BONNEVILLE DAM

FISHWAY STATUS ANNUAL REPORT

2015

By

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1. INTRODUCTION

The **2015** Fishway Status Annual Report for Bonneville Lock and Dam summarizes activities impacting fish at Bonneville Project from **01 December 2014 through 30 November 2015**.

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).

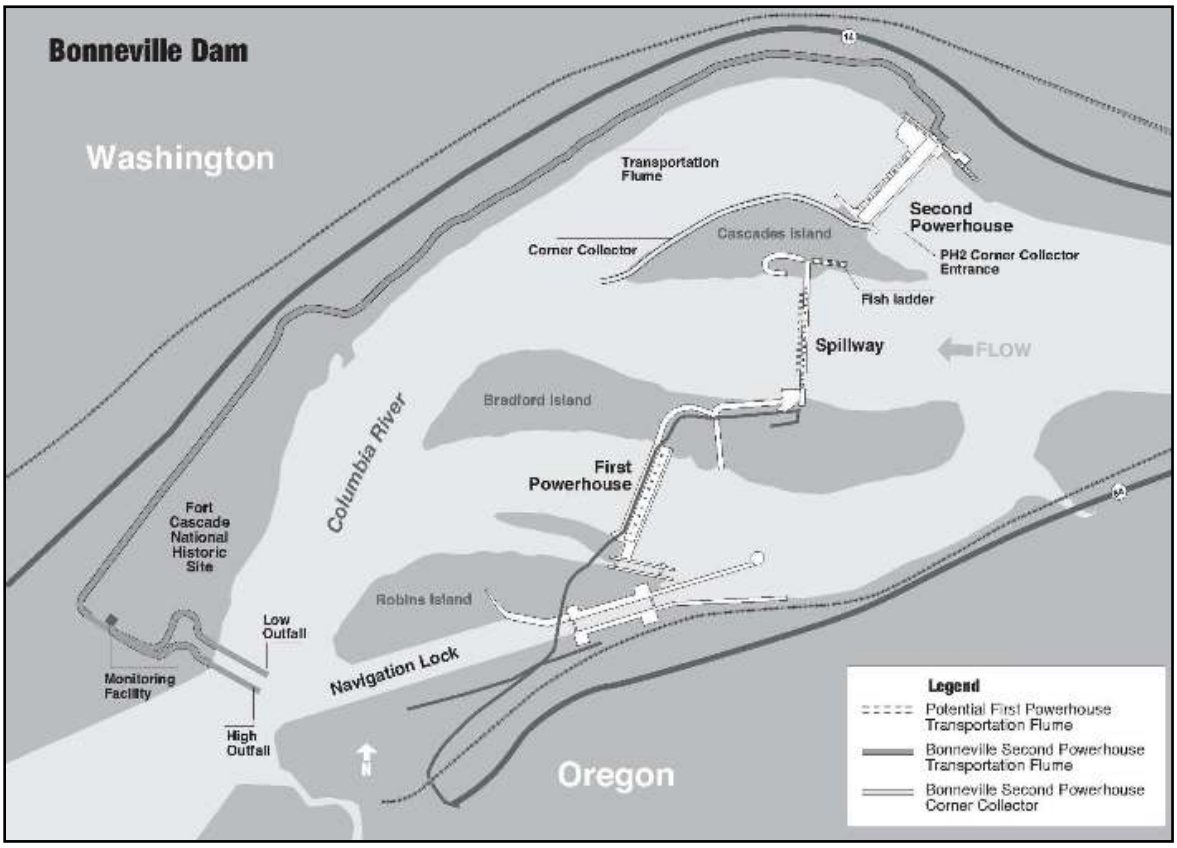

Figure 1. Bonneville Lock and Dam.

2. FISH-IMPACTING OPERATIONS

2.1 Fish Facility Outages

Table 1 shows the outage dates for Bonneville fishways, fish facilities, and lamprey passage structures.

Table 1. Fish facility outages of at least 24 hours.

Fish Facility	OOS Date 2014	In Service Date 2015	OOS Date 2015	Reason for Outage
BI Lamprey Passage Structure	20 Oct 14	31 Mar 15	29 Oct 15	Winter maintenance
CI Lamprey Passage Structure	30 Oct 14	06 Apr 15	30 Sep 15	Winter maintenance, pump issues, low passage numbers.
WS Lamprey Passage Structure	29 Oct 14	31 Mar 15	29 Oct 15	Winter maintenance
NDE Lamprey Flume System	02 Oct 14	06 May 15	31 Aug 15	Winter maintenance, entrained air issues, low passage numbers.
Bradford Island Ladder	N/A	N/A	08 Dec 15	Winter maintenance
A-branch Ladder	N/A	N/A	08 Dec 15	Winter maintenance
B-branch Ladder	N/A	N/A	08 Dec 15	Winter maintenance
Cascades Island ladder	03 Dec 14	26 Feb 15	19 Oct - 25 Nov	Winter maintenance. FV5-3 and 5-4 repairs.
UMT	03 Dec 14	26 Feb 15	N/A	Winter maintenance
WA Shore Ladder	08 Dec 14	25 Feb 15	N/A	Winter maintenance
DSM 2	06 Dec 14	26 Jan 15	23 Dec 15	Winter maintenance
B2CC	01 Sep 14	10 Mar 15	01 Sep 15	Opened 14 - 24 Feb for excess flows. Closed for end of spill season (FPP).
AFF	19 Nov 14	14 Apr 15	03 Dec 15	Winter maintenance
SMF	31 Oct 14	02 Mar 15	30 Oct 15	Winter maintenance

2.2 Turbine Outages

Table 2 shows turbine outages that lasted longer than 24 hours. Note that turbine outages lasting less than 24 hours did occur but are not included for the sake of brevity.

Table 2. Turbine Outages of at least 24 hours.

Turbine Unit	Date Out	Date In	Reason for Outage
11	25 Sep 12	10 Mar 15	High trust bearing temperatures
8	02 Dec 14	03 Dec 14	Cooling water strainer
10	09 Dec 14	10 Dec 14	Cooling water strainer install
15	10 Feb 15	27 Mar 15	4-year overhaul
12	17 Feb 15	24 Feb 15	T11 and T12 maintenance
13	17 Feb 15	24 Feb 15	T11 and T12 maintenance
14	17 Feb 15	24 Feb 15	T11 and T12 maintenance
15	17 Feb 15	24 Feb 15	T11 and T12 maintenance
16	17 Feb 15	24 Feb 15	T11 and T12 maintenance
17	17 Feb 15	24 Feb 15	T11 and T12 maintenance

18	17 Feb 15	24 Feb 15	T11 and T12 maintenance
12	09 Mar 15	12 Mar 15	Annual maintenance
16	13 Apr 15	16 Apr 15	Annual maintenance
17	27 Apr 15	30 Apr 15	Annual maintenance
14	08 Jun 15	25 Jun 15	Wicket gate seal replacement
3	15 Jun 15	25 Jun 15	RAS testing, bank 3/4 outage
4	15 Jun 15	25 Jun 15	RAS testing, bank 3/4 outage
1	06 Jul 15	16 Jul 15	Bank 1/2 outage, annual maintenance
2	06 Jul 15	16 Jul 15	Bank 1/2 outage, annual maintenance
2	21 Jul 15	22 Jul 15	Cooler tube leak
5	20 Jul 15	30 Jul 15	Bank 5/6 outage, annual maintenance
6	20 Jul 15	30 Jul 15	Bank 5/6 outage, annual maintenance
7	29 Jul 15	01 Oct 15	5-year overhaul
1	03 Aug 15	10 Aug 15	ITS gate reinstallation and WG-1 dive
2	03 Aug 15	11 Aug 15	ITS gate reinstallation and WG-1 dive
3	03 Aug 15	10 Aug 15	ITS gate reinstallation and WG-1 dive
4	03 Aug 15	10 Aug 15	ITS gate reinstallation and WG-1 dive
5	03 Aug 15	10 Aug 15	ITS gate reinstallation and WG-1 dive
6	03 Aug 15	10 Aug 15	ITS gate reinstallation and WG-1 dive
8	03 Aug 15	10 Aug 15	ITS gate reinstallation and WG-1 dive
9	03 Aug 15	10 Aug 15	ITS gate reinstallation and WG-1 dive
10	03 Aug 15	10 Aug 15	ITS gate reinstallation and WG-1 dive
18	03 Aug 15	20 Aug 15	Wicket gate seals and cooler
8	15 Aug 15	03 Sep 15	Annual maint, servo, bank 7/8
11	31 Aug 15	04 Dec 15	Kaplan pipe leak, T11 outage
12	01 Sep 15	04 Dec 15	T11 outage
13	01 Sep 15	04 Dec 15	T11 outage
14	01 Sep 15	04 Dec 15	T11 outage
7	29 Jul 15	01 Oct 15	5-year overhaul
4	19 Oct 15	26 Oct 15	Exciter voltage alarm
6	20 Oct 15	21 Oct 15	Breaker failure alarm
15	02 Nov 15	06 Nov 15	T11 and T12 deluge system modifications
16	02 Nov 15	06 Nov 15	T11 and T12 deluge system modifications
17	02 Nov 15	06 Nov 15	T11 and T12 deluge system modifications
18	02 Nov 15	06 Nov 15	T11 and T12 deluge system modifications
10	16 Nov 15	---	Annual maintenance and air gap
9	17 Nov 15	---	5-year overhaul, bank 9/10 maintenance

2.3 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.

UMT and Cascades Island fish ladder (12/3/14): ~20 adult salmonids, 1 Pacific Lamprey, 3 White Sturgeon.

Upper WA shore fish ladder (12/8/14): ~50 adult salmonids, 2 Pacific Lamprey, 4 White Sturgeon.

UMT fishway (12/11/14): ~10 adult salmonids.

Cascades Island diffuser pits FG6-6 and -7 (12/16/14): 15 Pacific Lamprey.

Cascades Island AWS channel (12/17/14): ~250 suckers, pikeminnow, and peamouth.

WA Shore serpentine section (1/6/15): ~60 suckers, pikeminoow, and peamouth.

Unit 15 tail logs (3/26/15): 10 sculpin, 1 crayfish.

Cascades Island fish valve pit (4/21/15): 12 juvenile salmonids.

Unit 14 draft tube (6/9/15): 6 juvenile salmonids, 6 sculpin.

Unit 14 tail logs (6/24/15): 1 smallmouth bass, 1 bluegill, ~15 sculpin.

Unit 18 draft tube (8/3/15): 10 White Sturgeon, 2 Pacific Lamprey, 1 sculpin.

Unit 11 draft tube (9/1/15): 1 White Sturgeon.

Unit 8 tail logs (9/2/15): 1 bluegill, 2 sculpin.

Unit 7 tail logs (9/30/15): 1 White Sturgeon.

Cascade Island fish ladder (10/19/15): 8 Pacific Lamprey, 7 Steelhead, 1 Chinook jack.

Cascade Island entrance (10/20/15): 1 Steelhead, 1 Chinook, ~2000 suckers and resident fish.

Cascade Island exit section (10/21/15): 4 Pacific Lamprey.

Cascade Island upper fish ladder (10/22/15): 1 Pacific Lamprey, ~300 suckers and resident fish (~20 in poor condition).

Unit 11 tail logs (10/28/2015): ~25 sculpin, 1 catfish, ~ 6 sunfish.

Unit 9 draft tube (11/18/2015): 4 Pacific Lamprey.

Fish Unit trash racks (11/20/2015): 1 White Sturgeon in poor condition.

AFF Dewatering (12/03/15): 4 Steelhead, 2 sculpin, 1 catfish, 10 Pacific Lamprey, ~1000 shad, ~1000 suckers (some pikeminnow).

2.4 Auxiliary Water Supply (AWS) Closures

The AWS include fish valves across Bonneville Project as well as fish units 1 and 2 at PH2. Collectively, they were closed on several occasions during the 2014-15 reporting year for reasons that include winter maintenance, trashrack cleaning, and remotely operated vehicle (ROV) fishway inspections. ROV fishway inspections occur

twice a year, once during the summer and once during the winter. Trashracks are usually cleaned multiple times each month with more frequent cleanings during the fall and winter seasons. When debris issues become excessive and cleaning doesn't keep pace, AWSs may be closed to float trash off the racks. This is initiated when the drawdown across the fish valve or fish unit trash rack measures one foot or greater and requires that the AWS in question be shut down. These closures usually occur at night.

Fish valve closures are given in Table 3. In April 2015, the Cascade Island fish valve 5-4 was forced out of service due to mechanical issues, and the Cascade Island ladder was dewatered in October and through November of 2015 for fish valve repairs.

A list identifying every closure for fish units 1 and 2 is shown in Table 4. Throughout the year, the fish units are cleaned using a crane-operated trash rake during working hours. Debris accumulation generally occurs on the weekends when personnel are unavailable to operate the trash rake, but may also occur overnight between daytime trash raking when debris loading is extremely high. The units may then be placed in standby to float debris, between the hours of 2200 and 0500 to minimize impact on adult fish passage. An adjacent unit is then operated to pull trash away from the fish unit trashracks. Note that records of floating trash off the fish units began in June of 2015.

In mid to late November debris accumulation on the fish units and AWS trash racks became unusually excessive. Trash raking of the fish units was unable to keep pace with the amount of debris accumulation, the majority of which was milfoil. Floating trash was required multiple times per night even while raking multiple times per day. Still, fish unit drawdowns in excess of several feet (exceeding 20' at times) would occur only hours later. Personnel believe the debris loading was a historic high, and may have been due to favorable river conditions for milfoil growth (high water temps and low river flow) throughout the year, followed by storm events/wind breaking off milfoil and flushing it downriver.

Table 3. Number of closures and total closure time for all fish valves.

Fish valve	Reason for closure	Closures	Total closure time
FV 5-3	Winter maintenance	1	
FV 5-4	Winter maintenance	1	
FV 5-9	Winter maintenance	1	
FV 6-9	Winter maintenance	1	
FV 1-1	Trashrack cleaning	36	15 hours, 41 min
FV 3-7	Trashrack cleaning	12	6 hours, 5 min
FV 3-9	Trashrack cleaning	39	19 hours, 13 min
FV 1-1	Floating trash	8	3 days, 11 hours
FV 3-7	Floating trash	8	3 days, 11 hours
FV 3-9	Floating trash	12	3 days, 20 hours
FV 1-1	ROV inspection	2	6 hours
FV 3-7	ROV inspection	2	6 hours
FV 4-3	ROV inspection	2	4 hours
FV 4-4	ROV inspection	2	4 hours
FV 5-3	ROV inspection	1	1.5 hours
FV 1-1	WG-1 recovery dives	1	
FV 3-7	WG-1 recovery dives (PH1CC bulkhead in/out)	2	
FV 5-3	Undergoing repairs	1	1 month, 16 days
FV 5-4	Undergoing repairs	1	7 months, 4 days

Table 4. List of fish unit outages. Time is given as hours:minutes unless otherwise denoted.

	Fish Unit 1			Fish Unit 2		
	Closure start	Closure finish	Duration (hr:min)	Closure start	Closure finish	Duration (hr:min)
Winter maintenance	12/1/14 0:01	2/24/15 21:30	2 mo, 25 day	12/2/14 6:30	2/24/15 21:30	2 mo, 24 day
Gate lock switch repair	3/11/15 1:13	3/11/15 7:56	6:43	3/11/15 8:10	3/11/15 9:51	1:41
				3/11/15 11:07	3/11/15 12:58	1:51
T11/T12 deluge mods	11/1/15 23:59	11/6/15 9:20	4 days, 9 hr	11/1/15 23:59	11/6/15 9:20	4 days, 9 hr
Turbine guide bearing alarm	11/27/15 2:52	11/27/15 4:11	1:19			
ROV inspection	7/29/15 10:02	7/29/15 15:11	5:09	7/29/15 10:01	7/29/15 15:12	5:11
Floating trash	6/6/15 0:59	6/6/15 2:59	2:00	8/22/15 22:03	8/23/15 5:00	6:57
(records began June	8/25/15 22:08	8/26/15 3:58	5:50	9/14/15 0:53	9/14/15 3:15	2:22
2015)	9/29/15 21:22	9/30/15 1:30	4:08	9/29/15 21:22	9/30/15 1:32	4:10
	10/16/15 1:23	10/16/15 3:00	1:37	10/16/15 0:20	10/16/15 1:20	1:00
	10/16/15 4:23	10/16/15 4:50	0:27	10/16/15 4:23	10/16/15 4:55	0:32
	10/16/15 21:04	10/17/15 0:31	3:27	10/16/15 21:04	10/17/15 0:34	3:30
	10/18/15 0:08	10/18/15 3:59	3:51	10/17/15 21:04	10/18/15 4:02	6:58
	10/24/15 21:00	10/25/15 0:28	3:28	10/24/15 21:00	10/25/15 0:29	3:29
	10/25/15 18:24	10/25/15 22:08	3:44	10/25/15 18:24	10/25/15 22:07	3:43
	10/27/15 22:00	10/28/15 2:00	4:00	10/27/15 22:00	10/28/15 2:00	4:00
	10/31/15 0:09	10/31/15 2:51	2:42	10/30/15 22:03	10/31/15 4:07	6:04
	11/12/15 0:29	11/12/15 4:00	3:31	11/12/15 0:29	11/12/15 3:59	3:30
	11/13/15 1:21	11/13/15 3:18	1:57	11/13/15 0:34	11/13/15 3:18	2:44
	11/22/15 18:37	11/22/15 19:52	1:15	11/22/15 18:37	11/22/15 19:48	1:11
	11/22/15 20:47	11/23/15 2:54	6:07	11/22/15 20:47	11/23/15 2:55	6:08
	11/23/15 20:13	11/23/15 21:17	1:04	11/23/15 19:13	11/23/15 21:16	2:03
	11/24/15 16:47	11/24/15 17:04	0:17	11/24/15 16:37	11/24/15 17:02	0:25
	11/24/15 21:13	11/25/15 2:15	5:02	11/24/15 18:22	11/25/15 2:14	7:52
	11/26/15 3:44	11/26/15 4:42	0:58	11/26/15 3:44	11/26/15 4:44	1:00
	11/26/15 22:42	11/27/15 0:40	1:58	11/26/15 22:42	11/27/15 0:40	1:58
	11/27/15 11:24	11/27/15 14:13	2:49	11/27/15 13:41	11/27/15 14:11	0:30
	11/27/15 15:28	11/27/15 16:41	1:13	11/27/15 16:36	11/27/15 16:45	0:09
	11/28/15 0:34	11/28/15 2:29	1:55	11/28/15 0:34	11/28/15 2:28	1:54
	11/29/15 1:04	11/29/15 3:43	2:39	11/28/15 23:00	11/29/15 3:43	4:43
	11/29/15 12:34	11/29/15 14:07	1:33	11/29/15 12:34	11/29/15 14:04	1:30
	11/29/15 23:20	11/30/15 2:31	3:11	11/29/15 23:20	11/30/15 2:33	3:13
	11/30/15 16:34	12/1/15 2:04	9:30	11/30/15 16:30	12/1/15 2:05	9:35
		Total time floating trash:	3 days, 8 hrs		Total time floating trash:	3 days, 19 hrs

3. FISH PASSAGE PLAN COMPLIANCE

3.1 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 315 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 (Table 4). Items in criteria 100% of the time are not listed. Explanations for items that were out of criteria more than 90% of the reporting year or having unusual circumstances are given below.

Table 5. Fish Passage Plan violations and percent in criteria.

Powerhouse 1	***Occurrences***	***In Criteria***
PH1 S differential	12	96.2%
PH1 N differential	5	98.4%
Gate Position: PH1 gate 1	315	0.0%
Gate Position: PH1 gate 2	315	0.0%
Gate position: PH1 gate 64	2	99.4%
Depth over weir at A-branch	177	43.8%
A-branch diffusers FG3-3, FG3-4, FG3-5, FG3-6	315	0.0%
Depth over weir at B-branch	3	99.0%
B-branch diffusers	1	99.7%
B branch entrance gates	225	28.6%
B branch entrance differential	1	99.7%
Powerhouse 2	***Occurrences***	***In Criteria***
Cascades Island diffusers	178	43.5%
Cascades Island entrance differential	66	79.0%
Depth over weir at UMT	5	98.4%
Head or depth: PH2 NUE	3	99.0%
Head or depth: PH2 NDE	3	99.0%
Head or depth: PH2 SUE	3	99.0%
Head or depth: PH2 SDE	3	99.0%
PH2 diffuser positions	315	0.0%
Depth over PH2 weir 67	2	99.4%
Depth over PH2 weir 38	8	97.5%
DSM Airburst system	1	99.7%
Depth over PH2 weir 37	8	97.5%
Calibration once a week	*4*	*98.7%*
# short of 3 inspections/week (winter) 7/week (fish passage) by Project Bios	3	99.0%

The intake gate for the Ice and Trash Sluiceway (ITS) was discovered to be in serious disrepair on 01 September 2013; the gate cable was frayed and the guide wheels needed repair. During a temporary closure, plating was placed over the guide slot and the ITS was re-opened on 25 September 2013 with no intake gate in place. The gate was reinstalled on 03 – 10 August 2015, during which time the ITS was closed.

A-branch diffuser FG 3-3 became mechanically bound in October 2014. Maintenance crews attempted to repair the motor and after electrical operation, the diffuser motor became bound again in the closed position. FG 3-4 was opened and placed in manual to help maintain entrance differentials at PH1. Repairs are scheduled for the 2015/16 winter maintenance.

PH2 diffuser B5 had a badly deteriorated diffuser gate, which was removed to facilitate repairs and is therefore open. Diffuser A2 is stuck in the closed condition. Repairs to these diffusers will occur during the next dewatering, in the winter of 2016/17.

The water depth over the A-branch weir often reads 1.2', which is higher than the 1.1' maximum prescribed in the FPP. The cause is thought to be leakage from the FV3-7 conduit into the ladder near the staff gauge, as water frequently upwells between the gravel and concrete margin of the fishway in that vicinity. Repairs to the conduit are being planned for the winter of 2017/18.

WG-1, one of the south PH1CC entrances, experienced a gate failure in November 2014. Divers recovered the gate hoist mechanism from the tailrace in August 2015. Repairs to allow the gate to operate will occur during the 2015/16 winter maintenance.

B-branch gate 4N, adjacent to the main fishway entrance to the B-branch ladder at the south side of the spillway, experienced a gate motor failure in July 2015. The gate was left in the closed position and gate 4S was manually opened in its place. The north gate is usually open below tailwaters of 17.0 msl and both gates are open below 9.0 msl. The motor was repaired and will be reinstalled during the 2015/16 winter maintenance.

FV5-4 was discovered to have mechanical problems in April 2015. Emergency measures were taken to isolate the valve from forebay and it was taken out of service. To mitigate for the loss of the south entrance diffusers at Cascades Island, extra north diffusers were opened and the ladder was place in shad mode. In spite of these measures, the entrance differential was often below criteria. In October FV5-3 also began to have mechanical issues. The Cascades Island ladder was taken out of service for repair of both fish valves from 19 October through 25 November.

3.2 STS/VBS Inspections

Submersible traveling screens (STS) and vertical barrier screens (VBS) are typically 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 for units 12-14 and 16-18 were installed between the dates of 17-18 February 2015 (Table 5). Units 11 and 15 were out of service and so their STSs were installed on 05 March and 15 March, respectively. Both units were out of service prior to those installation dates. Due to excessive amounts of debris accumulation, STSs were removed from units 16-18 on 24-25 November 2015, unit 15 was not removed until 03 December due to time constraints in cleaning other fishway areas. STSs were removed from units 11-14 on 1-2 December for T11 outage testing. All STSs remained out through the winter maintenance period to prevent fish from being directed into a gatewell with no means of egress.

Table 6. STS and VBS inspections for 2015. The run hour meter was not reset until after the first inspection.

Unit	STS Install Dates	STS Removal Dates	STS and VBS Inspection Dates and Run Hours Between Inspections								
11	05 Mar 15	01 Dec 15	4/14/15	5/4/15	6/1/15	7/6/15	8/3/15	9/8/15	10/5/15	11/2/15	12/1/15
			n/a	429	669	875	625	673	7	13	11
12	17-18 Feb 15	01 Dec 15	4/14/15	5/4/15	6/1/15	7/6/15	8/3/15	9/8/15	10/5/15	11/2/15	12/1/15
			n/a	257	478	440	81	176	8	13	11
13	17-18 Feb 15	01 Dec 15	4/14/15	5/4/15	6/1/15	7/6/15	8/3/15	9/8/15	10/5/15	11/2/15	12/1/15
			n/a	121	215	183	24	42	0	7	12
14	17-18 Feb 15	02 Dec 15	4/14/15	5/4/15	6/1/15	7/6/15	8/3/15	9/8/15	10/5/15	11/2/15	12/2/15
			n/a	113	463	84	10	11	8	5	27
15	23 Mar 15	03 Dec 15	4/14/15	5/4/15	6/1/15	7/6/15	8/3/15	9/8/15	10/5/15	11/2/15	12/3/15
			n/a	84	447	117	12	188	636	666	654
16	17-18 Feb 15	25 Nov 15	4/14/15	5/4/15	6/1/15	7/6/15	8/3/15	9/8/15	10/5/15	11/2/15	11/25/15
			n/a	7	49	67	12	187	647	661	455
17	17-18 Feb 15	25 Nov 15	4/14/15	5/4/15	6/1/15	7/6/15	8/3/15	9/8/15	10/7/01	11/2/15	11/25/15
			n/a	121	389	313	65	600	646	665	458
18	17-18 Feb 15	24 Nov 15	no insp	5/4/15	6/1/15	7/6/15	8/3/15	9/8/15	10/5/15	11/2/15	11/24/15
			n/a	474	631	878	619	457	646	666	443

3.3 Avian Abatement Measures

USDA Wildlife Service's avian hazing occurred from May through July 2015. This was done from the tailrace side of the powerhouses, the spillway, and the shoreline.

3.4 Fish Counts

The Corps of Engineers contracted with Normandeau Associates, Inc. for all fish counting during the 2014-2015 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 Fish Counts and Reports.

4. WATER QUALITY MONITORING

4.1 Zebra/Quagga Mussels

Through monthly inspections of the monitoring station at 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.

4.2 Fishway Temperature Monitoring

Project biologists monitor fishway temperatures throughout the fish passage season, from March through November. Temperature probes are installed in the upper Bradford Island and WA shore fishways, the Adult Fish Facility (AFF), and the Juvenile Monitoring Facility (JMF). Probes are also installed in rest boxes of all four lamprey passage structures (LPS), which are located at Bradford Island, Cascades Island, the Washington shore auxiliary water supply channel, and at the PH2 north downstream entrance (NDE). Additionally, the Technical Management Team (TMT) tracks BON forebay temperature on their website. The TMT temperature is publically accessible real-time, and is the standard utilized per the FPP to determine when high-temperature fish sampling restrictions are operative in BON facilities. In 2015, these temperatures were available from 18 March - 16 September. Detailed daily temperatures can be found in the weekly reports.

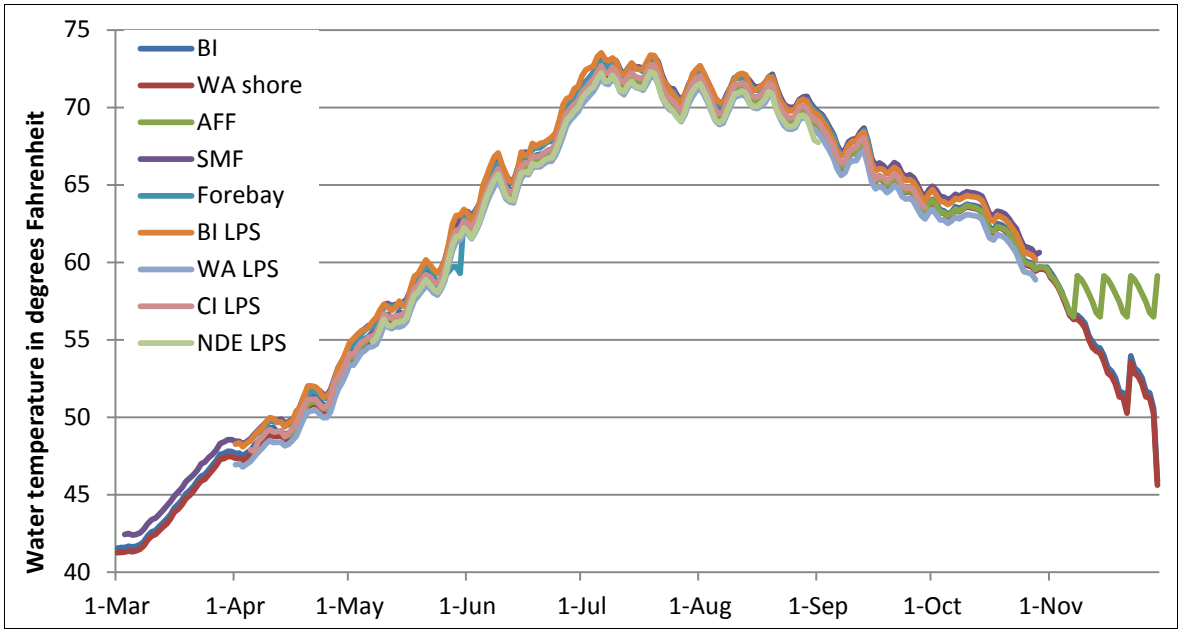

Figure 2. 2015 Bonneville temperatures.

5. FISHWAY MODIFICATIONS (1996 - present)

POWERHOUSE ONE ADULT

2012. Replaced PIT tag antenna in Bradford Island serpentine section.
2012. Dredged along the exit channel for the Bradford Island fish ladder.
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
2013/14. ITS gate removed for repairs, gate slot plated for fish passage during removal.
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
2013/14. Lamprey passage structure pumps relocated from forebay location to within the AWS to minimize debris buildup. Fry criteria screens placed on lamprey pumps.
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
2014/15. Picket lead spacing reduced and side gaps amended to block lamprey access to the AWS and ladder exit area above the lower pickets.
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
2013-2015. Modifications to the AFF to improve water velocity and sampling conditions.
2013. Replaced PIT antenna in WA Shore ladder serpentine section.
2013. Forebay dredging in front of the Fish Unit intakes.
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
2014. Testing of a flow control plate in Unit 15 A slot.
2013. Gantry 7 rehabilitation.
2013. Turbulence Reduction Device (TRD) testing in Unit 14 A slot.
2013. Alarm installed on the 2-way rotating gate at the SMF.
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 switch gates. This was to encourage fish to stay in the main channel and not seek shade by swimming under the switch gates.
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
2013. Lamprey refuge boxes installed in the WA Shore ladder, near the UMT confluence.
2012/13. Construction of Lamprey Flume System and associated LPS 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.

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.
LFS---------- Lamprey Flume System.
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

2014-2015. Daily fishway inspections for Bonneville Dam.

2015. Fish Passage Plan for Corps of Engineers Projects. U. S. Army Corps of Engineers, Northwestern Division, Portland, Oregon.

2015. Fish Passage Plan for Corps of Engineers Projects. U. S. Army Corps of Engineers, Northwestern Division, Portland, Oregon.

2014-2015. Weekly reports for Bonneville Dam. U.S. Army Corps of Engineers, Portland District. Bonneville Lock and Dam.