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Subject: RRF: Draft Five-Year Rocky Reach Biological Objectives Report
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Hello RRF,

Attached for your review is Chelan PUD's draft Five-Year Rocky Reach Biological Objectives Report. **Please send Steve Hemstrom your comments on the draft report by no later than Friday, 21 February 2014.** This report is required by FERC and the final will be submitted to the RRF and DOE by 30 March 2014. The Biological Objectives identified in the attached draft report are contained in the Water Quality 401 Permit for the Rocky Reach License.

Please let me or Steve Hemstrom know if you have questions.

Thanks,
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ROCKY REACH BIOLOGICAL OBJECTIVES 2013 STATUS REPORT

LICENSE ORDERING PARAGRAPH D, APPENDIX A, SECTION 5.3(3)

Draft

**ROCKY REACH HYDROELECTRIC PROJECT
FERC Project No. 2145**

January 30, 2014



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

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SECTION 1: INTRODUCTION

The Rocky Reach 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) was issued on February 19, 2009 and authorizes Chelan PUD to operate the Rocky Reach Dam and its reservoir for a period of 43 years. The License incorporated conditions regarding biological objectives that are anticipated to be achieved at the Rocky Reach Dam and in the Rocky Reach Reservoir (Ordering Paragraph D, Appendix A, Section 5.3(3)).

In accordance with the License Order issued by the FERC and the 401 Water Quality Certification issued by the Washington Department of Ecology (WDOE) on March 17, 2006 (WDOE 2006), Public Utility District No. 1 of Chelan County, Washington (Chelan PUD) is required to prepare a Biological Objectives Status Report in consultation with the Rocky Reach Fish Forum (RRFF). The draft report is due to WDOE and the RRFF on or before February 1, 2014, with a final draft due March 30, 2014 within five years (2013) of the effective date of the new license.

This Biological Objectives Status Report summarizes Chelan PUD's progress towards achieving the biological objectives for Designated Uses set forth in the 401 Water Quality Certification (Table 1-1) for the Rocky Reach License. Management Plans with associated Biological Objectives are the:

- 1) Rocky Reach Anadromous Habitat Conservation Plan (HCP);
- 2) Bull Trout Management Plan;
- 3) White Sturgeon Management Plan
- 4) Pacific Lamprey Management Plan;
- 5) Resident Fish Management Plan

For each biological objective, the report reviews (1) the results of each monitoring and evaluation program, and evaluates the need for modification of the program, (2) describes the degree to which the Biological Objectives have been achieved, and the prospects for achieving those objectives in the next reporting period, (3) reviews management options (both operational and structural) taken to meet those Biological Objectives, and (4) recommends any new or modified implementation, monitoring and/or evaluation measures that are needed to meet the Biological Objectives, to the extent reasonable and feasible.

Table 1-1. Biological Objectives and implementation measures per the Rocky Reach Fish Management Plans to support existing and designated uses.

Biological Objective	Evaluation Timeframe	Actions if Objective Achieved	Alternative Management Actions	Fish Management Plan Action
HCP Plan Species (Chinook, Steelhead, Sockeye, Coho) 91% Project Passage Survival	By 2013	Maintain Action.	Additional Tools (Bypass modifications, spill, other)	HCP Sections 3 and 5
HCP Plan Species NNI Hatchery Production Achieves 7%	By 2013	Maintain Action. Adjust 7% Production Level Every 10 Years	Modify hatchery facilities or use other method for artificial production	HCP Sections 3 and 8
HCP Plan Species Tributary Fund Implements Habitat Improvements For NNI	By 2013	Maintain Action.	Modify type of projects funded	HCP Sections 3 and 7
HCP Plan Species Adult Passage Survival Included in 91% Project Passage Survival.	By 2013	Maintain Action.	Additional Tools	HCP Sections 3 and 5
Take does not exceed 2% through the upstream fishway.	2005-2008	Maintain Action. Continue appropriate monitoring and the adaptive management process.	Develop and implement a plan, in consultation with the RRFF, to address identified problems.	Bull Trout Plan Sections 4.1.1-4.1.3
Take does not exceed 5% passing through turbines; 2% passing through spillways; and 2% passing through the downstream bypass.	2005-2008	Maintain Action. Continue appropriate monitoring and the adaptive management process.	Develop and implement a plan, in consultation with the RRFF, to address identified problems.	Bull Trout Plan Section 4.1.2
Take does not exceed 2 fish for the fish predator control program.	2005-2008	Maintain Action. Continue appropriate monitoring and the adaptive management process.	Develop and implement a plan, in consultation with the RRFF, to address identified problems.	Bull Trout Plan Section 4.1.2
Take does not exceed limits when established by USFWS.	As recommended by the RRFF	Maintain Action. Continue appropriate monitoring and the adaptive management process.	Pursue feasibility of Project operations of fishway/bypass if migration problems are identified	Bull Trout Plan Sections 4.1.1-4.1.3

Biological Objective	Evaluation Timeframe	Actions if Objective Achieved	Alternative Management Actions	Fish Management Plan Action
Take does not exceed limits when established by USFWS.	2005-2008	Maintain Action. Continue appropriate monitoring and the adaptive management process.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s).	Bull Trout Plan Section 4.1.2
Natural reproduction potential	Years 8-10, 13, and 18	Maintain Action. Continue appropriate monitoring and the adaptive management process.	Develop and implement a plan, in consultation with the RRFF, to address identified problem(s).	White Sturgeon Plan Section 4.4
Increase the white sturgeon population in the Reservoir through supplementation to a level commensurate with available habitat and allowing for appropriate and reasonable harvest.	Years 3-5, adjust stocking level; Years 6 – 50	Maintain Action. Continue appropriate monitoring and the adaptive management process.	RRFF to recommend stocking level, broodstock source. Develop and implement a plan, in consultation with the RRFF, to address identified problems.	White Sturgeon Plan Sections 4.1-4.3; 4.6
Success in creating population with a stable age-structure that allows for limited harvest	Years 20 – 50	Maintain Action. Continue appropriate monitoring and the adaptive management process.	Develop and implement a plan, in consultation with the RRFF, to address identified problems.	White Sturgeon Plan Sections 4.1-4.6
Success similar to best experience at other similar projects (Adult upstream fish passage as defined by the RRFF)	By Year 5	(Continuous reassessment every 10 years)	Develop and implement a plan, in consultation with the RRFF, to address identified problems.	Pacific Lamprey Sections 4.1.1-4.1.7and 4.4
Maintain safe, effective, and timely volitional passage Criteria (as defined by the RRFF)	TBD by RRFF with 5 year review by RRFF	Maintain Action. Continue appropriate monitoring and the adaptive management process.	Develop and implement a plan, in consultation with the RRFF, to address identified problems.	Pacific Lamprey Sections 4.2.1-4.2.2and 4.4
Avoid and minimize Project impacts on rearing habitat	By Year 5	Maintain Action. Continue appropriate monitoring and the adaptive management process.	Develop and implement a plan, in consultation with the RRFF, to address identified problems.	Pacific Lamprey Sections 4.3and 4.4

Biological Objective	Evaluation Timeframe	Actions if Objective Achieved	Alternative Management Actions	Fish Management Plan Action
No Net Impact	TBD by RRFF	Maintain Action. No additional action needed	Develop and implement a plan, in consultation with the RRFF, to address identified problems.	Pacific Lamprey Section 4
No negative impacts caused by ongoing Project operations	Years 1-4, with subsequent surveys determined by RRFF	Maintain Action. No additional action needed.	Develop and implement a plan, in consultation with the RRFF, to address identified problems.	Resident Fish Sections 4.2

SECTION 2: HABITAT CONSERVATION PLAN (HCP)

2.1 Objective: HCP Plan Species 91% Project Passage Survival

The Rocky Reach HCP provides a detailed phase designation system for planning, testing, and confirming progress towards achieving survival standards. The primary objective is reaching “Phase III Standards Achieved” which indicates that the appropriate standard has been met or the standard is likely to have been achieved but is yet untested for reasons outside Chelan PUD’s control. In this case, the standard may require periodic review to determine feasibility and ensure that the compensation for a Plan Species remains in compliance with No Net Impact (NNI).

Survival of HCP Plan Species (spring Chinook, steelhead, sockeye, and summer/fall Chinook) is overseen by the HCP Coordinating Committee (HCP CC). By March 30, 2013, Chelan PUD successfully achieved the HCP combined 91% survival standards for all spring migrating Plan Species. The HCP requires that Chelan PUD attain a 91% Combined Adult and Juvenile Survival Standard for the Project when both components can be validly measured over three separate studies. Juvenile survival was estimated with studies in years 2004-2011 (Table 2-1). In total, Chelan PUD conducted 13 juvenile survival studies at Rocky Reach from 2004 through 2011. Ten of those studies were used to assess and attain the juvenile survival standard (93%) at the Project (Table 2-1).

Table 2-1. Rocky Reach Project juvenile Project Survival estimates and study years for steelhead, spring Chinook, and sockeye at Rocky Reach.

Project	Species	Juvenile Survival	HCP Study Years
Rocky Reach	Steelhead	95.79%	2004-2006 (n = 3)
	Spring Chinook	92.37%	2004-2005, 2010-2011 (n = 4)
	Sockeye	93.59%	2006, 2008-2009 (n = 3)

The Combined Adult and Juvenile Project Survival estimate is the mathematical product of the average measured juvenile survival times the average measured adult survival for each species.

Sufficient numbers of PIT (passive integrated transponder) tagged adult spring Chinook salmon returning above Rocky Reach allowed measurement of adult passage survival at Rocky Reach for return years 2009 through 2011. Measurement of adult steelhead and sockeye conversion rates (survival) followed in return years 2010-2012 (Table 2-2). All Combined Adult and Juvenile Survival Standards for spring species were achieved by 2013 at Rocky Reach with standards approved by the HCP CC.

Because HCP survival standards have been achieved, Chelan PUD recommends to maintain the management actions of annual fishway maintenance at Rocky reach and continue appropriate monitoring of adult Plan HCP Plan Species passage and conversion rates by monitoring PIT tagged adult fish in the next five-year period at Rocky Reach. The HCP CC has not recommended any additional management actions beyond what Chelan PUD has implemented to achieve the HCP’s combined juvenile and adult survival standards.

Table 2-2. Juvenile, Adult, and Combined Survival for steelhead, spring-run Chinook, and sockeye as measured during HCP studies at the Rocky Reach Project.

Project	Species	Juvenile Survival	Adult Survival	Combined Survival ¹	Year Achieved
Rocky Reach	Steelhead	95.79%	98.93%	94.77%	2012
	Spring Chinook	92.37%	99.90%	92.28%	2011
	Sockeye	93.59%	98.92%	92.58%	2012

¹ Combined survival is the product of juvenile and adult survival estimates (e.g., .9579 × .9893 = 94.77%)

Table 2-3. Summary of HCP Phase Designations, Project survival estimates and dates achieved for all HCP Plan Species at Rocky Reach.

HCP Plan Species	Rocky Reach Phase Designation
Spring Chinook Yearlings (ESA Listed)	Phase III Standard Achieved 92.28 % Combined Adult & Juvenile (Aug 30, 2011)
Steelhead (ESA Listed)	Phase III Standard Achieved 95.79 % Juvenile Project (Oct 24, 2006) and 94.77% Combined Adult and Juvenile (January 25, 2013)
Sockeye (Not Listed)	Phase III Standard Achieved 93.59 % Juvenile Project (Dec 17, 2010) and 92.58% Combined Adult and Juvenile (January 25, 2013)
Coho (Not Listed)	Phase III Standard Achieved-Interim (June 26, 2007)
Summer/fall Chinook Sub-yearlings (Not Listed)	Phase III Additional Juvenile Studies (June 25, 2013)

Summer/fall Chinook

Measurement of sub-yearling juvenile Project Survival at Rocky Reach is not feasible due to technology limitations in juvenile salmon acoustic tag technology and uncertainties surrounding the sub-yearling life history of summer/fall Chinook salmon in the mid and upper-Columbia River Basin. Due to these limitations, HCP standards for subyearling and adult summer/fall Chinook have not been tested. The Rocky Reach HCP (Chelan PUD 2002) does not consider technology limitations as failure to achieve NNI, stating:

...The inability to measure a standard due to limitations of technology shall not be construed as a success or a failure to achieve NNI as further explained in Section 5.2.1 91% Combined Adult and Juvenile Survival and Section 5.2.2 “93% Juvenile Project Survival and 95% Juvenile Dam Passage Survival”.

Unlike spring Chinook, steelhead and sockeye, wild-origin subyearling summer/fall Chinook originating from above Rocky Reach Dam in the mid-Columbia are very small fish, and exhibit long outmigration times to pass through reservoirs (Douglas PUD 2013). Recent research demonstrated that PIT tagged subyearling Chinook salmon with fork lengths of between 62 and 104 mm (full range size distribution) took between five and 39 days to migrate between Wells Reservoir and Rocky Reach Dam in 2011 and 2012 (Douglas PUD 2013). Because of these issues, subyearling Chinook survival testing has not occurred at Rocky Reach.

The HCP CC convened a panel of experts in 2010 to discuss challenges and uncertainties associated with measuring sub-yearling survival in the mid-Columbia River. The District and HCP committees are currently investigating sub-yearling life history through monitoring at the Rocky Reach Juvenile Bypass System and regional monitoring and evaluation work conducted in the Wenatchee, Methow, and Okanogan rivers. Chelan PUD continues to compensate for unavoidable project mortality through the Hatchery Compensation and Tributary Conservation plans. Numerical abundance of summer/fall Chinook the mid-Columbia River has increased significantly since returns in the 1990s. Adult returns of summer/fall Chinook to Rock Island averaged only 18,650 adults in the 1990s, whereas returns since implementation of the HCPs have averaged 65,976 - a near four-fold increase (2004-2011).

While juvenile and adult project survival studies for subyearling Chinook are not yet feasible at Rocky Reach, the HCP CC voted in 2013 to maintain subyearling Chinook in Phase III (Additional Juvenile Studies) for up to three years (June 2016) at the Rocky Reach Project. Chelan PUD will annually assess improvements in acoustic tag technology and study design, and re-evaluate Project survival study feasibility by 2016.

Coho

On June 26, 2007, the Rocky Reach HCP CC agreed that a coho hatchery compensation program fulfills NNI obligations, as detailed in Section 8.4.3 of the Rocky Reach HCP. District funding is provided to the Yakama Nation to support the Coho Reintroduction Program. The HCPs further acknowledge that compensation for coho will be reassessed if a naturally reproducing population of coho salmon is established by efforts occurring outside of the HCPs.

As such, the Coordinating Committees agreed that a survival value of 93% is assumed and that juvenile and adult passage survival studies are not required.

2.2 Objective: HCP Plan Species NNI Hatchery Production Achieves 7%

The Rocky Reach HCP requires compensation for all Plan Species which includes spring Chinook, summer/fall Chinook, sockeye, and coho salmon, and steelhead. By implementing the Rocky Reach HCP's hatchery programs, Chelan PUD has achieved the Biological Objective of producing 7% compensation to achieve NNI. Production objectives, 2003-2013 are consistent with the overall HCP objectives of rebuilding natural populations and achieving NNI, as well as supporting harvest.

Funding, hatchery infrastructure, and space capacity is provided by the District to meet the compensation levels necessary to achieve NNI for all Plan Species. Initial estimated hatchery production levels were based on average adult returns of Plan Species for a baseline period, a 7% compensation requirement, and baseline adult to smolt survival rates for existing mid-Columbia River hatcheries. Hatchery compensation for Plan Species is implemented in accordance with Section 8 of the Rocky Reach HCP, ESA Section 10 permits held by Chelan PUD, and consultations with the Rocky Reach HCP Hatchery Committee.

Hatchery production in excess of the 7% took place as "initial production" through the 2013 (2003-2013) smolt releases. Adjustment of hatchery production levels can occur every ten years of HCP implementation, beginning in 2013 (to adjust production for release years 2014-2023). Adjustments are intended to account for changes in average adult returns, adult-to-smolt survival, and smolt-to-adult survival from hatchery production facilities. The HCP allows Chelan PUD to enter into agreements with other entities for the rearing, release, and monitoring and evaluation of hatchery production. The Hatchery Committee must approve any proposed agreements or trades of production, though it is Chelan PUD's responsibility to ensure that obligations under the Hatchery Compensation Plan are satisfied. The District has received Hatchery Committee approval via a Statement of Agreement for its compensation plan (Approved December 14, 2011) and has built the necessary capacity to meet NNI requirements (Table 2-4).

2.3 Objective: HCP NNI Hatchery Production Achieves 7%

To meet hatchery compensation requirements in the Rocky Reach HCP, Chelan PUD has built production capacity or contributed funding to operate 12 hatchery facilities in the mid-Columbia River Basin. These facilities include full life-cycle hatcheries: Chelan Hatchery and Eastbank Hatchery/Rocky Reach Annex; over-winter acclimation facilities: Chiwawa Ponds, Similkameen Ponds, and Chelan Falls Ponds; and other acclimation facilities such as Turtle

Rock Island¹, Dryden Ponds, Carlton Ponds, and Lake Wenatchee Net Pens.¹ Additionally, the District has provided funding and capacity at other facilities not owned by the District, such as the Methow and Ringold hatcheries, and Bonaparte and Blackbird acclimation ponds, and is currently co-funding with Grant PUD the construction of the Penticton Sockeye Hatchery in British Columbia. The District also provides operational funding for the new Chief Joseph Hatchery operated by the Confederated Tribes of the Colville Reservation and funding to the Yakama Nation for its Coho Reintroduction Program.

In addition to hatchery culturing capacity, the District also funds the operation and maintenance of several traps and weirs to support broodstock collection and management activities in the Wenatchee Basin. These include Tumwater trapping facility, Dryden Left-Bank and Right-Bank trapping facilities, and the Chiwawa Weir. Although their primary function is to support the HCPs’ hatchery programs, they also contribute to the management and research activities of the Yakama Nation, National Marine Fisheries Service, US Fish and Wildlife Service, and Washington Department of Fish and Wildlife.

Table 2-4. Hatchery Compensation Plan juvenile fish production to fulfill NNI requirements under the Rocky Reach HCP by 2013. Initial production levels expired with year 2013 smolt releases; recalculated smolt production levels are set for the 2014-2023 releases. Inundation production levels are not subject to recalculation. Recalculated production includes adjustments for measured increases in project survival and hatchery performance, in addition to changing population dynamics in the mid-Columbia River Basin.

Plan	Species	Inundation (fixed)	Initial production	NNI Rocky Reach Production		Location(s)
				Calculated 7%	Recalculated 7%	
	Spring Chinook	-	144,000	90,000	60,516	Methow/New program
		-	0	0	63,000	Chief Joseph
	Steelhead	165,000	35,000	30,000	9,000	Chiwawa
	Summer Chinook	400,000	0	0	0	Chelan Falls
		-	200,000	200,000	176,000	Chelan Falls
		-	200,000	0	0	Carlton
		-	0	0	91,000	Similkameen Chief Joseph
		-	0	0	49,000	(subs)
	Sockeye	-	0	300,000	Skaha program	Penticton

¹ The Turtle Rock Island and Wenatchee Net Pen facilities were integral for meeting the first 10 years of HCP-mandated hatchery production, but they are no longer in service for hatchery production. Production obligations reared at those facilities have been shifted to other locations, as approved by the RR HCP Hatchery Committee.

Monitoring is used to determine if the hatchery programs are performing as intended. The HCP Hatchery Committee adopted a monitoring and evaluation (M&E) approach that guides the assessment of the hatchery programs. The M&E program includes several objectives that focus on monitoring in-hatchery and in-river performance of hatchery-reared smolts, along with long-term monitoring to determine if the hatchery programs are contributing to rebuilding natural populations while conserving their long-term fitness. Monitoring activities include documenting broodstock collection, collection of life-history information, documenting hatchery spawning and rearing activities, juvenile monitoring within streams, and redd and carcass surveys. For all species the M&E program provides broodstock information; hatchery rearing history, release data, and survival estimates; disease information; juvenile migration and productivity estimates; redd counts, distribution, and spawn timing; spawning escapements; and life-history characteristics. The M&E program also addresses compliance with the Endangered Species Act and HCP mandates. In addition to annual reports that have been generated in each year of the HCPs' implementation, the first comprehensive five year Monitoring and Evaluation report (for Rocky Reach and Rock Island compensation) was completed in May of 2012 (Hillman et al. 2012)

2.4 Objective: HCP Plan Species Tributary Fund Implements Habitat improvements for NNI

The HCP Tributary Fund was established to provide funding for fish habitat restoration projects that would be expected, over time, to contribute improvement in the production of Plan Species. Since it is very difficult to measure fish production improvements for individual fish habitat improvements, the HCP specified that 2% of NNI would be credited for the annual contribution of \$229,800 (in 1998 dollars, adjusted annually for inflation) to the Rocky Reach Plan Species Account. These contributions have been used to provide funding, in most cases matching funds, for 25 projects. The expenditures allocated from the Rocky Reach Plan Species Account for these projects were \$1,824,999, while the total project costs allocated from all funding sources were \$6,014,180. The unallocated balance of the Rocky Reach Plan Species Account, as of January 15, 2014, is \$1,274,994. Habitat projects that have received funds from the Rocky Reach Plan Species Account are shown in Table 2-5.

In the period 2004 through 2013, Chelan PUD and the HCP Tributary Committee have successfully funded and implemented 25 different tributary habitat projects in the Wenatchee, Entiat, Methow, and Okanagan river basins from the Rocky Reach Plan Species Account. Biological Objectives for achieving NNI with Fund compensation and implementation management were fully achieved over the last five years. The committee process of reviewing and selecting habitat projects is functioning well. No changes or modifications to the existing process have been recommended by the Tributary Committee or Chelan PUD for the next 5-year period (2014-2018) of the Rocky Reach License.

Table 2-5. Tributary habitat projects funded through the Rocky Reach HCP Plan Species Account, 2004-2013.

Rocky Reach Plan Species Account							
Project Name	Sponsor	Fund Type	Project Type	Total Cost	Tributary Contribution	Tributary Contribution (actual to date)	Project Status
05 Entiat Instream Structure Engineering	Cascadia Conservation District	General	Instream Structures	\$59,340	\$59,340	\$48,659	Complete
05 Twisp River Conservation Acquisition	Methow Salmon Recovery Found	General	Protection	\$200,835	\$40,000	\$40,000	Complete
05 Clees Well and Pump	Okanogan Conservation District	General	Instream Flows	\$40,875	\$15,000	\$14,924	Complete
05 Entiat Instream Habitat Improvements	Chelan County NRD	General	Instream Structures	\$250,000	\$37,500	\$37,500	Complete
06 Entiat PUD Canal Juv Habitat Enhancement	Cascadia Conservation District	Small	Instream Structures	\$23,640	\$23,640	\$3,059	Complete
07 LWD Removal & Relocation	Chelan County NRD	Small	Instream Structures	\$5,000	\$5,000	\$871	Complete
07 LWD/Rootwad Acquisition & Transport	Cascadia Conservation District	Small	Instream Structures	\$24,600	\$24,600	\$24,600	Complete
07 Harrison Side Channel	Chelan County NRD	General	Off-Channel Habitat	\$797,300	\$90,105	\$68,647	Complete
08 Entiat PUD Canal Log-Boom Installation	Cascadia Conservation District	Small	Instream Structures	\$10,660	\$7,160	\$4,526	Complete
08 Twisp River Riparian Protection (Buckley)	Methow Conservancy	General	Protection	\$299,418	\$89,825	\$89,825	Complete
08 Below the Bridge	Cascadia Conservation District	General	Instream Structures	\$398,998	\$150,000	\$115,353	Complete
09 Foreman Floodplain Reconnection	Chelan County NRD	General	Off-Channel Habitat	\$0	\$0	\$0	Cancelled
09 Entiat NFH Habitat Improvement Project	Cascadia Conservation District	General	Off-Channel Habitat	\$285,886	\$61,373	\$61,373	Complete
10 Methow Subbasin LWD Acquisition & Stockpile	Methow Salmon Recovery Found	Small	Instream Structures	\$50,000	\$50,000	\$49,914	Complete
11 Chewuch River Permanent Instream Flow Project	TU–Washington Water Project	General	Instream Flow	\$1,200,000	\$325,000	\$306,752	Complete
11 Christianson Conservation Easement	Methow Conservancy	Small	Protection	\$16,350	\$15,000	\$15,000	Complete
12 Entiat Stormy Reach Phase 2 Acquisition	Chelan-Douglas Land Trust	General	Protection	\$165,000	\$46,800	\$44,003	Complete
12 Silver Protection	WA Dept. of Fish & Wildlife	General	Protection	\$660,000	\$125,000	\$0	In progress
12 Nason Creek/Lower White Pine Coulter Creek Barrier Replacement	Chelan County NRD	General	Fish Passage	\$83,126	\$12,469	\$0	In Progress
12 Nason Creek LWP Alcove Acquisition	Chelan-Douglas Land Trust	General	Protection	\$353,000	\$72,000	\$72,000	Complete
13 Fish Passage at Shingle Creek Dam	Okanagan Nation Alliance	General	Fish Passage	\$59,225	\$180,950	\$0	In progress
13 Upper Beaver Habitat Improvement Channel Restoration	Methow Salmon Recovery Found	General	Channel Restoration	\$674,600	\$102,613	\$24,987	In Progress
13 Okanogan Basin Stream Discharge Monitoring	Colville Confederated Tribes	Small	Instream Flows	\$90,954	\$74,984	\$0	In Progress
14 Silver Side Channel Design	CC Fisheries Enhancement Group	General	Design	\$180,733	\$132,000	\$5,186	In Progress
14 Similkameen RM 3.8 Design	Okanogan Conservation District	General	Design	\$84,640	\$84,640	\$0	In Progress
Total				\$6,014,180	\$1,824,999	\$1,027,178	
Current Rocky Reach Plan Species Account Balance (unallocated): \$1,274,933.90							

2.5 Objective: HCP Plan Species Adult Passage Survival

Chelan PUD has achieved adult passage survival standards set in the Rocky Reach HCP. The HCP metric for adult survival is 98%. Adult conversion rates (upstream passage survival) through Rocky Reach were estimated using adult PIT tagged spring Chinook passing from Rock Island Dam to Wells Dam in years 2009 through 2011, and for steelhead and sockeye salmon in years 2010 through 2012 (Buchanan and Skalski 2011, 2012). Three-year mean Chinook

passage survival was estimated to be 99.90%. Adult Sockeye and steelhead survivals were estimated to be 98.92% and 100%, respectively.

Adult passage survival through Rocky Reach is a measure of the probability that an adult fish detected at the downstream end of the dam’s tailrace survives passage through the tailrace, the dam, and the dam’s reservoir (Buchanan and Skalski 2011, 2012). Conversion rates are calculated from the number of unique PIT tagged adults detected at the upstream end of the Project divided by the number detected at the downstream end of the Project’s (tailrace). The estimate of survival through the Rocky Reach Project is estimated by the conversion from the Rock Island Dam fishways to the Wells Dam fishway. Survival rates shown for Rocky Reach are a minimum estimate of Project survival as the estimate includes passage through *multiple Projects* to allow for complete estimation of Rocky Reach passage survival. Some non-Project mortality may be included in conversion rate estimates, including losses from adult fish straying to tributaries, removal of PIT tagged fish through harvest in reservoirs, and missed-detections at the upstream dam. Tables 2-6, through 2-8 show the three-year arithmetic average survival rates estimated for each species (95% confidence).

Table 2-6. Wild and hatchery-origin adult spring Chinook PIT detections and conversion rate (passage survival) estimates (Ŝ) at the Rocky Reach Project, 2009-2011.

Year	Unique PIT Detected Fish		Rock Island to Wells Conversion Rate			Rocky Reach Conversion Rate		
	Rock Island	Wells	Ŝ Estimate	SE	95% CI	Ŝ Estimate	SE	95% CI
2009	22	22	1.0000	0	(0.9164, 1.0000)	1.0000	0	(0.9573, 1.0000)
2010	45	45	1.0000	0	(0.9582, 1.0000)	1.0000	0	(0.9789, 1.0000)
2011	166	165	0.9940	0.0060	(0.9738, 0.9997)	0.9970	0.0030	(0.9868, 0.9998)
Avg	-	-	0.9980	0.0020	(0.9941, 1.0000)	0.9990	0.0006	(0.9979, 1.0000)

Table 2-7. Wild-origin adult sockeye PIT detections and conversion rate estimates (passage survival, \hat{S}), adjusted for harvest, at the Rocky Reach Project, 2010-2012.

Year	Unique PIT Detected Fish		Rock Island to Wells Conversion Rate			Rocky Reach Conversion Rate		
	Rock Island	Wells	\hat{S} Estimate	SE	95% CI	\hat{S} Estimate	SE	95% CI
2010	536	525	0.9897	0.0031	(0.9824, 0.9946)	0.9909	0.0031	(0.9836, 0.9958)
2011	370	355	0.9795	0.0052	(0.9675, 0.9882)	0.9891	0.0053	(0.9770, 0.9978)
2012	974	950	0.9876	0.0025	(0.9820, 0.9919)	0.9876	0.0025	(0.9820, 0.9919)
Avg	-	-	0.9856	0.0022	(0.9813, 0.9899)	0.9892	0.0022	(0.9849, 0.9935)

Table 2-8. Adult wild and hatchery-origin steelhead PIT detections and conversion rate (passage survival) estimates (\hat{S}), adjusted for harvest, at the Rocky Reach Project, 2010-2012.

Year	Unique PIT Detected Fish		Rock Island to Wells Conversion Rate			Rocky Reach Conversion Rate		
	Rock Island	Wells	\hat{S} Estimate	SE	95% CI	\hat{S} Estimate	SE	95% CI
2010	67	64	0.9861	0.0261	(0.9824, 0.9946)	0.9931	0.0131	(0.9673, 1.0188)
2011	354	351	1.00	0.0094	(0.9675, 0.9882)	1.0650	0.0044	(1.0564, 1.0737)
2012	292	289	0.9897	0.0059	(0.9820, 0.9919)	0.9948	0.0030	(0.9867, 0.9987)
Avg	-	-	0.9856	0.0094	(0.9813, 0.9899)	1.00	0.0047	(1.0084, 1.0269)

With Phase III Standards Achieved for spring Chinook, steelhead and sockeye, Chelan PUD must conduct a 10-year check-in study at Rocky Reach in 2021 to verify that HCP survival standards are being maintained at the Project.

Chelan PUD has not been able to accurately measure adult passage survival for summer/fall Chinook due to intense sport-fishing harvest that results in significant loss of PIT tagged fish in the river reach between Rock Island Dam and Wells Dam. Based on high passage survival of adult spring-migrating species and steelhead, Chelan PUD believes passage survival is also high for summer Chinook.

SECTION 3: BULL TROUT

3.1 Objective: Incidental Take not exceeded- Bull trout Adult Upstream Passage 2005-2008

The 401 Water Quality Certification for the Rocky Reach Project contains a Biological Objective is attained if incidental take allowances authorized by the U.S. Fish and Wildlife Service (USFWS) for various Project Elements of the Rocky Reach License are not exceeded in any annual period. Allowable incidental take levels (Table 3-1) for the period 2005 through 2008 are shown in the Rocky Reach 401 Certification. These take levels were issued to Chelan PUD from the USFWS' 2004 Biological Opinion on FERC's Rocky Reach License Amendment to incorporate Chelan PUD's anadromous HCP into the License (USFWS 2004). Subsequently in 2008, the USFWS issued a new Biological Opinion for relicensing of the Rocky Reach Project (USFWS 2008). In the new Opinion, USFWS issued a new Incidental Take Statement for bull trout for Project Elements, superseding the 2004 take authorizations. Quantitative take levels for bull trout were issued for eight Project Elements of the new Rocky Reach License (Table 3-2). While neither the previous or current incidental take levels for bull trout were exceeded, Chelan PUD will adhere to the new take authorizations through the next 5-Year biological Objectives reporting period (2014-2018).

Table 3-1. Authorized Incidental Take levels of bull trout issued by the USFWS for Rocky Reach Project Elements, May 2004 through December 2008.

Project Element	Type of Take	Lethal Take
Turbine Operations	Harm or Harass	5%
Juvenile Fish Bypass	Harm or Harass	2%
Spillway Operations	Harm or Harass	2%
Adult Fishways	Harm or Harass	2%
Predator Control	Harm or Harass	2 fish

Table 3-2. Revised Incidental Take levels for bull trout issued in 2008 by the USFWS for Rocky Reach Project License Elements and the associated quantitative take levels for each element (USFWS 2008).

Project Element	Type of Take	Lethal Take		Non-lethal Take	
		Adult	Juvenile/ Sub-adult	Adult	Juvenile/ Sub-adult
Turbine Operations	Harm or Harass	20	5	57	46
Juvenile Fish Bypass	Harm or Harass	1	3	2	10
Spillway Operations	Harm or Harass	3	1	122	50
Adult Fishways	Harm or Harass	1	2	73	14
Hydrograph Variation	Harm or Harass	1	3	125	48
Predator Control	Harm or Harass	2	1	123	51
Hatchery Supplementation Plans	Harm or Harass	1	12	1198	*
Monitoring Plans	Harm or Harass	3	1	122	50
	Total	32	28	1198**	269***

From 2005-2009, Chelan PUD examined upstream passage of adult bull trout through fishways at Rocky Reach Dam. For the study, 71 adult bull trout were captured and tagged with radio-tags. Passage of fish was tracked using four radio-telemetry tracking techniques including fixed detection sites within the Rocky Reach Dam (turbine intakes, juvenile fish bypass system, spillway, adult fishway and fishway entrances) boat tracking in the reservoir, and truck and aerial tracking, to monitor incidental take of adult bull trout. Chelan PUD maintained multiple telemetry receivers at the dam and in the Wenatchee and Entiat rivers which operated continuously for 1,496 days during the study. Bull trout passed upstream through Rocky Reach Dam successfully using adult fishways in all study years, and no bull trout perished during upstream passage. During the monitoring period, no take occurred and the Biological Objective for not exceeding Chelan PUD's 2% incidental take allowance (USFWS 2004) was achieved.

Chelan PUD enumerates bull trout passing the Project upstream through fishways by round-the-clock counting using video and hi-definition cameras. Annual fishway passage counts of bull trout are shown in Table 3-3.

In the five-year telemetry monitoring period (2005-2009), a total of 41 upstream passage events by radio-tagged bull trout were observed and evaluated at Rocky Reach. Based on those passage events, the median amount of time tagged bull trout resided within the tailrace of Rocky Reach Dam was 0.28 days; the median time spent migrating in and out of the fishway was 2.48 days, and the median time spent migrating up the fishway after final entry was 0.25 days

(Stevenson et al. 2009). Collectively, the overall median Project migration time from tailrace to exit was 3.84 days. Fish spent relatively little time in the tailrace or within the fishway itself after last detection at the fishway entrance. No mortality was observed during any upstream passage event during the study period. Upstream passage and incidental take of bull trout will be monitored again at Rocky Reach in 2018.

Table 3-3. Monthly and total annual counts of bull trout passing Rocky Reach Dam (fishway window counts) 2005-2013.

Year	April	May	June	July	August	Sept	Oct	Nov	Total
2005	0	69	62	15	0	1	4	4	155
2006	0	58	49	13	1	1	2	7	131
2007	1	30	28	12	2	1	3	0	77
2008	1	21	41	6	6	2	8	15	100
2009	1	15	43	21	1	1	0	1	83
2010	0	24	61	13	8	1	5	12	124
2011	1	26	95	22	11	2	3	8	168
2012	1	40	91	25	14	1	16	31	219
2013	2	78	70	30	1	2	5	1	192

3.2 Objective: Incidental Take - Bull Trout Adult Downstream Migration 2005-2008

During the 2005 to 2009 study period, radio-tagged bull trout made a total of 47 downstream passages at Rocky Reach Dam (Stevenson et al. 2009). Of these downstream passage events by adult fish, 35 downstream passage events occurred through the powerhouse (turbines), two through the spillway, two through the Juvenile Bypass System, and eight through unknown routes, escaping radio-detection. For these 47 passage events observed over the entire study period, no documented bull trout mortality associated with downstream passage via any route through Rocky Reach Dam was documented (Stevenson et al. 2009). If any radio-tag signal was detected for more than three days in the tailrace within 400 meters of its last detection following a downstream passage, the tag location was pinpointed as close as possible and two scuba-divers were deployed from a boat into the tailrace to assess the status of the fish. During the entire study, two dives occurred. Each time, the tagged fish was alive and not visibly injured, rather, just holding position near the bottom usually near large boulder structure. When approached, the fish exited their positions quickly. No fish mortalities occurred in as a result of downstream passage at Rocky Reach during the study.

The allowances for incidental take for downstream passage through turbines (5%), spillways (2%), and juvenile bypass (2%) were not exceeded and therefore this Biological Objective was achieved. Chelan PUD will assess downstream passage of bull trout and monitor incidental take of bull trout again at Rocky Reach in 2018.

3.3 Objective: Incidental Take Not Exceeded - Predator Control Programs 2005-2008

Chelan PUD has not exceeded incidental take allowances established by the U.S. Fish and Wildlife Service (USFWS) for bull trout in Predator Control Program at the Rocky Reach Project. Therefore this Biological Objective has been achieved for the evaluation time frame, 2005 through 2008.

Table 3-4 shows the annual pikeminnow harvest from Rocky Reach Reservoir, 2005 through 2008. Chelan PUD will continue to apply efficient predator control programs in Rocky Reach Reservoir over the next ten years to help ensure that salmonid survival rates achieved for at the Rocky Reach Project (HCP) are maintained.

Table 3-4. Pikeminnow removed from Rocky Reach Reservoir during Chelan PUD's predator control programs and any associated incidental take of bull trout, 2005-2013.

Year	Pikeminnow Harvested	Bull Trout Take Allowance	Incidental Take	Take Method	Lethal Take?
2005	41,018	2	0	-	No
2006	45,630	2	0	-	No
2007	62177	2	0	-	No
2008	57,475	2	2	Fishway traps	No, released

3.4 Objective: Incidental Take not exceeded- Sub-Adult Downstream Migration 2005-2008

Quantitative incidental take allowances for sub-adult bull trout moving downstream through the Rocky Reach Project and juvenile fish bypass were established by the USFWS its December 5, 2008 Biological Opinion for re-licensing of the Rocky Reach Project (USFWS 2008). Juvenile bull trout observation rates are very low at the Project. Capture and handling rates of juvenile fish are also very low. Sub-adult bull trout passing downstream of the Project through the turbines or the spillway at the Project are not detectable due to lack of tagging technology and a source of juvenile bull trout for tagging evaluations. However, some juvenile fish are observed in the Juvenile Bypass System anadromous sampling facility. During daily bypass sampling from April through August, 2005 to 2008, Chelan PUD observed only 17 sub-adult bull trout less than 355 mm in length; 14 of these fish were collected in 2008. No lethal take occurred, as all of these fish were healthy and released in good condition into the tailrace of the Project.

3.5 Objective: Incidental Take not exceeded- Sub-Adult Rearing in Reservoir 2005-2008

The RRFF, including USFWS, have agreed that it is not yet feasible to fully assess sub-adult bull trout incidental take during upstream and downstream passage at the Project (Bull Trout Management Plan, 4.2.2) (Chelan PUD 2004) , nor is it feasible to assess direct effects on survival from Project-related operations during rearing in the reservoir.

In 2007, Chelan PUD compiled Rocky Reach daily reservoir inflow patterns (mainstem inflow plus tributary inflow) and hourly surface elevation data for the reservoir to construct Rocky Reach headwater duration curves (Figures 3-1, 3-2, and 3-3). These dates were used to assess potential for bull trout take as a result of stranding in the reservoir. The data demonstrated that Rocky Reach reservoir elevations are held fairly stable with very little drafting of more than two feet below maximum full pool elevation of 707 feet msl (mean sea level). Three years mean hourly elevations (2005-2007) show that Rocky Reach Reservoir operates within two feet of full pool greater than 90% of all hours.

These data was used in conjunction with field maps of backwater and off-channel areas in Rocky Reach Reservoir to evaluate potential effects of reservoir operations on these areas and whether or not movement of bull trout into, or out of, these areas is affected. Review of radio-telemetry detection data from 2005 and 2006 indicates that bull trout spend much of their time in deeper water habitats, and have not been observed using the limited number of backwater areas in Rocky Reach Reservoir during multiple telemetry surveys. Back water and side channel areas comprise a very small percentage of the total surface area of Rocky Reach Reservoir.

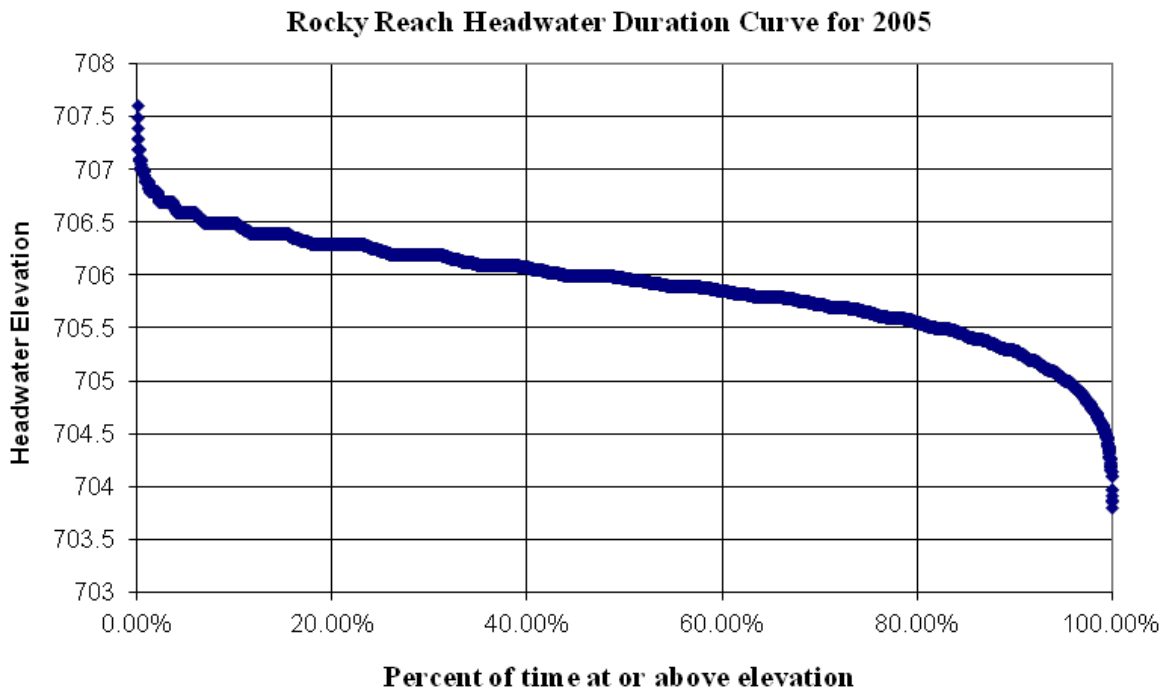


Figure 3-1. Rocky Reach Reservoir headwater duration curve for 2005 showing range of hourly reservoir (forebay) surface elevations and percent of time the reservoir was at or above a given elevation.

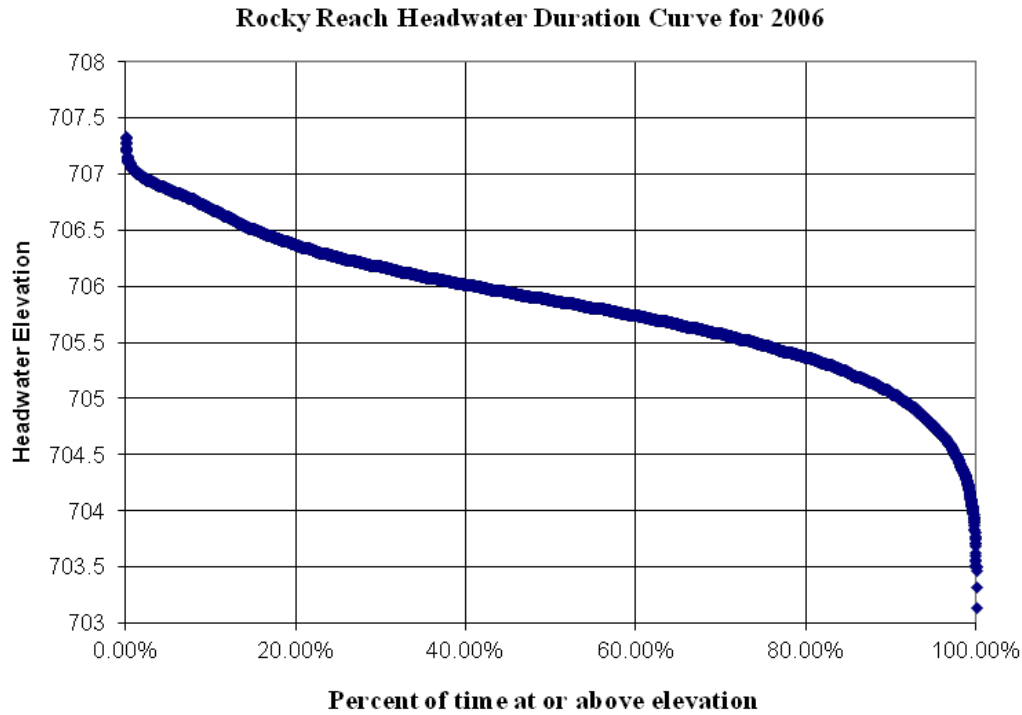


Figure 3-2. Rocky Reach Reservoir headwater elevation duration curve for 2006 operations showing percent of time the reservoir (forebay) was at or above a given surface elevation.

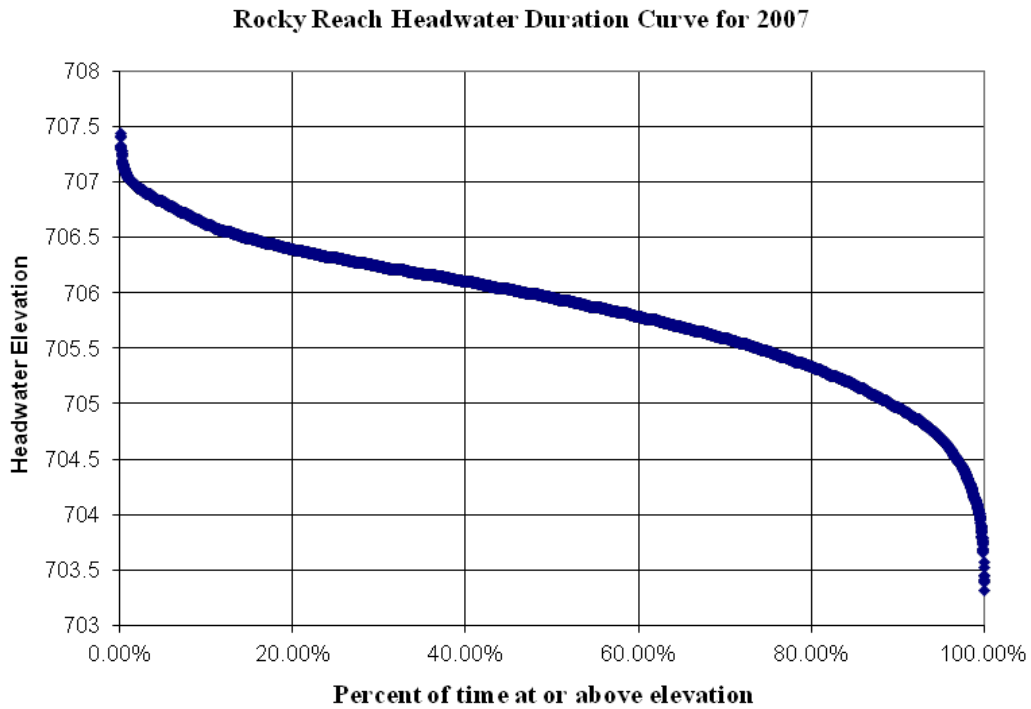


Figure 3-3. Rocky Reach Reservoir headwater duration curve for 2007 showing range of hourly reservoir surface elevations (forebay) and percent of time the reservoir was at or above a given elevation.

Juvenile Fish Bypass

Juvenile bull trout may enter the Rocky Reach juvenile fish sampling facility during collection of salmon and steelhead for daily species composition and fish condition monitoring. To the extent feasible, Chelan County PUD documents age-group, year-class, length-weight information, and degree and frequency of de-scaling for all juvenile bull trout observed during juvenile anadromous salmonid index sampling at the Juvenile Fish Bypass System. No de-scale or injuries were observed on any of the 17 juvenile bull trout (≤ 355 mm) was observed from 2005-2008 in the bypass system (Chelan PUD 2009).

Each bull trout captured at the sampling facility from 2005-2008 was tagged with a passive integrated transponder (PIT) tag and monitored for recapture of those tags in the adult fishway and the juvenile bypass system at Rocky Reach via the PIT tag detections systems installed at each location. No bull trout tags were re-detected in the fishway from 2005 through 2008.

Monitoring and additional PIT tagging of juvenile bull trout will take place for a one-year period, beginning in year 10 of the New License and continuing (2018) every 10 years thereafter, upon recommendation of the RRFF, to continue implementing appropriate and reasonable methods for monitoring sub-adult bull trout at Rocky Reach Dam. Specifically, Chelan PUD may continue to provide PIT tags and equipment, and facilitate training, to enable fish sampling entities to PIT tag sub-adult bull trout when these fish are collected incidentally during fish sampling operations at Rocky Reach fish facilities.

SECTION 4: WHITE STURGEON

4.1 Objective: Natural Reproduction Potential

Chelan PUD has initiated monitoring of white sturgeon natural reproduction potential through implementation of the White Sturgeon Management Plan (WSMP). Chelan PUD has deployed remote acoustic telemetry receivers throughout the Rocky Reach reservoir to monitor both juvenile and adult white sturgeon tagged with Vemco acoustic tags (Table 4-1). During data download of receivers in late June of 2013, seven adult sturgeon ranging in total length from 6.3 to 7.1 feet were captured on set lines and tagged with long-life (10-year) acoustic tags. All adult tagged fish were released as close as possible to their point of capture in the reservoir, with all captures occurring between the Wells and airport receiver locations.

Table 4-1. Acoustic Telemetry Receiver Locations in the Rocky Reach Reservoir.

Receiver Location	River Kilometer
Wells Tailrace 1	826.8
Wells Tailrace 2	826.7
Airport 1	819.0
Airport 2	817.8
Beebe Bridge 1	811.2
Beebe Bridge 2	811.1
Duck Tail Rock 1	794.0
Duck Tail Rock 2	793.8
Entiat 1	780.7
Entiat 2	780.7
Rocky Reach Boat Restriction Zone 1	762.9
Rocky Reach Boat Restriction Zone 2	762.9
Rocky Reach Tailrace 1	761.8
Rocky Reach Tailrace 2	761.2
Rocky Reach Tailrace 3	761.2

All tagged adult sturgeon were tracked throughout the remainder of 2013. Four fish showed slight downstream movements from their release location during the summer, with all four fish being last detected on the Airport 2 receiver. The remaining three fish exhibited further downstream movements. By August 2013, all three fish had migrated to the Entiat receivers. One fish continued to move downstream to the boat restriction zone receivers, but returned to the Entiat receiver by September 2013, where all three fish were last detected in 2013 (C. Wright, personal communication).

While the assessment of natural white sturgeon reproduction potential is required between years 8 through 18 of the new License (WSMP), Chelan PUD initiated this work by utilizing acoustic receivers deployed to monitor juvenile sturgeon movements during the initial three-year index monitoring program to jointly collect data on adult sturgeon in the reservoir.

Data compiled leading up to year eight of the License will be used to guide suitable locations and times to conduct spawning ground surveys of adult sturgeon to achieve this biological objective. The District plans to increase the sample size through further acoustic tagging of any adult sturgeon that may be encountered and, with the tags currently implanted in adult sturgeon expected to be active until June of 2023, the District expects to have a population of tagged adult sturgeon ready to track to identify potential spawning locations in years 8-10 (2016-2018) and year 13 (2021) of the License..

4.2 Objective: Increase the White Sturgeon Population in the Reservoir through Supplementation Commensurate with Habitat Carrying Capacity

The White Sturgeon Subcommittee comprised of Chelan and Grant PUDs, as well as the Co-Managers (Yakama Nation and WDFW) developed a recommended path forward for brood year 2010 that was presented to the RRFF on January 28, 2010 and approved on February 25, 2010 which stated a preference of obtaining broodstock from Mid-Columbia reservoirs (Priest, Wanapum, or McNary pools) (RRFF 2010a). Brood collection efforts in the Mid-Columbia resulted in a 1x2 cross. Due to 2010 brood collection efforts falling short of the 6x6 target, the RRFF approved the release of 6,500 juveniles made up of 2,600 fish from the 1 female x 2 male cross, and an additional 3,900 fish from a 3 female x 2 male captive brood cross collected by the Yakama Nation. Juveniles were reared at both Marion Drain (Yakama Nation facility) and Chelan Hatchery until April 2011 when 6,376 fish were released at river kilometer 816.7 in the Rocky Reach Reservoir. All juveniles released were scute marked and PIT tagged. Forty two fish were also implanted with acoustic tags.

Through collaborations with the Co-Managers and Chelan PUD, the 2011 White Sturgeon Hatchery Plan was presented to the RRFF on May 4, 2011 (RRFF 2011a). The document served as a summary of the 2010 Mid-Columbia Sturgeon Technical Workgroup, and outlined activities agreed to by the Co-Managers including description of acceptable locations of brood collection and the required effort, a minimal target spawning matrix, and steps to be taken by the Co-Managers should brood collection efforts fall short of the minimum spawning matrix to be targeted, all with a collaborative regional approach in mind (RRFF 2011b). Broodstock collection efforts were targeted in the tailrace of The Dalles dam with augmentation from Grant PUD in the Wanapum pool and additional effort in The Dalles tailrace from Chelan PUD, resulting in a 1 female x 1 male cross whose progeny was raised out at Marion Drain and Chelan Hatcheries. The RRFF determined that due to the low number of parental crosses achieved, stocking should be limited to 1,000 individuals (RRFF 2012a). Unfortunately, due to the confirmation of infections of White Sturgeon Iridovirus (WSIV) and complications causing fish to exhibit a hyper-inflated swim bladder from an unknown etiology, only 147 juveniles were stocked in May 2012 at river kilometer 816.7. All juveniles released were scute marked and PIT tagged. Ten individuals were also implanted with acoustic tags. An additional 25 tags were implanted in recaptured fish from brood year 2010 encountered during the 2012 Northern Pikeminnow Removal Program (Wright and Robichaud 2013).

A path forward for brood year 2012 was developed in collaboration with the Co-Managers and Chelan and Grant PUDs (RRFF 2012b). Broodstock collection efforts were

expanded to the tailraces of McNary (Chelan PUD) and The Dalles (Yakama Nations), as well as the Wanapum reservoir (Grant PUD), resulting in a 3 female x 1 male cross and an additional 1 female x 4 male cross. All spawning activities were carried out at Marion Drain. In addition to rearing fish at Marion Drain, fertilized eggs were also transported to Columbia Basin and Chelan Hatcheries for grow out purposes in an effort to protect against previous fish health issues experienced in 2012 (RRFF 2012c). Juvenile sturgeon at all three hatchery facilities were tested and determined to be free of disease and pathogens. In an effort to boost fish numbers in the Rocky Reach pool ahead of the monitoring and indexing effort in 2013, the RRFF agreed to stock approximately 1,100 juveniles over the upper limit of 6,500 fish stated in the WSMP (RRFF 2013a). In May of 2013, 7,979 fish from Columbia Basin and Chelan hatcheries were released into the Rocky Reach Pool, spread equally over three release locations at river kilometers 816.7, 784.5, and 778.9. All released individuals were PIT tagged and scute marked, with 65 fish being implanted with an additional acoustic tag in an effort to evaluate habitat usage lower in the reservoir during the 2013 monitoring and evaluation effort (Wright and Robichaud 2013).

In total, 14,502 juvenile sturgeon have been stocked since 2011 (Table 4-2). Although juveniles were released across the initial stocking timeframe outlined in the WSMP, the RRFF recognized the health issues that compromised fish scheduled for release in 2012 and agreed to extend the initial stocking period of the WSMP an additional year, allowing a juvenile release of up to 6,500 fish in 2014 (RRFF 2013b). Brood collection was similar to 2012, with an increased effort in the McNary tailrace by Chelan PUD from one week to two weeks. Broodstock collection yielded a 3 female x 3 male cross, plus an additional 1 female x 3 male cross. Fertilized eggs were once again delivered to Columbia Basin and Chelan Hatcheries, and discussion is currently on-going in the RRFF as to the appropriate number of juveniles to stock in 2014.

Table 4-2. Number of Juvenile White Sturgeon Stocked into the Rocky Reach Reservoir, 2011-13.

Year	Juveniles Stocked	Release Location (River km)
2011	6,376	816.7
2012	147	816.7
2013	7,979	816.7, 784.5, 778.9
Total	14,502	

The modified stocking timeline also altered the schedule for monitoring and evaluating stocked juveniles. Indexing was scheduled to start after stocking in 2012, but, since the modified stocking schedule resulted in decreased sample size, the first year of indexing was moved to 2013. However, in 2012 the bycatch data from the northern pikeminnow removal program were analyzed. A total of 98 juvenile sturgeon were recaptured, with all recaptures occurring in the upper three kilometers of the reservoir (river km 825.6-829.6) (Wright and Robichaud 2013).

The first indexing and monitoring study directly targeting sturgeon was conducted from August to October 2013. The combination of both a random and selective survey approach was used in an effort to collect data on survival, growth, habitat usage, age structure, and emigration

from fish released throughout the reservoir. Early data analysis continues to show high use of habitat in the upper end of the reservoir, with roughly 60% of the fish released in 2013 moving up above the highest release location (river km 816.7). Acoustic data were analyzed and PTAGIS was mined for downstream detections of marked fish, producing a weighted average emigration rate of approximately 4.8%. The 2013 monitoring and indexing report is currently being compiled and will be available to the RRFF in March 2013 (Wright, personal communication).

Through juvenile stockings and index and monitoring studies, Chelan PUD is currently meeting the supplementation and carrying capacity biological objective. The white sturgeon population has been increased through supplementation, and the analysis of habitat use and survival is currently in its first year and ongoing. The final year of initial juvenile stocking will occur in 2014 and will be followed by the second year of index and monitoring. Results will be added to the ongoing database to further analyze both current and previous releases of juveniles. The third year of index monitoring is planned for 2015, followed on a cycle of every three years thereafter. Ongoing analysis of the database will be used to provide data to the RRFF to aid in determination of stocking levels beyond the initial stocking period outlined in the WSMP. While adult broodstock collection has been unpredictable, Chelan PUD should continue to collaborate with the Co-Managers and the RRFF to identify proper sources of adult brood, as well as the exploration of other possible options, such as larval collection, to meet future stocking goals.

4.3 Objective: Success in Creating Population with Stable Age-Structure Allowing Limited Harvest

Chelan PUD, in collaboration with the Co-Managers and the RRFF, has released 14,502 juvenile white sturgeon into the Rocky Reach Reservoir from 2011 to 2013. Releases have been in excess of 6,000 fish each with the exception of 2012, when fish health concerns restricted the release to 147 juveniles (Table 4-2). Release strategies have structured the hatchery origin sturgeon population in Rocky Reach reservoir with three different age classes of juveniles. Once stocking is complete of fish scheduled to be released in 2014, the index and monitoring effort scheduled for August 2014 will collect data from fish ranging in residency time from 3 months to 40 months and across 4 different age classes (Table 4-3).

Table 4-3. Estimated age and residency time of juvenile white sturgeon stocked into Rocky Reach Reservoir from 2011 through 2014.

Release Date	Approximate Age ¹	Approx. Residency Time ²
April 2011	51 Months	40 Months
May 2012	39 months	27 Months
May 2013	27 Months	15 Months
May 2014 (estimated release date)	15 Months	3 Months

¹Juvenile white sturgeon are approximately 1 year old at release.

²Residency times are based on proposed sampling during year two of index and monitoring in August 2014

Although the evaluation timeframe for this biological objective is not scheduled until year 20 of the WSMP, Chelan PUD is on schedule for achievement. With the releases scheduled for 2014, there will be four different age classes of juveniles residing in the Rocky Reach Reservoir. The data to be collected from initial index and monitoring studies (2013-2015) is expected to meet the study objectives: determine survival rates; abundance; density; condition factor; growth rates; and identify distribution and habitat selection of juvenile sturgeon. The capture and tagging of additional adult sturgeon should increase knowledge of the existing population structure of older cohorts, which will help determine the current age-structure of the population. The objective of “success in creating a population with a stable age-structure that allows for limited harvest” now has a large cohort of very young juveniles, which may provide harvest opportunity in the future as this cohort reaches maturity.

Collaboration between the Co-Managers, the RRFF, and Chelan PUD to identify and collect supplementation fish should persist to ensure a wide range of age classes are present by year 20 of the WSMP. Data from index and monitoring studies should be analyzed to identify possible changes to hatchery practices and juvenile condition factors that may provide an increase to post-release survival. Chelan PUD should continue to refine release strategies to achieve good survival and distribution of juveniles in the reservoir commensurate with available habitat and carrying capacity. Successful incorporation of new information and adaptive management is expected to meet the objective of creating a population with a stable age-class structure that allows for limited harvest.

SECTION 5: PACIFIC LAMPREY

5.1 Adult Upstream Passage Success

The Biological Objective for the Rocky Reach Project associated with upstream passage of adult Pacific lamprey through fishways at Rocky Reach Dam is to achieve a passage rate that is similar to the best experience at other similar hydroelectric projects on the Snake and Columbia rivers. Two years of monitoring tagged lamprey has occurred, and at least one additional year of passage monitoring remains to complete this Biological Objective. Additionally, passage monitoring at other mainstem hydroelectric projects must be completed to compare passage rates at Rocky Reach before this objective can be completed.

In 2005, Chelan PUD conducted a relicensing study to evaluate adult Pacific Lamprey passage at Rocky Reach Dam using radio tagged adults (Stevenson et al. 2005). This analysis provided the basis to identify passage issues for adult lamprey in the fishway, and guide the scope of future work and improvements necessary to improve passage.

In 2010, Chelan PUD conducted a literature review, *Pacific Lamprey Upstream Passage modifications Literature Review and Analysis and Recommendations for Passage Improvements in the Rocky Reach Fishway* (Le and Nass 2010) to determine what modifications should be made within the fishway to improve lamprey passage. On October 28, 2010 Chelan PUD presented the RRFF with engineering plans and proposal to construct modifications to components of the adult fishway (RRFF 2010b). On December 6, 2010, Chelan PUD filed the design drawings for approval with FERC to make these modifications to adult fishway to improve adult lamprey passage.

After approval from FERC and review and approval of designs by the RRFF in October 2010 (RRFF 2010b), Chelan PUD began extensive work that was completed in two phases in the Rocky Reach adult fishway in 2011 and 2012. The work included rounding and smoothing of edges on fishway entrance structures, and fabrication and installation of aluminum ramps and plates to enable passage over gratings through orifices. Ramps were constructed and placed at perched orifices in the upper fishway. Plating was installed along fishway walls and over the diffusion grating in the bifurcation pool and left powerhouse fishway entrance to reduce fallback and increase overall passage. The second phase was completed early in 2012 which installed plating at all weir orifices in the lower fishway. The total cost of these improvements was \$102,000.

In 2011, Chelan PUD in consultation with the RRFF installed a half-duplex (HD) PIT tag detection system within the fishway at Rocky Reach at a cost of \$176,000 to monitor improvements in lamprey passage as a result of fishway modifications. The HD PIT detection system is composed of HD antennas installed at seven different locations within the fishway and at fishway entrances (Chelan PUD 2013; Anders and Lee 2011). This system is able to detect adult lampreys PIT tagged downstream at Bonneville and other Federal Columbia Power System (FCRPS) dams, with some fish providing passage data for multiple Columbia River Projects.

Adult lampreys were tagged with HD PIT tags by the Army Corps of Engineers and University of Idaho researchers at Bonneville Dam in 2012 and 2013. Lampreys migrating from that location to the mid-Columbia were monitored at Rocky Reach Dam in the same years (Chelan PUD 2013). Chelan PUD conducted bi-weekly checks of all detection equipment at Rocky and downloaded PIT data from the seven detection sites a total of 142 times each year.

From July through October 2012, 11 adult lampreys were detected and monitored in the fishway at Rocky Reach, with eight of the 11 fish passing upstream (72.7%) by the time monitoring ended in December with fishway maintenance (Table 5-2). From July through October 2013, 13 PIT tagged adult Pacific lampreys were detected at Rocky Reach Dam, with (Table 5-3) with six of the 13 lamprey passing by the end of the monitoring period in December. In 2013, the first and earliest detection occurred on 30 July, while the last fish of the season was first detected on October 3. Six of the 13 fish (46.2%) are assumed to have passed Rocky Reach as these fish were last detected at the last fishway antenna (RRH 07) with no subsequent detections afterward. No fish detected at Rocky Reach in 2012 were detected in 2013.

Table 5-1. HD PIT tag antenna sites and descriptions of antenna locations at entrances and within the Rocky Reach adult fishway.

HD Detection Site	Antenna Site Description	Number of Antennas
RRH(01)	Entrance, Left Powerhouse (LPE)	1
RRH(02)	Entrance, Main Spillway (MSE)	2
RRH(05)	Entrance, Right Powerhouse (RPE)	2
RRH(03)	Internal, trifurcation pool	2
RRH(04)	Internal, transportation channel	2
RRH(06)	Internal, beginning of pool and weir ladder	2
RRH(07)	Most upstream antenna before fishway exit to forebay	2

Table 5-2. PIT tag detections of adult Pacific lamprey at Rocky Reach in 2012.

HD Tag Code	Year	Count	Exit Date	Passed?
8FC08C8	2012	1	9/10/12	YES
9E9065B	2012	2	9/17/12	YES
A306F3C	2012	3	10/15 RR(06)	No
A306F44	2012	4	9/16/12	YES
A326DE5	2012	5	7/28/12	YES
AB79DCA	2012	6	9/5/12	YES
AB79E47	2012	7	8/25/12	YES
AB79F0D	2012	8	9/18/12	YES
AB79F41	2012	9	10/15 RR(06)	No
AB7A02B	2012	10	10/1 RR(06)	No
AB7A03F	2012	11	9/15/12	YES

Table 5-3. PIT tag detections of adult Pacific lamprey at Rocky Reach Dam in 2013.

HD Tag Code	First Detect Date	First Detect Location	First Detect Time	Last Detect Date	Last Detect Location	Last Detect Time	Date Passed
A326D65	30 July	RRH(07)	3:23:25	30 July	RRH(07)	3:55:37	30 July
AECBEFC	6 Aug	RRH(03)	20:37:00	7 Aug	RRH(07)	0:43:08	7 Aug
AECC5BB	15 Aug	RRH(03)	4:12:43	15 Aug	RRH(07)	4:12:56	15 Aug
AECC355	19 Aug	RRH(02)	23:02:46	20 Aug	RRH(07)	4:50:30	20 Aug
AECC36F	20 Aug	RRH(03)	2:40:32	20 Aug	RRH(07)	7:17:22	20 Aug
AEBB9B5	31 Aug	RRH(06)	21:35:20	1 Sept	RRH(07)	1:01:08	1 Sept
AEBB952	7 Sept	RRH(01)	23:22:30	7 Sept	RRH(01)	23:22:30	-
AEBB9E1	15 Sept	RRH(01)	21:41:29	12 Dec	RRH(03)	20:37:35	-
AECBEC0	11 Sept	RRH(01)	1:53:46	11 Sept	RRH(01)	1:53:46	-
AEBB942	22 Sept	RRH(02)	23:19:47	9-Nov	RRH(06)	0:33:16	-
AECBF0A	22 Sept	RRH(06)	23:16:00	23 Sept	RRH(03)	0:44:36	-
ABAC50E	25 Sept	RRH(06)	22:04:49	26 Sept	RRH(04)	3:08:05	-
AECC3AF	3 Oct	RRH(07)	5:29:03	27 Oct	RRH(04)	22:27:05	-

Upstream passage rates for adult Pacific lamprey are being evaluated currently at other mainstem Snake and Columbia river hydroelectric projects by their respective operators using HD PIT tag monitoring. These evaluations must be completed, as well as additional year(s) of monitoring at Rocky Reach to complete this biological objective. Upstream fishway counts (window counts) at Rock Island Dam and Rocky Reach Dam are being compiled to assess minimum conversion rates between the two projects. Adult lamprey passage counts at Rocky Reach Dam are shown in Table 5-4. The RRF has discussed funding HD PIT tag detection system installation in tributaries (Wenatchee River and Entiat River) to determine tributary escapement, and aid in determining overall passage success of adult lamprey at Rocky Reach (RRFF 2013d).

Table 5-4. Adult Pacific lamprey fishway passage counts at Rocky Reach Dam by month, 2008-2013.

Year	May	June	July	August	September	October	November	Total
2008	0	0	11	161	188	8	0	368
2009	0	1	13	155	105	4	0	278
2010	0	0	6	126	110	26	0	268
2011	0	0	0	85	482	51	0	618
2012	0	0	5	251	496	53	0	805
2013	0	0	37	577	1,000	11	0	1,625

5.2 5.2 Objective: Juvenile Lamprey - Maintain safe, effective, and timely volitional passage criteria (as defined by the RRF)

The Rocky Reach Pacific Lamprey Management Plan (PLMP) requirement in section 4.2.1 is to operate the Rocky Reach Juvenile Bypass System (JFB) in accordance with operations for anadromous salmonids and compatible with bull trout migration per the HCP and Rocky Reach Fish Passage Plan. Chelan PUD operates downstream juvenile passage facilities to maintain safe and volitional passage of juvenile lamprey.

Chelan PUD constructed the Rocky Reach juvenile bypass system to guide juvenile salmon and steelhead away from turbine intakes at Rocky Reach Dam. The system consists of one surface collector entrance (SC) and the intake screen (IS) system in turbine units 1 and 2. Please refer to Mosey et al. (2004) for a detailed description of the bypass production system.

The JFB is operated from April 1 through August 31 each year. Juvenile fish sampling at the Juvenile Sampling Facility (JSF) in 2013 occurred throughout the operating period, Monday through Sunday. Sampling is conducted on the hour for a maximum of 30 minutes from 0800 hours through 1130 hours. The target number of juvenile salmonids to be collected is 350 spring species and 125 summer species. Fish sampled are examined for run timing, fish condition, species composition, and origin of fish stocks and identification of marked (PIT tag; fin clip) individuals.

Each juvenile lamprey collected during sampling is measured for length, examined for fish condition and injury, categorized as migratory (eyes present) or non-migratory (eyes absent), and returned to the river.

Around the clock sampling was conducted from late April through early June at the JSF in 2009 through 2011 in conjunction with implementing survival studies for juvenile spring Chinook salmon. The intent of the increased sampling was to document diel migration of juvenile spring Chinook salmon in order to validate survival study assumptions. Additionally, diel migration data was collected for other spring migrants, such as steelhead, sockeye salmon, and juvenile lampreys.

Data from 2011 show a very strong peak juvenile lamprey passage at Rocky Reach in mid-May (Table 5-5). The vast majority of juvenile observed during the peak migration in 2011 were collected during nighttime hours: from 2200 hours to 0400 hours. A similar trend was observed in 2009 and 2010 although total numbers of juvenile lampreys were considerably lower than 2011. Few juvenile lampreys have been observed in samples collected outside the dates shown in Table 5-5 for years 2009 through 2013. The reduced number of juvenile lampreys observed in 2012 and 2013 is likely a result of reduced sampling times in those years.

Columbia River turbidity data were collected during May 2011. Turbidity (NTU) values from May 1 through May 15, 2001 ranged from 7.5 to 9.0 NTU from May 1 through May 15. Turbidity increased significantly on May 16, with a daily value of 4 NTU, dropped to 2.4 NTU on May 17, and remained between 3.5 and 4.7 NTU for the remainder of the month. During this period there was not a corresponding increase in mainstem Columbia River flow until May 18.

Several theories were discussed by Chelan PUD staff regarding the dramatic increase in juvenile lamprey passage and increased turbidity. One hypothesis is that juvenile lamprey undergoing metamorphosis into macrophthalmia migrate actively during nocturnal hours and during periods of increased water turbidity, using light and or reduced water clarity as a cue to initiate downstream migration. Another hypothesis is that higher flow events in tributaries potentially scour juvenile lamprey from rearing areas and forcibly move them downstream, resulting in increased numbers of juveniles observed at the Rocky Reach fish bypass system.

Table 5-5. Juvenile Lamprey Counts at the Rocky Reach Juvenile Sampling Facility, 2009-2013.

DATE	2009		2010		2011		2012		2013	
	Migratory	Non-Migr	Migratory	Non-Migr	Migratory	Non-Migr	Migratory	Non-Migr	Migratory	Non-Migr
27-Apr			9							
28-Apr			3	1						
29-Apr	2				1	1				
30-Apr		1	2			1			1	
1-May			1							
2-May						1				
3-May						1				
4-May					1	1				
7-May						1			1	
8-May										
9-May	1				1	1				
10-May	1					2				
13-May		1	2							
14-May					1					
15-May		1								
16-May					266	77				
17-May					349	262				
18-May	1		1	1	9	94				
19-May			2		1	7				
20-May						2				
21-May	1	1	5			2				1
22-May			7			2				
23-May			7			1				
24-May			3	2	1	3				
25-May			1			5				
26-May						4				
27-May					1	11				
28-May						6				
29-May				1		5				
30-May			1	1		3				
31-May		1	1	1		5				
1-Jun						1				
2-Jun		1	1			3				
3-Jun			3	1						
4-Jun			5	3						

Section 4.2.2 of the PLMP requires that “During the juvenile lamprey passage period, Chelan PUD shall continue to monitor potential lamprey impingement on turbine intake screens to assure impingement rates remain negligible until such time as the RRFF recommends that monitoring is no longer necessary.”

Juvenile lamprey impingement monitoring was conducted at Rocky Reach Dam in 2006 and 2010 (Chelan PUD 2010), and again in 2013 (Chelan PUD 2013). Although 2006 data were not collected during the timeframe of this Biological Objectives Status Report (2009-2013), the data provided information to the RRFF upon which the Forum made decisions regarding incidence of juvenile lamprey impingement and screen monitoring frequency.

Fish counters reviewed Unit C1 and C2 diversion screen cleaning operations for 23 days in 2006:

- 3 cleanings in April
- 4 cleanings in May
- 6 cleanings in June
- 7 cleanings in July
- 3 cleanings in August

During the 23 days, counters observed six possible juvenile lampreys on the screens: 5 in April and 1 in August. Four lampreys were reported for C1 and C2 screens combined (i.e. when screens in both units were cleaned in one night) and two were reported for C1 screen cleanings only.

Fish counters reviewed C1 and C2 diversion screen cleaning operations for three days in the 2010 monitoring period, April 15 through June 15. No juvenile lampreys were observed during any cleaning operations conducted on May 18, June 5, and June 22 on either C1 or C2 diversion screens.

The Rocky Reach Fish Forum concluded at their February 2, 2011 meeting that “...because of very low incidence of impingement observed over the past several years, ... that annual reporting of juvenile lamprey impingement monitoring under USFWS prescription Article 5(b)(2) would no longer be necessary. However, they will have a bi-annual review to evaluate the necessity to reinstate the monitoring and reporting.” (RRFF 2011a).

During the 2013 screen-monitoring period for juvenile lamprey (mid-May through mid-June), the screens in both units, C1 and C2, were cleaned a total of seven times (13 May, 17 May, 23 May, 28 May, 31 May, 7 June, and 14 June). The total video footage time for the seven cleaning events in 2013 was 15 hours, 45 minutes. Chelan PUD fisheries biologists reviewed the video recording of these cleaning events. No juvenile lampreys were confirmed to be impinged on screens. For the entire period, only two individual “shapes” were reported as possible juvenile lamprey, but determination was inconclusive and described by the reviewing biologist as 50/50 at best.

The RRFF concluded that bi-annual monitoring for turbine intake screen is acceptable based on the existing data demonstrating a “very low incidence of impingement.” Additionally, the RRFF has requested no further action other than bi-annual monitoring. Based on bi-annual monitoring approved by the RRFF, the next screening monitoring year will be spring 2015 at Rocky Reach. These decisions by the RRFF indicate that the Biological Objective of monitoring juvenile downstream passage is being achieved, and that safe volitional passage through turbine intakes is being maintained.

Section 4.2.3 of the PLMP requires that “Between years two and five of the New License, Chelan PUD shall continue to measure the type and magnitude of any ongoing Project impacts on the downstream passage of juvenile lamprey using appropriate and reasonable methodologies. Specifically, these methodologies will address juvenile lamprey downstream migration timing and passage survival through the Project.” Also, “...Chelan PUD shall, in consultation with the RRFF, develop means to provide sufficient numbers of juvenile lamprey for these evaluations. Chelan PUD, in consultation with the RRFF, may choose to contribute to other local or regional lamprey investigation programs in order to gain efficiencies in the development of methods for lamprey investigations at the Project.”

Efforts to investigate the type and magnitude of ongoing Project effects, and producing test fish are described in the following sections.

Laboratory studies have been conducted in efforts to investigate that type and magnitude of ongoing Project effects on downstream migration of juvenile lampreys in the Columbia and Snake rivers. Juvenile lamprey have been used as test fish in studies attempting to simulate passage conditions that juvenile lampreys may experience passing hydroelectric projects during their downstream migration. These studies involved introducing juvenile lampreys to high concentrations of total dissolved gas (TDG), which is produced by high spill levels at dams, and conditions that could occur during passage through turbines, such as blade strike, sudden changes in barometric pressure (baro-trauma), and shear stress near turbine blades and in draft tubes. The RRFF developed a draft Juvenile Lamprey Survival at Rocky Reach Dam Effects Analysis (RRFF 2012c) identifying potential sources of mortality, potential effects, level of perceived concern, and corrective actions specific to Rocky Reach Dam. Some excerpts from the effects analysis are as follows:

Total dissolved gas: Brief exposure to shallow depth is not sufficient to develop emboli. Juvenile lampreys generally reside below compensation depth. (Colotelo et al. 2012).

Turbine blade strike: Tests conducted for strike from turbine blades of varying thicknesses with American eels, approximately 300 mm in length, showed survival rates of 100 percent for most test conditions (Amaral, et al. 2008).

Turbine pressure: Limited effects have been observed on juvenile lampreys physical condition, immediate or delayed, and no observed behavioral response of juvenile lampreys to instantaneous pressure drop when applied (Colotelo et al. 2012).

Turbine shear stress: Shear force of 90 cm/sec per cm was applied, which is much higher than applicable to turbine passage. No immediate or delayed effect on survival of treatment juvenile lampreys was observed (Mueller 2012).

The RRF has not reached consensus on the effects analysis, and significant discussions continue at present regarding the type and magnitude of ongoing Project effects, corrective actions, data needs, and area and level of responsibility.

The RRF conducted several efforts to investigate the ability to produce test fish for survival studies as an additional method to "...measure the type and magnitude of any ongoing Project impacts on the downstream passage of juvenile lamprey." The RRF commissioned preparation of the report: Pacific Lamprey Artificial Propagation and Rearing Investigations: Rocky Reach Pacific Lamprey Management Plan report (GeoEngineers et al. 2011). The goal of the document was to "provide guidance as to the feasibility of culturing Pacific lamprey, assess types of associated facilities necessary for culture practices, and identify uncertainties for monitoring culture efficacy and rational for implementing Pacific lamprey artificial propagation." With the "ultimate goal" of the PLMP to achieve No Net Impact (NNI) to Pacific lamprey with regard to ongoing operations of the Rocky Reach Hydroelectric Project, the RRF went forward to conduct the study on potentials for artificial propagation of Pacific lamprey which is considered by the state and federal fishery agencies and Tribes as a potential Protection, Mitigation, and Enhancement measure (PME) for achieving NNI during the term of the current Rocky Reach license.

The document focused on three aspects: 1) developing an artificial propagation manual; 2) researching potential structured rearing facilities; and 3) researching potential riverine rearing facilities.

Juvenile Lamprey Artificial Propagation Manual

The Manual for the Intensive Culture of Pacific Lamprey was developed by the U.S. Fish and Wildlife Service (Ostrand et al. 2011). The manual demonstrates that culture of Pacific lamprey is definitely possible, from adult collection, spawning, fertilization, and early rearing to larval stage. However, it is recognized in the manual that Pacific lamprey propagation "has not been done intensively (where all life-stages are reared under controlled culture conditions) on a production scale or from gametes to reproductively mature adults." The manual also identifies "significant difficulties for intensive culture because of the long duration of the juvenile period that requires a food supply for anywhere from four to seven years while they are ammocoetes (Beamish 1987; Wydoski and Whitney 2003) and the maintenance of food sources for the parasitic life history form." Other articles corroborate the uncertainty and longevity of the juvenile rearing phase of Pacific lamprey life history (Pletcher 1963; Kan 1975; Richards 1980; Beamish and Northcote 1989). However, the specific length of larvae life of Pacific lamprey is mostly unknown because of inconsistent length frequency data and the lack of bony structures (Close et al. 1995).

The challenge of artificial propagation of Pacific lamprey is highlighted in the manual by the statement "Developing a methodology for the culture of Pacific lampreys through all life

history stages will take several years to achieve, and challenges will be encountered with each life history stage until they are successfully raised to adults.” Additionally, “This manual describes Pacific lamprey life stages and major bottlenecks to successful culture.” The manual also includes sections on Macrophthalmia Rearing/Maintenance/Release, Parasitic Pacific Lamprey Maintenance, and Disease and Treatment.

One conclusion included in the document is that the manual is the first attempt to summarize culture methodologies for rearing all life stages of Pacific lamprey and needs further actions to refine and test culture methods. Additional conclusions were that little is known about the intensive culture of lampreys, most work has been conducted on an experimental basis, and that development of effective and efficient techniques will likely involve the collective efforts of fisheries researchers, fish culturists, and nutritionists. Final recommendations provided in the manual are in the form of research needs to address critical uncertainties and suggestions for future research and evaluation.

Structured Rearing Facilities

Existing state, federal, Tribal, and research hatchery facilities in Washington and Oregon were evaluated for potential Pacific lamprey rearing sites. A questionnaire was developed specific to the needs of a basic lamprey aquaculture facility and sent to the managers and leaders of regional facilities. The focus was on facilities in the vicinity of the Rocky Reach Project near the Wenatchee, Entiat, and Methow drainages. Eleven facilities were identified, based on questionnaire results, and evaluated for hatchery staff experience and interest in lamprey culture, adult holding facilities, incubation and hatching facilities, available rearing space, water quality and quantity, ability to heat or cool water, ability to isolate lamprey culture from salmonids culture facilities, and water source pathogens and contaminants. Of these 11 facilities, 7 were recommended in the report as centers with capability and interest in Pacific lamprey propagation.

Riverine Rearing Facilities

This section of the report “discusses rearing facilities that may be appropriate for propagation of juvenile lamprey in the study area. The purpose of this inventory is to identify natural riverine sites within the study area watersheds (Methow, Chelan, Entiat and Wenatchee) that have high potential value to support the goals of the Pacific lamprey Artificial Propagation Project by providing rearing sites for artificially propagated juvenile Pacific lamprey.” Identified in the report are riverine facilities within each watershed that may be suitable for rearing juvenile lamprey. The report also provided monitoring recommendations that could be implemented to evaluate the potential effectiveness sites identified for achieving program goals.

Potential sites were evaluated throughout the Methow, Chelan, Entiat and Wenatchee watersheds. The Okanogan watershed was considered initially, but was eliminated due to time and budgetary constraints and the desire of the RRFF to one “untreated” watershed for potential comparison to “treated” watersheds. Draft criteria for potential lamprey propagation site selection included: 1) ability to recover macrophthalmia; 2) land ownership/accessibility; 3) vehicle accessibility; 4) suitable thermal, flow regimes, substrate; 5) oxbow/high-flow side channel; 6) associated downstream habitat; 7) implications of attracting adult lamprey to area;

and 8) predation risk. Following is the number of sites in each watershed recommended in the report, based upon the selection criteria, as having the highest habitat value/potential needed for Pacific lamprey release sites: Methow – 2; Chelan – 1; Entiat – 2; and Wenatchee – 3.

A primary conclusion offered in the report is that initial observations indicate that rearing within “riverine facilities” would not be as beneficial as rearing within “structural facilities”. Although the concept is viable, environmental factors and predation are not controllable. Within structural rearing facilities it becomes easier to manage environmental factors such as temperature and water quality while completely removing predation factors.

The RRFF commissioned the preparation of the Pacific Lamprey (*Lampetra tridentata*) Breeding and Rearing Methodologies - Recommendations for Chelan County P.U.D. report (Wade and Beamish 2012) as a further attempt to investigate the potential for providing test fish for juvenile survival studies or to implement other measures to achieve NNI. The objectives of the investigation were to:

1. Evaluate specific growth rates, health, and survival of Pacific lamprey reared at various densities to determine space requirements and vessel designs for culture of various life history stages, particularly ammocoetes; and
2. Identify and develop foods, rations, and feeding methods for optimal juvenile Pacific lamprey growth and nutrition.

Information from previous work conducted by Dr. Richard Beamish was compiled and summarized to address both stated objectives, and a literature search was provided to enable decision-makers to determine the best course of action for capture and culture of Pacific lamprey as a component of fulfilling section 4.2.3 Measurement of Impacts on Juvenile Downstream Passage of the PLMP. A very important caveat stated early in the report was that “Dr. Beamish’s experience with breeding and culture of lamprey was varied, but in no way was it a commercial scale breeding program; it was for experimental purposes and focused on providing accurate identification of ammocoetes.”

The report provided information from Dr. Beamish’s experience involving adult capture, culture methods and rearing conditions, transport, broodstock, spawning, egg incubation, rearing ammocoetes, and culture considerations for the artificial propagation of lamprey.

Wade and Beamish (2012) recommended releasing larval young-of-the-year ammocoetes into the wild to supplement natural populations. They suggested also that some cultured lamprey could be held for a year under experimental conditions, but that it may not be possible to raise large numbers of ammocoetes through to metamorphosis, when they could be used as test fish, in captivity due to the time and space required and potential for significant mortality during that time. The report identified that some type of tagging technology is a necessary evaluation component for assessing the efficacy of any supplementation program.

Recommendations in the report were primarily in the form of additional research needs, such as securing pathogen-free water source, holding wild broodstock, identifying appropriate rearing densities, disease treatments, and developing protocols for evaluating program efficacy.

One recommendation re-emphasized the suggested strategy of releasing larval ammocoetes versus holding ammocoetes to metamorphosis stage.

The report concluded: "...that the fertilizing and rearing of eggs from Pacific lamprey is not a significant obstacle. If very large numbers of eggs are incubated, typical of large Pacific salmon hatcheries, it will be necessary to develop protocols similar to those used in large production hatcheries." To date, no researcher has attempted to incubate large numbers of eggs nor have protocols or attempts been made to rear large numbers of juveniles to the migratory life-stage.

Considerations in Designing Juvenile Lamprey Survival Studies were presented at the Juvenile Pacific Lamprey Seminar held August 1, 2012 (Skalski 2012). The presentation addressed study design considerations, tag considerations, model assumptions and design options for tagging studies, strengths and weaknesses of design options, potential useful preliminary studies, and appropriate sample size calculations.

Skalski (2012) reported that if PIT-tags were used for a juvenile lamprey survival evaluation, then a large sample size (7,000 to 18,000 fish) would be required in order to achieve the appropriate precision for a survival estimate. Acquiring this number of test fish makes the ability to conduct a survival study prohibitive at the current time. Additional analyses showed that if active (i.e. acoustic) tags were used, then a much smaller sample size (709 to 2076 fish) would be required in order to achieve the appropriate precision of the survival estimate (Skalski and Townsend 2013). However, to date such a tag does not exist that is small enough with sufficient battery life to conduct a survival study. Additionally, Skalski (2012) presented that with either tag technology, a methodology for conducting an unbiased survival study with test fish that may not actively migrate does not exist. Study methods used for salmonid survival studies would be invalid if rearing behavior caused some tagged juvenile lamprey (test fish) to stop their active downstream migration through the study area after release. Active migration of test fish through the study area is critical in paired-release mark-recapture survival studies to achieve unbiased survival study results (Burnham et al. 1987).

Significant progress has been made from 2009 to 2013 toward collecting information and conducting investigations to measure the type and magnitude of any ongoing Rocky Reach Project effects on the downstream passage of juvenile lamprey. However, significant discussion is occurring, and will continue to occur in the foreseeable future within the RRFF as to management options and potential new or modified implementation, monitoring and/or evaluation measures that the RRFF will implement to achieve this Biological Objective. For example, the role of artificial propagation and production of larval Pacific lamprey is unclear at this time and is being discussed at RRFF meetings. Also being debated heavily within the RRFF are Project impacts on adult passage, specifically through the Rocky Reach Reservoir and the level of mitigation responsibility of Chelan PUD to address Project impacts and achieve NNI. These issues are expected to come to some level of agreement within the RRFF during the next 5-year reporting period thus supporting regional coordination and implementation efforts focused on addressing the challenges unique to Pacific lamprey life history and migration.

5.3 Objective: Avoid and minimize Projects impacts on rearing habitat

The RRF commissioned the Distribution, Composition, and Abundance of Juvenile Lamprey (*Lampetra* sp.) within the Observed Operating Range of Rocky Reach Reservoir, 2011 study report (Chelan PUD 2012). The intent of the report was to address the following objectives:

1. Assess frequency, magnitude, and duration of Rocky Reach Reservoir fluctuations.
2. Identify shoreline shallow water habitat that is consistent with desired juvenile lamprey habitat that may be dewatered by ongoing Project operations.
3. Document presence of juvenile lamprey within and adjacent to habitat.
4. Determine potential effects of Project operations on juvenile lamprey.

Existing aquatic habitat within the Rocky Reach Reservoir with juvenile lamprey rearing characteristics was identified using aerial photographs, bathymetry, shoreline slope, velocity, and substrate characteristics to segregate habitat types into those areas with high (Type 1), medium (Type 2), and low (Type 3) potential for use by juvenile lamprey. The magnitude, frequency, and duration of reservoir elevations in reference to habitats identified were assessed in order to identify potential sampling locations.

Juvenile lamprey presence was assessed using an ABP-2 backpack electrofisher in wadeable areas that may be affected by Project operations as well as deeper areas that likely remain watered during normal Project operations. Sampling areas were selected based on lamprey habitat types categorized by Hansen et al. (2003). Type 1 is the preferred habitat for juvenile lamprey and consists of sand, fine organic material, detritus, and/or aquatic vegetation. Type 2 habitat is suitable for juvenile lamprey and consists of shifting sand or gravel with little fine organic material. Type 3 habitat is composed of bedrock or hardpan clay along with larger gravel and is unsuitable for juvenile lamprey.

Juvenile lamprey sampling was conducted at sampling sites identified in Figure 5-1. Details of juvenile lamprey sampling locations, duration, and time of day are shown in Table 5-6.

Rocky Reach Reservoir Juvenile Lamprey Sampling

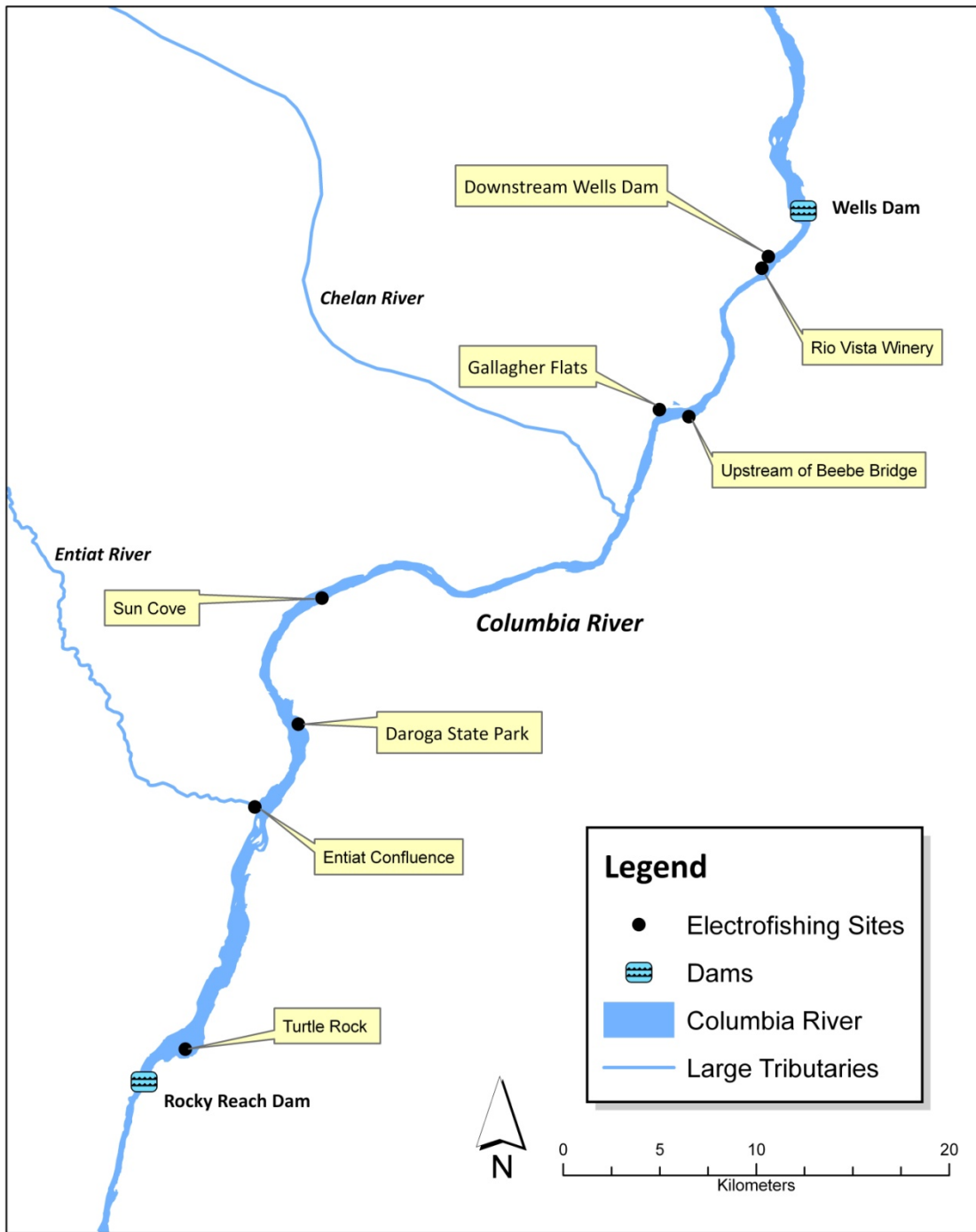


Figure 5-1. Juvenile lamprey electrofishing sampling locations.

Table 5-6. Juvenile Pacific lamprey sampling locations in Rocky Reach Reservoir, including sampling duration and time of day.

Site Name	Latitude	Longitude	Electrofishing Time	Time of Day
Turtle Rock (east side)	47.54682971	-120.2655617	10 min, 45 sec.	8:45
Entiat Confluence	47.66098251	-120.2243807	13 min.	9:30
Daroga State Park	47.70040801	-120.1967424	11 min, 42 sec.	10:01
Sun Cove	47.7595498	-120.1838521	11 min, 45 sec.	10:30
Gallagher Flats	47.8533302	-119.9555106	12 min, 58 sec.	11:59
Rio Vista Winery	47.9209587	-119.8880906	8 min, 10 sec.	12:15
Downstream of Wells Dam	47.9264806	-119.8839092	11 min, 49 sec.	12:30
Upstream of Beebe Bridge	47.8505602	-119.9348802	10 min, 15 sec.	13:30

Substrate was generally Type 1 habitat in all areas sampled. Substrate at the Daroga Park site exhibited more gravel/cobble composition close to shore, with Type 1 habitat more prevalent in water deeper than could be electrofished effectively. Substrate at the site upstream of Beebe Bridge was comprised of fine sand, but also contained large growths of aquatic vegetation.

Juvenile lampreys were captured only at the Sun Cove site. Five juvenile lamprey were captured, anesthetized, measured for total length, allowed to recover, and released at the location of capture. Lengths of the five juvenile lampreys were: 113 mm, 115 mm, 120 mm, 138 mm, and 142 mm.

Discussion of the study objectives is as follows:

1. Assess frequency, magnitude, and duration of Rocky Reach Reservoir fluctuations.

Assessment of Rocky Reach Reservoir fluctuations was conducted during the Bull Trout Stranding Investigation conducted in 2005, 2006, and 2007, and reported in 2008 (Chelan PUD 2008). Headwater elevations were compiled to create headwater duration curves that were then used to identify shallow-water habitat that may be dewatered on a regular basis. Headwater duration curves demonstrated little reservoir habitat was subject to dewatering due to very stable conditions provided by the operation of Rocky Reach. However, sampling stations were established in shallow-water habitat areas identified with the potential for dewatering and containing typical juvenile lamprey substrate size.

Identify shoreline shallow-water habitat that is consistent with desired juvenile lamprey habitat that may be dewatered by ongoing Project operations.

Shoreline shallow-water habitat (Type 1) preferred by juvenile lamprey was identified in the Rocky Reach Reservoir by reviewing aerial photographs, the Rocky Reach Aquatic Habitat

Mapping Study Report (DES 2001), and by conducting a boat survey of the reservoir for suitable sampling locations in November 2011.

2. Document presence of juvenile lamprey within and adjacent to habitat.

Juvenile lamprey captured at the Sun Cove site were found along the outside edge of a fairly steep drop-off, at depths of approximately 0.61 m to about 1.2 m deep, on the upstream side of a point. No juveniles were captured further toward the inner part of the bay inside the point in shallower water. Substrate was comprised primarily of fine sand, but also contained a considerable amount of leaf litter, more so than any other sample site. The size of the juveniles indicated that they were older year classes, and the larger specimens may be approaching the size of metamorphosis from ammocoetes to macrophthalmia.

3. Determine potential effects of Project operations on juvenile lamprey.

The sampling crew believed that the location at which the juveniles were collected was deeper than the lowest point of reservoir fluctuation, thus protecting the juveniles from becoming dewatered or stranded. If true, then the sampling conducted in 2011 indicates that juvenile lamprey were not present within suitable habitat within the area of reservoir fluctuations.

To evaluate Rocky Reach Reservoir hydraulic characteristics to identify potential adverse effects of reservoir operations on juvenile lamprey rearing and migration, in 2013 Chelan PUD calculated full content, mean monthly water residence times and flow-through water velocities for the reservoir. Actual river flow data for Rocky Reach were evaluated for years 2001-2012. Mean monthly (January-December) reservoir water resident times ranged between 1.25 to 3.01 days; average monthly water velocities ranged between 0.88 to 2.27 feet per second (Chelan PUD 2012). Based on these data, the RRFF determined that the strongly riverine-like flow conditions that dominate the reservoir were not likely to be a significant limiting factor on juvenile lamprey rearing or migrating (RRFF 2012b). The RRFF has not requested any additional juvenile lamprey reservoir habitat sampling to date. Additionally, the RRFF has requested no further actions to address potential effects of ongoing reservoir operations on juvenile lamprey reservoir rearing or migrating habitat. The RRFF indicated in its effects analysis that while reservoir operations did not appear to be affecting juvenile lamprey rearing or migrating conditions, future sampling or other investigation may be directed by the RRFF in the next five year period.

5.4 Objective: No Net Impact

Section 4.4 of the PLMP requires Chelan PUD to identify and implement measures to address unavoidable impacts to achieve NNI. Progress in the first five years of implementing the PLMP and objectives achieved to by Chelan PUD, as directed by the RRFF to address the 10 requirements of the PLMP identified on pages 5-1 and 5-2 of the Executive Summary of the PLMP will be used to identify the framework ultimately used to achieve NNI for Pacific Lamprey. The 10 measures are intended to address the objectives described on page 5-14, section 4: Protection, Mitigation, and Enhancement Measures, which are as follows:

- Objective 1: Measure any ongoing Project impacts on upstream and downstream passage of adult Pacific lamprey, and eliminate those impacts to the extent appropriate and reasonable;
- Objective 2: Measure any ongoing Project impacts on downstream passage of juvenile Pacific lamprey, and eliminate those impacts to the extent appropriate and reasonable;
- Objective 3: Measure any ongoing Project impacts on the existing reservoir habitat used currently by juvenile Pacific lamprey, and eliminate those impacts to the extent appropriate and reasonable; and
- Objective 4: Identify and implement appropriate and reasonable measures to address unavoidable impacts to achieve NNI.

Specifically, section 4.4 on the PLMP requires Chelan PUD to “collect and compile information regarding Pacific lamprey distribution, population status and trends, and juvenile downstream migration timing, to identify and implement appropriate and reasonable measures in order to achieve NNI.” Additionally, “Chelan PUD shall, in consultation with the RRFF, identify and implement appropriate and reasonable measures to address unavoidable losses at the Project in order to achieve NNI. Chelan PUD... may consider implementation of off-site actions in order to address unavoidable impacts.”

The previous sections describe the significant efforts undertaken during the past 5 years to identify, measure, and address avoidable effects on Pacific lamprey due to ongoing Rocky Reach Project operations. These sections highlight areas where Project effects have been identified and have been or are in the process of being addressed, and also many areas where additional data needs to be collected and discussions held in order to identify and address ongoing Project effects. Some areas, such as direct measurement of potential effects on downstream juvenile passage, may not be possible to identify and address until technologies and methods are satisfactorily developed. Discussions are occurring at present within the RRFF to determine the next steps to achieve NNI for Pacific lamprey at the Project.

Key discussions topics that have occurred within the RRFF include the following issues:

- Can tag technology produce an active tag in the near time-frame small enough with sufficient battery life to conduct juvenile lamprey survival studies?
- If a tag can be developed, then can a methodology be developed to conduct an unbiased juvenile lamprey survival study given the complexities of juvenile outmigration behavior;
- What is happening to adult Pacific lamprey in the Project reservoirs given very low passage counts at the upstream dam?
- Can an accurate assessment of adult lamprey behavior in reservoirs be conducted?
- Should Half-duplex PIT-tag detection equipment be installed in tributaries to assess adult Pacific lamprey “escapement into tributaries” to aid in solving discrepancies in dam passage counts?

- Is there a role for artificial propagation of lampreys, beyond providing juvenile lamprey for study needs, to achieve NNI, and if so, what would it entail?
- Can alternative strategies and projects be used to achieve NNI even though studies to determine unavoidable project effects to juvenile lamprey downstream passage are yet to occur?
- How does information collected to answer the previous questions help to achieve NNI?

At present, the RRFF is discussing alternative actions and projects, both on-site and off-site that could be used to achieve NNI. Uncertainties identified through the previous questions need to be evaluated prior to the RRFF directing specific actions to measure and address unavoidable Project effects and achieve NNI. Ongoing efforts by the RRFF to identify specific actions to achieve NNI will be reported in the next 5-year Biological Objectives Status Report.

SECTION 6: RESIDENT FISH

6.1 Objective: No Negative Impacts on Native, Non-Stocked Resident Fish Species

The fish resources of Rocky Reach Reservoir include native resident species, introduced residentspecies and anadromous species. The native resident fish species include white sturgeon, mountain whitefish, rainbow trout, bull trout, northern pikeminnow, peamouth, chiselmouth, largescale sucker, longnose sucker, bridgelip sucker, redbreast shiner, sculpins, and threespine stickleback (Chelan PUD 1991).

During the Rocky Reach Hydroelectric Project relicensing project, the Resident Fish Technical Group developed the Resident Fish Management Plan (RFMP) (Chelan PUD 2006). A goal within the RFMP is to protect and enhance resident fish populations and habitat within the Rocky Reach Project. Protection, Mitigation, and Enhancement measures (PMEs) were developed to achieve the RFMP's goal. One RME required Chelan PUD to conduct a resident fish survey to assess potential predation effects of non-native predators on native fish and to estimate relative fish abundance and fish species composition in Rocky Reach Reservoir (Section 4.2 of the RFMP). In 2012, Chelan PUD contracted with the Washington Department of Fish and Wildlife (WDFW) Large Lakes Research Team to conduct a Rocky Reach Resident Fish Survey (Burgess et al. 2013).

Fyke nets, pop nets and electrofishing were used to sample fish during the summer and fall of 2012. Species composition was determined for all three sampling methods; catch per unit effort (CPUE) was estimated for electrofishing and fyke netting; and population abundance was estimated from the pop netting. Additionally, the data collected was used to calculate community metrics scores and an Index of Biotic Integrity (IBI) (Karr and Dudley 1981) for Rocky Reach Reservoir.

Species composition of fish captured with pop netting was dominated by the family *Gasterosteidae* (Table 6-1). Species composition and CPUE was dominated by northern pikeminnow, a native predator, during the summer and fall boat electrofishing and fyke netting efforts (Table 6-2). During the summer and fall surveys, 20 species of fish (seven non-native and 13 endemic to Washington State) were captured, including very low numbers of exotic predators. The IBI score for Rocky Reach Reservoir was classified as "Good-Fair".

Table 6-1. Number of fish captured (*n*), the expanded population estimate (*N*), and species composition (%) using expanded population estimates of fish captured in summer pop nets within dense macrophyte mats at specific locations of the Rocky Reach Reservoir.

Species	<i>n</i>	<i>N</i>	%	Species	<i>n</i>	<i>N</i>	%
Chiselmouth	7	7	0.9	Sculpin spp.	21	22	2.7
Minnow spp.	1	1	0.1	Smallmouth bass	1	1	0.1
Northern pikeminnow	74	99	12.3	Sucker spp.	47	60	7.4
Peamouth	9	9	1.1	Threespine stickleback	435	568	70.5
Redside shiner	37	37	4.6	Unknown	2	2	0.2

Table 6-2. Percent species composition for electrofishing (EB%), fyke netting (FN%), and CPUE electrofishing (EB fish/hour) for summer and fall sampling at Rocky Reach Reservoir.

	Origin	Summer Sampling			Fall Sampling		
		EB%	FN%	EB fish/hour	EB%	FN%	EB fish/hour
Bluegill	Introduced	0.21	0.00	0.86	0.0	0.4	0.00
Bridgelip sucker	Native	0.46	0.00	1.89	0.5	0.0	2.40
Carp	Introduced	0.33	0.00	1.37	0.1	0.0	0.34
Chinook salmon	Native	0.04	0.71	0.17	16.8	5.6	77.49
Chiselmouth	Native	8.52	5.71	35.14	0.2	0.0	1.03
Largescale sucker	Native	22.10	9.29	91.20	11.1	1.6	51.26
Longnose sucker	Native	0.25	0.00	1.03	0.3	0.4	1.54
Minnow spp. ¹	Native	0.42	0.00	1.71	0.2	0.0	0.86
Northern pikeminnow	Native	30.83	60.00	127.20	15.5	8.7	71.49
Peamouth	Native	3.32	0.71	13.71	5.0	1.1	23.14
Pumpkinseed	Introduced	0.04	0.00	0.17	0.0	0.0	0.00
Redside shiner	Native	22.35	0.71	92.23	43.0	10.3	198.53
Sculpin spp.	Native	6.94	2.14	28.63	4.2	0.0	19.20
Smallmouth bass	Introduced	0.50	0.00	2.06	0.1	0.4	0.69
Steelhead	Native	0.00	0.00	0.00	0.0	0.2	0.00
Sucker spp.	Native	2.29	0.00	9.43	0.7	0.7	3.43
Tench	Introduced	0.46	2.86	1.89	0.0	0.0	0.17
Threespine stickleback	Native	0.37	17.86	1.54	1.2	70.4	5.66
Walleye	Introduced	0.04	0.00	0.17	0.1	0.0	0.51
Whitefish	Native	0.46	0.00	1.89	0.8	0.0	3.77
Yellow Perch	Introduced	0.08	0.00	0.34	0.1	0.2	0.69

¹All minnows unidentified to species were of native origin.

The composition of the fish assemblage in Rocky Reach Reservoir and the spatial distributions of the various species present are similar to those reported for other similar run-of-the-river reservoirs in the upper Columbia River drainage (Duke Engineering and Services 2001). The results and conclusions from Burgess et al. 2013 characterized the native, resident fish assemblage in Rocky Reach Reservoir as relatively unchanged compared to pre-project construction. The report also confirmed limited presence of non-native predators (i.e., smallmouth bass and walleye). Project operations have not drastically changed fish habitat within Rocky Reach Reservoir. Project operational characteristics reduce the frequency and magnitude of forebay-reservoir water surface fluctuations to approximately two feet. This operational regime limits fish stranding along the shoreline or entrapment of fish in isolated pools as water recedes (BioAnalysts 2000, Chelan PUD 2008), reducing negative impacts to resident juvenile fish. Additionally, project operations that maintain a run-of-the-river reservoir, continues to provide habitat for resident, native fish. With very limited water storage capability, movement of river water through Rocky Reach Reservoir is rapid with mean monthly reservoir water resident times between 1.25 to 3.01 days, and average water velocities between 0.88 to 2.27 feet per second (Chelan PUD 2012).

The sampling results and conclusions from Burgess et al. 2013 identified no negative impacts to native, non-stocked resident fish assemblages in Rocky Reach Reservoir in Rocky Reach Reservoir by project operations and determined that non-native predator abundance was low. Therefore this Biological Objective has been achieved for the evaluation time frame, 2008 through 2013. Based on the results from Burgess et al. 2013, the RRFF (RRFF 2013) determined that Chelan PUD will conduct three more similar studies (also specified in the RFMP) once every 10 years (2023, 2033, and 2043), over the next 30 year period.

The RRFF has recommended no new implementation measures specific to monitoring resident fish in the reservoir and or alternatives to project operations. Chelan PUD and the RRFF propose to maintain Rocky Reach Project current operations over the next five-year period, and continue appropriate monitoring to ensure protection for native non-stocked resident fish species.

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