

# BONNEVILLE DAM

## FISHWAY STATUS ANNUAL REPORT

### 2012



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31 January 2013

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## INTRODUCTION

The 2012 Fishway Status Annual Report for Bonneville Lock and Dam summarizes activities impacting fish at Bonneville Project from 1 December 2011 through 30 November 2012.

Primarily a synopsis of weekly reports, this document summarizes all activities affecting fish passage including maintenance outages, dewaterings, and recent modifications to fishway components. This document is required by the Corps of Engineers' Northwestern Division, as described in the Fish Passage Plan (FPP). The FPP contains the following reporting requirements: "The (weekly) reports shall include: any out of criteria situations observed and subsequent corrective actions taken; equipment malfunctions, breakdowns or damage, along with a summary of resulting repair activities; adult fish control calibrations; STS and VBS inspection; any unusual activities which occurred at the project which may affect fish passage." Project biologists and operators perform inspections of the fish passage facilities three times per day, seven days per week during fish passage season, and three times per day at least three times per week during winter maintenance season as outlined in the FPP.

The Project includes two powerhouses, a spillway and two navigation locks. The older of the two navigation locks has not operated since early 1993. There are four adult fish ladders for upstream migration, located at each powerhouse and the north and south ends of the spillway. There are three Juvenile Bypass Systems (JBS) for downstream migration: an Ice and Trash Sluiceway (ITS) at Powerhouse 1 (PH1), a downstream migration transportation channel (DSM) at Powerhouse Two (PH2), and the corner collector at PH2 (B2CC).

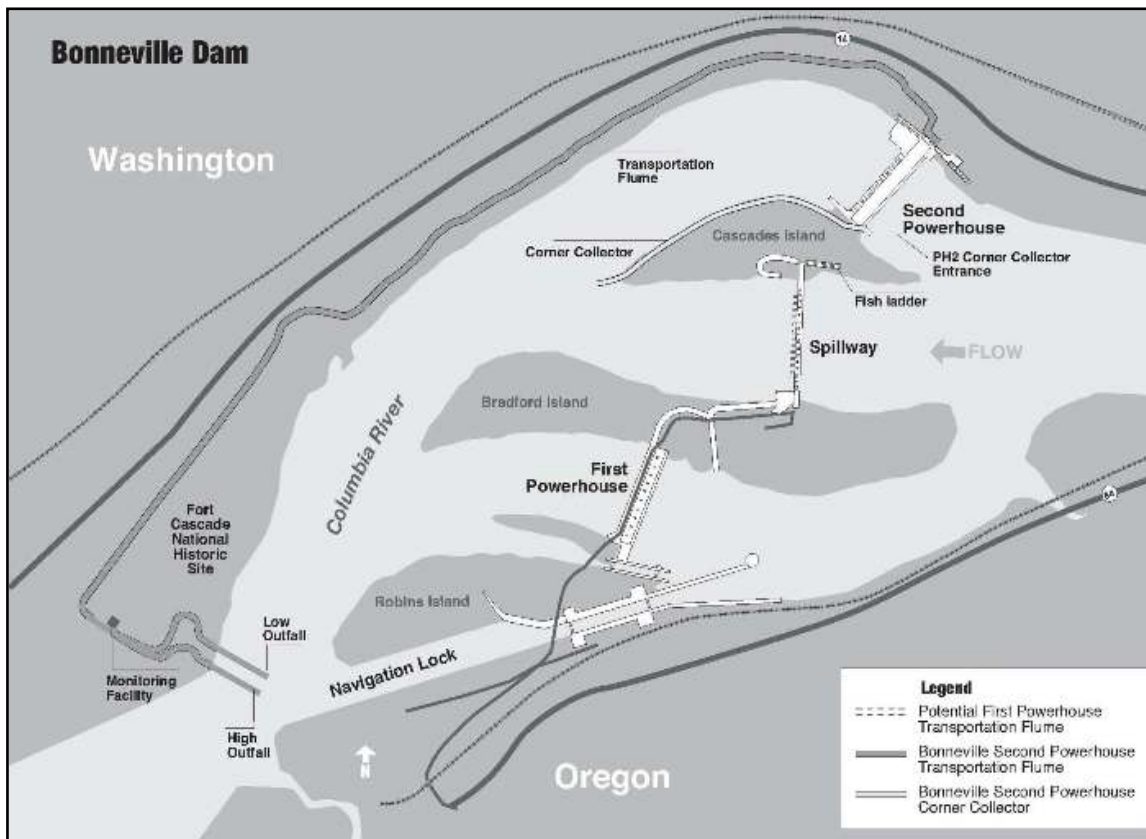


Figure 1. Bonneville Lock and Dam.

# FISHWAY OPERATION AND ACTIVITIES

## ***Fish Passage Plan Violations***

Project Fisheries and the control room operators conduct inspections each day during fish passage season, and at least 3 days per week during winter maintenance. Project Biologists conducted 311 daily fishway inspections, and the National Oceanic and Atmospheric Administration (NOAA) Fisheries conducted 9 fishway inspections. Listed below are the FPP violations and the percentage of days the item was **in** criteria based on Project Biologist's inspections only. Items **in** criteria 100% of the time are not listed.

**Table 1. Fish Passage Plan violations and percent in criteria.**

<i>Powerhouse 1</i>	<i>Occurrences</i>	<i>In Criteria</i>
Head at PH1 S. collection channel entrance	10	96.9%
Head at PH1 N. collection channel entrance	5	98.4%
PH1 collection channel velocity	2	99.4%
PH1 ITS end gate	1	99.7%
PH1 ITS chain gates	1	99.7%
PH1 ITS channel	1	99.7%
Depth over weir at BI	64	79.4%
Depth over weir at A-branch	70	80.3%
A-branch diffusers	34	78.4%
PH1CC diffusers	311	0.0%
Depth over weir at B-branch	73	77.5%
Position or Head at FV4-3 or FV4-4	68	79.1%
B-branch diffusers	69	78.8%
B branch entrance gates	71	78.1%
B branch differential	84	74.1%
<i>Powerhouse 2</i>		
Cascades Island diffusers	3	99.1%
Cascades Island differential	2	99.4%
Depth over weir at UMT	11	96.6%
Spillway Bays	96	70.0%
Head or depth: PH2 NUE	72	77.5%
Head or depth: PH2 NDE	91	71.6%
Head or depth: PH2 SUE	75	76.6%
Head or depth: PH2 SDE	76	76.3%
PH2 velocity meter	311	0.0%
Depth over PH2 weir 67	5	98.4%
Depth over PH2 weir 38	17	94.7%
Depth over PH2 weir 37	32	90.0%
VBS differential	8	97.5%
PH2 gatewell debris	8	97.5%
DSM add-in valve	8	97.5%
DSM channel elevation	8	97.5%
DSM orifices	8	97.5%
DSM mechanical screen cleaners	8	97.5%
DSM airburst system	8	97.5%
PH2 fish unit F1	5	94.4%
PH2 fish unit F2	5	96.9%
Unit priority	3	99.1%
Gull lines	87	0.0%
Calibration once a week	2	96.2%
# short of 3 inspections/week (winter) 7/week (fish passage) by Project Bios	3	99.1%

### **Out of criteria details**

The following paragraphs are explanations for items (Table 1) that were out of criteria more than 90% of the reporting year or were unusual circumstances.

PH1 Collection Channel (PH1CC) diffusers were out of criteria the entire fish passage season. FG 2-19 failed to open at water-up in 2006. The collection channel, however, remained within FPP criteria. The next available time for the diffuser to be repaired is during the winter of 2013/2014.

A-branch diffusers FG 3-3 and FG 3-5 both became mechanically bound, resulting in motor failure. These failures contributed to out of criteria items during the month of August. Maintenance crews attempted to manually open and close these valves according to tailwater elevations through this period to help maintain entrance differentials at PH1.

The "B" branch of the Bradford Island ladder was taken out of service in September 2012. In August 2012, FV 4-4 was found broken in the fully open position. Upon inspection, the trunnion bracket was found to be sheared from its attachment point on the wall. The B-branch ladder was taken out of service on 25 September by installing solid orifice blocks and weir bulkheads at the junction pool. Fish were then recovered from the ladder to tailwater. The B-branch entrance pool was dewatered and fish were recovered below tailwater on 27 September. The FV 4-4 gate was removed and repairs to the gate are ongoing. With A-branch and the Bradford Island ladder above the junction pool watered up, flows in the ladder are unbalanced causing below criteria levels in the upper ladder and above criteria levels in A-branch.

The hoist for spillbay 17 remained out of service throughout the spill period for 2012. The gate was positioned and dogged in the closest position to match the spill pattern but still remained out of criteria for the majority of the spill season. Final repairs were completed in September, but commissioning will be delayed until the gate can be calibrated during the next spill season.

The PH2 entrances were found out of criteria several times beginning in April and continuing through June. High tailwater elevations (typically greater than 25 msl) restrict the ability to maintain both submergence and differential criteria. When both could no longer be met, preference was given to maintaining differential criteria. In July, it was discovered that the North Downstream Entrance (NDE) could not lower to the normal bottom limit. Upon ROV inspection it was determined that the gate was immobilized by large piles of sand and silt. Maintenance crews remedied this problem in August.

The PH2 velocity meter was found to be reading incorrectly. The Project maintenance crews have constructed a new one that is scheduled to be installed during the 2012/2013 winter maintenance period.

The Washington Shore ladder (WA shore) and the DSM were taken out of service in November 2012 to allow construction workers early access to the North Monolith in order to construct and install a lamprey passage system (LPS) and make additional repairs in the North Monolith area. In addition, the South Monolith was dewatered in order to allow the removal of large quantities of sand and silt from the WA shore Auxiliary Water Supply (AWS) and accompanying diffuser chambers.

Gantry 7 (PH2 +90 deck crane) began a scheduled overhaul in August 2012. In preparation for the crane being out of service throughout the fall and winter, Submersible Traveling Screens (STs) were removed at the end of July 2012 from units 13 through 17. STs remained installed in units 11, 12, and 18. When the DSM was taken out of service for the WA Shore LPS construction in November 2012, Vertical Barrier Screens (VBSs) were removed from units 11, 12, and 18 to prevent fish from being directed into a gateway with no means of egress.

The remaining lines of the B2CC avian array as well as the spillway array were taken down in September 2011 to accommodate barge crane access to the B-branch ladder repair site. The spillway array was reinstalled in March 2012, and was removed again in October 2012 to facilitate

barge access for the spillway erosion repair. The spillway array and the B2CC array will be reinstalled during the winter of 2012/13.

### ***STS/VBS Inspections***

Submersible traveling screens (STS) and vertical barrier screens (VBS) are inspected once a month. Each STS has a timer that automatically shows elapsed time of operation, with one month of continuous operation equaling 720 hours. Bonneville uses an underwater video camera to inspect STSs and VBSs. This gives the project the ability to inspect the screens while they are installed and while the unit is running, and has eliminated the need to dip gatewells. PH2 STSs are normally installed from the end of February until December 15 in operational units for juvenile fish passage and for adult fallbacks. PH1 screens have been permanently removed.

STSs were installed on 20-21 February 2012. On 1 August 2012, the Gantry 7 crane at PH2 went out of service for rehabilitation until February 2013. Bonneville Project, with input from regional fish managers and FPOM approval, pulled STSs from units 13 – 17 in July and left STSs and VBSs installed in Units 11, 12, and 18. When the DSM was taken out of service for the WA Shore LPS construction in November 2012, VBSs were removed from units 11, 12, and 18 to prevent fish from being directed into a gatewell with no means of egress.

**Table 2. STS and VBS Inspections 2011-2012**

Unit	STS Removal Dates	STS Install Dates	STS and VBS Inspection Dates and Run Hours Between Inspections			
			4/11/12	5/3/12	6/1/12	Unit OOS
11	Installed	2/20/12	Unit OOS	5/3/12 4 hrs	6/1/12 225	Unit OOS
12	Installed	2/20/12	4/11/12 N/A	5/3/12 476	6/1/12 752	
13	7/25/12	2/20/12	4/11/12 1467	5/3/12 502	6/1/12 690	
14	7/25/12	2/20/12	4/11/12 1381	5/3/12 503	OOS	
15	7/25/12	2/21/12	4/11/12 1166	5/3/12 503	6/1/12 694	
16	7/26/12	2/21/12	4/11/12 892	5/3/12 503	6/1/12 714	
17	7/26/12	2/21/12	4/11/12 1353	5/3/12 503	6/1/12 651	
18	Installed	2/21/12	4/11/12 1139	5/3/12 495	6/1/12 629	

### ***Zebra/Quagga Mussels***

Through monthly inspections of the monitoring station at the PH1 and of all dewatered fishways, no indication of zebra or quagga mussel colonization was found. It is widely believed that their arrival is inevitable. The Project stays involved in regional preparation for zebra/quagga mussel arrival by sending project personnel to training and seminars to stay abreast of the latest information concerning these invasive species. Monitoring will continue with hopes that control programs can be initiated at the first indication of the mussel's arrival in the Pacific Northwest.

### ***Avian Abatement Measures***

Avian lines are strung over the PH1 tailrace, spillway tailrace, PH2 tailrace, and over the B2CC plunge pool. During unusually high tailwaters experienced in spring and summer of 2011, most of the avian lines were torn down at the B2CC array. The remaining lines at the B2CC array were taken down in September 2011 to accommodate barge crane access to the B-branch ladder repair site. A regional decision was made that the B2CC array would not be reinstalled until Spring 2013,

during which time an assessment was made resulting in the decision that the array made significant improvements to avian predation. The spillway array was removed on 11 October 2012 to facilitate barge access for spillway erosion repair. The spillway array and the B2CC array will be reinstalled during the winter of 2012/13. All other lines were intact during the fish passage season. USDA Wildlife Services avian hazing occurred from May through August 2012. This was done from the tailrace side of the powerhouses, the spillway, and the shoreline.

### **Auxiliary Water System (AWS) Closures**

The AWSs were closed on several occasions for varying reasons during the 2011-2012 reporting year. AWS valves were closed for winter maintenance, trolley pipe repair, a hydroacoustic survey, trashrack cleaning, floating trash, a remotely operated vehicle (ROV) fishway inspection, and emergency maintenance. Trashracks are usually cleaned multiple times each month with more frequent cleanings during fall and winter season. ROV fishway inspections occur twice a year, once in the summer and once during the winter. WA Shore underwent an early closure for construction, necessitating the closure of FV 6-9. FV 4-4 broke in the open position, and Bradford Island B-branch experienced an emergency dewatering requiring the FV 4-3 and FV 4-4 AWS to be closed. Table 3 shows the number of closures and total closure time per fish valve.

**Table 3. Fish Valve closures and closure times.**

<b>Fish valve</b>	<b>Reason for closure</b>	<b>Closures</b>	<b>Total closure time</b>
FV1-1	Winter maintenance	1	3 months, 12 days
FV 3-7	Winter maintenance	1	3 months, 12 days
FV 3-9	Winter maintenance	1	3 months, 23 days
FV 4-3	Winter maintenance	1	3 months, 23 days
FV 4-4	Winter maintenance	1	3 months, 23 days
FV 6-9	Winter maintenance	1	22 days, 4 hours
FV 4-3	Trolley pipe repair	1	3 hours, 12 minutes
FV 4-4	Trolley pipe repair	1	3 hours, 12 minutes
FV 4-3	Hydroacoustic survey	1	1 hour, 44 minutes
FV 4-4	Hydroacoustic survey	1	1 hour, 44 minutes
FV1-1	Trashrack cleaning	22	19 hours, 46 minutes
FV3-7	Trashrack cleaning	9	5 hours, 26 minutes
FV 3-9	Trashrack cleaning	9	3 hours, 55 minutes
FV 5-9	Trashrack cleaning	5	47 minutes
FV 6-9	Trashrack cleaning	5	1 hour, 6 minutes
FV 4-3	Floating trash	2	7 hours, 55 minutes
FV 4-4	Floating trash	2	7 hours, 55 minutes
FV 5-3	Floating trash	2	7 hours, 55 minutes
FV 5-4	Floating trash	2	7 hours, 55 minutes
FV 4-3	Remotely operated vehicle inspection	1	4 hours, 5 minutes
FV 4-4	Remotely operated vehicle inspection	1	4 hours, 5 minutes
FV 5-3	Remotely operated vehicle inspection	1	3 hours, 10 minutes
FV 5-4	Remotely operated vehicle inspection	1	3 hours, 10 minutes
FV 4-3	Emergency maintenance	1	4 months, 28 days
FV 4-4	Emergency maintenance	1	4 months, 28 days

### **Fish counts**

The Corps of Engineers contracted with the Washington Department of Fish & Wildlife (WDFW) for all fish counting during the 2011-2012 fish passage season. The fish count season is year round with visual counts from March until November and video counts during the rest of the year. All fish count numbers may be found at: <http://goo.gl/RWjJK>.

### **Fishway Temperature Monitoring**

Project biologists normally monitor fishway temperatures throughout the fish passage season, from March through November. The Adult Fish Facility (AFF) and Juvenile Monitoring Facility (JMF) are usually monitored primarily during the summer months when high temperatures can result in the need for sampling restrictions to minimize impact on fish passage. In 2012, the temperature recording system was not functioning and temperature data was not available from the probes in the fish ladders or the sampling facilities. In lieu of this, temperatures were monitored with the aid of the TMT's [website](http://goo.gl/YR7cw) (<http://goo.gl/YR7cw>) which shows data for the BON forebay. These temperatures were available from 14 March until 19 September. Detailed daily temperatures can be found in the weekly reports.

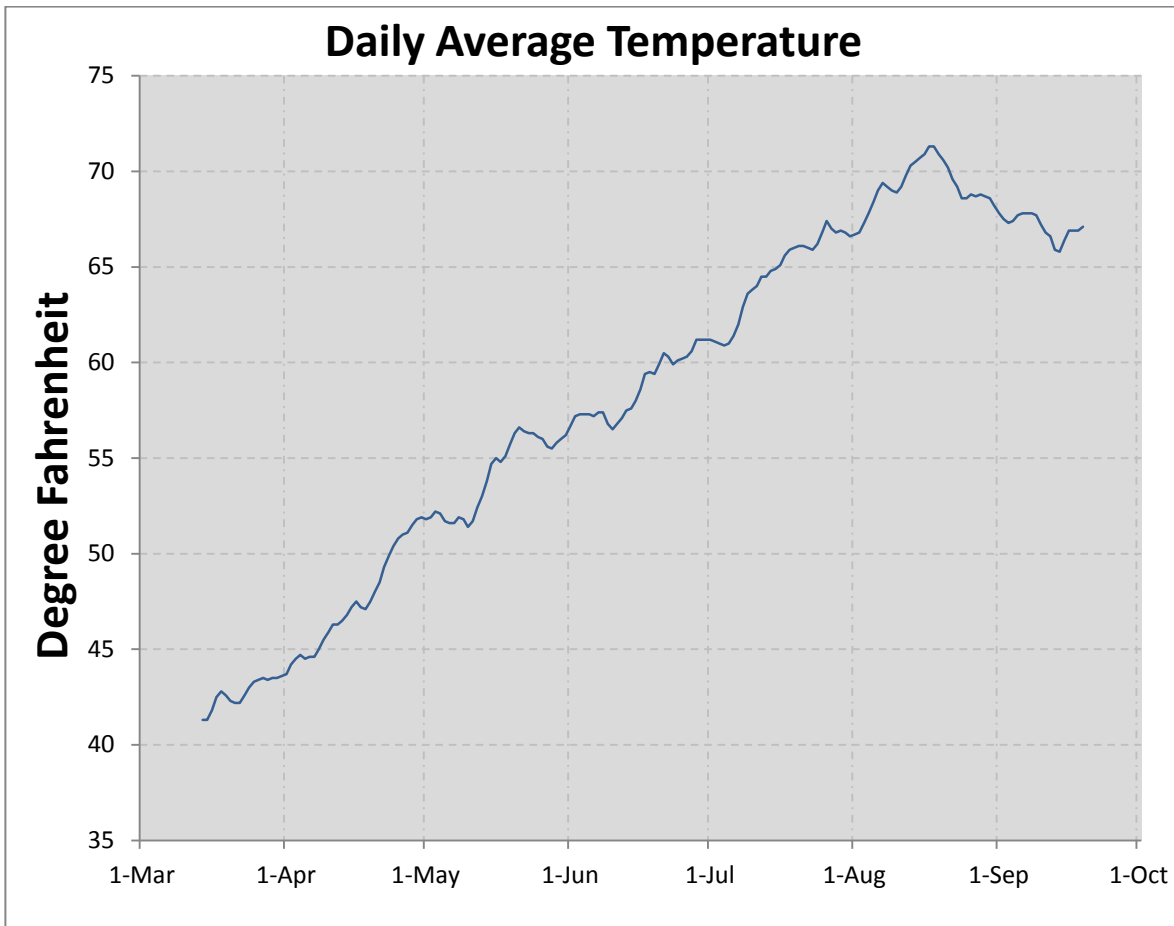


Figure 2. 2012 Bonneville forebay temperatures.



## FISH FACILITY AND TURBINE OUTAGES

**Table 4. Fish Facility Outages of at least 12 hours.**

Fish Facility	OOS Date 2011	In Service Date 2012	OOS Date 2012	Reason for Outage
BI Lamprey Passage Structure	09 Nov 11	24 May 12	26 Nov 12	Winter maintenance
CI Lamprey Passage Structure	15 Sep 11	23 May 12	20 Sep 12	Winter maintenance
WS Lamprey Passage Structure	09 Nov 11	23 May 12	11 Nov 12	Winter maintenance
Bradford Island Ladder	13 Dec 11	22 Feb 12	N/A	Winter maintenance
A-branch Ladder	14 Dec 11	22 Feb 12	N/A	Winter maintenance
B-branch Ladder	17 Sep 11	22 Feb 12	25 Sep 12	Early outage for emergency erosion repair/Winter Maintenance (2011); FV4-4 repairs (2012)
Cascades Island ladder	N/A	08 Nov 12	N/A	CI exit opened in lieu of early WA Shore ladder outage
UMT	N/A	N/A	13 Nov 12	Winter maintenance and LPS construction on N monolith
WS Ladder	N/A	N/A	13 Nov 12	Winter maintenance and LPS construction on N monolith
DSM	03 Nov 11	14 Feb 12	11 Nov 12	Winter maintenance and LPS construction on N monolith
B2CC	01 Sep 11	19 Mar 12	16 Sep 12	Closed for winter maintenance until 2012 fish passage season, Kelt trigger reached on 19 March, closed for repairs on 16 Sept.
AFF	12 Oct 11	11 Apr 12	07 Nov 12	Early 2012 outage for WA Shore LPS construction.
JMF	31 Oct 11	05 Mar 12	31 Oct 12	System in bypass for winter

**Table 5. Fish Unit Outages and Reduced Loads.**

Dates	Fish Unit 1
10/14/11 - 02/08/12	OOS for WA shore dewatering and maintenance
2/27/12 - 2/29/12	Dive operations
7/6/2012 - 7/13/12	Servo oil leak repairs
7/30/12 - 7/31/12	BPA line work
7/31/12 - 8/1/12	BPA line work
11/10/12 - Present	OOS for WA shore dewatering and maintenance
Dates	Fish Unit 2
10/14/11 - 12/08/11	OOS for WA shore dewatering and maintenance
6/4/12 - 6/6/12	Servo oil leak repairs
2/27/12 - 2/28/12	Dive operations
7/30/12 - 8/1/12	BPA line work
8/1/12 - 8/2/12	BPA line work
11/10/12 - Present	OOS for WA shore dewatering and maintenance

Fish units 1 and 2 were placed on standby at other times during the year to “float” trash away from the trash racks. When drawdown measured one foot or greater, fish units were shut down. An adjacent unit was then operated to pull trash away from the fish unit trashracks. This procedure helped prevent debris and silt from accumulating in front of the fish units. Most of the unit outages associated with the floating of trash and debris occurred between 2400 and 0300 to minimize impact on adult fish passage.

**Table 6. Turbine Outages of at least 24 hours.**

<b>Turbine Unit</b>	<b>Date Out</b>	<b>Date In</b>	<b>Reason for Outage</b>
11	12 Jun 08	27 Jun 12	Rotor cracks
16	04 Sep 11	02 Mar 12	Exciter failure
18	23 Nov 11	12 Mar 12	4 year overhaul
5	05 Dec 11	25 Jan 12	5 year overhaul
9	01 Jan 12	04 Jan 12	Model verification testing
9	09 Jan 12	24 Jan 12	Lantern ring inspections
12	08 Jan 12	20 Jan 12	Servo oil leakage
18	13 Mar 12	14 Mar 12	Governor hunting issues
4	27 Mar 12	28 Mar 12	Switching
0	09 Apr 12	18 Apr 12	Semi-annual overhaul
8	07 May 12	10 May 12	Annual overhaul
18	12 May 12	15 May 12	Oil leak in governor piping
7	14 May 12	17 May 12	Annual maintenance
6	21 May 12	24 May 12	Annual maintenance
1	04 Jun 12	14 Jun 12	Annual maintenance
14	11 Jun 12	06 Sep 12	4 year overhaul
15	12 Jun 12	13 Jun 12	Governor oil leak
3	18 Jun 12	28 Jun 12	Bank 3/4 outage and annual maintenance
4	18 Jun 12	28 Jun 12	Bank 3/4 outage
11	06 Jul 12	28 Aug 12	Governor trouble
10	09 Jul 12	30 Aug 12	5 year overhaul
18	09 Jul 12	12 Jul 12	Head gate swap
9	16 Jul 12	19 Jul 12	Annual maintenance
2	23 Jul 12	26 Jul 12	Annual maintenance
17	01 Aug 12	26 Sep 12	Air gap monitor installation
12	05 Aug 12	16 Aug 12	Annual maintenance and T12 outage
13	05 Aug 12	16 Aug 12	T11 outage
15	27 Aug 12	25 Sep 12	T12 bi-annual
16	27 Aug 12	25 Sep 12	T12 bi-annual
18	27 Aug 12	25 Sep 12	T12 and annual maintenance
14	07 Sep 12	10 Sep 12	Governor trouble
11	25 Sep 12	Currently OOS	High thrust bearing temperatures
3	01 Oct 12	15 Nov 12	5-year overhaul
17	01 Oct 12	04 Oct 12	Bearing adjustment
2	05 Nov 12	07 Nov 12	Oil leak repair
13	16 Nov 12	21 Nov 12	Oil leak repair
14	10 Nov 12	13 Nov 12	Oil leak repair

## FISH REMOVAL

Fish passage facilities and turbine units are taken out of service and dewatered to allow for inspection, preventative maintenance, repairs, and modifications. As facilities and turbine units are dewatered, project biologists, outside agency personnel, and other project personnel follow procedures outlined in the FPP and detailed in the Fish Salvage Plan to minimize impacts on fish. Adult fish recovered are typically released into the forebay above the new navlock with the exception of sturgeon which are usually released below the dam at Hamilton Island. Juvenile salmonids are also released below the dam at Hamilton Island. The following is a summary of the number of fish that were removed during facility and turbine unit dewaterings. All fish were recovered in good condition unless otherwise noted.

Unit 5 draft tube (12/08/11): 1 sturgeon.

Bradford Island ladder (12/14/11): 9 shad, 4 rainbow trout, 1 peamouth, 2 adult steelhead, and 14 juvenile salmonids from the junction pool; and 7 steelhead and 1 shad were recovered from the A-branch ladder.

Unit 18 Scroll case (12/22/11): 200-250 white sturgeon. These fish were released into the forebay of PH2 in fair to poor condition. More information can be found in MFR [BON 111228 BON U18 Scroll Case](#) (<http://goo.gl/gNv2>).

Navlock 2 (03/07/12): 12 yearling chinook, 20 sculpin, 7 small mouth bass, and 25 crayfish.

Unit 11 draft tube (5/16/12): 19 white sturgeon, 3 adult Chinook.

Unit 6 head gate (05/22/12): 15 juvenile steelhead, 25 yearling Chinook.

Unit 6 head gate (05/23/12): 66 juvenile salmonids (primarily yearling Chinook, some steelhead and sockeye).

Unit 4 head gate (06/04/12): 175 juvenile salmonids (Chinook, coho, steelhead, sockeye).

Unit 1 scroll case (06/05/12): 1000 juvenile salmonids (Chinook, coho, steelhead, sockeye), 1 adult Chinook.

Unit 1 draft tube (06/05/12): 35 lamprey, 3 juvenile Chinook, 1 white sturgeon, 2 adult Chinook.

Unit 11 tail logs (06/08/12): 2 lamprey, 20 sculpin, 1 catfish.

Unit 14 draft tube (06/12/12): 2 white sturgeon, 36 lamprey, and 1 juvenile salmonid.

Unit 1 tail logs (06/13/12): 4 white sturgeon, 5 juvenile salmonids, 2 bass, 1 crayfish, and approximately 50 sculpin.

Unit 11 tail logs (06/26/12): 3 sculpin, 1 catfish, 1 crayfish.

Unit 10 head gate (07/09/12): 50 subyearling Chinook, 5 mini-jacks.

Unit 10 scroll case (07/09/12): 600 subyearling Chinook, 15 American shad, 30 Chinook mini-jacks.

Unit 10 draft tube (07/10/12): 15 white sturgeon, 30 lamprey, 20 subyearling Chinook.

Unit 11 draft tube (07/24/12): 17 lamprey, 5 white sturgeon, 2 channel catfish, 12 bullhead catfish.

Tainter valve 3 (08/06/12): 80 American shad, 1 carp.

Unit 11 tail logs (8/28/12): 1 smallmouth bass.

Unit 10 tail logs (8/29/12): 2 white sturgeon, 12 sculpin, 10 crayfish.

Unit 14 tail logs (9/5/12): 1 smallmouth bass, 25 sculpin.

Unit 17 tail logs (9/20/12): 1 smallmouth bass, 26 sculpin, 1 lamprey.

Unit 11 draft tube (9/25/12): 75-100 white sturgeon.

B-branch fish ladder (9/25/12): 30-40 salmonids.

B-branch entrance bay (9/27/12): 1 adult Chinook and 1 Largescale sucker.

Unit 3 draft tube (10/3/12): 17 white sturgeon.

Unit 3 tail logs (11/8/12): 30 white sturgeon, 21 sculpin.

AFF fish ladder (11/8/12): 2 white sturgeon, 12 lamprey, 10 suckers, 13 peamouth.

WA shore to TW (11/13/12): 9 adult Chinook, 4 adult steelhead, 6 lamprey, 2 small-mouth bass, 12 suckers, 10 peamouth.

WA shore entrance pool (11/15/12): 3 white sturgeon, 1 adult Chinook, 1 trout, 4 small-mouth bass, 9 shad, 10 suckers.

PH2CC south entrance pool (11/20/12): 5 suckers, 1 small-mouth bass.

Unit 13 tail logs (11/21/12): 12 sculpin.

## **Fishway Modifications and Substantial Maintenance (1996-Winter 2012/13)**

### **POWERHOUSE ONE ADULT**

**2012.** Replaced PIT tag antenna in Bradford Island serpentine section.

**2012.** Dredged along the exit channel for the Bradford Island fishladder.

**2011.** Repaired erosion cavities under the B-branch ladder of Bradford Island.

**2006-present.** Sea lion exclusion devices (SLEDs) are installed at the fishway entrances to prevent sea lion access to the fish ladder.

**2005/06.** Bulkheads were installed in the orifice gate and telescoping gate slots. Gates were removed along with the associated electronic and mechanical equipment.

**2005/06.** Passive Integrated Transponder (PIT) tag detectors installed in four serpentine weirs in the Bradford Island fishway.

**2004-present.** Utilize ROVs for fishway inspections instead of divers.

**2003/04.** Installed new electronic velocity meter at the north end of the PH1CC. No longer used.

**2002/03.** PH1CC orifice gates and telescoping gates are closed and disabled. Studies indicated more fish exited these gates than entered. Weir gates were left in service.

**2001/02.** Extra orifices in the overflow weirs were filled with concrete.

**2000/01.** PIT tag detectors installed in four orifice weirs in A-branch and four orifice weirs in B-branch.

**1998/99.** FG3-10 through 17 disabled and filled with concrete. FG3-14 (at the junction pool) covered with metal plates instead of concrete.

### **POWERHOUSE ONE JUVENILE**

**2012/13.** Spillway erosion hole and ogee repair.

**2010/11.** Welded elevation indicators on chain gates 3B, 6C, and 10B.

**2010.** PH1 JBS outfall pipe removed.

**2009/10.** Removal of the wall separating the Powerhouse 1 downstream migrant channel (DSM1) from the ITS completed to improve surface passage at PH1. The floor was raised and sloped.

**2009.** All remaining PH1 screens scrapped.

**2008/09.** ITS automated chaingates installed in 3B, 6C, and 10B.

**2004-2007.** The Powerhouse 1 downstream migrant channel (DSM1) is disabled as a juvenile bypass route. Screens are not installed during fish passage season except from 15 September until 15 December for adult fallback. DSM1 runs south during this time.

**2001-2003.** Unit 8 extended submerged bar screens were deemed undesirable and replaced with standard STSs.

**2001-present.** The 2000 Biological Opinion (BiOp) required the removal of impediments to fish passage from the turbine environments. Removal and replacement of excess metal, with fish friendly alternatives, occurs as units go out of service for rehab.

**2000-2010.** Turbine rehab involves installing minimum gap runners on all PH1 main units.

### **POWERHOUSE ONE LAMPREY**

**2012.** Picket lead modifications to insure one inch spacing between leads and sill plate and prevent lead bending. Spacers installed.

**2011.** Lamprey count improvements including video verification network at exit flume.

**2011.** Picket lead spacers for lamprey passage removed on 29 June.

**2011.** One inch picket lead spacers installed on 24 May to allow lamprey passage under leads.

**2005/06.** PIT tag detection and expanded lamprey ramp installed in the Bradford Island FV3-9 AWS channel.

**2003/04.** Lamprey ramp installed in the Bradford Island FV3-9 AWS channel.

### **CASCADES ISLAND FISHWAY/ UMT**

**2004-present.** Utilize ROVs for fishway inspections instead of divers.

**2004/05.** UMT fish count window crowder and window cleaner removed.

**2001/02.** New diffuser covers built and installed.

**2000/01.** More PIT tag detectors installed in four orifice weirs.

**1999/00.** FG6-1 through 4 filled in with concrete.  
**1998/99.** PIT tag detectors installed in four orifice weirs.  
**1996-2000.** The UMT drain is blind flanged and no longer used.

### **CASCADES ISLAND LAMPREY**

**2012/13.** Lamprey passage system extension into the forebay and conversion to volitional passage system.  
**2008/09.** Lamprey ramp and bollards installed in CI entrance pool. Variable width entrance weir installed in May.  
**2005/06.** Half duplex PIT tag detectors were installed along the picket leads to track lamprey.

### **POWERHOUSE TWO ADULT**

**2012/13.** Repairs to the gates and guides on B-valves 3 and 4.  
**2012.** Debris removal from the AWS and accompanying diffusers.  
**2011.** SA-24 board replaced with new PH2 Collection Channel Fishway PLC.  
**2011.** Reattached blown off diffuser grating in ladder at North Monolith and debris removal from AWS and accompanying diffusers.  
**2010/11.** AFF sample flume modified to accommodate an auxiliary sample tank used by WDFW. CRITFC obtained and installed a new, larger sample tank complete with a PIT tag detector at the entrance to the tank.  
**2008/09.** Picket leads installed perpendicular to existing AFF picket leads. Not used after 2009 sample season.  
**2007/08.** Manufactured new FOG SLEDs.  
**2006/07.** Installed new staff gauges in the monoliths.  
**2006/07.** AFF lamprey orifice gate removed due to pulley failure resulting in salmon passage blockage and dewatering difficulties.  
**2005-present.** SLEDs installed at fishway entrances to prevent sea lion access to the fish ladders.  
**2005/06.** AFF count window crowder removed due to structural failure.  
**2004-present.** Utilize ROVs for fishway inspections instead of divers.  
**2004/05.** Repaired the AWS conduit.  
**2004/05.** Installed new velocity meter at South Upstream Entrance (SUE).  
**2004/05.** PIT tag detectors installed in four serpentine weirs.  
**2004/05.** AFF brail pool modifications made. The brail pool is now the primary recovery pool.  
**2003/04.** AFF electrical upgrades complete.  
**2003/04.** Picket leads for the triangle section were removed.  
**2002/03.** Removed old metal staff gauge frames from monolith entrances.  
**2001/02.** PIT tag detectors installed in eight orifice weirs, four upstream and four downstream of the AFF.  
**1999/00.** AFF exit ladder equipped with orifice PIT tag detectors.

### **POWERHOUSE TWO JUVENILE**

**2012.** B2CC bulkhead converted to permanent hoist with automatic control.  
**2012.** B2CC joint repair to fix spalling and decrease channel roughness.  
**2008/09.** Release pipe attached to JMF outfall pipe for juveniles trucked from Walla Walla District.  
**2007/08.** Behavioral Guidance Structure (BGS) installed in PH2 forebay. Removed in December 2010.  
**2007/08.** PH2 Downstream Migrant transportation channel (DSM2) LED lights returned to halogen lights due to the unknown effects of LEDs.  
**2007/08.** Units 14 and 18 are modified for new VBSs and improved FGE.  
**2006/07.** New LED lights replace the halogen lights. The LED lights are cooler and will last years longer than the halogens. These lights were salvaged from DSM1.  
**2006/07.** Units 11, 15, 16 are modified for new VBSs and improved FGE.  
**2005/06.** B2CC PIT tag antenna installed.  
**2005/06.** SMF full flow PIT tag antenna installed.  
**2005/06.** Units 12 and 13 modified for new VBSs and improved Fish Guidance Efficiency (FGE).  
**2004/05.** VBS modifications for Unit 17 result in screen failure. The design for the new VBSs is re-examined and redrawn.

**2004/05.** SMF Outfall hydrocannon piping is replaced.  
**2004/05.** B2CC complete and online.  
**2003/04.** Unit 17 VBSs and gatewells are modified to improve FGE. Modifications include gap closure devices on the STSs and modified VBSs.  
**2002/03.** NOAA Fisheries fyke net frame is removed from the tailrace.  
**2002/03.** Unit 15 gatewells are partially modified to improve FGE. Modifications include gap closure devices on the STSs.  
**2002/03.** Biologists noticed places of ovality while inspecting the two mile pipe. The pipe has been monitored regularly to document potential changes.  
**2002-present.** The 2000 BiOp required the removal of impediments to fish passage from the turbine environments. Removal and replacement of excess metal, with fish friendly alternatives, occurs as units come out of service for maintenance.  
**2001/02.** Raised the DSM2 walkway grating to prevent fish from impacting it.  
**2001/02.** Modified the DSM2 add-in screen to vertical bars to allow juveniles to move out of the add-in water and into the channel. The bars didn't reach the walkway so a perforated plate was added later in the season to prevent adults from jumping into the add-in section.  
**2001/02.** Flume covers were added over the switchgates. This was to encourage fish to stay in the main channel and not seek shade by swimming under the switchgates.  
**2000/01.** Saltwater rearing moved into the SMF.  
**2000/01.** Modifications were made to the primary dewatering structure drain pipe to divert more water into the wetlands. This reduced the flow fluctuations and air bubbles under the perforated plate in the primary dewatering structure.  
**1998-2000.** SMF construction completed. The facility goes online.

#### **POWERHOUSE TWO LAMPREY**

**2012/13.** Construction of new lamprey passage system at NDE on the north monolith.  
**2012/13.** Picket lead modifications to insure 1 ½ inch spacing between leads and sill plate and prevent lead bending. Spacers installed.  
**2011.** Picket lead spacers for lamprey passage removed on 29 June.  
**2010/11.** NOAA installed a picket lead sill ramp to ease the transition from the ladder into the AWS. NOAA also installed ¾ inch crowder picket leads at the count station.  
**2010.** One inch picket lead spacers installed on 25 May for lamprey passage under leads.  
**2007/08.** Lamprey ramp installed in the Washington Shore FV6-9 AWS channel.  
**2004/05.** Lamprey ramp installed at North Downstream Entrance (NDE).  
**2000/01.** Lamprey plates are installed over the Washington Shore diffuser grates.

#### **BASS LAKE**

**2006.** The leaking drain is repaired. The lake holds water and coho are seen spawning in the outlet (Moffett Creek) of Bass Lake. The salvaged logs create log jams over the sink hole.  
**2004.** Salvaged logs are placed in Bass Lake to provide habitat.

## PHOTOGRAPHS



B2CC Joint Repair.



B2CC Automatic Hoist.



Bradford Island Picket Lead Mods





WA Shore LPS Construction.



Cascades Island LPS Extension.



Spillway Erosion Repair.

## GLOSSARY

AFF-----	Adult Fish Facility. Lab associated with the Washington Shore ladder. Adult fish are trapped for research purposes.
AWS-----	Auxiliary Water Supply.
B2CC-----	Powerhouse Two Corner Collector. A surface bypass system located in the southern corner of the Bonneville Second Powerhouse forebay.
BI-----	Bradford Island Fishway.
BiOp-----	Biological Opinion.
BPA-----	Bonneville Power Association.
CI-----	Cascades Island Fishway.
Collection Channel(CC)	Part of the adult fishway spanning the length of the downstream side of each powerhouse.
DSM2-----	Downstream Migrant transportation channel (PH2). Transport channel for juvenile fish from gatewell orifices to the juvenile transport pipe.
FG-----	Fish diffusion gate.
FGE-----	Fish Guidance Efficiency.
FOG-----	Floating Orifice Gate.
Forebay-----	That area of a reservoir immediately upstream of a dam.
FPOM-----	Fish Passage Operations and Maintenance Coordination Team
FPP-----	Fish Passage Plan.
FV-----	Fish Valve.
ITS-----	Ice and Trash Sluiceway.
JBS-----	Juvenile Bypass System.
JMF-----	Juvenile Monitoring Facility. Lab associated with the PH2 JBS.
NDE-----	North Downstream Entrance. Refers to one of the four large overflow weir adult fishway entrances at PH2.
NUE-----	North Upstream Entrance. See NDE.
NOAA-----	National Oceanic and Atmospheric Administration.
OOS-----	Out of Service.
PH1-----	Bonneville Powerhouse One.
PH2-----	Bonneville Powerhouse Two.
PIT-----	Passive Integrated Transponder. A tag inserted into juvenile and adult fish. Detectors are installed at all fish passage systems.
Project-----	Bonneville Lock & Dam.
ROV-----	Remotely Operated Vehicle.
SDE-----	South Downstream Entrance. See NDE.
SLED-----	Sea Lion Exclusion Device
SUE-----	South Upstream Entrance. See NDE.
STS-----	Submersible Traveling Screen.
Tailrace-----	The portion of a river immediately downstream of a dam or powerhouse.
TDG-----	Total dissolved gas.
UMT-----	Upstream Migrant Transportation channel. This channel connects Cascades Island ladder to Washington Shore ladder through PH2.
VBS-----	Vertical Barrier Screen.
WDFW-----	Washington Department of Fish & Wildlife.

## References

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