouse) - 2428 cfs/21.0 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	1	0	0	1 (12")	0	0	0	0	0	0	78	1943	30	0	0	2	0	0	0	0	0	0	0
#1	0	0	0	0	0	0	0	0	0	12	0	5	8	0	0	0	0	0	0	0	0	0	0
#2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
#3	1	0	0	0	0	0	0	0	0	14	0	88	0	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	0	0	0	0	0	0	34	0	0	0	0	0	0	0	0	0	0	0	0	0
#5	0	0	0	2 (<10")	0	0	0	0	1	18	10	8	0	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	1 (16")	1 (12")	0	0	0	0	9	38	54	3	0	0	17	0	0	0	0	0	0	0
#7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pool	3	0	0	(2-18",3-16'	1 (12"-16")	0	0	1	0	0	48	34	9	0	0	54	0	0	0	0	0	0	0
Total	5	0	0	9	2	0	0	1	1	87	174	2133	50	0	0	73	0	0	0	0	0	0	0

Notes: Chinook in tailrace was a jack, one sculpin counted in Section 3

Rainbow/steelhead Parr - 30mm-60mm size range inhabiting mid stream areas behind largecobble/boulder riffle mex substrate, distinctive parr marks

8/15/2013 **Flow/Temperature in Channel - 87 cfs/22.2 C** **Flow/Temperature in Tailrace (powerhouse) - 2420 cfs/23.7 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	1 (12"-16")	0	0	0	0	0	0	0	13	27	0	0	0	0	0	0	17	0	0	0
#1	0	0	0	0	0	0	0	0	0	0	0	0	23	0	0	0	0	0	0	0	0	3	0
#2	0	0	0	0	0	0	0	0	0	3	0	3	22	0	0	0	0	0	0	0	0	0	0
#3	0	0	0	0	0	0	0	0	0	2	0	0	21	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0
#5	0	0	0	0	0	0	0	0	0	0	4	1	9	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	2 (12"-16")	0	0	0	0	0	0	11	14	5	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	2 (12"-16")	0	0	0	0	0	0	13	2	32	0	0	0	0	0	0	0	0	2	0
Pool	0	0	0	0	0	0	0	0	0	0	2	0	7	0	0	0	0	0	0	0	0	3	0
Total	0	0	0	5	0	0	0	0	0	5	31	33	148	0	0	0	0	0	0	17	0	8	0

9/10/2013 **Flow/Temperature in Channel - 85 cfs/20.2 C** **Flow/Temperature in Tailrace (powerhouse) - 2450 cfs/22.0 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	4	0	0	0	0	0	0	0	0	0	0	126	21	0	0	0	0	0	0	0	30000	3	0
#1	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	200	0	0
#2	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	50	0	0
#3	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0
#5	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	40	0	0
#6	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	10	0	0
#7	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	1000	0	0
Pool	1	0	0	2 (6"-8")	0	0	0	0	0	0	17	12	2	0	0	0	0	0	0	0	1340	0	0
Total	5	0	0	2	0	0	0	0	0	0	18	191	23	0	0	0	0	0	0	0	32640	3	0

Notes: Turbid due to gravel relocation in progress

Chelan River Habitat Channel Snorkel Fish Survey

10/3/2013 **Flow/Temperature in Channel - 84 cfs/15.7 C** **Flow/Temperature in Tailrace (powerhouse) - 2470 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	20	0	0	0	0	0	0	0	0	0	0	29	3	12	0	0	0	0	0	0	15000	2	0
#1	2	0	0	2 (>6")	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
#2	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	600	0	0
#3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	0	0
#4	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	90	0	0
#5	0	0	0	1 (>6")	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	510	0	0
#6	0	0	0	0	0	0	0	0	0	0	4	0	1	0	0	0	0	0	0	0	0	0	0
#7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pool	45	0	0	2 (>6")	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	550	0	0
Total	70	0	0	5	0	0	0	0	0	0	48	29	4	13	0	0	0	0	0	0	16781	2	0
Notes	Two sockeye in pool																						

11/5/2013 **Flow/Temperature in Channel - 85 cfs/11.4 C** **Flow/Temperature in Tailrace (powerhouse) - 2390 cfs/13.0 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	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
#1	42	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0
#2	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#3	58	0	0	0	0	2 (12"-14")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#4	30	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#5	77	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#6	46	5	0	2 (>12")	0	1 (12"-14")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#7	48	0	0	1 (>12")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pool	113	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	442	6	0	3	1	3	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0

3/13/2014 **Flow/Temperature in Channel - 82 cfs/7.1 C** **Flow/Temperature in Tailrace (powerhouse) - 1260 cfs/7.7 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	3	0	5	0	0	0	0	0	0	154	0	0	0	0	8	0	0	0	0	0	0	0
#1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#7	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	3	0	5	0	0	0	0	0	0	154	0	0	0	0	8	0	0	0	0	0	0	0

4/23/2014 **Flow/Temperature in Channel - 287 cfs/11.3 C** **Flow/Temperature in Tailrace (powerhouse) - 1270 cfs/11.4 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	4090	0	0	1	2	0	0	0	8	0	0	0	6	0	0	0
#1	0	0	0	1 (>12")	0	0	0	25	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
#2	0	0	0	0	0	0	0	1400	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0
#3	0	0	0	1 (>12")	0	0	0	2700	0	0	150	0	0	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	0	0	0	0	1700	0	0	31	0	0	0	0	0	0	0	0	0	0	0	0
#5	0	0	0	0	0	0	0	3070	0	0	26	0	0	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	0	0	0	0	1650	0	0	28	0	0	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	2(>12")1(<12	0	0	0	490	0	0	22	0	20	0	0	0	0	0	0	0	0	0	0
Pool	0	0	0	1 (12")	0	0	0	2600	0	0	125	0	2	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	6	0	0	0	17725	0	0	404	2	22	0	0	8	0	0	0	6	0	0	0
Notes	19 Hatchery Chinook smolts in the swim area																						

Chelan River Habitat Channel Snorkel Fish Survey

5/21/2014 **Flow/Temperature in Channel - 205 cfs/17.2 C** **Flow/Temperature in Tailrace (powerhouse) - 2500 cfs/16.7 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	3000	0	0	2	0	0	0	0	0	0	0	0	200	3000	0	0
#1	0	0	0	0	0	0	0	0	0	0	1200	0	0	0	9	0	0	0	0	3	0	0	0
#2	0	0	0	0	0	0	0	3110	0	0	100	0	2	0	0	2	0	0	0	0	0	0	0
#3	0	0	0	0	1	0	0	550	0	0	37	0	3	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	1(12")2(14)	2	0	0	750	0	0	60	0	2	0	0	0	0	0	0	0	0	0	0
#5	0	0	0	0	0	0	0	100	0	0	300	0	6	0	0	12	0	0	0	0	0	0	0
#6	0	0	0	0	0	0	0	200	0	0	30	0	6	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	0	0	0	0	0	0	0	60	0	0	0	0	0	0	1	0	0	0	0	0
Pool	0	0	0	0	0	0	0	22	0	0	325	0	11	0	0	17	0	0	0	0	0	0	0
Total	0	0	0	3	3	0	0	7732	0	0	2114	0	30	0	9	31	0	1	0	203	3000	0	0
Notes	300 Chinook fry in the swim area							4710															

6/17/2014 **Flow/Temperature in Channel - 207 cfs/17.1 C** **Flow/Temperature in Tailrace (powerhouse) - 2510 cfs/16.7 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	6	2	6	0	0	2	0	0	6>24"	108	0	0	0
#1	0	0	0	0	0	0	0	0	0	0	30	5	3	0	0	65	0	0	0	0	0	0	0
#2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1000	0	0	0	0	0	0	0
#3	0	0	0	4(16")	0	0	0	0	0	0	100	6	5	0	0	400	0	0	0	0	0	0	0
#4	0	0	0	1(8")	1	0	0	0	0	0	200	800 fry	2	0	0	500	0	0	0	0	0	0	0
#5	0	0	0	1(12")	0	0	0	0	0	0	400	0	3	0	0	1000	0	0	0	0	0	0	0
#6	0	0	0	3(12")1(18")	0	0	0	0	0	3 parr	150	2, 1000 fry	0	0	0	150	0	0	0	0	0	0	0
#7	0	0	0	12(12")	1	0	0	0	0	0	500	5, 1000 fry	0	0	0	500	0	0	0	0	0	0	0
Pool	0	0	0	1(16")	1	0	0	0	0	0	700	15	25	0	0	550	0	0	0	0	0	0	0
Total	0	0	0	23	3	0	0	0	0	3	2086	35	44	0	0	4167	0	0	6	108	0	0	0
Notes	Swim Area-12 smallmouth<12", 4>12", 12 Bluegill, 3 Tench Rainbow Notes - Section 6 = 18" was Triploid											Smallmouth plus 2800 fry											

7/9/2014 **Flow/Temperature in Channel - 1003 cfs/22.0 C** **Flow/Temperature in Tailrace (powerhouse) - 2460 cfs/21.6 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	53	0	0	0	0	0	0	0	0	0	18	6	15	0	0	5	0	0	9	0	1 school	0	0
#1	0	0	0	0	0	0	0	0	0	0	400	2	5	0	0	1500	500	0	0	0	0	0	0
#2	0	0	0	0	0	0	0	1 parr	0	0	210	5, 50 fry	1	0	0	500	200	0	0	0	0	0	0
#3	0	0	0	0	0	0	0	0	0	0	400	3	1	0	0	200	250	200	0	0	0	0	0
#4	0	0	0	4 (4")	0	0	0	0	0	0	50	1	1	0	0	800	0	0	0	0	0	0	0
#5	0	0	0	3 (8")	1(10")	0	0	0	0	0	70	0, 400 FRY	9	0	0	5	0	0	0	0	0	0	0
#6	0	0	0	3(<12")	0	0	0	0	0	0	100	4, 200 fry	18	0	0	420	500	1000	0	0	0	0	0
#7	0	0	0	1	0	0	0	0	0	0	0	0	6	0	1	0	0	0	0	0	0	0	0
Pool	7	2	0	0	0	0	0	0	0	0	800	0	10	0	0	800	0	0	0	0	0	0	0
Total	60	2	0	11	1	0	0	1	0	0	2048	21	66	0	1	4230	1450	1200	9	0	1 school	0	0
Notes	Swim Area-7 smallmouth<12", 1>12"											Smallmouth plus 650 fry											

8/28/2014 **Flow/Temperature in Channel - 84 cfs/21.4 C** **Flow/Temperature in Tailrace (powerhouse) - 2480 cfs/22.9 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	2	2	0	0	0	0	0	0	0	20	0	0
#1	0	0	0	0	0	0	0	0	0	0	0	10	20	0	0	0	0	0	0	0	0	0	0
#2	0	0	0	0	0	0	0	0	0	0	0	5	6	0	0	0	0	0	0	0	0	0	0
#3	0	0	0	1(6")	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
#4	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
#5	0	0	0	3(>12")	0	0	0	0	0	0	0	6	1	0	0	1	0	0	0	0	0	0	0
#6	0	0	0	0	0	0	0	0	0	0	14	6	6	0	0	0	6	0	0	0	0	0	0
#7	0	0	0	3(12")	1(8")	0	0	0	0	0	1	8	0	0	0	0	0	0	0	0	0	0	0
Pool	161	0	0	1 (>12")	0	0	0	0	0	0	18	12	14	0	0	0	0	0	0	0	0	0	0
Total	161	0	0	8	1	0	0	0	0	0	33	54	49	0	0	1	7	0	0	0	20	0	0
Notes	Pool had 2 dead Chinook adults																						

Chelan River Habitat Channel Snorkel Fish Survey

9/25/2014 **Flow/Temperature in Channel - 87 cfs/18.2 C** **Flow/Temperature in Tailrace (powerhouse) - 2460 cfs/19.1 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	124	0	0	1(9")	0	0	0	0	0	0	1	4	1	0	0	0	0	0	0	0	800	0	0
#1	1	0	0	1(22")	0	1(24")	0	0	0	0	15	4	0	0	0	0	0	0	0	0	3000	0	0
#2	0	0	0	0	0	0	0	0	0	0	5	4	3	0	0	0	0	0	0	0	150	0	0
#3	1	0	0	2(8")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	200	0	0
#4	0	0	0	3(8",10",18")	0	0	0	0	0	1 parr	4	3	8	0	0	0	0	0	0	0	50	0	0
#5	0	0	0	2(8"),2(12")	0	0	0	0	0	0	3	4	2	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	5(12")	2(12")	0	0	0	0	0	9	4	3	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	1	0	0
Pool	375	0	0	, 3(12") 1	0	0	0	0	0	0	30	6	5	0	0	0	0	0	0	0	0	0	0
Total	501	0	0	22	2	1	0	0	0	1	67	33	26	0	0	0	0	0	0	0	4201	0	0
Notes	Dead Chinook Adults - #1-1, #2-2, Pool-3											Swim Area-18 smallmouth<12", many stickleback											

11/25/2014 **Flow/Temperature in Channel - 287 cfs/9.5 C** **Flow/Temperature in Tailrace (powerhouse) - 2340 cfs/9.6 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	100s+	8	0	0	0	2(13"), 1(15") 1(21")	3(11")	0	0	0	130	0	0	0	0	0	0	0	0	0	0	0	0
#1	3	0	0	0	0	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0
#2	5	0	0	1(15"),1(17")	0	1(21")	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
#3	1	0	0	1(11")	0	0	2(11")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#4	0	1(21")	0	2(15"),1(17")	0	1(17")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#5	0	0	1	1(15")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#6	0	0	0	1(11"), 1(13") 2(15")	0	1(13")	1(15")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#7	0	0	0	0	0	0	1(11")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pool	0	0	0	1(15"), 2(19")	0	1(7")	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0
Total	9 + 100s	9	1	14	0	8	7	0	0	0	170	0	16	0	0	0	0	0	0	0	0	0	0
Notes	Swim Area-565 stickleback																						

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

AUGUST REACH 1-3 SURVEYS CANCELLED - SAFETY POLICY ISSUES REGARDING ACCESS/SPILLWAY TAGOUTS

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

4/9/2013 **Flow/Temperature in River - 83 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 >6"	Chiselmouth	Peamouth	Walleye	Carp	Stickleback	Bluegill	Cyprinid Fry
Reach 1	0	0	0	5 (10"-15")	5 (10"-15")	0	0	0	0	0	0	0	0	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	0	0
Reach 3	0	0	0	5 (10"-15")	3 (10"-15")	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	10	8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0

Chelan River Reach 1-3 Snorkel Fish Survey

8/16/2013 **Flow/Temperature in River - 87 cfs/22.4 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
Reach 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reach 2	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reach 3	0	0	0	0	2 (> 6")	0	0	0	0	0	0	3	4	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

11/5/2013 **Flow/Temperature in River - 85 cfs/14.4 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
Reach 1	0	0	0	1 (12"-14")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reach 2	0	0	0	7 (12"-14")	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Reach 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	8	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0

4/22/2014 **Flow/Temperature in River - 88 cfs/12.4 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
Reach 1	0	0	0	5 (6"- >12")	19 (8"- 18")	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Reach 2	0	0	0	5 (12"-16")	2 (12"-14")	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
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	10	21	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0

8/25/2014 **Flow/Temperature in River - 85 cfs/22.1 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
Reach 1	0	0	0	58 (>6")	6(<6")5(>6")	0	0	0	0	0	0	125	2	0	10	0	0	0	0	0	0	0	0
Reach 2	0	0	0	39 (>6")	2 (>6")	0	0	0	0	0	0	70	4	0	0	0	0	0	0	0	0	0	0
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	97	13	0	0	0	0	0	0	195	6	0	10	0	0	0	0	0	0	0	0

1 Tench >6"

11/24/2014 **Flow/Temperature in River - 83 cfs/9.4 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
Reach 1	0	0	0	51	20	0	0	0	0	0	0	7	0	0	0	1	0	0	0	0	0	0	0
Reach 2	0	0	0	32	1(9")	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	83	21	0	0	0	0	0	0	7	0	0	0	1	0	0	0	0	0	0	0

5 Tench >6"; Rainbow Reach 1 - 1-7",6-9",15-11",1-12",7-13",6-15", 15>12"; Cutthroat Reach 1 - 2-7",4-9",4-11",8-13",2-15"
Reach 2 survey incomplete - too dark; Rainbow Reach 2 - 2-9:,2-11",25-13",3-15"

APPENDIX C: CONSULTATION RECORDS

Chelan PUD is providing a draft of the 2015 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 second report to be due April 30,
2015.

The following individuals were sent draft copies for a 30-day review period.

NAME	***AGENCY***	***Comments***
Coffin, Chris	Washington State Department of Ecology	
McKinney, Charlie	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	
Grover Wier, Kari	United States Department of Agriculture – Forest Service	
Martinez, Alex	United States Department of Agriculture – Forest Service	
Vacirca, Richard	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	
Goedde, Robert	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	
Petersen, Wai	Manson Parks and Recreation Department	
Uhlhorn, Richard	Lake Chelan Recreation Association	
O'Keefe, Thomas	American Whitewater	

From:	Hays, Steve
To:	"chris.coffin@ecy.wa.gov"; ""McKinney Charlie"; "Jim Pacheco"; "Korth, Jeffrey "; "Graham Simon"; "travis.maitland@dfw.wa.gov"; "Gina.McCoy@dfw.wa.gov"; "Kari Grover Wier"; "Alex Martinez (ramartinez@fs.fed.us)"; "rvacirca@fs.fed.us"; "Ashley_Rawhouser@nps.gov"; "Hugh_Anthony@nps.gov"; "Steve Lewis (Stephen_Lewis@fws.gov)"; "Rich Domingue (richard.domingue@noaa.gov)"; "Justin Yeager (Justin.Yeager@noaa.gov)"; "Bill Towey"; "Bob Rose (rosb@yakamafish-nsn.gov)"; "Carl Merkle (carlmerkle@ctuir.com)"; "Robert Goedde (bgoedde@cityofchelan.us)"; "Phil Archibald (ndmarkey@gmail.com)"; "Nick Elwell"; "tom.ernsberger@parks.wa.gov"; "nona.snell@rco.wa.gov"; "wai@mansonparks.com"; "Richard Uhlhorn (richard@richarduhlhorn.com)"; "Thomas O"Keefe (okeefe@amwhitewater.org)"
Cc:	Osborn, Jeff; Smith, Michelle; Sokolowski, Rosana; Frantz, Waikele M.; Steinmetz, Marcie; Bitterman, Deborah; Buehn, Scott; Campbell, Rob; Willard, Catherine
Subject:	For Review - Draft 2015 Chelan River Biological Objectives Status Report
Date:	Monday, March 16, 2015 1:41:21 PM
Attachments:	Final Draft 2015 Biological Objectives Status Report.pdf Final Draft 2015 Biological Objectives Status Report.docx

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P U B L I C U T I L I T Y D I S T R I C T N O . 1 o f C H E L A N C O U N T Y

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(509) 663-8121 • Toll free 1-888-663-8121 • 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)

City of Chelan

Lake Chelan Sportsman Association

United States Geological Survey

Washington State Parks and Recreation Commission

Washington State Recreation and Conservation Office

Manson Parks and Recreation Department

Lake Chelan Recreation Association

American Whitewater

From: Steven Hays, Fish & Wildlife Senior Advisor

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

steve.hays@chelanpud.org

(509)661-4181

Re: Lake Chelan Hydroelectric Project No. 637 (Project)

License Article 408

Draft 2015 Chelan River Biological Objectives Status Report

Dear Chelan River Fishery Forum,

The Draft 2015 Chelan River Biological Objectives Status Report is attached for your review. The due date for comments is April 16, 2015. 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.

Thank you in advance for your review of this document. Please submit your comments to me on or before 3:00 PM, Thursday, April 16, 2015.

In addition, please feel free to call me or email questions/comments to me as you review this report.

Regards,

Steve

Steven Hays

Fish and Wildlife Senior Advisor

steve.hays@chelanpud.org

(509) 661-4181

From: Hays, Steve
Sent: Thursday, April 23, 2015 11:23 AM
To: 'Pacheco, James (ECY)'
Subject: Comments on Chelan River Biological Objectives Status Report

Jim,

The comment period for the Chelan River Biological Objectives Status Report has ended and you are the only person who provided comments. Thank you for taking the time to review the draft and providing the comments.

I have modified the report in response to your comments, either incorporating the edits verbatim or modifying language to address the edits and comments. Below is a summary of the changes, identified by the page number in the draft:

Page 10:
Comment:

2014, with a high count of 729 in 2013 (Table 2-1). Prior to 2008, the highest redd count was 253. Spawning has also been distributed throughout the ~~available~~ suitable habitat created in the tailrace and in the Reach 4 Habitat Channel (Table 2-2)~~, with all areas being used~~.

Comment [JP1]: There were places even the Chinook did not use so the "all" statement is not correct.

Change to Report:

2014, with a high count of 729 in 2013 (Table 2-1). Prior to 2008, the highest redd count was 253. Spawning has also been distributed throughout the suitable habitat created in the tailrace and in the Reach 4 Habitat Channel (Table 2-2).

Page 11:
Comment:

Washington Department of Ecology (Ecology), Washington Department of Fish and Wildlife (WDFW), and Chelan PUD staff have commented that water velocities being provided in the Habitat Channel currently, particularly for steelhead, ~~may be~~are too high, based on Habitat Suitability Index (HSI) measurements, flow observations in stream margin habitat and log structures during early rearing of Chinook salmon fry, and best professional judgment that the Habitat Channel "just looks better" at lower flows. A remedy for reducing flows in the Habitat

Comment [JP2]: The PHABSIM analysis showed more suitable habitat at the lower flow.

Change to Report:

Washington Department of Ecology (Ecology), Washington Department of Fish and Wildlife (WDFW), and Chelan PUD staff have commented that water velocities being provided in the Habitat Channel currently, particularly for steelhead, are higher than desirable when all pumps are operating. Observations included Ecology's Habitat Suitability Index (HSI) measurements, which showed more suitable habitat at lower flows, flow observations in stream margin habitat and log structures during early rearing of Chinook salmon fry, and best professional judgment that the Habitat Channel would provide more habitat for steelhead spawning and juvenile Chinook rearing at lower flows. A remedy for reducing flows in the Habitat Channel for Chinook salmon and steelhead spawning and Chinook salmon fry early rearing is to reduce the number of pumps operated during the March 15 through May 15 steelhead spawning period. Lower flows can be provided by reducing pump operations from 5 pumps to 4 pumps (200-208 cfs) and

Page 26:

Comment:

The first redds have been observed in late March, with the majority of spawning initiated in mid to late April. In 2011, one redd was initiated at the end of May. Steelhead redds were distributed ~~throughout~~ in limited areas of the Habitat Channel and a few redds were also in the pool formed by the hydraulic control structure. Most of the redds have been in the vicinity of cover from either boulders or log structures. Steelhead redds were 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~~ velocities in the Habitat Channel ~~may be~~are 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

Change to Report:

The first redds have been observed in late March, with the majority of spawning initiated in mid to late April. In 2011, one redd was initiated at the end of May. In the Habitat Channel, steelhead redds (2011-2013) were most concentrated in the downstream sections (22 and 10 redds from downstream to upstream), with fewer redds in the upper sections (3, 3 and 7 redds). A few redds were also in the pool formed by the hydraulic control structure. Most of the redds have been in the vicinity of cover from either boulders or log structures. Steelhead redds were 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 velocities in some areas of the Habitat Channel are 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

Page 27:
Comment:

preference for this species, with some redds deeper than 30 inches and in velocities exceeding three feet per second. Also, the higher flows reduce the available low velocity habitat preferred by Chinook fry, which are rearing in the Habitat Channel from April – June.

Comment [JP3]: Let's verify this. The data I looked at showed SH redds at locations predicted by the preference curve.

would provide suitable conditions for steelhead spawning and early rearing. It appeared that the availability of suitable small gravel substrate has diminished over time including some of the

Comment [JP4]: Diminished gravel did not only occur in old spawning areas, but in areas throughout the channel

Change to Report:

result in Habitat Channel flows of 340 cfs or greater. Depth and velocity measurements taken in 2011 and 2013 at steelhead redds found most were within the expected preferences for this species, but some redds were deeper than 30 inches (8 of 34) or with mid-depth velocities exceeding three feet per second (4 of 34). Also, the higher flows reduce the available low velocity habitat preferred by Chinook fry, which are rearing in the Habitat Channel from April – June.

The Chelan River Fishery Forum has approved testing a lower flow during the steelhead spawning period, which is discussed in Section 3.2.1.

Degree of Achievement of Objective

The Habitat Channel was constructed to provide spawning and rearing habitat for Chinook salmon and steelhead, with an expectation that the wood and boulder cover and riffle habitat would provide suitable conditions for steelhead spawning and early rearing. It appeared that the availability of suitable small gravel substrate has diminished over time, including some of the areas of the Habitat Channel where steelhead redds had been observed. To provide more small gravel substrate, the CRFF approved the addition of 70 cubic yards of small gravel to various

Page 28:
Comment:

3.2 Steelhead Use of Spawning Habitat Throughout Constructed Habitat

The distribution of steelhead redds within the Habitat Channel was fairly even between the upper and lower parts of the channel in 2010 and 2011. However, by 2013 the preponderance of redds was in the lower channel areas, while the upper part of the channel had only two of the 21 redds observed. This observation is concurrent with the observation that some of the small gravel

Comment [JP5]: This is not what I remember. Can we review the photos?

Change to Report:

3.2 Steelhead Use of Spawning Habitat Throughout Constructed Habitat

The distribution of steelhead redds within the Habitat Channel was fairly even between the upper and lower parts of the channel in 2010 and 2011. However, by 2013 the preponderance of redds was in the lower channel areas, while the upper part of the channel had only three of the 20 redds observed in the Habitat Channel. This observation is concurrent with the observation that some of the small gravel patches in the upper Habitat Channel that were previously used by spawning steelhead appeared to have diminished. The Habitat Channel has changed over time, with a more

Jim,

I do not have redd maps for 2010, but for 2011 there were 9 redds in the lower sections (2 and 3) and 8 redds in sections 4-6. The main point of the discussion is that since the first two years of steelhead redd counts, the proportion of redds has shifted to be predominately in the lower two sections. I did find that I had missed counting one of the redds in the upper three sections in the 2013 maps, so I made that correction and also changed the sentence to just reference the redds in theHabitat Channel.

Thank you again for your comments,

Steven Hays
Fish and Wildlife Senior Advisor
steve.hays@chelanpud.org
(509) 661-4181