ADULT AND JUVENILE FISH FACILITIES MONITORING REPORT
LITTLE GOOSE DAM – 2012

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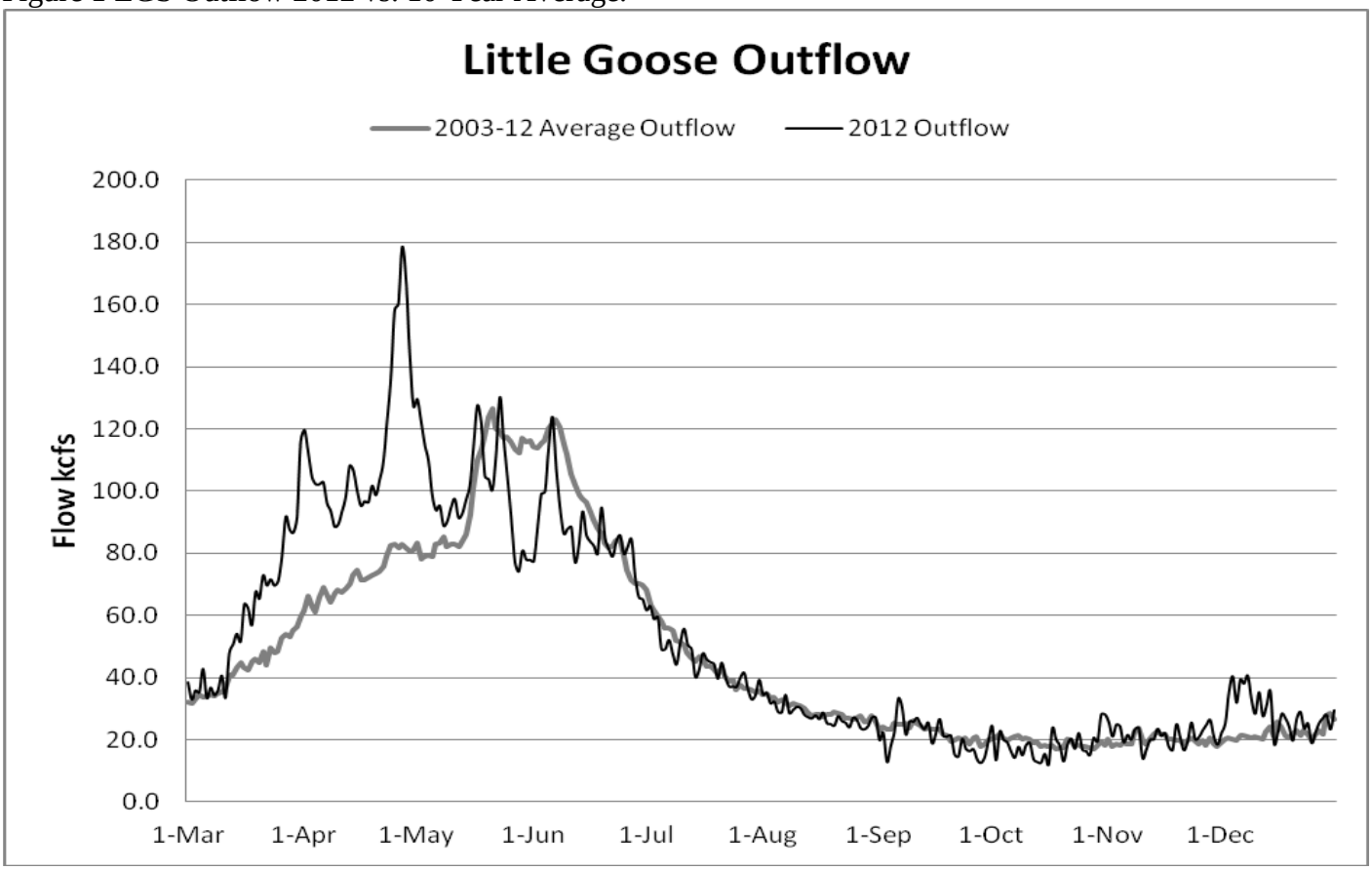
Introduction

This report summarizes the operation and maintenance of the adult fish passage facility located at Little Goose Dam (LGS) from March 1, 2012 to February 28, 2013. The report also summarizes activities and results associated with the collection, transportation, and bypass of migrating juvenile salmon and steelhead at LGS in 2012. A more detailed annual report on juvenile fish is available upon request.

River Condition

A wet spring produced above average river flows from mid March through early May followed by a dry summer that produced flows near average for the remainder of the year (Figure 1). The average daily flow past LGS was 52.3kcfs compared to the 2003-2012 ten year average of 47.0 kcfs. The peak daily flow of 178.4 kcfs occurred on April 27 and the minimum, 12.1 kcfs occurred on October 16.

Figure 1 LGS Outflow 2012 vs. 10 Year Average.



Spill to aid downstream fish passage occurred from April 3 through August 31in accordance with the 2012 Fish Passage Plan (FPP). Factors that affected spill management were excess flows from runoff, total dissolved gas (TDG) levels, generation unit outages, low power demand, debris management, and adult fish passage. The spill target was 30% of total flow for both spring and summer spill periods. Actual spill levels varied to adaptively manage real-time operational requirements (fish research, fish passage, total dissolved gas, debris, navigation safety and/or powerhouse and transmission constraints). All variations of the spill mandates were coordinated through the Technical Management Team (TMT).

Adult Fish Facility

Facility Description

The adult fish facility is located on the downstream side of the dam and functions to attract and pass adult migrating fish upstream over the dam. The facility consists of a fish ladder and a collection channel. The collection channel acts to both attract and route fish from across the tailrace to the fish ladder. Components of the collection channel system include two South Shore Entrances (SSE), two North Powerhouse Entrances (NPE), two North Shore Entrances (NSE), the collection channel itself, a fallout fence, a auxiliary water supply system, and an electronic monitoring and control system.

The pool-and-weir fish passage ladder is located on the south shore. It is approximately 1,000 feet long and rises a vertical distance of about 100 feet. The ladder begins at the junction pool near the SSE and leads upstream westward approximately 400 feet and switches backed with a curve south and then east. It continues another 550 feet to the east where it passes under the dam's intake deck and exits into the forebay.

The viewing room and fish counting windows are located approximately 300 feet from the start of the ladder at the junction pool. The fish counting slot is 18" deep by 36" high by 48" wide. Underwater vertical fences called "Picketed Leads" guide and confine fish to pass through the counting slot.

The two SSE (SSE1 and 2) have overflow weirs that are normally open. The two NPE (NPE1 and 2) have overflow weirs and were normally open. NPE3, a lift gate entrance, was permanently closed with a concrete bulkhead in February 2011. The two north shore entrances (NSE1 and 2) are also overflow weirs and were normally open. NSE3, a lift gate entrance, was also permanently closed with a concrete bulkhead in 2011.

Additionally, ten floating orifice gates located in front of the powerhouse have been removed and permanently sealed with bulkheads. Floating orifice gates 1, 4, 6, and 10 have been closed since the 2000 fish passage season and floating orifice gates 2, 3, 5, 7, 8, and 9 have been closed since January 1996. Research has proved that adult fish attraction into the adult fish channel improved with these gates closed.

The adult collection channel begins at the NSE, passes under the spillway, past the NPE and fallout fence then continues along the base of the powerhouse, and terminates in the junction pool near the base of the ladder. A separate short channel connects the SSE to the junction pool and ladder. The fallout fence, consisting of a pipe framework and chain link fencing, is located in the channel near NPE1 and 2. It functions to prevent fish in the channel from leaving the channel and re-entering the tailrace via NPE.

The collection channel water is supplied from three sources. First, the fish ladder coupled with a diffuser (diffuser 13) supplies approximately 75 cfs of water and flows via gravity into the channel. Second, three turbine-driven pumps (fish pumps) supply approximately 1,700-2,000 cfs of auxiliary water. The fish pumps move water from the tailrace into a head channel that through gravity forces water through floor diffusers located on the bottom of the collection channel in front of the powerhouse, near the junction pool and lower end of the ladder. Third, 175-230 cfs of excess water from the primary dewater unit of the juvenile fish collection system also flows into the floor diffusers.

An electronic computer interface system for operating and monitoring the adult fishway was put in service in March 1994. The Fishway System Control (FSC) monitors and controls the fishway. The FSC includes water elevation sensors for the fishway channel and for the tailrace near each entrance (six sensors total). All six-overflow weirs also have elevation sensors and controls. The FSC system is based on an old DOS computer and 5 and 1/4 inch disk to make calibrations and corrections. An electronic water velocity meter

(flowmeter) was added to the collection channel near the SSE in November 1997. The meter was positioned near the junction pool and diffuser 2. Diffuser 2 (the largest of the water supplying diffusers) produced upwelling and non-laminar flows and the flowmeter was consistently unreliable. The flowmeter failed in spring of 2011 and was replaced with a newer manually operated "current meter". The current meter is located near the NPE, approximately midpoint of channel and is more representative of the average underwater flows throughout most of the channel.

Fish Passage and Fishway Activities

In 2012 a total of 288,633 salmonids were counted passing upstream through the adult fish ladder. The species counts were 125,114 chinook adults, 25,164 chinook Jacks, 105,038 Steelhead, 30,038 wild steelhead, 453 sockeye, 2,549 coho and 277 coho Jacks. Additionally, 91 adult lamprey were counted migrating upstream through the adult fishway system.

Operations and Maintenance

The adult fishway facility was in service from February 15 through December 31, 2012. The facility was operated similar to that in 2010 and 2011. NSE1, NSE2 weir gate hoists continued to be out of service in 2012 and the top of the weir gates were held fixed at 531.5 ft. The fixed position of the NSEs was determined to be best elevation throughout the season with fluctuating pool elevations of 5 feet. The weirs were unable to move using the chain-fall hoist once the pumps were operating and flow forces were established. At times the NSE elevations were slightly below criteria when tailrace elevations decreased below 537.5 feet. The new metal halide lamps installed in the spillway section of the channel in February 2011 significantly improved the visibility in this section and work well all season.

Fish pump performance in 2012 was good through September 24. On September 25, fish pump 3 would not rotate following repairs to fix a cooling water leak. The pump remained out of service through the remainder of the fish passage season. Fish pumps 1 and 2 were increased from 72 rpm to 80 rpm to "make-up" some of the water lost due to the outage of fish pump 3. Fish pump 3 was repaired in February 2013 which included replacing the turbine drive shaft bearings.

The FSC computer system originally installed in 1994 was again problematic in 2012. The system uses the antiquated DOS and 5.25 inch floppy disks. The computer readouts values were often incorrect during the season at which manual measurements were used to record channel and tailwater elevations. In addition, the hard drive on the interface computer used to set weir parameters failed on September 17. Fortunately, weirs positions were preset to parameters and continued to adjust to meet parameters for the remainder of the season. The procedure to purchase and install a new computer system to operate the fishway has been started.

The old flowmeter which failed in early 2011 was positioned near the junction pool and electronically measured water velocity using a formula calculated from the average water speed from three sections of the channel; near the surface, mid depth and near the bottom. As determined by the 2001 hydraulic evaluation, water velocities near the junction pool more often than not would not meet criteria due to strong upwelling flows from diffuser 2. The upwelling interfered with measurements of horizontal laminar flows.

A new "current" flowmeter to determine subsurface velocity was positioned near the NPE approximately mid-point of the length of the channel. This position best measures laminar flows that represent the overall flow rates of the channel. Subsurface water velocities were measured monthly and averaged 2.7 fps with all three pumps operating at approximately 70 rpm and 2.3 fps with two pumps operating at increased speeds, approximately 80 rpm. Surface water velocities were measured near the junction pool and near the

NSE. As in past years, these velocities were calculated by recording the time of travel of sticks or bubbles over a known distance. Often the surface water velocities at the junction pool area did not meet criteria (1.5-4.0 fps) due to diffuser 2 upwelling and during two pump operations (table 1 and 2).

The adult fishway was removed from service beginning January 1, 2013 with the shutdown of fish pumps and the closure of the south shore and north powerhouse fish entrances (SSE and NPE). Diffuser 13 makeup water valve closed on January 2. On January 8, the fish ladder was dewatered and north shore fish entrances were closed. The powerhouse section of the collection channel was dewatered on January 10 followed by the spillway section on January 14.

Routine ladder maintenance included; inspecting weirs, removing debris, cleaning the picketed leads, servicing the window brush cleaning motors, replacing light bulbs, cleaning lamp lenses and cleaning viewing windows.

Collection channel maintenance included; inspecting diffuser grating and supporting beams, and removing debris. Repairs to the fall-out fence were made in January 2006, 2007, February 2008, 2010, 2011 and 2012. New stainless steel welded mesh panels were installed in February 2013.

Fish ladder modifications to improve adult lamprey passage were added in February 2013. The modifications included installation of lamprey plates over diffuser 3, 4, 5 and 13 grading in the immediate vicinity of existing fish passage orifices and new orifices were installed to the 10 vertical slot weirs at the top of the ladder. The lamprey orifices are 2.5" high by 16" wide designed specifically for lamprey passage.

Adult Fishway Inspections

Adult fishway inspections during the 2012 fish passage season were conducted by Corps fishery biologists and/or technicians and by natural resources specialists with the Oregon Department of Fish and Wildlife (ODFW). Inspections by the ODFW were done twice a week from April through October, generally on designated days. Inspections by the Corps were conducted weekly but on different days and at different times each week through October and conducted two to three times each week during March, November and December. Problems observed during an inspection were reported to the Project Biologist and/or the Dam Operator for appropriate action. Chronic problems with no immediate fix (e.g. inadequate weir depth at the NPE) were simply recorded. The more important problems are detailed below in the results section.

All inspection data were entered into a computer spreadsheet that provided an indication as to whether operating criteria were met (Appendix 1). Spreadsheet outputs includes: "yes" (meets criteria), "no" (does not meet criteria), "NA" (no reading taken), "closed" (entrance closed due to weir failure or for two-pump operation), and "sill" (overflow weir bottomed out on its sill, due to minimum operating pool (MOP) conditions). The two criteria used to determine "sill" is listed below. In all cases when both criteria were met, then a weir was judged to be on sill. Criteria were:

1) Weir elevation was less than or equal to 532.20' for NPE and less than or equal to 529.20' for SSE and NSE.
2) Weir depth was less than 8.00' for SSE, less than 7.00' for NPE and less than 6.00' for NSE. (Minimum required depths in accordance with the 2009 Fish Passage Plan.)

Inspection Results

The adult fish ladder portion of the fishway which includes differentials at the ladder exit, ladder weirs and counting station) met criteria 100% in 2012 (Table 1). The ladder exit trash rack and picketed leads remained relatively clean throughout the season. The air bubbler at the ladder exit was in service during the season and kept debris from collecting in front of exit area.

The collection channel of the fishway performed adequately throughout the season. NSE1 and 2 weir depths did not meet enough depth criteria on 26 and 25 of the 128 inspections respectively (Table 1). This was due to the fixed depth of the weirs at 531.5 feet. When tailrace water elevations lowered to below 537.5 feet the weir depth would register too shallow and out of criteria. Most of the out of criteria were greater the 0.2 feet but less than 0.5 feet. This ½ foot or less did not appear to adversely affect adult fish guidance or migration into the fishway system. NPE1 and 2 weir depths met criteria 100% and 70.5% respectively when coupled with on-sill criteria (Table 2). Low tailwater elevations caused the NPE1 weir to bottom-out on sill elevation at 532 feet on 84 of the 125 inspections. NPE2 bottomed-out on 68 inspections and due to failure of fish pump 3, NPE2 was raised and closed from September 28 through December 31. This accounted for 38 inspections or 29.5% that the weir was out of criteria.

Surface water velocities measured near the south shore junction pool (S) and near the NSE (N) met criteria (1.5 – 4.0 fps) 80.6 and 99.0% respectively (Tables 1 and 2). Most, 21 of 25, out of criteria measurements of water velocities near the south shore junction pool occurred after fish pump 3 outage.

Table 1. Summary of adult fishway inspections at Little Goose Dam, 2012. [1]

LITTLE GOOSE						----------Not Enough Depth----------		
Criteria and	**No. in**	**% In**	**No./%**	**No./%**	**No./%**	**No./%**	**No./%**	**No./%**
Locations	**Criteria/**	**Criteria/**	**Within**	**Within**	**>0.2**	**Within**	**Within**	**>0.2**
	No. on Sill/	**% On**	**0.01-0.1**	**0.11-0.2**	**Foot**	**0.01-0.1**	**0.11-0.2**	**Foot**
	No. of	**Sill**	**Foot**	**Foot**		**Foot**	**Foot**	
	Inspections							
Channel Velocities (S)	104	80.6	***	***	***	***	***	***
	***	***	***	***	***	***	***	***
	129							
Channel Velocities (N)	95	99.0	***	***	***	***	***	***
	***	***	***	***	***	***	***	***
	96							
Differentials								
Ladder Exit	129	100.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	129							
Ladder Weirs	129	100.0	0	0	0	0	0	0
	***	***	0.0	0.0	0.0	0.0	0.0	0.0
	129							
Counting Station	110	100.0	***	***	***	0	0	0
	***	***	***	***	***	0.0	0.0	0.0
	110							
South Shore	127	98.4	0	1	0	0	1	0
	***	***	0.0	0.8	0.0	0.0	0.8	0.0
	129							
North Powerhouse	125	96.9	2	0	0	0	1	1
	***	***	1.6	0.0	0.0	0.0	0.8	0.8
	129							
North Shore	122	95.3	2	1	1	0	1	0
	***	***	1.6	0.8	0.8	0.0	0.8	0.0
	128							
Weir Depths								
SSE-1	128	99.2	0	0	1	***	***	***
	Not Applic.	***	0.0	0.0	0.8	***	***	***
	129							
SSE-2	124	96.1	1	2	2	***	***	***
	Not Applic.	***	0.8	1.6	1.6	***	***	***
	129							
NPE-1	42	33.3	0	0	0	***	***	***
On Sill	84	66.7	0.0	0.0	0.0	***	***	***
	126							
NPE-2	23	17.8	0	0	2	***	***	***
On Sill	68	52.7	0.0	0.0	1.6	***	***	***
	129							
NSE-1	102	79.7	4	6	16	***	***	***
	Not Applic.	***	3.1	4.7	12.5	***	***	***
	128							
NSE-2	103	80.5	4	6	15	***	***	***
	Not Applic.	***	3.1	4.7	11.7	***	***	***
	128							

[1] Data are from Appendix 1.
[2] "On sill" means the weir gate was bottomed out on its sill and within criteria at this location.

Table 2. Inspection in-criteria success rates for adult collection channel components at Little Goose Dam, 2008-2012.

Location	Collection Channel Success Rates - Annual Comparison				
	2008	2009	2010	2011	2012
Channel Surface Water Velocities					
Near Junction Pool	100%	98.4%	83.2%	100.0%	80.6%
Near NSE	99.1%	74.3%	99.1%	98.6%	99.0%
Channel Head Differentials					
SSE	99.2%	98.4%	97.6%	98.5%	98.4%
NPE	97.5%	93.5%	97.6%	95.5%	96.9%
NSE	96.7%	90.3%	81.6%	94.7%	95.3%
Channel Weir Depths					
SSE1	100%	98.4%	99.2%	94.7%	99.2%
SSE2	100%	98.4%	98.4%	93.2%	96.1%
NPE1 without on-sill criteria NPE1 with on-sill criteria	43.4% 98.3%	49.2% 100%	33.6% 100%	33.8% 95.5%	33.3% 100%
NPE2 without on-sill criteria NPE2 with on-sill criteria	44.3% 98.4%	49.2% 100%	28.0% 89.6%	35.36% 97.0%	17.8% 70.5%
NSE1	100%	90.3%	99.2%	78.2%	79.7%
NSE2	98.4%	48.4%	98.4%	78.2%	80.5%

[1] Data compiled from Appendix 1, previous monitoring report appendixes and inspection forms for the years 2007-2011.

Average tailrace elevations in 2012 were similar to those recorded in 2008 - 2011 (Table 3). To enhance lotic conditions supporting juvenile fish out-migration, reservoirs were drafted down to minimum operating pool (MOP) elevations from April through September. During MOP, Lake Herbert G. West was operated between 537.0 and 538.0 as measured at Lower Monumental Dam. At Little Goose Dam, during the spring freshet tailrace elevations range one to four feet higher. After the freshet the tailrace elevations subsided to range from one to four tenths of a foot higher as measured at LMO.

During inspections, tailrace water elevations were simultaneously collected at the FSC for the SSE, NPE and NSE locations. These readings usually varied from 0 to 3 tenths of a foot in height difference. The variations are caused by the upwelling of water being released from the turbine draft tube and the number of and/or sequence of turbine units operating. In general, over the course of the season, water elevations are generally higher at the SSE and lowest at the NSE with the NPE ranging in-between. Table 3 doesn't reflect this observation for all years at the NSE location. This is because the FSC electronically measures the water surface using a transducer and debris can collect and hold at the location of the transducer. Water elevations were often exaggerated because woody debris floating on the surface of the water was measured in place of the actual water surface. Wave action also interfered with accurate electronic measures. Whenever possible, manual measurements were used to correct these discrepancies.

Table 3. Average tailrace water elevations at Little Goose Dam, 2008-2012.

Location	Average Tailrace Water Elevations Per FSC					
	2008	2009	2010	2011	2012	2008 – 2011 Average
SSE	538.38	538.60	538.82	538.88	538.67	538.67
NPE	538.38	538.65	538.84	538.65	538.52	538.63
NSE	538.44	538.68	538.91	538.43	538.39	538.62

Overall, average channel to tailwater head differentials in 2012 were higher to those recorded in 2008 through 2010 but similar to 2011 (Table 4). The higher head differentials may be due to the permanent closure of both NSE 3 and NPE 3 in 2011. These concrete gates were broken and loosely fitting which allowed water to pass through. Both NSE and NPE 3 were permanently sealed with concrete in February 2011.

Weir depths were similar in all years for the SSE's and NPE's but NSE's have increased in recent years due to fixed positions. In 2010 NSE-1 failed and the weir lowered to sill elevation and could only be recovered after the fish passage season. Both NSE 1 and 2 were not operational during 2011 and 2012 and placed at fixed positions at 561.5 feet in elevation. At higher tailwater pool elevations water over these weirs often reached 9 feet or more. As a result average weir depths increased in 2010 – 2012 for NSE-1 and 2011 and 2012 for NSE-2.

Table 4. Average channel/tailwater differentials and weir depths for the adult fishway at Little Goose Dam, 2007-2011.[1]

Location	**Average Differential or Depth in Feet Per FSC**					
Head Differential	2008	2009	2010	2011	2012	2008 – 2011 Average
SSE	1.49	1.49	1.57	1.68	1.68	1.56
NPE	1.34	1.28	1.52	1.68	1.66	1.46
NSE	1.23	1.18	1.14	1.37	1.48	1.23
Weir Depth						
SSE-1	8.33	8.29	8.29	8.40	8.34	8.33
SSE-2	8.31	8.27	8.29	8.37	8.31	8.31
NPE-1	6.44	6.47	6.34	6.47	6.40	6.43
NPE-2	6.46	6.47	6.23	6.50	6.22	6.42
NSE-1	6.21	6.61	9.10	6.93	6.87	7.21
NSE-2	6.22	4.99[2]	6.61	6.93	6.89	6.19

[1] Data compiled from Appendix 1 and previous monitoring report appendixes for the years 2007-2011.

[2] Data does include weir gate in the raised position but not in the closed position.