2015 ADULT AND JUVENILE FISH FACILITY MONITORING REPORT ICE HARBOR DAM

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BPA – Bonneville Power Administration
CFS – Cubic feet per second
FPC – Fish Passage Center
FPP – Fish Passage Plan
JCC – Juvenile Collection Channel
JFF – Juvenile Fish Facility
KCFS – kilo cubic feet per second
NFL – North shore fish ladder
OOS – Out of service
PDS – Primary dewatering structure
PLC – Programmable logic controller
RSW – removable spill weir
SFL – South shore fish ladder
STS – submersible traveling screens
USDA-WS – United States Department of Agriculture-Wildlife Services
VBS – vertical barrier screen

Summary

This report summarizes the operations and maintenance of the adult and juvenile fish passage facilities at Ice Harbor Dam in 2015. Submersible traveling screens (STSs) for all operating units were installed between March 23-24, 26, and 31. The juvenile collection channel was watered up on March 18 and fish condition monitoring began on April 14 and continued through June 29. The juvenile collection channel was dewatered on December 20.

Total smolts sampled in the 2015 season were 2,606. This season's sample by species group included: 925 clipped and 234 unclipped steelhead, *Oncorhynchus mykiss*, 274 clipped and 212 unclipped yearling Chinook salmon, *O. tschawytscha*, 381 clipped and 549 unclipped subyearling Chinook salmon, 24 clipped/unclipped coho salmon, *O. kisutch*, and 5 clipped and 2 unclipped sockeye/kokanee, *O. nerka*.

The removable spillway weir (RSW) was operated for juvenile fish passage beginning April 3. The RSW was closed on August 31.

Facility Introduction and Description

The juvenile fish passage facility at Ice Harbor Dam consists of standard -length submersible traveling screens, vertical barrier screens, 36 12-inch diameter orifices, a collection channel and dewatering structure, fish sampling facilities and a transportation flume to the tailrace downstream from the dam. The juvenile fish collection channel is operated with approximately 300 cubic feet per second (kcfs) flow (forebay head-dependent), which is the designed operating flow produced by 20 of the juvenile fish passage orifices open. All but 30 kcfs of the flow is removed at the primary dewatering structure and utilized as adult fish attraction water. The remaining 30 kcfs flow and fish are routed through a transport pipe and flume to the fish sampling facility or directly to the tailwater.

The adult fish passage facilities at Ice Harbor dam are comprised of separate north and south shore systems. The north shore facilities include a fish ladder with an adult counting station, an adult fish collection channel, and a pumped auxiliary water supply system. The collection system includes two downstream entrances near the navigation lock wall at the base of the dam and one side entrance, which is bulkheaded off from the spillway basin. The downstream entrance nearest the navigation lock wall is normally open for fish passage. Three electric pumps supply the auxiliary water for fish attraction flow. Two of the three pumps operate continuously during normal operation. The third pump serves as a backup in the case of a pump failure.

The south shore facilities are comprised of a fish ladder with an adult counting station, two south shore entrances, a powerhouse collection system, and a pumped auxiliary water supply system. The powerhouse collection system includes two downstream entrances and on side entrance, which is bulkheaded off from the spillway basin at the north end of the powerhouse, twelve floating orifices, and a common fish transportation channel. The fishway entrances used during normal operation include: one south shore entrance nearest the powerhouse, one downstream north powerhouse entrance, and four floating orifice gates. Eight electric pumps are available to supply the auxiliary water for fish attraction, of which five to eight pumps are used during normal operation.

River Conditions

During the 2015 season, the average daily project outflow and spill was lower than the 2011-2015 monthly average, Table 1.

The highest daily outflow for the season was on May 20 at 128.5 kilo cubic feet per second (kcfs). The lowest daily outflow for the season occurred on October 18 with an outflow of 16.9 kcfs. The average flow for the season was 54.6 kcfs, Figure 1. The highest spill was 74.6 on May 19 and the lowest spill above 0.0 occurred on September 16 at 0.07 kcfs. The average spill was 23.7 kcfs.

Table 1. Comparison of average monthly project outflow (kcfs) and spill (kcfs) at Ice Harbor Dam, 2011-2015 and the 5-year average.

Project Outflow						
Month	**2011**	**2012**	**2013**	**2014**	**2015**	**2011-2015 Avg**
April	123.5	110.3	60.0	77.6	51.5	84.6
May	104.6	145.3	83.4	105.3	60.9	99.9
June	89.9	177.7	56.6	86.7	41.1	90.4
July	46.4	96.8	34.1	46.9	27.5	50.4
August	28.1	41.2	23.4	27.8	20.9	28.3
September	21.5	34.0	19.2	19.8	17.6	22.4
Spill						
Month	**2011**	**2012**	**2013**	**2014**	**2015**	**2011-2015 Avg**
April	78.1	67.7	0.0	92.0	34.3	54.4
May	54.3	78.7	0.2	92.0	36.3	52.3
June	59.4	95.9	32.9	22.9	20.6	46.3
July	31.0	57.7	45.4	16.5	16.5	33.4
August	17.7	31.1	32.6	10.9	10.9	20.6
September	0.0	0.0	21.9	0.0	0.0	4.4

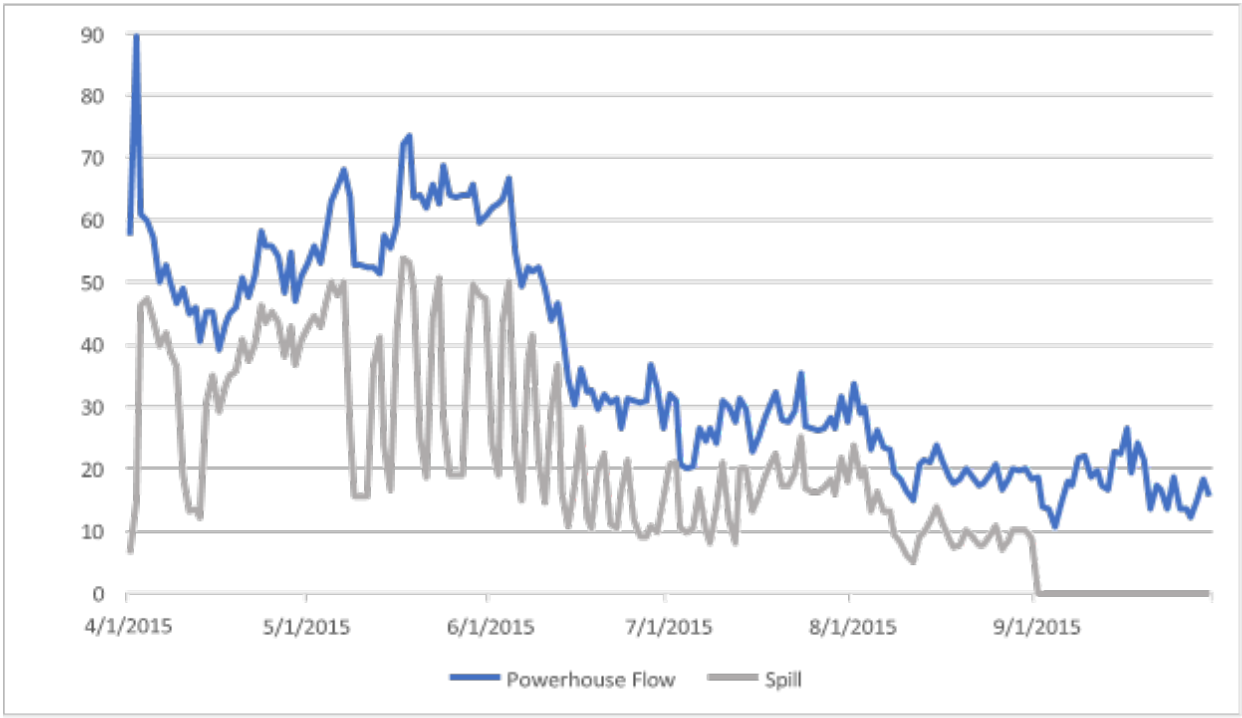

Figure 1. Comparison of daily project outflow and spill at Ice Harbor Dam, 2015.

River Temperature

The 2011-2015, 5-year average monthly temperature was lower than the 2015 monthly average temperatures, April 1 to September 30 (Table 2). The month with the highest average temperature during that same period was in July and the month with the coldest average temperatures was April.

Table 2. Monthly average river temperatures, 2011-2015 at Ice Harbor Dam and 5-year average.

Temperature						
Month	2011	2012	2013	2014	2015	2011-2015 Avg
April	47.5	46.9	39.0	49.1	49.8	46.5
May	52.3	52.3	40.7	53.8	56.1	51.1
June	56.8	55.3	43.1	59.0	64.4	55.7
July	66.6	61.6	46.9	68.2	70.3	62.7
August	69.7	68.4	52.9	67.8	69.6	65.7
Sept.	66.6	67.4	57.0	63.0	67.0	64.2

Juvenile Fish Facility Operations and Maintenance

Sampling

Sampling is defined as diverting and segregating groups of fish in a consistent fashion to collect data from those segregated groups to accurately represent all the fish collected. Fish were sampled at Ice Harbor to monitor fish condition. This type of sampling is called sampling for condition. The goal of a sampling event is to collect 100 fish of the predominant species within a four-hour period. Fish are visually counted as they come into the fish separator structure. During the beginning and the latter part of the season, migrating fish numbers can be low, so the target number of fish may not be collected during the four-hour period. Fish condition sampling began on April 14 and occurred on Mondays and Thursdays each week. The Washington State permit was received late, which delayed the beginning of sampling. The last sample of the season occurred on June 29.

Fish (predominantly Chinook) were dipped out of gatewell slot 1B and transported to the fish facility to become the fish for condition sampling on June 23.

The sampling facility water temperature was 71.0 ºF on the morning of July 1. After consulting with District biologists, the decision was made not to sample fish that day. High water temperatures continued until the end of the sampling season and no further sampling was conducted.

A total of 2,606 juvenile salmonids were sampled during the 2015 season (Table 3). This is a decrease from the 3,242 fish sampled in 2014. There were two clipped steelhead *Oncorhynchus mykiss* mortalities in the April 22 sample that appeared to have died a few days before being collected and sampled.

Within each species group the number and percent sampled of those collected in that group was: 925 clipped steelhead (35.5%), 274 clipped yearling Chinook salmon, *O. tschawytscha* (10.5%), 549 unclipped subyearling Chinook salmon (21.1%), 381 clipped subyearling Chinook salmon (14.6%), 212 unclipped yearling Chinook salmon (8.1%), 234 unclipped steelhead, *(*9.0%), 24 clipped/unclipped coho salmon, *O. kisutch* (0.9%), 2 unclipped sockeye/kokanee salmon, *O. nerka*, (0.1%), and 5 clipped sockeye/kokanee salmon (0.2%) (Tables 4 & 5).

In 2015 the peak daily collection total and date for each species group were: 103 clipped steelhead (April 30), 86 unclipped subyearling Chinook salmon (June 23), 55 clipped yearling Chinook salmon (April 14), 69 clipped subyearling Chinook salmon (June 9), 55 unclipped yearling Chinook salmon (April 14), 34 unclipped steelhead. (May 14), 1 unclipped sockeye/kokanee salmon (May 18), 2 clipped sockeye/kokanee salmon (May 20), and 8 coho salmon (May 20). The largest total daily number collected was 143 fish occurring on May 28 (Table 6).

Table 3. Number of juvenile salmonids sampled per day at Ice Harbor Dam, 2015.

Date	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Daily Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
14-Apr	55	55	0	0	8	0	0	0	0	118
16-Apr	42	40	0	0	20	0	0	0	0	102
20-Apr	16	17	0	0	23	2	0	0	0	58
22-Apr	32	22	0	0	31	5	0	1	0	91
28-Apr	28	26	0	0	79	2	0	0	0	135
30-Apr	9	4	0	0	103	3	0	0	0	119
4-May	4	2	0	0	92	7	0	0	0	105
6-May	12	12	0	0	85	24	0	0	0	133
12-May	27	4	0	0	79	21	0	0	0	131
14-May	10	4	0	0	70	34	0	0	3	121
18-May	11	3	0	11	67	20	2	1	7	122
20-May	10	8	0	24	51	29	2	0	8	132
26-May	5	3	2	4	59	32	0	0	4	109
28-May	11	5	0	1	98	26	0	0	2	143
1-Jun	2	4	9	15	38	23	1	0	0	92
3-Jun	0	1	59	31	9	2	0	0	0	102
9-Jun	0	0	69	54	3	2	0	0	0	128
11-Jun	0	0	57	74	0	0	0	0	0	131
15-Jun	0	2	31	55	7	2	0	0	0	97
17-Jun	0	0	43	57	1	0	0	0	0	101
23-Jun	0	0	41	86	1	0	0	0	0	128
25-Jun	0	0	41	62	0	0	0	0	0	103
29-Jun	0	0	29	75	1	0	0	0	0	105
Totals	274	212	381	549	925	234	5	2	24	2606
% Totals	10.51%	8.14%	14.62%	21.07%	35.50%	8.98%	0.19%	0.08%	0.92%	***

Table 4. Number of juvenile salmonids sampled at Ice Harbor Dam, 2011-2015.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2011	624	566	456	630	722	205	14	74	14	3, 305
2012	639	631	240	494	585	325	0	18	35	2,970
2013	327	271	338	525	676	260	10	12	9	2, 428
2014	477	484	465	676	763	243	10	86	38	3,242
2015	274	212	381	549	925	234	5	2	24	2, 606

Table 5. Annual percentage sampled of each juvenile salmonid species at Ice Harbor Dam, 2011-2015.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip
2011	18.9%	17.1%	13.8%	19.1%	21.8%	6.2%	0.4%	2.2%	0.4%
2012	21.5%	21.2%	8.1%	16.6%	19.7%	10.9%	0.0%	0.6%	1.2%
2013	13.5%	11.2%	13.9%	21.6%	27.8%	10.7%	0.4%	0.5%	0.4%
2014	14.7%	14.9%	14.3%	20.9%	23.5%	7.5%	0.3%	2.7%	1.2%
2015	10.5%	8.1%	14.6%	21.1%	35.5%	9.0%	0.2%	0.1%	0.9%

Table 6. Annual peak collection dates at Ice Harbor Dam, 2011-2015.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip
2011	16-May 94	21-Apr 79	20-Jun 85	5-Jul 98	19-May 114	19-May 35	9-Jun 7	14-Apr 13	26-May 4
2012	7-May 89	12-Apr 83	21-Jun 45	9-Jul 84	26-Apr 63	2-Apr 44	---- 0	4,7-Jun 2	4-Jun 12
2013	6-May 43	6-Apr 16	11-Jun 67	15-Jul 90	14-May 67	19-Jun 70	22-May 5	22-May 9	3-Jun 5
2014	6-May 69	28-Apr 57	25-Jun 64	11-Jun 66	12-May 97	30-May 30	22-May 7	2-Apr 9	20-May 10
2015	14-Apr 55	14-Apr 55	9-Jun 69	23-Jun 86	30-Apr 103	14-May 34	20-May 2	18-May 1	20-May 8

---No species sampled

Descaling

The descaling rate for all fish sampled in 2015 was 4.6% (Tables 7 & 8). The highest descaling by day came from the samples on April 30, May 6, and May 12. The majority of descaling was observed in unclipped steelhead. The annual descaling rate by species group was clipped yearling Chinook salmon (4.0%), unclipped yearling Chinook salmon (4.2%), clipped subyearling Chinook salmon (2.6%), unclipped subyearling Chinook salmon (1.6%), clipped steelhead (6.5%), unclipped steelhead (8.1%), and coho salmon (4.2%). No sockeye/kokanee salmon showed signs of descaling (Table 8).

In 2015 the descaling of 4.6 % for all fish examined was higher than the descaling rates in 2011-2014 (Table 9). Steelhead had the highest amount of descaling observed in 2011-2015.

Table 7. Number of salmonids sampled with descaling at Ice Harbor, 2015.

Date	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
14-Apr	0	0	---	---	0	---	---	---	---	0
16-Apr	0	0	---	---	1	---	---	---	---	1
20-Apr	0	0	---	---	1	0	---	---	---	1
22-Apr	1	1	---	---	3	1	---	0	---	6
28-Apr	0	1	---	---	2	1	---	---	---	4
30-Apr	3	2	---	---	10	0	---	---	---	15
4-May	2	0	---	---	4	0	---	---	---	6
6-May	0	1	---	---	9	2	---	---	---	12
12-May	3	0	---	---	9	2	---	---	---	14
14-May	0	2	---	0	5	1	---	---	1	9
18-May	1	2	---	1	3	2	0	0	0	9
20-May	1	0	---	0	2	4	0	---	---	7
26-May	0	0	0	0	1	0	---	---	0	1
28-May	0	0	0	0	5	2	---	---	0	7
1-Jun	0	0	0	0	4	4	0	---	---	8
3-Jun	---	0	1	0	0	0	---	---	---	1
9-Jun	---	---	3	1	0	0	---	---	---	4
11-Jun	---	---	2	2	---	---	---	---	---	4
15-Jun	---	0	0	1	0	0	---	---	---	1
17-Jun	---	---	0	0	0	0	---	---	---	0
23-Jun	---	---	1	3	1	---	---	---	---	5
25-Jun	---	---	0	0	---	---	---	---	---	0
29-Jun	---	---	3	1	0	---	---	---	---	4
Totals	11	9	10	9	60	19	0	0	1	119

-- No fish of this species sampled

Table 8. Percent of descaled salmonids at Ice Harbor Dam, 2015.

Date	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
14-Apr	0.0%	0.0%	---	---	0.0%	---	---	---	---	0.0%
16-Apr	0.0%	0.0%	---	---	5.0%	---	---	---	---	1.0%
20-Apr	0.0%	0.0%	---	---	4.3%	0.0%	---	---	---	1.7%
22-Apr	3.1%	4.5%	---	---	10.3%	20.0%	---	0.0%	---	6.6%
28-Apr	0.0%	3.8%	---	---	2.5%	50.0%	---	---	---	3.0%
30-Apr	33.3%	50.0%	---	---	9.7%	0.0%	---	---	---	12.6%
4-May	50.0%	0.0%	---	---	4.3%	0.0%	---	---	---	5.7%
6-May	0.0%	8.3%	---	---	10.6%	8.3%	---	---	---	9.0%
12-May	11.1%	0.0%	---	---	11.4%	9.5%	---	---	---	10.7%
14-May	0.0%	50.0%	---	---	7.1%	2.9%	---	---	33.3%	7.4%
18-May	9.1%	66.7%	---	9.1%	4.5%	10.0%	0.0%	0.0%	0.0%	7.4%
20-May	10.0%	0.0%	---	0.0%	3.9%	13.8%	0.0%	---	---	5.3%
26-May	0.0%	0.0%	0.0%	0.0%	1.7%	0.0%	---	---	0.0%	0.9%
28-May	0.0%	0.0%	---	0.0%	5.1%	7.7%	---	---	0.0%	4.9%
1-Jun	0.0%	0.0%	0.0%	0.0%	10.5%	17.4%	0.0%	---	---	8.7%
3-Jun	---	0.0%	1.7%	0.0%	0.0%	0.0%	---	---	---	1.0%
9-Jun	---	---	4.3%	1.9%	0.0%	0.0%	---	---	---	3.1%
11-Jun	---	---	3.5%	2.7%	---	---	---	---	---	3.1%
15-Jun	---	0.0%	0.0%	1.8%	0.0%	0.0%	---	---	---	1.0%
17-Jun	---	---	0.0%	0.0%	0.0%	---	---	---	---	0.0%
23-Jun	---	---	2.4%	3.5%	100.0%	---	---	---	---	3.9%
25-Jun	---	---	0.0%	0.0%	---	---	---	---	---	0.0%
29-Jun	---	---	10.3%	1.3%	0.0%	---	---	---	---	3.8%
Total	274	212	381	549	925	234	5	2	24	2,606
% Descaled	4.0%	4.2%	2.6%	1.6%	6.5%	8.1%	0.0%	0.0%	4.2%	4.6%

-- No fish of this species sampled

Table 9. Annual descaling rates in percent for fish sampled at Ice Harbor Dam, 2011-2015.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2011	3.9%	2.3%	0.7%	0.6%	3.3%	3.9%	0.0%	5.4%	0.0%	2.6%
2012	2.7%	3.2%	4.2%	2.0%	5.5%	3.7%	0.0%	0.0%	0.0%	3.5%
2013	3.7%	3.3%	1.5%	2.5%	3.4%	2.7%	30.0%	0.0%	0.0%	3.0%
2014	2.3%	1.9%	2.2%	1.3%	7.9%	7.8%	0.0%	0.0%	2.6%	3.7%
2015	4.0%	4.2%	2.6%	1.6%	6.5%	8.1%	0.0%	0.0%	4.2%	4.6%

Mortality

Total juvenile facility mortality for all salmonids in 2015 was 4 (Table 10). Fish that are dead prior to coming into the lab are not examined for condition but are included in the sample number of fish.

Table 10. Total sample mortality at Ice Harbor Dam, 2015.

Date	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
14-Apr	0	0	0	0	0	0	0	0	0	0
16-Apr	0	0	0	0	0	0	0	0	0	0
20-Apr	0	0	0	0	0	0	0	0	0	0
22-Apr	0	0	0	0	2	0	0	0	0	2
28-Apr	0	0	0	0	0	0	0	0	0	0
30-Apr	0	0	0	0	0	0	0	0	0	0
4-May	0	0	0	0	0	0	0	0	0	0
6-May	0	0	0	0	0	0	0	0	0	0
12-May	0	0	0	0	0	0	0	0	0	0
14-May	0	0	0	0	0	0	0	0	0	0
18-May	0	0	0	0	0	0	0	0	0	0
20-May	0	0	0	0	0	1	0	0	0	1
26-May	0	0	0	0	0	0	0	0	0	0
28-May	0	0	0	0	0	0	0	0	0	0
1-Jun	0	0	0	0	0	0	0	0	0	0
3-Jun	0	0	0	0	0	0	0	0	0	0
9-Jun	0	0	0	0	0	0	0	0	0	0
11-Jun	0	0	0	0	0	0	0	0	0	0
15-Jun	0	0	0	0	0	0	0	0	0	0
17-Jun	0	0	0	0	0	0	0	0	0	0
23-Jun	0	0	0	1	0	0	0	0	0	1
25-Jun	0	0	0	0	0	0	0	0	0	0
29-Jun	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	1	2	1	0	0	0	4

Annual mortality for all groups combined was 0.2% in 2015. Only 2 species groups had mortalities in 2015. The mortalities and percentages were 1 unclipped subyearling Chinook salmon (0.4%), 2 clipped steelhead (0.2%), and 1 unclipped steelhead (Table 11).

Table 11. Annual mortality in percent at Ice Harbor Dam, 2011-2015.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye/Kokanee		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clip/Unclip	
2011	0.2%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%
2012	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
2013	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2014	0.4%	0.0%	0.2%	0.1%	0.1%	0.4%	0.0%	1.2%	0.0%	0.2%
2015	0.0%	0.0%	0.0%	0.2%	0.2%	0.4%	0.0%	0.0%	0.0%	0.2%

Maladies

Maladies are recorded for each sample and sent to the Fish Passage Center (FPC) after the sample is completed. For the 2015 season, maladies found within all species groups included body injury, head injury, eye injury, eye hemorrhage, popeye, operculum injury, fin injury, fungus, fin hemorrhage, fin deformity, parasites, *Columnaris*, and fin discoloration. The highest malady from all species groups combined was fin injuries. The second highest maladies were operculum injury and body injury. Diseases that were the most prevalent were fin hemorrhage and parasites. Fin hemorrhage was the most prominent in Chinook salmon and in the clipped steelhead population. No exact counts are listed within this report for maladies, only general observation of the data provided from the samples was used.

Incidental Species

Non-target fish species were counted and then released at the separator or with the sample fish. The most common incidental species group for 2015 was Siberian prawn, *Exopalaemon modestus* (25) and smallmouth/largemouth bass, *Micropterus dolomieu/salmonids* (6). All other incidentals found totaled 1 (Table 12).

Table 12. Incidental species collected during sampling at Ice Harbor Dam, 2015.

Common Name	Scientific Name	Sample
Chiselmouth	*Acrocheilus alutaceus*	1
Northern Pikeminnow	*Ptychocheilus oregonensis*	1
Sculpin	*Cottus* spp.	1
Siberian Prawn	*Exopalaemon modestus*	25
Largemouth & Smallmouth Bass	*Micropterus dolomieu/salmoides*	6
Sunfish	*Lepomis* spp.	1
Walleye	*Stizostedion vitreum*	1
Yellow Perch	*Perca flavescens*	1
Total	37	

Adult Fallbacks

A total of 2 salmonids were released from the separator in 2015. The salmonids consisted of 1 jack Chinook salmon and 1 unclipped steelhead. All the salmonids were classified in good condition (Table 13).

Table 13. Daily totals of adult salmonids released from the separator and condition at Ice Harbor Dam, 2015.

Date	Chinook	Chinook Jack	Steelhead Clipped	Steelhead Unclip	Sockeye	Coho	Condition
20-May	0	0	0	1	0	0	Good
1-Jun	0	1	0	0	0	0	Good
Total	0	1	0	1	0	0	

The annual totals of adults released from the separator for 2015 was less than the previous years. (Table 14).

Table 14. Annual totals of adult salmonids released from the separator at Ice Harbor Dam, 2011-2015.

Year	Chinook	Chinook Jack	Steelhead Clipped	Steelhead Unclip	Sockeye	Coho	Total
2011	3	4	0	0	0	0	7
2012	3	1	2	3	0	0	9
2013	3	1	1	0	0	0	5
2014	4	1	2	8	0	0	15
2015	0	1	0	1	0	0	2

Facility Operations and Maintenance

Turbine Operations

Efforts were made to operate all turbine units within 1% of peak efficiency from April 1 to October 31. Deviations were infrequent and brief. Units were operated within hard constraint beginning April 1 to October 31. Unit priority was in effect from March 1 to November 30. Units were taken out of service one at a time for trash rack raking and STS inspections. Units were taken out of service (OOS) for various reasons throughout the year. Table 15 provides a summary of unit outages and causes.

Table 15. Unit outages and return to service dates for Ice Harbor Dam, 2015.

Dates OOS	Unit	Reason OOS
6 Mar	1	Validation testing
9 Mar	6	Accommodated contractor moving dive barge for spillbay modification
20 Mar	4	Accommodate electrical check of 3's wiring
26 Mar	1	Installation of transducers and wiring on 1B STS frame
7 July-2 Aug	3	Governor upgrades, maintenance, and repairs
7-8 Apr	1	Installation of transducers on 1B trash rack
7 -8 Apr	2	Accommodate divers installing transducers on 1B trash rack
16-Jun	2	Asbestos sampling
23 Jun	1	Gatewell dipping for fish sampling
6 Jul-30 Jul	5	Annual maintenance
6 Jul-19 Aug	6	Annual maintenance
7 Jul	4	Wicket gate not releasing, failure of exciting
20 Jul	1,2	Accommodate BPA work on line 1 115 kV disconnect
12-13 Aug	5	115 kV restrictions
12-13 Aug	1	Install and remove fish research equipment
12 Aug	2	Safety of divers removing fish equipment
31 Aug- 1 Oct	3	Annual maintenance
31 Aug- 30 Sep	4	Annual maintenance
9 Sept	5,6	Provide calm water for spillway survey for dam safety
21 Sept-24 Sept	2	Vacuum break stuck open
2 Nov-18 Dec	2	Annual maintenance
9 Nov-14 Nov	6	Repair oil cooler
16-17 Nov	2	Relay testing
1-2 Dec	2	Adjust breaks and wicket gate packing
5-7 Dec	6	Adjust and test wicket gates and main unit for water leakage
8 Dec	6	Generator breaks not releasing
9 Dec	4	High differential on water cooling strainers
9-16 Dec	6	Diagnose possible oil leak, none found
17 Dec	6	High differential due to shad build up

Unit 1 was out of service for model validation testing on March 6 from 0740 to 1702 hours. Unit 3 also had validation testing and was out on March 25. The testing took up to 6 hours for each unit. Units 4 and 6 were mistakenly operated out of priority ahead of unit 2 on March 6, from 1105 to 1219 hours, while unit 1 was out of service (with no line switching occurring). Unit 6 was out of service from 0655 to 1709 hours on March 9 to accommodate the contractor moving the dive barge used for the spillbay 2 modification. Reactive limit testing was done on the units one at a time on March 11, from 1115 to 1322 hours. Units were operated above the 1% peak efficiency range on March 26 to meet BPA's load request. Unit 3 was operated below the 1% peak efficiency range on March 23 for commissioning testing. Unit 6 was operated out of priority ahead of unit 3 from 1159 hours on June 28 to 0439 hours on June 29 due to a BPA

power system contingency request for generation out of line 3. Unit 1 was operated above the 1% range as needed on October 6 to accommodate the turbine environment characterization study. Unit 1 was out of service from 1403 hours on October 21 to 1048 hours on October 22 for STS inspections and to repair the STS in slot 1A. Unit 4 was operated out of priority (ahead of unit 6) on November 5 from 1653 hours to 1807 hours, due to unit 6 having a high-level alarm for turbine bearing oil. During the week of November 20 units 4 and 6 were periodically operated slightly below the 1% peak efficiency range (soft constraint), due to BPA load requirements and the narrow 1% range of unit 2 (fixed-blade unit). During the week of November 27 unit 2 was periodically operated slightly below or above the 1% peak efficiency range (soft constraint), due to BPA load requirements and the narrow 1% range of unit 2 (fixed-blade unit).

Removable Spillway Weir

The modification of spill bay 2 ogee and flow deflector was completed during the 2015 year. Flow over spill bay 2 occurred on March 30. Spill in excess of powerhouse capacity occurred on April 1 and 2. Therefore, a spill was done on those dates. Mandated spill for fish passage began on April 3. Spillbay 2 was closed from 0751 hours to 1008 hours on April 14, and from 0710 hours to 1420 hours on April 15, for the fish release pipe removal from the RSW walkway structure. The RSW was in operation, except beginning August 9 when spill gate #2 periodically did not have enough river flow to operate the RSW. Mandated spill for fish passage ended August 31.

Debris and Trash Racks

March 14-15 and 17 debris was raked from the trash racks prior to installing STSs. Eight cubic yards of debris was removed.

Gatewells

Gatewell slots were checked daily for debris. Amounts of woody material were noted in gatewell slots, but never approached the 50% coverage criteria point for mandatory cleaning. Gatewells were dipped as needed prior to installing STSs.

Submersible Traveling Screens

Submersible traveling screens (STSs) were installed on March 27-29 for units 1 and 3, 4,5, and 6. On March 31 the STS screens for unit 2 were installed. They were removed on December 16-18, except for unit 1. Unit 1 STSs were removed on November 4, since the unit will remain out of service through December 15. An underwater video camera was used to conduct monthly inspections of all installed STSs from April 1 through November. No significant problems were found except what is listed below.

STS operation was changed from cycling mode to continuous-run mode on June 3 due to the average fork length of subyearling Chinook salmon being less than 120 mm at the juvenile fish

facility. STS operation was changed from continuous-run mode to cycling mode on July 9 due to the average fork length of subyearling Chinook being greater than 120 mm.

During STS inspections on October 19 and 21, it was found that the mesh of the STS in gatewell 1A was starting to separate at the end of several seams due to missing screen clips. The missing clips were replaced with new ones.

Vertical Barrier Screens

Project personnel inspected vertical barrier screens (VBS) while conducting STS inspections. No problems were found.

Juvenile Collection Channel (JCC) Orifices

The juvenile fish bypass was watered up and 20 orifices were opened on March 18 and dewatered December 18. Sixty-one clipped adult steelhead, 17 unclipped adult steelhead, 7 clipped juvenile steelhead, and 3 channel catfish were recovered during the dewatering process and released at Hood Park in good condition. During the season at least one orifice was open in each gatewell slot. Some exceptions to this were if orifices were closed in individual gatewells for brief periods during the season to accommodate routine maintenance and repair, such as backflushing, STS inspections, or STS repair. Beginning between May 1-7 orifices were cycled and backflushed 3 times a day. On July 9 a juvenile steelhead was found dead near the juvenile collection channel. The fish died in that location because it had jumped through a gap in the jump-netting located near the handrail and grating. Additional cable ties were added to the bottom of the netting in the location to eliminate gaps where the fish could fit through to prevent this occurring again.

Primary Dewatering Structure

The juvenile fish collection channel, including the PDS was opened on March 18 and closed December 18. The PDS functioned well throughout the 2015 season. However, some problems were experienced with the mechanical screen cleaner.

On June 8, the mechanical screen cleaner was disabled when the track for the power cord became tangled up in a cleaning tool that fell onto the track. The track was temporarily separated to untangle and remove the cleaning tool, and the mechanical screen cleaner was returned to service on June 9. On August 13, the cable that raises and lowers the brush on the mechanical screen cleaner at the primary dewaterer broke. The brush was manually raised out of the water and the screen cleaner was taken out of service for repair. The cable was replaced, and the screen cleaner was returned to service on August 18. On September 31, the PDS was found to be dysfunctional due to a pump failure. The pump was replaced, and it was returned to service on October 27. November 23, the mechanical screen cleaner was found to be stuck midway down the channel with the brush up. A metal tray was jammed between the brush and the wall, preventing the screen cleaner from moving. Personnel freed the screen cleaner, but the tray fell into the water. Personnel probed the bottom of the channel for the tray, but believe the current pushed the tray through the bypass pipe and out into the river.

Juvenile Fish Facility

The main raw water and branching pipes at the fish facility were filled on March 25. The raw water supply was shut off on October 26 and winterized on October 27.

Cooling Water Strainers

Turbine unit cooling water strainers were examined for biologic content at least once per month from January through July during 2015. The strainers were also cleaned when accumulation of debris and fish resulted in a high-pressure differential or became clogged.

The total number of Pacific lampreys *Entosphenus tridentatus* removed, dead or alive, from the water cooler strainers for the last 5 years are in Table 16. Less Pacific lamprey were found in 2015 than 2011-2014. In addition, 2,168 American shad, *Dorosoma cepedianum*, 152 Siberian prawns, 8 juvenile steelhead, 4 juvenile Channel catfish, *Ictalurus punctatus*, 1 Sand roller, *Percopsis transmontana*, 1 Crawfish, *Cambarus callainus*, and 1 Sculpin, *Myoxocephalus scorpius,* were found in the strainers. The largest percentage of species in the strainers were American shad at 84.8%. The second largest percentage were lamprey totaling 8.7%. The third was Siberian Prawns at 5.9%. All other species found in the strainers made up less than 1% of the sample.

Probability of individuals being alive at the time of strainer cleaning was likely more related to time of entry rather than which unit's strainer the lamprey was found in.

Table 16. Pacific lamprey removed from turbine cooling water strainers from Ice Harbor Dam, 2011-2015.

Pacific lamprey (Juvenile)			
Year	Live	Dead	Total
2011	26	1518	1544
2012	12	608	620
2013	2	290	292
2014	0	483	483
2015	3	221	224

Fish Salvage

On May 26 the 4 tainter valve chamber began to be dewatered to perform maintenance on the valve. Afloat switch that turns the pump off a the preferred depth (1-2 feet) did not activate, resulting in only 3 inches of water being left in the chamber, which was not discovered until the morning of the May 27. The morning that it was discovered 19 steelhead and 2 Chinook were also discovered dead. This was due to hypoxic related stress from the lack of water. Once the low level of water was discovered a fish rescue was planned and commenced. A total of 81 salmonids, mostly steelhead, were rescued and returned to the river in good condition. During

the dewatering of the north ladder, 1 clipped steelhead was seen and volitionally left the ladder. In addition, three bass were found alive and released into the forebay in good condition. On December 7, gatewell 1C slot was dipped prior to swapping a leaking head gate. Three live steelhead in good condition were discovered and were released into the forebay. On December 8, a fish salvage occurred in unit 1 scroll case. During the salvage, 25 dead shad and one dead steelhead were found. No cause of death was discovered for the steelhead. In addition, 1 crappie in poor condition, 2 shad in poor condition, 1 juvenile tench, 1 adult lamprey and 2 crayfish were discovered and released into forebay. Lastly, Siberian prawns were found, but not salvaged. They were difficult to see, and some may have gone down the drain.

Research

Installation of the fish release pipe, for the spillbay 2 direct fish injury and survival study, occurred on March 19 and 20, with final adjustment occurring on March 30. The spillbay 2 direct fish injury and survival study began on April 7 and ended on April 12, with the release of balloon/radio-tagged fish and sensor fish over spillbay 2. Transducers were mounted on the STS frame in gatewell slot 1 B on March 26 for the turbine intake fish distribution study. The hydroacoustic equipment began collecting data on April 8. Hydroacoustic transducers were mounted on the STS frame in gatewell slot 1 B on March 26 and mounted on 1B trash rack on April 7 and 8, for the turbine intake fish distribution study. Sensor fish release pipes were installed on the STS framework from gatewell slot 1B on August 13, in preparation for the turbine environment characterization study occurring in September. On September 9, sensor fish were released into the unit 1 turbine intake, via pipes installed on the STS framework in gatewell slot 1B, for the turbine environment characterization study. Sensor fish releases temporarily ended on September 18 and recommenced on October 6 for one day. The sensor fish release pipes were removed from the STS framework in gatewell slot 1B on November 4. An adult fish trap was installed in the south ladder exit pool on the afternoon of December 7 so that Pacific States Marine Fisheries Commission personnel could finish wiring in PIT-tag detection capability for the trap. The work was performed in the afternoons, when generally fewer adult fish were using the ladder. The doors to the trapping cage were open so that fish could pass straight through the trap. The trap was removed on the afternoon of December 11.

Avian Predation

Avian Predation-General

Bird monitoring occurred from April 1 to July 31. Gulls, Caspian terns, western grebes, and American white pelicans were counted once per day, 6 or 7 days a week from April 1 to June 30, and 4 days (Monday to Thursday) from July 1 to July 31. Areas of avian predation monitoring included: forebay, powerhouse tailrace (two areas), spillway tailrace (three areas), Eagle Island and the JFF bypass outfall. Deterrent measures include hydro sprinklers, bird wires and hazing (April 1 to June 30) under the animal control contract with United States Department of Agriculture-Wildlife Services (USDA-WS). Land-based hazing of piscivorous birds for 8 hours per day began on April 1, expanded to 16 hours per day April 12, decreased to 8 hours per day on June 21 and ended on June 30. Boat-based hazing for 8 hours per day, 3 days per week, began

on the week of April 12 and increased to 5 days the week of April 26. It than was decreased to 3 days a week on May 31 and ended on June 20. Land-based hazing was generally effective at dispersing birds away from zones adjacent to the dam. Boat-based hazing has been effective at moving birds out of zones further downstream of the dam.

Gulls

From April 1 to July 31 the total monthly count of gulls varied. However, the highest number of birds observed from April 1 to the end of July peaked in the month of July (Figure 2). 1,120 gulls in total were observed for the month of July. The highest average daily count of gulls observed in a month occurred during July, totaling 120 on July 29. The lowest monthly total count of gulls was during April at 147.

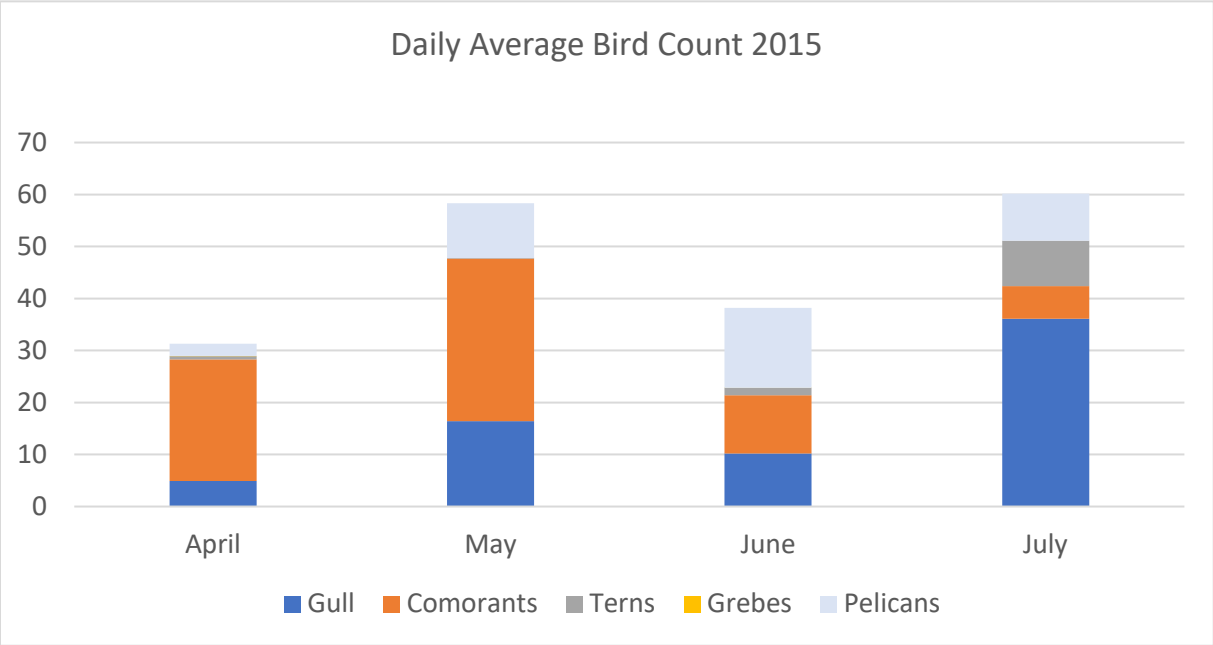

Figure 2. Average daily counts of avian predators by month at Ice Harbor, 2015.

Cormorants

Cormorant total monthly counts continued to climb from April to May and then declined during June and July. The highest monthly count of cormorants occurred in May at 971. The highest daily count was on April 19, 80 birds. The lowest monthly total was in July.

Terns

From April 1 to July 31 terns' monthly totals for Caspian terns continued to climb until peaking in the month of July. The highest total monthly count was observed in July at 270, and the highest daily count was 41 on July 29. The lowest monthly total was during April.

Grebes

Very few grebes were observed from April 1 to July 31. For the months of July and May no grebes were observed. In April, the monthly total was three and for June it was one. No more than a single grebe was observed in a day.

Pelicans

In 2015, American white pelicans were often the most numerous piscivorous birds observed around the dam. Pelicans could not be targeted for hazing because they are a species of concern in Washington State.

The monthly average daily count of pelicans in 2015 was highest in June, however, it only exceeded July by a total of three pelicans. July's total monthly number of pelicans was 460 and June's was 463. The highest daily observed number pelicans occurred on July 30 at 46. The lowest monthly total was in April.

Recommendations for the Juvenile Fish Facility

1. Repaint the interior of the juvenile fish bypass pipe/flume and separator exit flume. The inside surfaces of the pipe and flumes have peeling paint and corroded areas, which created rough spots that could possibly descale or injure fish.
2. Extend the air bubbler screen cleaning system under the entire unwatering floor screen in the primary dewatering structure. This system would serve as a reliable extra cleaning system in the event of failure of aging components of the mechanical screen cleaner.
3. Replace the outfall pipe hydrocannon black iron water line with stainless steel to prevent corrosion. Install a walkway alongside the outfall pipe to provide access to the outfall pipe and hydrocannon water line to conduct inspections and maintenance.
4. Install a fish release chute connecting to the main bypass pipe downstream of the JFF lab. This would permit fish rescued during certain unwatering events to be more easily returned to the tailrace via the bypass pipe.
5. Install stairs on the hillside to provide a direct and safe walking path between the JFF and tailrace deck level.
6. Pave the road and parking area inside the JFF and provide curbing that would direct any water runoff away from the juvenile facility and the hillside. Pavement would provide stable ground for heavy equipment access and setup as needed to perform maintenance and repairs.

Adult Fish Facility

Operations and Maintenance

The south shore fish ladder (SFL) and north shore fish ladder (NFL) were operated for fish passage for most of the year. The south ladder was dewatered January 5, and the north fish

ladder was dewatered January 26. Adult fish counting ended for the season on October 31. For all species groups, more fish were counted passing the SFL than the NFL. The total counts for Chinook jack, clipped and unclipped steelhead, coho, and coho jack salmon were below the previous ten-year average (Table 17). American shad and Pacific lamprey were significantly higher than the ten-year average.

Table 17. Number of adult fish passing Ice Harbor Dam in 2015 and average of previous ten years.

	Chinook	Jack Chinook	Clipped steelhead	Unclipped steelhead	Sockeye	Coho	Jack coho	Shad	Lamprey
SFL	123, 390	6, 539	12, 498	7, 306	731	0	0	192, 938	406
NFL	21, 517	2, 548	3, 513	1, 999	321	0	0	27, 819	297
Total (SNL + NFL)	144, 907	9, 087	16, 011	9, 305	1, 052	0	0	220, 757	703
10 YR-Avg (SNL + NFL)	104, 643	31, 233	178, 382	45, 121	771	4, 081	355	146, 440	327

Auxiliary Water Supply

The auxiliary water supply (AWS) pumps were operating or available for operation to help maintain fish entrance criteria in 2015. AWS pumps were turned off, taken OOS, or forced OOS during the fish passage season to facilitate maintenance, operations, or emergency repairs. Five to eight AWS pumps were operated to maintain criteria in the SFL depending on tailwater elevation. Zero to two AWS pumps were operated to maintain criteria in the NFL. In season maintenance and minor repairs can be performed on the pumps that are in standby. Each north shore pump operates at 350 kcfs and each south shore pump operates at 30 kcfs. In addition, approximately 270 kcfs of excess water from the juvenile fish collection channel is added to the south shore AWS pump discharge chamber. Any outages or disruptions that occurred in 2015 are listed below or are cited in Table 18.

Table 18. AWS pump outages and significant events requiring pumps to be shut off at Ice Harbor Dam, 2015.

Date	Pump Number or How Many Pumps Affected	Pump Outage Description or Reason for Turning Off
22 Apr-19 Aug	#3	Replace pre-lubrication pump
19-25 Aug	#1	Repair an oil leak

On March 1 and 2, a faulty pre-lube pump on pump #1 and a faulty temperature switch on the gearbox of pump #2 resulted in only pump #3 being operated. Pump #1 was restarted on March 2 at 1355 hours. Pump #1 momentarily tripped off at 0051 hours on June 27.

Only one of the north shore pumps was running from 1530 hours to 1615 hours on July 30 when pump #1 was forced out of service to repair a leaky intermediate oil seal. From 1010 hours to 1021 hours on August 10, only pump #2 was operating out of the three north shore pumps to allow testing of pump #3.

Adult Fishway Inspections

Visual Inspections

Ice Harbor project fisheries personnel conducted visual inspections of the fish ladders during the adult fish passage season of April 1 to October 31. In addition, powerhouse operators conducted daily limited inspections of the fishways. Fish facility staff averaged 3 fishway inspections per week with 142 inspections completed. The inspections were conducted by visually inspecting various areas of the fishways and recording reading from staff gauges, fishway entrance hoist motors, meters, and tape measures. The north ladder was taken out of operation on January 26 and returned to service February 24 and the south ladder was dewatered on January 5 and returned to service on January 22. Fisheries staff also collected data on flow discharge, AWS pump operation and juvenile fish orifice operation (Appendix 1).

In addition, estimates of the amount of debris that accumulated in the forebay, fish ladder exits, and gatewells were made. When a fishway was out of criteria, the powerhouse operator was notified to make any needed adjustments to the control system or arrange for repairs as needed. The combined fish passage data collected was used to compose weekly reports on the status of the fish facility operation and maintenance.

Inspection Results

Channel Velocity

The water velocity in the south shore channel junction pool was in criteria [1.5-4.0 feet per second (fps)] on 97.9% of inspections. More of the stationary weirs in the fish ladder are submerged during high flows and high tailwater elevations, slowing the velocity of the water coming down the ladder into the junction pool. The out of criteria readings ranged from 0.7 to 1.4 fps. The south shore channel velocity was under criteria at 1.4 on March 17. On March 31 the velocity was out of criteria at 0.9 feet/second.

Ladder Exits

The north and south fish ladder exit head differentials were in criteria (<0.3 feet) during all inspections. Picketed leads were put down March 31. Between the week of August 7 and the week of August 20, the south shore upstream picketed lead needed to be cleaned frequently to stay within criteria. The south shore picketed leads were raised out of the water on November 2 and the north shore picketed leads were raised out of the water November 5. On July 27, one Pacific lamprey was found in the bars of the upstream picketed lead and on August 7, one dead Pacific lamprey were found in the bars of the downstream picketed leads. To correct this problem the leads were checked and cleaned once a day and once a night beginning August 8.

Ladder Weirs

The weirs were in criteria during all inspections. Two Chinook salmon were found on the ground at the base of the stairs leading to the south picketed leads, July 1 and July 9. They

jumped out of a small gap in the bottom of the jump-netting attached to the top of the fence at the upstream overflow weir section of the south side ladder. Additional cable ties were added to the bottom of the netting in the location to eliminate gaps where the fish could fit through.

Counting Stations

The differential across the north shore picketed leads were in criteria (<0.3 feet) on all inspections. An adult Pacific lamprey that appeared to have been dead for at least a day was observed floating in the south fish ladder just downstream of the ladder exit pool on August 9. The lamprey was missing its head and tail. The carcass most likely drifted into the ladder from the forebay. Two other adult lamprey mortalities that were found at the south shore fish count station in August.

South Shore Entrance

The SFE-1 weir gate depth was in criteria (> 8 feet or on sill) 94.3% of the inspections. The weir gate was in sill criteria on 53.5% of inspections.

SFE-1 weir depth was observed to be slightly under criteria on March 30 and April 1. Operations set SFE-1 weir on automatic control, and the powerhouse operator increased the set point for the weir depth to bring it back. The south shore entrance was out of criteria on March 31. Electricians were contacted to calibrate the location. They completed this on April 2. The entrance was out of criteria on April 13. This was a result of the entrance gate control needing calibration with the selsyn readout. The south shore entrance (SFE) depth was out of criteria on June 29 and July 1. The operator lowered the entrance gate in manual control to put it in criteria. This out of criteria event occurred when the gate was off sill (not more than 0.5 feet) in manual control. The powerhouse operator was informed, and the gate was lowered down to sill. The south shore entrance (SFE) depth was out of criteria on July 6 which occurred when the gate was slightly off sill in manual control. The powerhouse operator was informed, and the gate was lowered down to sill. The south shore entrance (SFE-1) depth was out of criteria on July 27. This was caused by the entrance gate being 0.4 feet off sill in automatic control. The gate control was switched to manual and lowered down to sill.

North Powerhouse Entrance

The NFE-2 weir gate depth was in criteria (> 8 feet or on sill) 89.4% of the inspections. The weir gate was in on-sill criteria on 54.9% of inspections.

The north powerhouse entrance weir depth was out of criteria on March 2 due to entrance gate control issues. The weir depth was out of criteria on March 11. The gate was switched from manual to automatic control to fix the problem. The NFE depth was out of criteria on March 19, 23, 24, 26, and 31. The location was reported to the electrician for calibration. The electrician calibrated the location on April 2. The entrance gate was out of criteria on all ladder inspection between April 7-9. This is a result of the gate needing further calibration. On April 13, the entrance was out of criteria. This was a result of the entrance gate control needing calibration with the selsyn readout. The north powerhouse entrance was out of criteria on May 11 due to the

entrance gate mistakenly being positioned off sill in manually control. The entrance was out of criteria on June 8. The powerhouse operator was informed and lowered these two entrance gates in manual control to meet the depth criteria.

North Shore Entrance

The NSE-1 was in criteria for 95.8% of inspections. The weir gate was in sill criteria on 67.6% of inspections. NSE-1 was out of criteria on March 2 due to only 1 north shore auxiliary pump being operational. The gate was switched from manual to automatic mode to fix the problem. The entrance was out of criteria on April 6 because the gate was off sill in manual control at the time of the inspection. The north shore was out of criteria on June 8. The operator lowered the entrance gate in manual control to reach the required criteria depth. NSE depth was out of criteria on June 23 when the gate was slightly off sill in manual control. The powerhouse operator was notified, and the gate was lowered down to sill. NSE depth was out of criteria on June 29 when the gate was off sill (not more than 0.5 feet) in manual control. The powerhouse operator was informed, and the gate was lowered down to sill. NSE-1 depth was out of criteria on November 17 when the entrance gate was off sill. The gate control was put in manual and lowered back down to sill.

Fish Collection Channel and Tailwater Head Differential

South Shore Entrance

The south shore entrance (SFE) channel/tailwater head differential was in criteria (1 - 2 feet) on 98.6% of inspections. SFE-1 channel/tailwater differential was out of criteria on November 12. This high differential was most likely the result of the automated control system transducer for the south shore channel needing calibration. The problem was reported to electricians for repair.

North Powerhouse Entrance

The north powerhouse entrance head differential was in criteria (1 -2 feet) on 99.3% of inspections. The inspections where it was not in criteria, fell below criteria by >0.2 feet. The channel/tailwater differential was not in criteria on March 2. This reading was due to only one north shore auxiliary water supply pump being operational at the time.

North Shore Entrance

The north shore entrance head differential was in criteria (1-2 feet) on 93.7% of inspections. The north shore channel/tailwater differential was out of criteria on March 19, 24, 25, and 26. The location was reported to the electricians for calibration. The channel/tailwater differential was out of criteria on April 6. This was caused by the gate being off sill in manual control. The north shore differential was out of criteria on April 15. This was caused by fluctuating tailwater from the spill making it difficult to get an accurate tailwater elevation reading. The north shore entrance channel/tailwater differential was out of criteria on July 22 and 23, respectively. These out of criteria differentials can most likely be attributed to the turbulent tailwater from spill making it difficult to get an accurate north shore tailwater level read.

Table 19. Adult Fishway Inspections.

2	3	4	5	6	7	8	9	Rows in Table
			------Not Enough Depth-----			------Too Much Depth-----		1
No. in Criteria/ No. on Sill/ No. of Inspections	**% In Criteria/ % On Sill**	**No./% Within 0.01-0.1 Foot**	**No./% Within 0.11-0.2 Foot**	**No./% >0.2 Foot**	**No./% Within 0.01-0.1 Foot**	**No./% Within 0.11-0.2 Foot**	**No./% >0.2 Foot**	2 3 4 5 6
139	97.9	***	***	***	***	***	***	7
***	***	***	***	***	***	***	***	8
142								9 10 11
142	100.0	***	***	***	0	0	0	12
***	***	***	***	***	0.0	0.0	0.0	13
142								14
142	100.0	0	0	0	0	0	0	15
***	***	0.0	0.0	0.0	0.0	0.0	0.0	16
142								17
142	100.0	***	***	***	0	0	0	18
***	***	***	***	***	0.0	0.0	0.0	19
142								20 21
142	100.0	***	***	***	0	0	0	22
***	***	***	***	***	0.0	0.0	0.0	23
142								24
142	100.0	0	0	0	0	0	0	25
***	***	0.0	0.0	0.0	0.0	0.0	0.0	26
142								27
	0.0	***	***	***	0	0	0	28
***	***	***	***	***	0.0	0.0	0.0	29
142								30 31
140	98.6	0	0	0	0	0	2	32
***	***	0.0	0.0	0.0	0.0	0.0	1.4	33
142								34
141	99.3	0	0	0	0	0	1	35
***	***	0.0	0.0	0.0	0.0	0.0	0.7	36
142								37
133	93.7	1	3	2	0	0	3	38
***	***	0.7	2.1	1.4	0.0	0.0	2.1	39
142								40 41
58	40.8	1	0	0	***	***	***	42
76	53.5	0.7	0.0	0.0	***	***	***	43
142								44
49	34.5	1	3	0	***	***	***	45
78	54.9	0.7	2.1	0.0	***	***	***	46
142								47
40	28.2	6	12	7	***	***	***	48
96	67.6	4.2	8.5	4.9	***	***	***	49
142								50

Recommendations for the Adult Fish Facility

1. Continue to repair south fish ladder mud valves in the auxiliary water supply conduit to facilitate unwatering the lower ladder for inspection and maintenance.
2. Remove the accumulated silt in the south shore AWS conduit that is clogging the mud valves and blocking access to some of the mud valves and sluice gates for inspection and maintenance.
3. Rehabilitate fish ladder entrance weir gates and hoisting equipment.
4. Install a handrail along the outside edge of the north and south shore fish ladders to allow routine in-season inspection of the entire fish ladders and to facilitate safer unwatering and fish evacuation procedures for personnel.
5. Replace the debris booms and attachment systems at the north and south shore fish ladder exits. The log booms are prone to detachment under high winds.
6. Proactively replace fish ladder diffuser grating as needed.
7. Replace broken/dirty staff gauges and guides so that the gauges are easier to clean and read.
8. Relocate staff gages and transducer units as needed so the staff gage and the automated fishway control system readings will be more precise.
9. Install an audible alert on the automated control system PLC when the fish ladder entrance criteria are not being met.
10. Initiate a contract to repair leaks in the fish ladder joints.