CENWW-ODG ST. JOHN 25 May, 2020

MEMORANDUM THRU:
Norman Bloom, Operations Project Manager, Little Goose Dam

FOR Chief, Operations Division
ATTN: Eric Hockersmith / Chris Peery / Ann Setter

SUBJECT: Submission of 2018 Juvenile and Adult Fish Passage Report, Little Goose Dam.

1. Enclosed find the 2018 Juvenile and Adult Fish Passage Report for Little Goose Dam as requested.

2. If you have any questions contact Scott St. John at Little Goose Dam, (509) 399-2233 ext. 263.

Scott J. St. John
Supervisory Fisheries Biologist, Little Goose Dam

Enclosure

2018 Juvenile and Adult Fish Passage Report
Little Goose Dam

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U.S. Army Corps of Engineers

and

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Anchor QEA

April 2020

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Introduction

Little Goose Lock and Dam (LGS), located at river mile (RM) 70.3, is the third of four hydroelectric dams impounding the lower Snake River. Little Goose Dam is 2,655 feet long and impounds Lake Bryan, a 10,025-acre reservoir with normal operating elevations ranging from 633-638 feet above mean sea level (msl). Lower Monumental Dam impounds the Snake River below LGS, forming Lake Herbert G. West, creating tailwater elevations at LGS ranging from 537-544 feet msl. LGS is comprised of five major components; the powerhouse, navigation lock, earthen embankment, spillway and adult and juvenile fish passage facilities.

Adult Fish Passage

This report summarizes the operation and maintenance of the adult fish passage facility from March 01, 2018 to December 31, 2018. The Adult fishway was in service from February 22, 2018 to January 07, 2019. Fish counting activities took place from April 01 to October 31, 2018. A total of 130 fishway inspections were conducted by U.S. Army Corps of Engineers (USACE), Anchor QEA and Oregon Department of Fish and Wildlife (ODFW) biologists and technicians.

The adult fishway includes a north shore entrance and a channel under the spillway that connects to the powerhouse collection system. The powerhouse collection system has a north powerhouse entrance and a channel under the tailrace deck that connects with the fish ladder. This section also includes an adult fallback fence near the north powerhouse entrance. Ten floating orifice gates along the powerhouse channel were removed and closed off with bulkheads between 1996 and 2000. A south shore entrance also connects to the fish ladder. The ladder rises about 100’ on a 1:10 slope and exits into the forebay above the dam. Gravity provides adequate water flows for the fish ladder. For the rest of the system, however, auxiliary water is needed to attract fish into the various entrances. Auxiliary water is supplied by three turbine-driven pumps that pump water from the tailrace to the pump chamber which gravity feeds various floor diffusers in the powerhouse channel and at the bottom of the fish ladder. Additional water, gravity-fed, is provided by diverting excess water from the primary dewaterer (a juvenile fish facility component) to the pump chamber and floor diffusers.

Additionally, the fish ladder includes a fish viewing room which is not only popular for visitors, but is utilized to provide adult fish count data. Fish counting by the Normandeau Associates, under contract with the Corps, takes place from April through November.

Juvenile Fish Passage

This report summarizes activities and results associated with the collection, transportation and bypass of out-migrating juvenile steelhead *Oncorhynchus mykiss*; Chinook salmon *O. tschawytscha*; sockeye salmon *O. nerka*; and coho salmon *O. kisutch* at LGS in 2018. The data represented in this report was collected from March 1 through October 31, 2018 by USACE, Anchor QEA and ODFW Smolt Monitoring Program (SMP) and transportation biologists and technicians.

The juvenile fish collection and bypass system at LGS extends from the upstream face of the dam downstream to the Juvenile Fish Facility (JFF) and tailwater area. System components include 18 extended length submersible bar screens (ESBS), 18 vertical barrier screens (VBS), 36 gatewell orifices, a collection channel, a dewatering structure, and a corrugated flume, which

routes fish diverted from the forebay to the JFF. The JFF consists of a fish separator, routing flumes, fish holding raceways, a sampling and marking laboratory, truck and barge loading facilities, and a passive integrated transponder (PIT) tag detection and diversion system.

The objective of the transport program is to improve survival of out-migrating smolts, resulting in increased adult salmon and steelhead returns. Operating parameters are set forth annually in the Fish Passage Plan (FPP) and Fish Operations Plan (FOP).

River Conditions

River Flows

Above-average winter and spring precipitation resulted in flows that were 121.0% of the 5-year average. During the 2018 fish passage season, March 1 through October 31, the average daily flow was 58.4 thousand cubic feet per second (kcfs). The maximum average daily flow of 176.2 kcfs occurred on May 27 and the minimum average daily flow of 13.0 kcfs occurred on October 18 (Figure 1).

Table 1. Comparisons of average monthly flow and spill in kcfs at Little Goose Dam JFF 2013-2018.

Month	2013	2014	2015	2016	2017	2018	2013 to 2017 Average
				Flows (kcfs)			
Mar	—	—	—	—	—	57.34	—
Apr	56.68	74.33	48.27	87.05	132.84	91.81	79.83
May	79.99	99.66	59.08	87.36	139.59	133.80	93.14
Jun	55.41	84.92	41.34	52.30	127.97	80.76	72.39
Jul	33.44	45.53	27.69	32.11	50.02	37.57	37.76
Aug	23.16	26.87	20.91	23.70	29.96	28.49	24.92
Sep	18.37	19.93	17.96	18.90	25.79	21.84	20.19
Oct	21.75	17.55	15.53	20.74	22.81	17.82	19.63
				Spill (kcfs)			
Mar	—	—	—	—	—	0.02	—
Apr	16.30	22.37	12.84	24.70	43.41	31.78	23.92
May	24.75	29.34	17.68	25.77	76.33	50.73	34.77
Jun	16.62	24.95	12.74	15.68	50.41	27.89	24.08
Jul	10.57	13.97	9.11	10.42	14.94	11.43	11.80
Aug	7.64	8.73	6.98	8.51	10.34	10.47	8.44
Sep	0.50	0.17	0.13	0.18	0.21	0.24	0.24
Oct	0.00	0.00	0.00	0.00	0.00	0.31	0.00

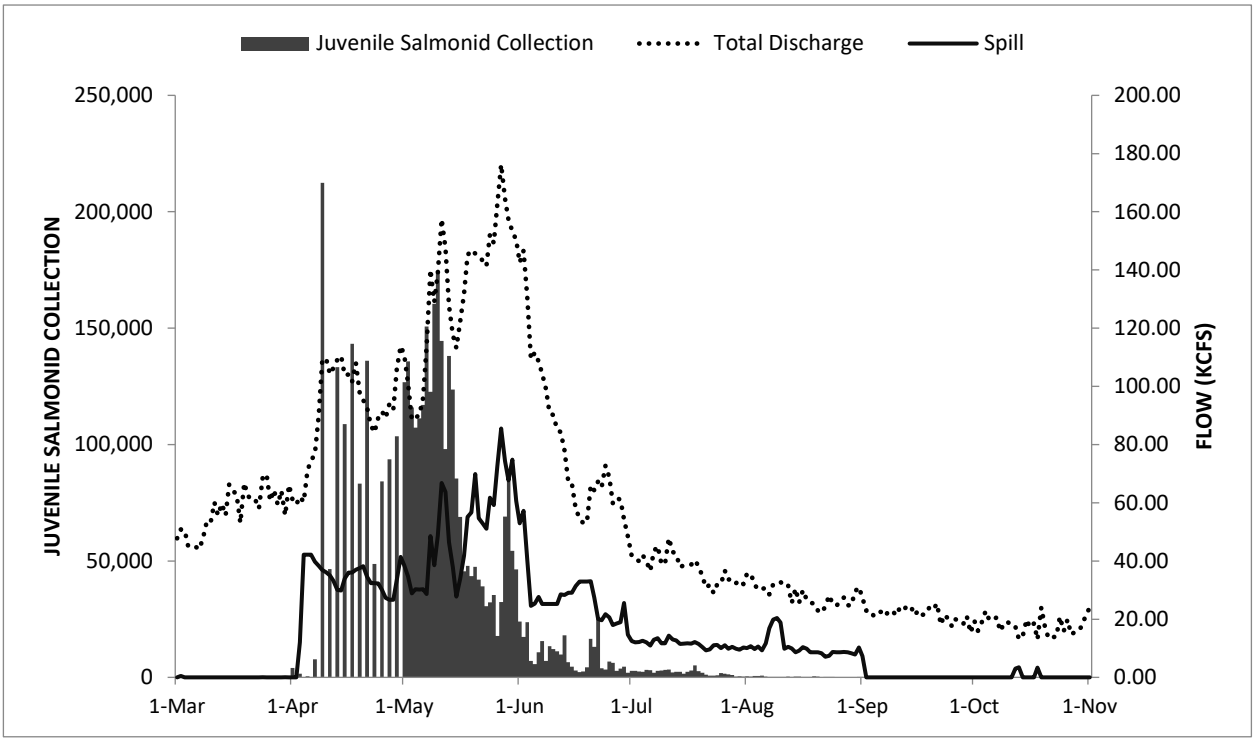

Figure 1. Total river flow, spill, and number of juvenile salmonids collected at Little Goose Dam during the fish collection and transport season, 2018.

Spill to aid juvenile fish passage occurred from April 3 through August 31, in accordance with the 2018 FPP. In previous years, the spill target was 30% of total flow from April 3 through August 31. The 2018 Fish Operations Plan, however, specifies that during the spring passage season, April 3 through June 20, all four projects on the lower Snake River will spill to the gas cap (115% in the forebay or 120% in the tailrace). Target spill remained 30% of total flow during the summer passage season, June 21 through August 31. The target of 30% was met all but 7 days between June 21 and August 31. Flow decreased to below 32 kcfs on August 8, and in accordance with the FPP, spill was changed to a constant rate between 7 and 11 kcfs, whichever more closely provided the target spill rate of 30.0% of the total flow. The Adjustable Spillway Weir was installed into Spillbay 1 on April 3 and removed on July 20 due to high river temperatures.

To enhance fish migration and in compliance with the 2018 supplemental Federal Columbia River Power System Biological Opinion, Minimum Operating Pool (MOP) elevations were placed into effect during the spill to aid fish passage. Forebay elevations were increased from MOP elevations (633 to 634 feet MSL) to MOP +2 (634 to 636 feet MSL) after September 1, 2018, when spill to aid fish passage ended. All deviations from the FPP were coordinated through the Technical Management Team or FPOM, as necessary, to meet real-time operational requirements.

River Temperature

The average daily river temperature during the 2018 fish passage season was 58.9 °F.

Average monthly water temperatures were within 1.0 °F of the 5-year average for every month except June, which was 1.6 °F warmer and August, which was 1.3 °F warmer than the 5-year average. The maximum river temperature of 70.9 °F was recorded on August 15 and was higher than the 5-year average maximum of 69.4 °F. The 2018 minimum river temperature of 38.6 °F was recorded March 01, and due to the early start of the season, was significantly below the 5-year average minimum of 47.0°F. The minimum river temperature between April 01 and October 31 was 44.7°F and was recorded April 2 and was above the 5-year average minimum of 45.0 °F.

As per the Water Management Plan, summer river temperatures were tempered by cool-water releases from Dworshak Reservoir. Supplemental flow from Dworshak Reservoir started July 06 averaging 12.0 kcfs at 44.6°F for that period of July, 9.5 kcfs at 46.8°F for the month of August, and 4.2 kcfs at 49.1°F for the month of September (sourced from Columbia River Data Access in Real Time [DART]). Water temperatures recorded daily in the LGS JFF averaged 68.1°F in July, 69.3°F in August, and 66.2°F in September.

Total Dissolved Gas

Total dissolved gas (TDG) data are automatically collected and transmitted hourly to the Columbia River Operational and Hydromet Management System to provide information for spill and gas saturation management. TDG was monitored in the forebay from March 29 through September 20, and year-round in the tailwater.

The USACE Reservoir Control Center coordinates efforts to maintain TDG saturation levels in accordance with the Washington State TDG Level Variance Standard of 120.0% saturation in the project tailwater and 115.0% in the forebay of the next project downstream, as measured throughout 12 consecutive hours.

The average daily TDG level in the LGS forebay, from March 29 through September 20, was 110.3% saturation. TDG saturation ranged from 97.8% on September 20 to 119.7% on April 26. From March 29 to June 12, there were 17 days in which TDG saturation levels exceeded 115.0% in the LGS forebay, with an average of 117.1%.

The TDG level in the LGS tailrace ranged between 93.0% on October 14 to 127.5% on May 25, averaging 114.1% during the spill to aid fish passage season (April 3 to August 31). Tailwater TDG levels exceeded 120.0% saturation 15 days between May 10 and June 01, averaging 123.2%.

Forebay TDG levels at LMN ranged from 102.7% on March 29 to 129.0% on May 27, averaging 113.4% from March 29 through August 31. The LMN forebay TDG levels exceeded 115.0% 54 days between March 29 and June 22, with an average of 119.4% (USACE via Columbia River DART).

Turbidity

Water clarity was measured during adult fish passage facility inspections. Measurements were taken in the adult fish ladder using a Secchi disc lowered to a maximum depth of 6 feet. The fish ladder water supply is gravity fed from the forebay and is representative of river conditions. The lowest Secchi disk readings occurred during periods of high outflow from April 01 through May 31, with measurements ranging between 1.0 and 3.9 feet and averaging 2.7 feet.

The highest Secchi disk readings occurred during periods of low flow, from July 01 through November 01, with measurements ranging from 4.0 feet to 6.0 feet and averaging 5.3 feet.

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 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, an 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 back 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 fixed at a width of no less than 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 are 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 shown 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 steel tube framework and wire mesh panels, 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 for which gravity forces water through 21 sluice gates and up through 20 diffusers

located on the floor 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 head channel and up through 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) includes water elevation sensors for the fishway channel and tailrace near each entrance and elevation sensors and controls for each of the 6 entrance weirs.

An electronic water velocity meter (flow meter) was added to the collection channel near the SSE in November 1997. The meter was programmed to measure subsurface water velocities near the junction pool and diffuser 2. Diffuser 2 (the largest of the water supplying diffusers) produced upwelling and non-laminar flows making measurements unreliable. The flow meter failed in spring of 2011 and was replaced with a hydrologic current meter. In 2018, subsurface water flow velocities were measured near the NPE approximately midpoint of collection channel where flows are more representative of the entire collection channel.

Adult Fish Passage and Fishway Activities

Research and Monitoring Activities

In 2018 a total of 111,519 salmonids were visually counted passing upstream through the adult fish ladder. The species counts were: 56,434 Chinook adults; 7,469 Chinook jacks; 45,584 steelhead; 280 sockeye; 1,434 coho adults and 318 coho jacks. Additionally, 61 adult lamprey were counted migrating upstream at the adult fish counting window. No bull trout were counted in 2018.

Several monitoring activities involving the use of the adult fishway were in progress in 2018. These included:

- Normandeau Associates Inc. conducted visual fish counting activities from 0400 hours to 2000 hours April 1 – October 31[1].

- Water temperature within the adult ladder was recorded on an hourly basis in an ongoing trend study in support of safe fish passage.

- Invasive species were monitored with particular attention to zebra and quagga mussels. Reports were submitted weekly to District biologists.

Operations and Maintenance

The Adult fishway was in service from February 22, 2018 to January 07, 2019. Adult fishway inspections were conducted three times per week by U.S. Army Corps of Engineers, Anchor QEA and Oregon Department of Fish and Wildlife biologists and technicians. The in-water maintenance period occurred from January 2 to February 27, 2018.

[1] 0500 to 2100 Hours during daylight savings time. No nighttime counts are made at Little Goose Dam.

The fish ladder functioned adequately throughout the season. The air bubbler located at the ladder exit to push back debris performed well all season. Diffuser 13 functioned without incident and water level over the weirs were maintained within criteria. Picketed leads remained clear of debris and the counting window backboard was routinely cleaned throughout the season.

Water clarity and temperature were measured during adult fish passage facility inspections near the fish counting window area. Water clarity was measured using a Secchi disc that was lowered to a maximum depth of just over 6 feet (see River Conditions).

The packing material in expansion joints in the fishway has decomposed over the years and when water temperatures fall below 50°F, the ladder contracts and water leaks through these joints. When temperatures drop below freezing, large icicles form overhead and large patches of ice form on the ground below. Both are hazards to safe working conditions.

An electronic computer interface system for operating and monitoring the adult fishway was put in service in March 1994. The original Fishway System Control (FSC) includes water elevation sensors for the fishway channel and tailrace near each entrance and elevation sensors and controls for each entrance weir (6). The FSC system that monitors and controls the fishway failed in March, 2012. A new control panel and updated software were installed during the winter of 2015. The updated software was placed into service for 2016, however the system failed to maintain fishway criteria and was placed back into manual mode.

The Rickly hydrologic current meter was again used in 2018 to determine subsurface velocities in the adult collection channel. Measurements were taken monthly just downstream of the NPE before the channel enters under the spillway, 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 velocities were measured just below the surface, at mid-depth, and just above bottom and averaged. The subsurface velocities were measured once per month and submitted in weekly reports. Collection channel surface water velocities were measured using a floating stick or bubble that was timed over a distance and calculated into feet per second. Measurements ranged from 0.6 to 2.3 feet per second (fps) near the SSE's, from 1.4 to 3.5 feet per second (fps) near the NPE's and 1.7 to 3.4 fps near the NSE's. Auxiliary water supply (AWS) system operated with three fish pumps for 2018.

The adult fishway was removed from service on January 2, 2018 when the ladder was dewatered. Fish ladder maintenance included repairing expansion joints, inspecting weirs, removing debris, cleaning the picketed leads, cleaning lamp lenses, cleaning viewing windows and installing an automatic fish window cleaning system. Collection channel maintenance included inspecting diffuser grating and supporting beams, removing debris and repairing the fallback fence from the powerhouse section of the adult channel. Sluice gates that function to pass auxiliary supply water to the fish channel are in poor or non-operating condition. These gates are adjusted to position using a mobile electric operator. Many of the sluice gate indicator rods are bent and need replacing/repair. These gates and indicators need to be operational working condition to adjust correct gate position to provide the optimum water supply and flow criteria for adult fish passage.

Adult Fishway Inspections

Adult fishway inspections during the 2018 fish passage season were conducted by USACE, Anchor QEA and ODFW biologists and technicians. Inspections by the ODFW were

done once a month from April through October, generally on designated days. Inspections by USACE and Anchor QEA were conducted three times a week from March through December. Problems observed during an inspection were reported to the Project Biologist and/or the Dam Operator for appropriate action. Adult fishway criteria 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.

Inspection Results

The adult fish ladder section of the adult fishway includes differentials at the ladder exit, ladder weirs and counting station. The ladder weirs and counting station met criteria throughout the entire season and the ladder exit was found out of criteria on one inspection (Table 2). 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 continued to have mechanical and electrical problems but for the most part performed adequately throughout the season. Channel to tailwater elevation criteria was met 92.3% or better at all locations throughout the season. Weir depth criteria was met at least 94.6% of the time at NSE, 33.8% of the time at NPE and 96.9% of the time at SSE. NPE weirs were on sill for at least 64.6% of all inspections (Table 2). Low tailwater elevations will cause NPE weirs to bottom-out on its sill elevation at 532 feet.

Surface water velocities measured near the NPE and near the NSE both met criteria (1.5 – 4.0 fps) 99.2% of the time (Tables 2 and 3). Surface water velocities near the SSE were measured in 2018 and met criteria 87.6% of the. As mentioned earlier, upwelling from diffuser 2 interferes with laminar flows near the South shore junction pool.

Table 2. Summary of adult fishway inspections at Little Goose Dam, 2018. [1]

LITTLE GOOSE	No. in		Not Enough Depth				Too Much Depth		
Criteria and	Criteria/	% In	No./%	No./%	No./%	No./%	No./%	No./%	No./%
Locations	No. on Sill/	Criteria/	Weir Raised	Within	Within	>0.2	Within	Within	>0.2
	No. of	% On	Or Closed	0.01-0.1	0.11-0.2	Foot	0.01-0.1	0.11-0.2	Foot
	Inspections	Sill		Foot	Foot		Foot	Foot	
Channel Velocities (SSE)	78	87.6	***	***	***	***	***	***	***
	***	***	***	***	***	***	***	***	***
	89								
Channel Velocities (NPE)	129	99.2	***	***	***	***	***	***	***
	***	***	***	***	***	***	***	***	***
	130								
Channel Velocities (NSE)	118	99.2	***	***	***	***	***	***	***
	***	***	***	***	***	***	***	***	***
	119								
Differentials									
Ladder Exit	129	99.2	***	***	***	***	0	0	1
	***	***	***	***	***	***	0.0	0.0	0.8
	130								
Ladder Weirs	128	98.5	***	0	0	0	1	0	1
	***	***	***	0.0	0.0	0.0	0.8	0.0	0.8
	130								
Counting Station	128	100.0	***	***	***	***	0	0	0
	***	***	***	***	***	***	0.0	0.0	0.0
	128								
South Shore	128	98.5	***	1	0	1	0	0	0
	***	***	***	0.8	0.0	0.8	0.0	0.0	0.0

	130								
North Powerhouse	130	100.0	***	0	0	0	0	0	0
	***	***	***	0.0	0.0	0.0	0.0	0.0	0.0
	130								
North Shore	120	92.3	***	2	4	2	0	0	0
	***	***	***	1.5	3.1	1.5	0.0	0.0	0.0
	130								
Weir Depths									
SSE-1	126	96.9	0	0	1	2	***	***	***
On Sill[2]	1	0.8	0.0	0.0	0.8	1.5	***	***	***
	130								
SSE-2	127	97.7	0	0	0	2	***	***	***
On Sill[2]	1	0.8	0.0	0.0	0.0	1.5	***	***	***
	130								
NPE-1	46	35.4	0	0	0	0	***	***	***
On Sill[2]	84	64.6	0.0	0.0	0.0	0.0	***	***	***
	130								
NPE-2	44	33.8	0	0	0	0	***	***	***
On Sill[2]	86	66.2	0.0	0.0	0.0	0.0	***	***	***
	130								
NSE-1	124	95.4	0	2	1	3	***	***	***
On Sill[2]	0	0.0	0.0	1.5	0.8	2.3	***	***	***
	130								
NSE-2	123	94.6	0	1	3	3	***	***	***
On Sill[2]	0	0.0	0.0	0.8	2.3	2.3	***	***	***
	130								

[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 3. LGS collection channel in-criteria rates 2014-2018.[1]

Location	**Collection Channel Success Rates - Annual Comparison**				
	2014	2015	2016	2017	2018
Channel Surface Water Velocities					
South Shore Entrance (SSE)	84.1%	N/A	N/A	N/A	87.6%
North Powerhouse Entrance (NPE)		99.1%	96.8%	97.4%	99.2%
North Shore Entrance (NSE)	98.3%	99.1%	95.7%	99.1%	99.2%
Channel Head Differentials					
SSE	100.0%	96.6%	93.7%	97.4%	98.5%
NPE	99.2%	94.8%	92.1%	97.4%	100.0%
NSE	96.6%	84.5%	93.7%	95.7%	92.3%
Channel Weir Depths					
SSE1	98.4%	90.5%	89.7%	96.6%	96.9%
SSE2	93.6%	87.9%	84.9%	93.1%	97.7%
NPE1 without on-sill criteria	37.1%	9.5%	38.1%	51.7%	35.4%
NPE1 with on-sill criteria	96.0%	19.0%	87.3%	100.0%	100.0%
Location	**Collection Channel Success Rates - Annual Comparison**				
	2014	2015	2016	2017	2018
NPE2 without on-sill criteria	38.7%	9.5%	33.3%	49.1%	33.8%
NPE2 with on-sill criteria	96.0%	19.8%	90.5%	100%	100.0%
NSE1	65.0%	88.8%	46.0%	92.2%	95.4%
NSE2	65.0%	88.8%	45.2%	91.4%	94.6%

[1] Data compiled from Appendix 1, previous monitoring report appendixes and inspection forms for the years 2014-2018.

Average tailrace elevations in 2018 were similar to the 5-year average at all locations (Table 4). To enhance fish migration, reservoirs were drafted down to minimum operating pool (MOP) elevations from April through August. During MOP, Lake Herbert G. West was operated between 537.0 and 538.0 as measured at Lower Monumental Dam.

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.

Table 4. LGS average tailrace water elevations, 2013-2018.[1]

Location	Average Tailrace Water Elevations						
	2013	2014	2015	2016	2017	2018	2013 – 2017 Average
SSE	538.27	538.46	538.34	538.43	538.83	538.50	538.47
NPE	538.22	538.42	538.26	538.34	538.65	538.40	538.38
NSE	538.05	538.48	538.36	538.44	538.76	538.46	538.42

[1] Data compiled from Appendix 1 and previous monitoring report appendixes for years 2013-2018.

Average channel to tailwater head differentials in 2018 were slightly lower than the 5-year average at all entrance locations. NPE3 and NSE3 were permanently sealed with concrete in February 2011.

Average entrance weir depths at SSE and NSE were in criteria for 2018 (Table 5). The NPE entrance was on-sill or in criteria for all of 2018. In 2016, NSE weir depths were lower than average due to electrical limits within the FSC software. Project staff were only able to lower weirs to approximately 532.7 feet for the majority of the passage season. New FSC software was placed into operation in 2016, but failed to maintain fishway criteria while operating in automatic mode and the system was returned to manual operation.

Table 5. LGS adult fishway average differentials and weir depths 2013-2018.[1]

Location	Average Differential or Depth in Feet						
Channel to Tailwater Differential	2013	2014	2015	2016	2017	2018	2013 – 2017 Average
SSE	1.69	1.54	1.21	1.41	1.40	1.42	1.45
NPE	1.77	1.49	1.61	1.67	1.65	1.62	1.64
NSE	1.67	1.31	1.09	1.32	1.29	1.16	1.34
Weir Depth							
SSE-1	8.31	8.28	8.49	8.44	8.73	8.72	8.45
SSE-2	8.29	8.21	8.45	8.38	8.68	8.71	8.40
NPE-1	6.15	6.32	5.46	6.47	6.99	6.50	6.28
NPE-2	6.83	6.33	5.47	6.45	6.94	6.50	6.40
NSE-1	6.05	6.35	6.48	5.74	6.63	6.85	6.25
NSE-2	6.05	6.35	6.53	5.62	6.60	6.77	6.23

[1] Data compiled from Appendix 1 and previous monitoring report appendixes for years 2013-2018.

Fishway Modifications and Improvements

Fishway System Control (FSC) panel and software was installed in 2016. The new software was installed to automatically adjust adult fish entrance weirs and ensure the adult fishway remained in criteria. Unfortunately, improper data was programmed and the automatic controls did not function as expected. Therefore, the control system was operated in manual for the 2018 season.

An adult fish ladder cooling pump was installed during the 2017-2018 in water maintenance period. Little Goose experienced numerous issues operating the cooling pump through 2018. The pump was not started on time (MFR 18 LGS 12), the pump tripped offline (MFR 18 LGS 14), supply power was not available for operation during Doble testing and the pump experienced water intrusion (MFR 18 LGS 16).

Adult Fish Facility Recommendations

1. Repair and/or replace ladder expansion joint seals
2. Repair and/or replace collection channel sluice gates and indicator rods
3. Continue to replace diffuser grating and supporting beams
4. Replace the North Shore Rip Rap dike that protects the NSE entrance from turbulent water forces created by the north shore clockwise eddy.
5. Repair or replace the Fishway Control System
6. Rotate the rebuild of fish pump gear boxes to ensure the ability to run on three fish pumps

Juvenile Fish Facility

Facility Description

The Little Goose Juvenile Fish Facility was designed to bypass juvenile salmon and steelhead to the tailrace, or to collect for transport by truck and barge below Bonneville Dam. The bypass system includes extended length submersible bar screens in the turbine intakes, vertical barrier screens, 12-inch diameter gatewell orifices, a 14-inch diameter gatewell orifice, a collection channel running the length of the powerhouse, a dewatering structure, two emergency bypass routes, and a corrugated metal flume.

The transport system includes a fish separator, fish distribution system, raceways, a sampling and marking building, truck and barge loading areas, and a passive integrated transponder (PIT) tag detection and diversion / bypass system. Untagged fish (without PIT tags) may also be bypassed from the transport system.

Juvenile Fish Collection and Bypass

Migration and Collection

The juvenile fish bypass and collection facility was placed into primary bypass operations on February 20. Every other day collection for sampling began at 0700 on March 01. A total of 4,608,381 smolts were collected during the 2018 season (Table 6). Of those, 3,669,879 were

transported, 927,993 were bypassed, and 10,509 were facility (separator, raceway, or sample) mortalities.

Table 6. Annual collection, bypass, and transport activity at Little Goose Dam JFF, 2013-2018

	Chinook Yearling		Chinook Sub-yearling		Steelhead		Coho		Sockeye		
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Total
Collection											
2013	768,720	257,791	155,896	297,206	864,292	310,421	50	36,839	15,952	6,683	2,713,850
2014	1,487,105	462,499	278,019	463,013	1,013,203	346,944	0	41,542	9,115	51,956	4,153,396
2015	643,606	163,926	169,349	478,654	590,849	158,004	8,276	33,797	11,050	2,818	2,260,329
2016	1,873,536	564,588	203,981	414,605	1,261,259	339,520	29,781	74,575	18,868	4,032	4,784,745
2017	957,932	380,014	236,813	386,867	812,224	252,851	17,941	25,257	7,164	6,618	3,083,681
2018	1,358,654	498,442	233,371	336,373	1,518,859	450,840	16,892	120,257	56,863	17,830	4,608,381
Bypass											
2013	24,036	22,662	5	343	56,575	9,627	0	200	0	2	113,450
2014	78,418	102,125	0	294	178,448	32,046	0	600	0	5,911	397,842
2015	192,212	69,754	0	140	191,460	21,760	400	1,320	0	40	477,086
2016	1,032,728	382,708	1	2,876	766,337	163,410	3,600	10,000	6	1	2,361,667
2017	554,485	282,676	3,282	15,172	612,738	138,805	1,200	2,001	0	3,322	1,613,681
2018	163,625	142,644	342	1,387	534,670	77,151	7	447	9	7,711	927,993
Truck											
2013	0	0	638	25,106	13	18	0	4	2	16	25,797
2014	0	4	400	7,520	4	6	0	0	0	34	7,968
2015	1	1	44	5,982	35	8	0	9	0	2	6,082
2016	0	0	1,345	10,576	23	3	0	0	0	0	11,947
2017	0	0	435	6,156	5	3	0	0	5	41	6,645
2018	0	0	370	4,163	2	6	0	2	4	13	4,560
Barge											
2013	744,193	235,046	155,117	271,046	807,600	300,745	50	36,635	15,950	6,657	2,573,039
2014	1,408,338	360,039	277,207	453,966	834,621	314,847	0	40,932	9,107	45,757	3,744,814
2015	451,267	94,129	168,929	470,315	399,120	136,176	7,868	32,447	11,046	2,772	1,774,069
2016	840,410	181,791	202,183	400,476	494,818	176,078	26,140	64,542	18,645	4,024	2,409,107
2017	399,531	96,175	232,159	363,553	199,312	113,958	16,726	23,230	7,099	2,930	1,454,673
2018	1,191,502	354,645	230,891	328,304	983,890	373,576	16,843	119,534	56,450	9,684	3,665,319
Total Transport											
2013	744,193	235,046	155,755	296,152	807,613	300,763	50	36,639	15,952	6,673	2,598,836
2014	1,408,338	360,043	277,607	461,486	834,625	314,853	0	40,932	9,107	45,791	3,752,782
2015	451,268	94,130	168,973	476,297	399,155	136,184	7,868	32,456	11,046	2,774	1,780,151
2016	840,410	181,791	203,528	411,052	494,841	176,081	26,140	64,542	18,645	4,024	2,421,054
2017	399,531	96,175	232,594	369,709	199,317	113,961	16726	23,230	7,104	2,971	1,461,318
2018	1,191,502	354,645	231,261	332,467	983,892	373,582	16,843	119,536	56,454	9,697	3,669,879

Transportation

Collection for transport began at 0700 on April 23, was suspended September 15, resumed October 16, and ended at 0700 on November 01. An estimated total of 3,681,305 smolts were collected for transport during this period. Of this total, 3,665,319 smolts were barged, 4,560 were trucked, 1,060 were bypassed, and 10,366 were facility mortalities. An

additional 145 smolts were bypassed between September 16 and October 13 when trucking was suspended.

Juvenile salmonids collected for transport by barge or truck were held in raceways, wet-lab holding tanks, or directly loaded into barges or trucks. Maximum fish holding time prior to transport varied from 24 to 48 hours, depending on the transportation schedule. Transport time from LGS to the approved release point was approximately 2 days by barge or 6 hours by truck. Fish transported by truck were transported in a mild saline solution of 1 to 2 grams per liter to treat presumed Columnaris disease. All fish transport operations were performed without incident in 2018. Daily barging and direct loading operations occurred from April 24 to May 22, every-other-day barging occurred from May 24 to August 14, and every-other-day trucking occurred from August 16 to September 15 when transportation was suspended due to mortality rate exceeding 10.0% for 3 consecutive days. Collection for every-other-day trucking resumed October 13 and continued through the end of the transport season on November 01.

Of the 3,669,879 juvenile salmonids transported from LGS in 2018; 3,665,319 of them, or 99.9%, were transported by barge (Table 6). The estimated species composition and clip type of the fish transported by barge was as follows: 32.5% clipped yearling Chinook salmon, 9.7% unclipped yearling Chinook salmon, 6.3% clipped subyearling Chinook salmon, 9.0% unclipped subyearling Chinook salmon, 26.8% clipped steelhead, 10.2% unclipped steelhead, 1.5% clipped sockeye salmon, 0.3% unclipped sockeye salmon, 0.5% clipped coho salmon, and 3.3% unclipped coho salmon.

Of the 3,667,930 juvenile salmonids transported from LGS, 2,611 of them, or 0.1% of the total, were transported by truck. The species composition of salmonids transported by truck was as follows: 8.1% clipped subyearling Chinook salmon, 91.3% unclipped subyearling Chinook salmon, <0.1% clipped steelhead, 0.1% unclipped steelhead, 0.1% clipped sockeye salmon, 0.3% unclipped sockeye salmon, and <0.1% unclipped coho salmon. No yearling Chinook salmon or clipped coho salmon were transported by truck in 2018.

In previous years, due to high numbers of fish collected, Lower Granite Fish Facility trucked Little Goose Fish using the 3500 gallon tanker. This “piggyback” operation delayed transport time for those fish transported from Lower Granite by approximately one hour. In 2018, Little Goose did not conduct any piggybacking operations with Lower Granite. Fish transported by truck from Little Goose were transported in a mild saline solution of 1 to 2 mg/L to reduce stress and treat Columnaris disease.

The maximum daily estimated collection of 212,443 fish occurred on April 9 and accounted for 4.6% of total collection (Table 7). The composition of the collection for that date was as follows: clipped yearling Chinook salmon (10.5%), unclipped yearling Chinook salmon (7.4%), clipped steelhead (78.8%), unclipped steelhead (3.3%), unclipped coho salmon (<0.1%), and unclipped sockeye salmon (<0.1%).

Table 7. Peak passage dates and totals by species group at Little Goose Dam JFF, 2013-2018.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Season
2013	10-May	10-May	10-Jun	8-Jun	14-May	14-May	17-May	19-May	14-May	10-May

	156,233	44,008	15,290	14,452	107,846	46,209	4,600	2,400	5,200	280,443
2014	6-May	22-Apr	2-Jun	3-Jun	22-Apr	8-May	10-May	20-May	10-May	6-May
	156,006	53,031	19,016	24,044	89,625	25,215	3,600	4,003	6,813	279,206
2015	28-Apr	24-Apr	29-May	13-Jul	28-Apr	09-May	19-May	12-May	17-May	28-Apr
	53,656	16,602	15,400	18,551	66,016	11,601	3,500	400	4,700	136,712
2016	30-Apr	18-Apr	11-Jun	11-Jun	24-Apr	30-Apr	21-May	12-May	9-May	28-Apr
	180,800	62,401	15,750	25,750	183,201	28,400	4,400	400	1,320	432,007
2017	28-Apr	16-Apr	6-Jun	2-Jun	28-Apr	28-Apr	20-May	26-Apr	18-May	28-Apr
	115,678	50,001	16,772	16,208	119,203	27,601	803	1,209	3,200	298,107
2018	10-May	21-Apr	29-May	29-May	9-Apr	3-May	20-May	19-May	13-May	9-Apr
	87,294	26,408	28,966	34,245	167,390	19,400	8,712	1,009	10,404	212,443

Bypass

From March 1 to April 23, the facility was rotated between primary bypass (fish are routed directly to the river) and secondary bypass (fish are routed through the fish facility for PIT-tag detections) every 24 hours for every-other-day condition sampling and gas bubble trauma (GBT) monitoring. Fish were routed to the river without being sampled on non-sample days. An estimated total of 926,930 smolts entered the facility on sampling days between March 1 and April 23. Of this total, 926,788 were bypassed and 142 were facility mortalities. The facility was also rotated between primary bypass and secondary bypass for every third day condition sampling between September 15 and October 13 in accordance with Section 4.6.5 of Appendix B of the 2018 Fish Passage Plan after mortality rate exceeded 10.0% for 3 consecutive days.

A total of 902 smolts entered the facility on passage days during March. There are no passage estimates for the 26 non-sample days during the months of March and April. The species composition for the month of March was as follows: 9.1% clipped yearling Chinook salmon, 33.9% unclipped yearling Chinook salmon, 13.7% clipped steelhead, 25.5% unclipped steelhead, 0.6% clipped sockeye salmon, 17.1% unclipped sockeye salmon, and 0.6% coho.

Adult Fallbacks

Fallbacks are adult salmonids that have migrated above the dam and have "fallen back" into the downstream juvenile fish collection and bypass system. Fallbacks collected at the separator were usually too large to pass between the separator bars and were released back to the river. Fallbacks were identified by species and fin clip and assessed for condition prior to being released.

A total of 2,177 adult salmon and steelhead fallbacks occurred in 2018 (Table 8). Of these, 2,169 were bypassed from the separator. The remaining 8 were small adult salmon or steelhead that passed through the separator bars and were collected in the sample and released back to the river.

There were 1,506 steelhead fallbacks in March, April, May and June (Table 9). In previous years, USACE classified out-migrating kelts due to their post spawned condition, kelts collected during this period accounted for the majority of fish in fair, poor, and dead condition.

In April of 2018, FPOM asked that steelhead fallbacks be classified as adult steelhead rather than steelhead kelt. Table 10 lists the numbers of fish by species and condition.

Other fish of particular interest that were bypassed back to the river from the separator and/or raceways included 137 adult Pacific lamprey and 20 white sturgeon. The 137 adult Pacific lamprey were transported to one mile above the dam and released.

Table 8. Total annual adult salmonid fallbacks at Little Goose Dam JFF, 2013-2018.

Year	Adult Chinook	Jack/mini Chinook	Clip Steelhead	Unclip Steelhead	Sockeye	Coho	Total
2013	1,341	1,050	1,469	1,061	15	2	4,938
2014	991	558	1,518	1,425	46	186	4,724
2015	515	240	659	903	15	10	2,342
2016	643	452	1049	1272	17	9	3,442
2017	1,345	455	583	528	4	47	2,962
2018	374	210	923	667	3	0	2,177

Table 9. Monthly totals of fallbacks bypassed from separator at Little Goose Dam, 2018.

Month	Adult Chinook	Jack Chinook	Clip Steelhead	Unclip Steelhead	Sockeye	Coho	Total
March	0	0	192	77	0	0	269
April	0	0	172	138	0	0	310
May	46	0	470	332	0	0	848
June	114	4	44	81	0	0	243
July	54	12	2	7	1	0	76
August	21	9	3	8	2	0	43
September	65	45	16	10	0	0	136
October	74	140	24	14	0	0	252
Total	374	210	923	667	3	0	2,177

Table 10. Condition of adult salmonids released at Little Goose Dam, 2018.

Fish	Chinook		Chinook Jack		Steelhead		Sockeye		Coho	
Condition[1]	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total
Good	201	128	84	115	696	533	1	1	0	1,759
Fair	30	12	7	2	149	92	0	1	0	293
Poor	2	1	1	0	64	36	0	0	0	104
Dead	0	0	1	0	14	6	0	0	0	21
Total	233	141	93	117	923	667	1	2	0	2,177

[1] Condition ratings for live fish were determined subjectively based on the presence/absence and severity of fungus, headburn, fin wear, and other injuries.
Note: Table 10 does not separate post spawned "kelt" steelhead from pre-spawned healthier steelhead.

Separator Efficiency

Separator efficiency is a measure of how fish entering the facility are separated by size. Smaller fish, primarily salmon smolts, are expected to enter through the narrower bars on the upstream end of the separator (A-side). Larger fish, primarily steelhead, are expected to enter through the wider bars on the downstream end of the separator (B-side). Table 11 gives efficiency expressed as the percentage of each group, passing through the desired side of the

separator, for 2013 to 2018. Efficiency rates are based on expanded sample counts.

Separator efficiency was highest for clipped steelhead and unclipped yearling Chinook, with 81.1% of clipped steelhead entering the B-side and 71.5% of unclipped yearling Chinook salmon entering the A-side. Separator efficiency was lowest for clipped and unclipped sockeye salmon with 24.0% of clipped sockeye salmon and 13.7% of unclipped sockeye salmon entering on A-side (Table 11).

Table 11. Annual juvenile salmonid separator efficiency (%) at Little Goose Dam JFF, 2013-2018.

	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye	
Year	Clip A-side	Unclip A-side	Clip A-side	Unclip A-side	Clip B-side	Unclip B-side	Clip A-side	Unclip A-side	Clip A-side	Unclip A-side
2013	71.5	71.2	53.8	48.8	82.1	62.1	100.0	23.7	64.5	52.4
2014	81.8	78.6	58.5	56.5	75.9	54.7	—	41.3	49.5	37.6
2015	72.9	69.3	65.8	62.8	72.7	57.0	39.0	35.9	45.2	38.2
2016	65.4	64.0	57.3	56.1	88.6	68.7	36.0	32.2	23.9	27.3
2017	62.0	56.5	45.6	46.9	85.8	69.6	24.9	22.0	11.2	34.8
2018	69.7	71.5	55.8	52.0	81.1	62.6	31.8	33.2	24.0	13.7

Note: Counts do not include sample mortalities. There were no clipped coho sampled in 2014.

Sampling

The fish sampling system was operated without incident throughout the 2018 season. Sampling procedures followed the smolt monitoring guidelines developed by the Fish Passage Center and USACE. The resulting data were used for management of facility and fish transport operations. Collection and fish condition data were also transmitted daily by ODFW personnel to the Fish Passage Center electronic database in support of the Smolt Monitoring Program (SMP).

Sample rates were set by USACE project biologists. To obtain the target sample of 300 to 500 smolts, sample rates were varied between 0.25 and 100.0% as fish migration numbers fluctuated. The percentage of each species sampled was dependent on their migration timing and the overall sample rate in effect at that time (Table 12).

Table 12. Annual percentages of juvenile salmonids collected per species and clip type that were sampled at Little Goose Dam JFF, 2013-2018[1].

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total
2013	0.4	0.7	3.0	6.1	0.6	0.6	0.6	0.9	0.6	1.4
2014	0.8	1.0	2.8	4.7	1.0	1.1	0.9	0.9	1.0	1.8
2015	0.3	0.5	4.7	7.8	0.5	0.6	2.9	1.0	0.7	1.3
2016	0.5	0.5	3.1	5.0	0.5	0.7	1.3	1.1	1.3	1.6
2017	0.5	0.5	3.3	6.4	0.5	0.7	1.3	1.9	1.2	1.5
2018	0.5	0.7	3.1	5.8	0.7	0.7	0.8	1.9	0.7	1.1

[1]All research fish and sample mortality are included in percentages.

All fish in the sample were examined to determine species, clip type, and prevalence of descaling. In addition, Chinook salmon age class was determined as subyearling or yearling. All

yearling Chinook salmon in the sample were examined for characteristics typical of holdover or Lyons Ferry Hatchery fall Chinook salmon. All unclipped salmon were scanned for coded wire tags. Chinook, sockeye and coho fry were defined by length, under 60 mm, and were bypassed for continued growth. None of the 2018 hatchery releases above LGS were marked with elastomer eye tags.

Fish condition data were collected from a random subsample of 100 fish from the dominant species in the daily sample. Data collected included weight, length, descaling, injury, disease, predation, and "other" monitored conditions including pink fin, fin hemorrhage, fin discoloration, popeyes (exophthalmos), and eye hemorrhage. Injury and descaling data were used by managers to assess passage conditions at the dam.

Pound counts (number of fish per pound) were taken daily during condition sampling and provided to USACE from March 02 through November 01, 2018. During transport, when the sample rate was set below 100.0%, weights were also recorded on all non-salmonid species in the sample to determine their contribution to barge loading densities.

A total of 51,721 fish were sampled during the 2018 season. Of these, 49,815 were examined for descaling, 54 were salmonid fry, 302 were sample mortalities, and 1,555 smolts were removed from the separator during GBT monitoring (Table 13).

Table 13. Weekly sample as percent of collection total and sample totals at LGS JFF, 2018.

Week Ending	Weekly % Sampled (%)	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	Totals[1]
		Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		
8-Mar	85.2	1	19	0	0	5	26	1	23	0	75
15-Mar	98.9	3	38	0	0	3	21	0	25	0	90
22-Mar	99.1	11	80	0	0	9	88	1	34	1	224
29-Mar	100.0	36	138	0	0	24	66	2	43	0	309
5-Apr	14.1	100	107	0	0	525	77	1	65	0	875
12-Apr	1.3	627	470	0	0	2,129	102	1	42	2	3,373
19-Apr	0.5	439	410	0	4	1,426	266	0	7	1	2,553
26-Apr	0.5	644	489	0	0	868	214	0	12	3	2,230
3-May	0.5	1,115	527	0	0	1,839	517	0	4	58	4,060
10-May	0.5	2,085	432	0	2	1,256	438	3	4	157	4,377
17-May	0.3	1,058	194	1	3	464	260	34	6	123	2,143
24-May	0.8	626	217	78	52	540	307	333	30	177	2,360
31-May	1.2	150	124	1,209	1,281	539	360	81	12	188	3,944
7-Jun	1.9	37	45	662	817	180	139	13	3	90	1,986
14-Jun	3.2	23	14	1,075	1,222	78	44	3	5	52	2,516
21-Jun	6.6	2	1	1,185	1,823	17	3	0	1	22	3,054
28-Jun	3.9	3	6	657	1,307	43	12	1	0	20	2,049
5-Jul	9.1	1	1	577	1,207	29	6	0	0	5	1,826
12-Jul	12.5	0	1	503	1,943	14	0	0	0	2	2,463
19-Jul	10.4	0	0	401	1,641	6	1	0	0	0	2,049
26-Jul	18.0	0	0	236	1,377	1	0	0	1	2	1,617
2-Aug	19.3	0	0	97	743	3	0	0	0	2	845
9-Aug	48.0	0	0	173	1,128	5	3	0	0	2	1,311
16-Aug	61.4	1	0	107	928	0	2	0	0	0	1,038
23-Aug	99.9	0	0	134	1,498	1	3	1	0	2	1,639
30-Aug	99.6	0	0	50	474	1	1	0	1	0	527

6-Sep	99.8	0	0	85	836	0	0	1	0	0	922
13-Sep	99.0	0	0	35	545	0	0	0	2	0	582
20-Sep	97.8	0	0	11	75	0	0	0	2	0	88
27-Sep	100.0	0	0	0	12	0	0	0	0	0	12
4-Oct	100.0	0	0	3	50	0	0	0	2	0	55
11-Oct	100.0	0	0	5	64	0	0	0	0	0	69
18-Oct	100.0	0	0	5	120	0	0	1	6	0	132
25-Oct	100.0	0	0	4	95	0	1	0	3	0	103
1-Nov	100.0	0	0	16	205	0	1	2	1	0	225
Total Sampled		6,962	3,313	7,309	19,452	10,005	2,958	479	334	909	51,721
Total Collection		1,358,654	498,442	233,371	336,373	1,518,859	450,840	56,863	17,830	137,149	4,608,381
Percent of Sample		13.5	6.4	14.1	37.6	19.3	5.7	0.9	0.6	1.8	100.0
Percent of Collection		29.5	10.8	5.1	7.3	33.0	9.8	1.2	0.4	3.0	100.0

[1]All research fish, GBT fish and sample mortality included in species group and clip type numbers.
[2]Separator mortalities are included in collection totals but are not sampled.

Fish Condition

Fish condition was monitored daily by Anchor QEA and ODFW biologists. The primary role of the condition monitoring is to identify the proportion of each species of migrant juvenile salmonid and larval and juvenile lamprey (where applicable) that are descaled (salmonids only) or have significant injuries indicative of problems in fish passage at dams such as debris in fish bypass apparatus. Secondarily, the data collected on disease, predation, and other injuries will provide a relative indication of the health of fish passing at the dams (Condition Sampling Protocol, 2018 Smolt Monitoring Season).

Injuries

Prior to 2009, recorded injuries were based solely on the presence of an injury, with no attempt made to determine the age or origin of the injury. From 2009 to date, only fresh injuries presumed to have occurred during passage through Little Goose Dam have been recorded (Table 14).

Table 14. Annual injury rates (%) for salmonids examined at Little Goose Dam, 2013-2018.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total
2013	3.4	4.3	8.9	17.0	1.8	1.6	0.0	3.2	2.9	12.1
2014	8.4	8.4	9.0	12.3	4.3	3.4	13.3	12.9	8.6	9.8
2015	12.5	14.1	12.9	16.6	6.2	5.5	7.0	11.5	11.1	13.4
2016	10.2	12.2	19.5	23.5	0.1	6.4	5.6	13.5	14.8	17.9
2017	9.9	10.6	12.3	16.6	5.4	4.9	11.8	7.8	7.1	13.0
2018	10.0	13.3	14.0	14.1	3.3	4.7	10.1	15.1	7.3	10.7

A total of 24,129 smolts from the condition subsample were examined for injuries. Of the fish examined, 10.7% or 2,580 individual smolts, were observed with one or more injuries. A total of 2,627 individual injuries were observed this year. The majority of injuries involved damage to fins (87.4%) followed by operculum injury (7.1%), body injury (2.2%), head injury (1.5%), and eye injury (1.7%; Table 15). The highest rates of injury this year were observed in

unclipped sockeye salmon at 15.1% followed by unclipped subyearling Chinook salmon at 14.1% and clipped subyearling Chinook salmon at 14.0%.

Table 15. Percent of fish examined that were injured, had predation marks, or had signs of disease by species and clip type at Little Goose Dam, 2018.

	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye		
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Total[1]
Injuries											
Eye	0.6	0.4	0.1	0.1	0.1	0.1	0.0	0.3	0.6	1.2	0.2
Operculum	1.0	0.8	0.6	0.4	1.0	1.3	0.5	0.6	1.7	3.4	0.8
Head	0.2	0.3	0.2	0.1	0.1	0.2	0.0	0.4	0.0	0.3	0.2
Body	0.2	0.1	0.1	0.2	0.3	0.5	0.5	0.1	0.2	0.9	0.2
Fin	8.6	11.9	13.2	13.4	1.8	2.8	4.2	6.5	7.8	9.6	9.5
Total Injury	**10.0**	**13.3**	**14.0**	**14.1**	**3.3**	**4.7**	**5.3**	**7.8**	**10.1**	**15.1**	**10.7**
Disease											
Fungus	0.4	0.3	0.1	<0.1	0.7	0.6	0.5	0.4	1.7	6.5	0.4
Columnaris	0.0	0.0	1.4	4.8	0.1	0.0	0.0	0.1	0.4	1.2	2.0
BKD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Parasites	0.3	0.7	0.2	0.2	0.8	5.9	0.5	0.1	0.0	0.3	0.8
Deformity	0.1	0.1	0.4	0.3	0.1	0.2	0.0	0.0	0.4	0.6	0.2
Disease Other	1.1	0.6	1.3	2.4	<0.1	0.3	0.5	0.1	0.6	0.0	1.3
Total Disease	**2.0**	**1.8**	**3.3**	**7.3**	**1.8**	**6.9**	**1.6**	**0.9**	**3.2**	**8.6**	**4.5**
Predation											
Bird	0.8	0.5	0.2	0.3	1.8	2.0	0.0	0.7	0.6	0.6	0.8
Fish	1.4	0.5	1.1	0.8	0.4	0.4	1.6	0.7	1.3	0.9	0.8
Lamprey	0.0	0.0	0.1	0.1	<0.1	0.0	0.0	0.0	0.0	0.0	0.1
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Predation	**2.2**	**1.0**	**1.5**	**1.3**	**2.2**	**2.5**	**1.6**	**1.4**	**1.9**	**1.5**	**1.7**
Misc. Conditions											
Pop Eye	0.4	0.2	<0.1	0.0	<0.1	0.1	0.0	0.0	0.6	0.0	0.1
Fin Hemorrhage	4.0	5.9	14.3	15.1	2.1	3.4	2.1	0.4	5.3	4.0	9.0
Pink Fin	8.3	9.7	27.2	35.4	4.8	9.7	3.2	1.6	1.1	0.9	19.7
Fin Discoloration	6.7	4.4	3.1	3.6	0.8	1.8	0.5	0.7	1.3	1.2	3.2
Eye Hemorrhage	0.4	0.9	<0.1	0.1	0.1	0.4	0.0	0.0	0.0	0.9	0.2
Total Misc. Conditions	**18.0**	**18.2**	**37.2**	**45.3**	**7.5**	**14.5**	**5.8**	**2.7**	**7.6**	**5.9**	**27.5**
Total sample size	**3,263**	**1,716**	**2,690**	**8,999**	**3,899**	**1,868**	**190**	**705**	**475**	**324**	**24,129**

[1] Overall disease and injury rates are less than the sum of the individual categories because some individual fish had more than one injury or disease.
BKD = bacterial kidney disease

Descaling

All live smolts in the sample were examined for descaling. A smolt was considered descaled if more than 20% of the scales were missing from either side of the fish. Only descaling that appeared fresh enough to have occurred at LGS was recorded. Prior to 2009, all descaling, old or new, was recorded.

A total of 49,815 smolts were examined for descaling in 2018. Smolts examined for descaling include live smolts in the sample and do not include smolts examined for GBT, sample mortalities, or fry. The overall rate of descaling was 1.2% (621 descaled), which is comparable to rates observed in previous years (Table 16). Of the 49,815 smolts examined for descaling, 48.4% (24,129) were examined as part of condition subsampling. During condition subsampling, fish with descaling greater than or equal to 20.0% were differentiated into two categories: 1) descaling associated with dam passage, and 2) descaling on fish with bite marks indicative of predation attempts by birds, fish, or lamprey. The rate of descaling observed in the condition subsample was 1.5% (372 descaled smolts). Of the 372 descaled smolts observed in the condition subsample, descaling associated with dam passage was 71.2% of the condition descale total, and the rate of descaling on fish with predation marks present was 28.8% of the condition descale total. The rate of descaling observed in the non-condition sample was 1.0% (249 descaled smolts) from a sample size of 25,868 salmon. Note that all descaling recorded from the non-condition sample does not differentiate between descaling as a result of passage and descaling as a result of predators.

Table 16. Annual descaling rates (%) for salmonids examined at Little Goose Dam JFF, 2013-2018.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Totals
2013	0.7	1.0	0.8	1.0	0.6	0.8	0.9	1.1	0.7	0.9
2014	1.2	0.5	1.0	0.9	1.0	1.2	0.0	3.4	1.9	1.0
2015	1.3	1.1	0.7	0.7	1.9	1.9	0.0	3.8	1.4	1.0
2016	1.1	0.7	1.0	1.5	1.2	1.2	1.3	2.4	1.8	1.3
2017	2.2	1.5	1.2	1.4	1.5	0.8	3.1	6.5	1.7	1.5
2018	1.7	0.8	1.2	1.0	1.3	1.9	1.1	4.6	1.9	1.2

Note: GBT sample numbers not included in descaling rate calculations.

For fish in the condition subsample, in addition to descaling of 20% or greater, partial descaling was also recorded. Partial descaling was considered scale loss above background levels of approximately 5% scale loss but below the 20% threshold for descaling. The rate of partial descaling was 3.8% of the 24,129 smolts examined for condition in 2018.

Overall weekly descaling rates per species and clip types are listed in Table 17. The average weekly descaling rate ranged from 0.0% to 8.7%. The 2 weeks with the highest descaling occurred as a result of a low number of smolts to examine those weeks.

Table 17. Weekly descaling rates (%) for salmonids examined at Little Goose Dam JFF, 2018.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Week Ending	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total[1]
1-Mar	—	—	—	—	—	—	—	—	—	—
8-Mar	0.00	5.26	—	—	0.00	0.00	0.00	0.00	—	1.33
15-Mar	0.00	0.00	—	—	0.00	0.00	—	0.00	—	0.00
22-Mar	0.00	0.00	—	—	11.11	0.00	0.00	9.09	0	1.82
29-Mar	0.00	0.00	—	—	8.33	0.00	0.00	7.14	—	1.63
5-Apr	1.00	1.89	—	—	0.38	0.00	0.00	3.17	—	0.80
12-Apr	1.69	0.00	—	—	0.77	0.00	0.00	2.44	0	0.83

19-Apr	1.23	0.77	—	—	0.72	0.78	—	0.00	0.00	0.82
26-Apr	1.78	0.43	—	—	0.97	1.46	—	25.00	0.00	1.27
3-May	1.95	1.57	—	—	1.22	2.98	—	0.00	1.72	1.70
10-May	1.67	1.42	—	—	2.06	1.86	0.00	0.00	0.64	1.74
17-May	1.48	1.11	0.00	0.00	1.40	3.28	0.00	0.00	1.63	1.62
24-May	2.17	0.48	0.00	2.17	3.25	2.12	1.21	0.00	0.57	1.88
31-May	2.68	0.81	0.85	0.48	1.98	2.62	1.25	8.33	3.72	1.28
7-Jun	0.00	0.00	1.08	0.65	2.63	1.71	0.00	0.00	3.33	1.12
14-Jun	0.00	0.00	0.87	0.87	2.86	0.00	0.00	25.00	1.92	0.96
21-Jun	0.00	0.00	1.31	1.03	0.00	0.00	—	0.00	4.55	1.16
28-Jun	0.00	0.00	0.80	0.64	2.78	0.00	0.00	—	0.00	0.72
5-Jul	0.00	—	1.08	0.61	0.00	0.00	—	—	0.00	0.75
12-Jul	—	—	2.47	1.08	0.00	—	—	—	0.00	1.36
19-Jul	—	—	2.37	1.03	0.00	0.00	—	—	—	1.29
26-Jul	—	—	2.20	1.40	0.00	—	—	—	0.00	1.52
2-Aug	—	—	0.00	1.36	0.00	—	—	—	0.00	1.19
9-Aug	—	—	1.76	0.62	0.00	0.00	—	—	0.00	0.77
16-Aug	—	—	0.95	0.33	—	0.00	—	—	—	0.39
23-Aug	—	—	0.76	0.80	0.00	0.00	0.00	—	0.00	0.80
30-Aug	—	—	2.13	0.65	0.00	—	—	0.00	—	0.78
6-Sep	—	—	0.00	0.97	—	—	0.00	—	—	0.88
13-Sep	—	—	3.13	1.39	—	—	—	0.00	—	1.49
20-Sep	—	—	0.00	2.90	—	—	—	0.00	—	2.53
27-Sep	—	—	—	0.00	—	—	—	—	—	0.00
4-Oct	—	—	0.00	4.00	—	—	—	50.00	—	5.45
11-Oct	—	—	0.00	9.38	—	—	—	—	—	8.70
18-Oct	—	—	0.00	4.24	—	—	0.00	0.00	—	3.82
25-Oct	—	—	0.00	2.11	—	0.00	—	0.00	—	1.94
1-Nov	—	—	0.00	2.44	—	0.00	0.00	0.00	—	2.22
Total Exam.	**6,705**	**3,176**	**7,049**	**18,718**	**9,632**	**2,831**	**475**	**324**	**905**	**49,815**
Percent Desc.	**1.70**	**0.82**	**1.21**	**0.97**	**1.30**	**1.87**	**1.05**	**4.63**	**1.88**	**1.25**
Median	**0.50**	**0.43**	**0.83**	**1.03**	**0.72**	**0.00**	**0.00**	**0.00**	**0.00**	**1.28**

[1] Descaling figures do not include sample mortalities or fish examined for GBT.
[2] "-----" means species group not present in sample during this week.

Disease

Data on the presence of disease symptoms were collected from fish in the condition subsample to provide relative information about fish health. Disease classifications included fungus, Columnaris, BKD, body parasites, deformity, and other disease such as cysts or tumors. 2014 was the first season parasites were identified and documented to genus which included fish louse (*Argulus*), gill lice (*Salmincola*), and leech (*Piscicola*). Types of deformity including spinal curvatures such as scoliosis and lordosis, and also dwarfism or truncated body were also documented.

A total number of 1,083 smolts (4.5%) of the total condition subsample were observed with one or more symptoms of disease (See Table 15 above). Of the 1,131 individual signs of disease observed this year, Columnaris was the most prevalent at 42.0% of the total, followed by other disease (27.5%), parasite (17.3%), fungus (8.6%), deformity (4.6%), and presumed bacterial kidney disease (0.0%). Almost all the other diseases this season consisted of observations of smolts with rotted caudal fins or smolts with symptoms of abdominal distention

similar to BKD. In 2015, several subyearling fall Chinook salmon smolt mortalities were observed with these symptoms which prompted ODFW to collect a specimen for the ODFW Fish Health Laboratory in La Grande, Oregon. Preliminary results were positive for the intestinal protozoan parasite (*Ceratomyxa shasta*). As a result, nearly all fish exhibiting symptoms of abdominal distention have been reported as "disease other" rather than BKD since 2015.

Predation Marks

Bite marks were recorded on fish from the condition subsample, which were indicative of predation attempts by bird, fish, lamprey, and mammalian predators such as mink and otter. A total of 399 smolts were observed with one or more predatory wounds, for an overall rate of 1.7% of the total condition subsample. The majority of marks observed in the subsample were indicative of attempted predation by fish at 49.6% of the 399 total individual bite marks recorded, followed by bird bites (46.1%), and lamprey bites (4.3%). No mammalian bite marks were observed this year. Steelhead and clipped yearling Chinook salmon sustained the highest rate of predatory attempts, which were predominately a result of predation attempts by birds (See Table 15 above).

The overall rate of bird bite marks decreased from last year and was slightly lower than the 5-year average of 1.0 (Table 18). The highest prevalence of bird bite marks was observed on clipped steelhead.

Table 18. Annual bird bite rates (%) for salmonids examined at Little Goose Dam, 2013-2018.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip		Total
2013	1.0	1.0	0.1	0.5	1.8	2.6	2.2	1.6	1.4	0.8
2014	0.5	0.5	0.3	0.3	2.7	2.5	0.0	0.7	0.9	0.7
2015	0.8	0.9	0.2	0.3	4.4	3.3	0.0	3.9	<0.1	1.1
2016	0.8	0.2	0.5	1.6	2.3	2.7	1.7	0.0	1.0	1.4
2017	1.0	0.3	0.3	0.5	2.7	2.2	2.2	1.9	0.2	0.9
2018	0.8	0.5	0.2	0.3	1.8	2.0	0.6	0.6	0.6	0.8

Other Miscellaneous Conditions

The other miscellaneous conditions category included popeye (exopthalmos), hemorrhaged fin, pink fin, discolored fin, and hemorrhaged eye. There were 6,632 smolts with one or more miscellaneous conditions, for an overall miscellaneous condition rate of 27.5% of the total condition subsample (See Table 15 above). A total of 7,770 individual observations of miscellaneous conditions were found. Many smolts that were examined had multiple conditions. For example, pink fin and hemorrhaged fins often occurred on the same individual fish, though in different fins. Pink fins constituted most of the observations in this category at 61.1% of the individual miscellaneous conditions total followed by hemorrhaged fin(s) (27.9%), fin discoloration (10.1%), eye hemorrhage (0.6%), and popeye (exopthalmos) (0.3%). Subyearling fall Chinook salmon had the highest rates in this condition category at 45.3% for unclipped and 37.2% for clipped due to the high incidence of pink and hemorrhaged fin(s).

Mortality

Mortality at the JFF included fish that entered the JFF system dead as well as those that

died at the facility. Mortality was recorded by location within the facility and was divided into facility mortality (raceways and separator) and sample mortality. Total facility mortality is the sum of facility mortality (raceway and separator) and sample mortality.

Total facility mortality rate this year was roughly twice that of the 5-year average at 0.2% from a total collection of 4,608,381 smolts (Table 19) but was lower than in 2017. The average weekly total facility mortality rate ranged from less than 0.0% to 16.7% (Table 20). The minimum weekly rates of less than 0.1% occurred frequently during the month of April when mortalities that occurred represented a small proportion of the total collection. Increased mortality rates later in the collection season occurred when total collection numbers decreased and descaling, disease, predation, and injury rates increased. The average monthly total facility mortality rate was highest in September at a rate of 6.7% from a collection total of 1,486 smolts.

The maximum weekly total facility mortality rate of 16.7% occurred during the week ending September 20, 2018, with a total weekly collection of 90 fish and 15 mortalities. The relatively high mortality rate was presumed to be the result of the high prevalence and severity of Columnaris. The median weekly total facility mortality rate for all smolts was 0.6%. The highest number of facility mortalities occurred during the week ending May 31 when a total of 2,567 mortalities were recorded. The high number was the result of high debris and at least one event when an orifice was plugged resulting in 847 mortalities. Another debris-related mortality event occurred April 29 when an orifice was discovered partially plugged. A total of 894 mortalities were attributed to this event.

Sample mortality for smolts was 0.6% of 51,721 smolts sampled (Table 21). As in 2017, increased sample mortality in late summer was observed when river temperatures and outbreaks of disease, such as Columnaris, were higher than in the spring and fall. On average, monthly sample mortality rates were lowest in April at 0.2% from a sample total number of 10,913 smolts and October at 0.2% from a sample total of 521. The highest sample mortality rate was in September at 4.2% from a sample total number of 1,486 smolts.

The total sample mortality rate for Pacific lamprey ammocoetes was 2.6%, which was 6 of 230 total ammocoete sampled. The sample mortality rate for Pacific lamprey macropthalmia was 4.3%, which was 21 from a total of 492 sampled (Table 21). No notable peak in sample mortality for either life stage of juvenile Pacific lamprey was observed.

Table 19. Annual total facility mortality as a percentage of total collection at LGS JFF 2013-2018.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho		Pacific lamprey	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total	Ammocoete	Macropthalmia
2013	<0.1	<0.1	0.1	0.2	<0.1	<0.1	0.0	0.1	0.0	0.1	0.2	<0.1
2014	<0.1	0.1	0.2	0.3	<0.1	<0.1	0.1	0.5	<0.1	0.1	0.4	0.2
2015	<0.1	0.1	0.2	0.5	<0.1	<0.1	<0.1	0.1	0.1	0.1	<0.1	<0.1
2016	<0.1	<0.1	0.2	0.2	<0.1	<0.1	1.2	0.2	<0.01	<0.1	0.2	<0.1
2017	0.4	0.3	0.4	0.5	<0.1	<0.1	0.8	4.9	0.1	0.3	0.3	0.3
2018	0.3	0.2	0.8	0.7	<0.1	<0.1	0.7	2.4	0.2	0.2	0.1	0.1

Note: Mortality rate for collected fish includes sample, raceway, and separator mortalities. Lamprey numbers are not included in "Totals" column.

Table 20. Weekly total facility mortality in percent at Little Goose Dam JFF, 2018.

Week Ending	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	Total[1]
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		
1-Mar	—	—	—	—	—	—	—	—	—	—
8-Mar	0.0	0.0	—	—	0.0	0.0	0.0	0.0	—	0.0
15-Mar	0.0	2.6	—	—	0.0	0.0	—	0.0	—	1.1
22-Mar	0.0	3.7	—	—	0.0	0.0	0.0	5.7	0.0	2.2
29-Mar	0.0	1.4	—	—	0.0	0.0	0.0	2.3	—	1.0
5-Apr	0.0	0.3	—	—	0.0	0.0	0.0	0.1	—	0.1
12-Apr	<0.1	<0.1	—	—	<0.1	0.0	0.0	0.1	0.0	<0.1
19-Apr	<0.1	<0.1	—	0.0	<0.1	0.0	—	2.2	0.0	<0.1
26-Apr	<0.1	<0.1	—	—	<0.1	0.0	—	0.8	0.2	<0.1
3-May	0.5	0.4	—	—	<0.1	<0.1	100.0	13.9	0.1	0.2
10-May	0.2	0.2	—	0.7	<0.1	<0.1	0.2	8.6	0.1	0.1
17-May	0.2	0.3	0.0	0.1	<0.1	<0.1	0.7	2.5	0.2	0.1
24-May	1.2	1.2	0.3	0.3	0.1	0.1	0.5	1.8	0.6	0.6
31-May	0.5	0.4	1.0	1.0	0.1	0.1	1.4	3.7	0.2	0.8
7-Jun	0.3	0.8	1.3	1.1	0.1	0.1	2.2	5.9	0.2	1.0
14-Jun	0.2	0.3	0.3	0.3	0.2	0.2	6.6	4.7	0.2	0.3
21-Jun	0.0	0.0	0.1	0.1	0.0	0.0	—	0.0	0.0	0.1
28-Jun	3.1	0.0	0.1	0.1	0.2	0.0	10.0	—	0.4	0.1
5-Jul	0.0	0.0	0.1	0.4	0.4	2.0	—	100.0	0.0	0.3
12-Jul	—	0.0	0.3	0.6	2.3	—	—	100.0	0.0	0.6
19-Jul	—	—	0.7	1.0	0.0	0.0	—	—	—	1.0
26-Jul	—	—	1.8	1.1	0.0	—	—	30.0	10.0	1.2
2-Aug	—	—	1.4	1.2	0.0	—	—	—	11.1	1.2
9-Aug	—	—	0.8	0.8	0.0	0.0	—	—	16.7	0.8
16-Aug	100.0	—	1.7	1.1	—	0.0	—	—	—	1.2
23-Aug	—	—	1.5	0.6	0.0	0.0	100.0	—	0.0	0.7
30-Aug	—	—	6.0	3.2	0.0	0.0	—	0.0	—	3.4
6-Sep	—	—	4.7	1.3	—	—	0.0	—	—	1.6
13-Sep	—	—	8.6	12.3	—	—	—	0.0	—	12.1
20-Sep	—	—	18.2	14.3	—	—	—	100.0	—	16.7
27-Sep	—	—	—	0.0	—	—	—	—	—	0.0
4-Oct	—	—	0.0	0.0	—	—	—	0.0	—	0.0
11-Oct	—	—	0.0	1.6	—	—	—	—	—	1.4
18-Oct	—	—	0.0	0.8	—	—	0.0	0.0	—	0.8
25-Oct	—	—	0.0	0.0	—	0.0	—	0.0	—	0.0
1-Nov	—	—	0.0	0.0	—	0.0	0.0	0.0	—	0.0
4-Oct	—	—	0.0	0.0	—	—	—	0.0	—	0.0
Median Weekly Rate	0.0	0.3	0.5	0.7	0.0	0.0	0.2	2.0	0.2	0.6

[1]Total facility mortality includes facility, sample and raceway mortality.
Note "-----" indicates that the species group was not present in the sample during the week

Table 21. Annual sample mortality as percent of total sample at Little Goose Dam JFF, 2013-2018.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho		Pacific Lamprey	
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total	Ammocoetes	Macropthalmia
2013	0.2	0.1	0.3	0.8	0.1	0.1	0.0	4.1	0.0	0.6	3.8	1.9
2014	0.3	0.3	0.3	0.8	0.2	0.1	1.7	4.7	0.4	0.6	20.4	5.6
2015	0.2	0.5	0.3	0.9	0.2	0.2	2.0	0.0	0.0	0.6	20.0	4.1

2016	0.3	0.2	0.4	0.4	0.2	0.1	4.0	0.0	0.1	0.4	8.6	3.8
2017	0.5	0.4	0.4	0.7	0.2	0.1	0.0	12.1	0.2	0.5	4.6	2.3
2018	0.3	0.6	0.7	0.9	0.1	<0.1	0.8	3.0	0.4	0.6	2.6	4.3

Note: Mortality rate in sampled fish excludes research, raceway, and separator mortalities. Includes GBT sample fish. Pacific lamprey mortalities are not included in the total mortalities to facilitate across year comparisons. In 2014, the sample mortality rate for Pacific lamprey ammocoete includes 2 unknown ammocoetes.

Incidental Species

The total incidental fish collection was determined by using the sample rate to expand the number of incidental fish in the sample and adding the number of incidental fish removed from the separator to the expanded sample count. Incidental species were counted individually, except when handling large numbers of Siberian prawn. When the number of Siberian prawn was too large to practically count each individual, a weekly fish per pound calculation was obtained for these species; the result was then multiplied by the daily weight of the sampled species to obtain an estimated count for the day. All sampled incidental fish were returned to the river except for Siberian prawn. Siberian prawns that occurred in the sample were euthanized per the directive issued by Washington Department of Fish and Wildlife on July 24, 2007. All Siberian prawns from the sample were frozen and disposed into a landfill.

When the sample rate was less than 100%, incidental species were inadvertently collected and transported along with the smolts. Therefore, when the sample rate was below 100%, incidental fish species were weighed, and the average weight was applied to the expanded sample count to determine their contribution to transport loading densities. When the sample rate was at 100%, all incidental species, except Siberian prawns, were collected and returned to the river.

Incidental collections totaled 155,891. This included an expanded sample count of 116,723 fish and 11,159 Siberian prawns, plus 28,009 fish from the separator (Table 22). Collection for sampling in 2018 began on March 01 compared to April 01 in previous years. Incidental collection totaled 931 during the month of March, which included 395 from the sample and 536 from the separator. Also, due to the suspension of truck transport between September 16 and October 13, incidental collection totals do not include data from the 19 non-sample days during that period when the system was in primary bypass.

For the third consecutive year, juvenile American shad collection totals were substantially higher than previous years and accounted for the majority of total incidental collection numbers, though they were lower than in 2016 and 2017. Of the 91,725 juvenile American shad collected for the season, 76,799 (83.7%) occurred between October 3 and November 1. Collection totals for Siberian prawns were the lowest since 2009. Numbers of largemouth bass (*Micropterus salmoides*), Pacific lamprey ammocoete, Pacific lamprey macropthalmia, mountain whitefish (*Prosopium williamsoni*), and sculpin (*Cottus sp.*) were much higher than the 2013–2017 average (Table 23), while collection numbers for crappie (*Pomoxis sp*.), kokanee (*Oncorhynchus nerka*), northern pikeminnow (*Ptychocheilus oregonensis),* peamouth *(Mylocheilus caurinus),* sand roller *(Percopsis transmontana),* and Siberian prawn were much lower. Collection totals for most other groups that contribute substantial numbers to the incidental collection were similar to those in 2017.

This year saw a high number of juvenile *Oncorhynchus mykiss* too large to fit through the separator bars. Because it could not be determined in some cases if these fish were rainbow trout

or residualized steelhead, they were all reported simply as "*O. mykiss*" and are included in the totals for rainbow trout in Tables 22 and 23.

Adult Pacific lamprey (*Entosphenus tridentatus*) collections totaled 137 in 2018, 123 from the separator and raceways and 14 from the sample. The first adult Pacific lamprey of the season was collected March 22 and the last on October 20. Upriver adult migrants were most frequently observed falling back into the collection system from July through August. For the sixth consecutive year, USACE transported all adult Pacific lamprey captured at the facility to above the dam, releasing them at Little Goose Landing. In addition, to avoid exposure to sampling anesthesia, any adult Pacific lamprey found in the sample tanks were removed by USACE, ODFW, or Anchor QEA personnel prior to SMP sampling.

Table 22. Collection of incidental species at Little Goose Dam, 2018.

Common Name	Scientific Name	Expanded Sample	Separator	Total Collection [1]
American shad	*Alosa sapidissima*	67,448	24,277	91,725
Banded killifish	*Fundus diaphanus*	0	0	0
Bass—smallmouth	*Micropterus dolomieu*	2,849	90	2,939
Bass—largemouth	*M. salmoides*	28	0	28
Bullhead	*Ameiurus* sp.	570	4	574
Bull trout	*Salvelinus confluentus*	0	0	0
Channel catfish	*Ictalurus punctatus*	47	52	99
Chiselmouth	*Acrocheilus alutaceus*	50	7	57
Common carp	*Cyprinus carpio*	26	77	103
Crappie	*Pomoxis* sp.	1,288	2,519	3,807
Dace	*Rhinichthys* sp.	3	0	3
Kokanee	*Oncorhynchus nerka*	1	0	0
Lamprey Adult-Pacific	*Entosphenus tridentatus*	14	123[2]	137
Lamprey ammocoete-Pacific	*E. tridentatus*	4,794	0	4,794
Lamprey macropthalmia-Pacific	*E. tridentatus*	31,332	0	31,332
Mountain whitefish	*Prosopium williamsoni*	3,180	9	3,189
Northern pikeminnow	*Ptychocheilus oregonensis*	0	0	0
Peamouth	*Mylocheilus caurinus*	612	95	707
Rainbow trout	*O. mykiss*	225	111	336
Redside shiner	*Richardsonius balteatus*	0	0	0
Sand roller	*Percopsis transmontana*	73	65	138
Sculpin	*Cottus* sp.	2,908	0	2,908
Siberian prawn	*Exopalaemon modestus*	11,159	0	11,159
Sucker	*Catostomus* sp.	536	261	797
Sunfish[3]	*Lepomis* sp.	702	34	736
Tadpole madtom	*Noturus gyrinus*	1	0	1
Walleye	*Stizostedion vitreum*	11	159	170
White sturgeon	*Acipenser transmontanus*	0	20	20
Yellow perch	*Perca flavescens*	14	106	120
Other[5]	—	11	0	11
Total		**127,882**	**28,009**	**155,891**

[1] Collection totals are estimated by expanding the sample counts, then adding the separator counts. Numbers include live and dead incidental fish.

[2] Number includes adult lamprey removed from the separator and from raceways.

[3] "Sunfish collection total includes bluegill/pumpkinseed and warmouth.

Table 23. Numbers of incidental species collected at Little Goose Dam JFF, 2013-2018.

Common Name	Scientific Name	2013	2014	2015	2016	2017	2018	2013-2017 Average
American shad	*Alosa sapidissima*	6,678	1,799	5,634	157,259	136,814	91,725	61,637
Banded killifish	*Fundus diaphanous*	117	111	53	0	1	0	56
Bass, smallmouth	*Micropterus dolomieu*	1,279	3,528	2,102	2,992	8,977	2,939	3,776
Bass, largemouth	*M. salmoides*	2	3	1	13	5	28	5
Bullhead	*Ameiurus* sp.	291	235	284	166	1,263	574	448
Bull trout	*Salvelinus confluentus*	6	4	0	10	1	0	4
Channel catfish	*Ictalurus punctatus*	381	204	440	80	91	99	239
Chiselmouth	*Acrocheilus alutaceus*	6	10	7	19	3	57	9
Common carp	*Cyprinus carpio*	96	102	44	49	296	103	117
Crappie	*Pomoxis* sp.	1,139	887	9,407	3,135	38,778	3,807	10,669
Dace	*Rhinichthys* sp.	3	19	3	0	6	3	6
Goldfish	*Carassius auratus*	0	0	0	0	0	0	0
Kokanee	*Oncorhynchus nerka*	0	14	1	101	4	0	24
Lamprey adult, Pacific	*Entosphenus tridentatus*	28	77	163	117	232	137	123
Lamprey ammocoete, Pacific	*E. tridentatus*	525	2,495	89	1,592	5,157	4,794	1,972
Lamprey macropthalmia, Pacific	*E. tridentatus*	55,077	18,673	8,155	33,631	2,431	31,332	23,593
Mountain whitefish	*Prosopium williamsoni*	324	163	271	81	973	3,189	362
Northern pikeminnow	*Ptychocheilus oregonensis*	41	43	32	29	106	0	50
Peamouth	*Mylocheilus caurinus*	1,292	864	1,230	512	4,687	707	1,717
Rainbow trout[2]	*O. mykiss*	0	8	27	2	25	336	12
Redside shiner	*Richardsonius balteatus*	0	0	0	0	0	0	0
Sand roller	*Percopsis transmontana*	6,241	3,681	1,603	294	559	138	2,476
Sculpin	*Cottus* sp.	1,239	391	1,836	633	199	2,908	860
Siberian prawn	*Exopalaemon modestus*	45,015	81,310	464,586	51,518	31,668	11,159	134,819
Sucker	*Catostomus* sp.	1,353	1,062	1,631	504	1,225	797	1,155
Sunfish[3]	*Lepomis* sp.	865	791	263	501	1,182	736	720
Tadpole madtom	*Noturus gyrinus*	8	3	4	3	1	1	4
Walleye	*Stizostedion vitreum*	9	14	27	65	110	170	45
White sturgeon	*Acipenser transmontanus*	16	27	11	15	4	20	15
Yellow perch	*Perca flavescens*	17	14	63	78	77	120	50
Other[4]	—	7	52	52	2	0	11	23
Total		**122,055**	**116,584**	**498,019**	**253,401**	**234,875**	**155,891**	**244,987**

Notes:
Numbers include expanded sample counts and separator releases.
[1] No data on incidentals exist for 19 days between September 16 and October 13 in 2018 due to the system being in primary bypass.
[2] Starting in 2018, includes all juvenile O. mykiss too large to fit through the separator bars.
[3] Sunfish include bluegill/pumpkinseed and warmouth.
[4] "Other" fish include expanded counts of live non-salmonid and unidentifiable/decomposed non-salmonid.

Research

ODFW and USACE personnel provide various types of research assistance during the fish passage season. Typically, ODFW provides research specimens that are collected on site via

the sample. The summaries below describe each research or monitoring project that occurred at LGS in 2018.

Gas Bubble Trauma Monitoring

GBT monitoring was performed by Pacific States Marine Fisheries Commission biological technicians from LMN. When juvenile salmonid numbers permitted, a maximum of 100 fish were examined. Sampling occurred weekly from April 08 through July 24, 2018, when GBT monitoring was discontinued due to small sample sizes. Sampling was designed to determine the relative proportion of migrating juvenile salmonids passing the dam that exhibited symptoms of GBT in the unpaired fins and eyes.

A total of 1,583 smolts were handled by Pacific States Marine Fisheries Commission GBT personnel in 2018. Twenty-eight fish had been previously PIT-tagged and were enumerated and released without examination. A total number of 1,555 smolts were examined for GBT. Of those, 46.0% were subyearling Chinook salmon, 22.7% were yearling Chinook salmon, and 31.3% were steelhead smolts. Of those examined, 1.4% (21) showed signs of GBT. The total GBT mortality rate was 0.0% of the 1,583 smolts handled.

PNNL Juvenile Salmon and Steelhead Passage and Survival through the Snake and Columbia River Hydropower System and Adult Salmonid Passage at Little Goose Dam during Spring Gas Cap Spill

The primary goals of this study were to evaluate the effects of increased spill on: 1) passage, in-river survival, and travel time of yearling Chinook salmon and juvenile steelhead migrating through the Snake and Columbia River hydrosystem; 2) passage routing, survival, and tailrace egress time at LGS; and 3) passage of adult Chinook salmon and steelhead at LGS during gas cap spill in the spring of 2018. Yearling Chinook salmon, subyearling Chinook salmon and juvenile steelhead were collected from the daily sample at LWG to be tagged with PIT and acoustic tags and then released above or below LWG. Tagged yearling Chinook salmon, subyearling Chinook salmon and juvenile steelhead used for the LWG passage and survival study were also used to estimate passage and survival through LGS. In addition, adult spring Chinook salmon and steelhead were collected at Ice Harbor Dam and implanted with acoustic and PIT tags and released upstream of Ice Harbor Dam. Receivers deployed in the LGS tailrace near ladder entrances and in the fishway were used to evaluate adult Chinook salmon and steelhead passage metrics. The number of fish taken from the daily sample at LWG is reported in the Anchor QEA LWG annual report.

Sample System/PIT Tag System

The PIT tag detection and diversion systems at the lower Snake and Columbia River dams are maintained and operated by the Pacific States Marine Fisheries Commission. PIT tagged salmonids have been monitored for movement and behavior in the Columbia and Snake rivers since 1987. At Little Goose Dam, there are 11 PIT tag monitors located throughout the JFF. Further discussion of the PIT Tag System, including the Divert During Sample (DDS) system, can be found in the Facility Operations & Maintenance portion of this report.

Miscellaneous Monitoring

Juvenile Lamprey Monitoring

Beginning in 2011, all SMP sites were directed to report juvenile lamprey collections in more detail. Lamprey numbers are not included in the overall salmonid mortality data in this report, but have been added to the mortality tables for future years' comparisons (Tables 19 and 21). The lamprey ammocoete total mortality rate in 2018 was 0.1%, from a total collection count of 4,681 lamprey ammocoetes. The total mortality rate for Pacific lamprey macropthalmia this year was 0.1%, from a collection total number of 30,881 Pacific macropthalmia. No notable peak in total facility mortality for either life stage of juvenile lamprey was observed.

Mussel Monitoring

USACE personnel at the Little Goose JFF monitored the facility for both zebra mussel *Dreissena polymorpha* and quaggu mussel *Dreissena rostriformis bugensis* infestations. The mussel monitor is a piece of substrate suspended in the adult fish ladder near the ladder exit. There were no zebra or quaggu mussels observed during the 2018 season.

Turbine Strainers

USACE continued to monitor turbine unit strainers this year at LGS. Strainers are located in the piping associated with the cooling water intake valve for each of the six turbine units. Strainers were rotated and flushed weekly by USACE staff. Inspections took place at least once per month in accordance with the Fish Passage Plan. USACE staff inspected for any fish entrapment, particularly juvenile lamprey and results were reported monthly to District biologists.

Avian Predation and Behavior

Avian activity was monitored and recorded at LGS by USACE and Anchor QEA. New bird protocols documenting bird behavior were established and implemented in 2012 and revised in 2014 by the USACE Fisheries Field Unit. One of the main goals of the avian data collection process is to standardize bird survey methodologies amongst the eight Federal Columbia River Power System hydro-projects. Collecting behavioral data will augment existing historical bird data and aid in bird hazing activities during the smolt outmigration.

Anchor QEA personnel conducted avian surveys daily from March 01 through November 2, 2018. Surveys were typically conducted between 1100 and 1400 during the juvenile fishway inspection. Piscivorous birds present in 2018 included seagulls, double crested cormorants, American white pelicans, bald eagles, osprey and red-tailed hawks. Only two specific bird behaviors were recorded this year—foraging and non-foraging—compared to the loafing/resting (on land or water), flyby, scavenging, and predating behaviors previously recorded.

As in previous years, copies of the juvenile inspection form were forwarded to project USACE biologists. Survey results, along with the USACE survey results, were entered into a USACE database by USACE fishery personnel and included in weekly reporting.

Juvenile Facility Operations & Maintenance

The juvenile fish bypass system was inspected at a minimum twice daily during the fish passage season. The juvenile bypass system and the collection facility were heavily impacted by debris, and some components, such as the Vertical Barrier Screen (VBS), failed making 2018 a challenging year for safe fish passage.

Forebay Debris/Trashracks

The surface area covered by debris and its location in the forebay was estimated daily by Anchor QEA personnel during juvenile bypass system and adult fishway inspections. In 2014, the trash sheer boom cable separated rendering the equipment ineffective. It was repaired in 2018 prior to the start of the season. Consequently, this year all forebay debris was recorded as outside trash sheer boom, inside trash sheer boom, or in front of the spillway. All debris passed through the project via spill, turbine intakes, or the juvenile collection system. Minimal to moderate accumulations of woody debris averaging 3,382 square feet and ranging from 0 to 25,000 square feet were present in the forebay from April through June which caused various debris-related issues within the juvenile collection system and likely contributed to the relatively higher juvenile fish mortality rate in 2018. Orifice blockages were frequent and numerous from April through June. Increased orifice rotations were necessary to decrease debris accumulations within the juvenile collection system this year. Forebay debris decreased to minimal amounts after June averaging 89 square feet from July 1 through November 1. The decrease in debris may have been correlated to opening and/or detaching the portion of the boat barrier directly upstream of the Adjustable Spillway Weir (ASW) on June 04.

Spillway Weir

The ASW was placed into operation on April 03 in the high crest (622 ft. msl) position. The SW was placed into low crest position (618 ft. msl) on April 08. The SW was placed back into the high crest position on June 11. The SW was closed daily from 04:00 through 16:00 from July 26 through August 1 per regional guidance, but failed to open on July 28. Repairs were conducted and the SW returned to service on July 31. The spillway weir was removed from service for the 2018 season on August 03.

Turbine Operation

Efforts were made to operate all turbine units within 1% limitation of best efficiency from April 1 to October 31. There were numerous scheduled and unscheduled turbine unit outages during the fish passage season. Unit out of service (OOS) and return to service (RTS) dates, times and descriptions are listed in Table 24.

Table 24. Little Goose turbine unit outages, 2018.

Turbine Unit	Date OOS	Date RTS	Description
Unit 1	27-NOV-07:15	04-JAN-14:53	Annual Maintenance
	08-JAN-18:30	09-JAN-06:30	Boats and diving in forebay
	09-JAN-17:00	10-JAN-05:45	Boats and diving in forebay
	10-JAN-10:50	10-JAN-17:15	Diving in forebay
	22-JAN-07:05	22-JAN-16:20	Boats and diving in forebay

	21-FEB-07:05	21-FEB-10:15	ESBS install
	12-MAR-08:00	12-MAR-14:30	Trash raking
	16-MAR-08:10	16-MAR-16:10	Trolley pipe install
	19-MAR-10:00	19-MAR-13:15	Tailrace work
	16-APR-06:56	16-APR-10:09	Trash raking
	17-APR-09:29	17-APR-15:24	Trash raking
	18-APR-09:47	18-APR-11:12	Trash raking
	01-MAY-12:40	01-MAY-13:01	VBS/ESBS inspection
	01-MAY-17:43	02-MAY-14:29	Head cover pumps not keeping up
	19-MAY-07:05	19-MAY-10:50	Trash raking
	29-MAY-08:12	29-MAY-11:05	Trash raking
	11-JUN-08:03	11-JUN-16:40	VBS inspections / Trash raking
	28-JUN-07:05	28-JUN-15:50	Line outage to repair BRK supplying fish facility
	17-JUL-08:50	17-JUL-10:30	ESBS/VBS inspections
	06-AUG-05:40	09-AUG-19:10	Doble testing
	04-SEP-08:45	04-SEP-13:00	Spillgate inspection
	05-SEP-08:25	05-SEP-11:30	Spillway inspection
	06-SEP-08:45	06-SEP-12:55	Spillway inspection
	06-OCT-23:05	07-OCT-14:45	Unit tripped on 15KV ground
	09-OCT-19:00	18-OCT-17:30	Unit tripped on 15KV ground
	22-NOV-06:46		Unit tripped on 15KV ground
Unit 2	10-JAN-10:50	10-JAN-17:15	Boats and diving in forebay
	13-FEB-09:15	13-FEB-10:36	Trash raking
	13-FEB-10:36	15-FEB-16:00	Brakes not releasing on start up
	21-FEB-10:05	21-FEB-13:10	Forebay work
	12-MAR-12:10	12-MAR-16:45	Trash raking
	16-MAR-08:10	16-MAR-16:10	Trolley pipe install
	19-MAR-10:00	19-MAR-13:15	Trolley pipe install
	18-APR-09:47	18-APR-13:04	Trash raking
	09-MAY-15:42	09-MAY-15:57	Tripped on loss of AC power during PH switching due to lack of DC turbine oil pump
	14-MAY-08:27	14-MAY-08:44	Forced OOS unit 86 lockouts during P/H switching
	19-MAY-07:05	19-MAY-13:05	Trash raking
	29-MAY-10:05	29-MAY-13:16	Trash raking
	11-JUN-08:03	11-JUN-16:40	VBS inspections / Trash raking
	12-JUN-06:55	12-JUN-08:55	VBS inspections / Trash raking
	28-JUN-06:56	28-JUN-15:51	Line outage to repair BRK supply to fish facility
	12-JUL-17:38	13-JUL-07:15	86GX lockout trip
	17-JUL-07:30	17-JUL-08:35	ESBS inspections
	06-AUG-05:40	09-AUG-19:10	Doble testing
	04-SEP-08:45	04-SEP-13:00	Spillgate inspections
	05-SEP-08:25	05-SEP-11:30	Spillgate inspections
	06-SEP-08:45	06-SEP-12:55	Spillway inspection
	28-SEP-15:48	28-SEP-16:15	Unit tripped due to loose wire in gov control cab
	01-OCT-07:43	22-OCT-13:58	Scheduled annual maintenance
	23-NOV-10:11	29-NOV-16:40	

	30-NOV-21:20	30-NOV-21:30	Tripped on protective relay
	18-DEC-06:30		
Unit 3	11-JAN-09:10	11-JAN-16:45	Boats and diving in forebay
	13-FEB-09:15	13-FEB-13:38	Trash raking
	21-FEB-13:20	21-FEB-16:20	Fish screen install
	01-MAR-17:26	02-MAR-16:45	Bad fish screen
	12-MAR-14:15	12-MAR-16:50	Trash raking
	18-APR-12:16	18-APR-14:20	Trash raking
	23-APR-16:05	01-MAY-16:33	Oil Leak
	19-MAY-10:58	19-MAY-15:35	Trash raking
	29-MAY-12:10	29-MAY-14:25	Trash raking
	05-JUN-07:13	05-JUN-09:17	Orifice 3A1 Camera inspection
	12-JUN-06:55	12-JUN-11:50	Trash raking/VBS inspection
	28-JUN-06:56	28-JUN-15:51	Line outage to repair BRK supply to fish facility
	16-JUL-08:46	16-JUL-11:30	ESBS/VBS inspections
	06-AUG-05:40	09-AUG-19:10	Doble Testing
	10-OCT-06:58	12-OCT-19:18	All units OOS to de-energize line and open T1 disconnects. 15KV ground on unit 1.
	15-OCT-12:08	17-OCT-19:10	De-energized line to isolate T1 so unit 1 could be tied to XFMR
Unit 4	11-JAN-09:10	12-JAN-15:40	Boats and diving in forebay
	23-JAN-14:00	23-JAN-17:00	Boats and diving in forebay
	05-FEB-09:46	05-FEB-17:14	Shear boom install
	06-FEB-07:14	06-FEB-17:50	Shear boom install
	07-FEB-09:25	07-FEB-17:55	Shear boom install
	13-FEB-12:14	13-FEB-15:29	Trash raking
	15-FEB-10:30	15-FEB-18:10	Shear boom install
	20-FEB-12:05	20-FEB-16:10	ESBS install
	15-MAR-08:01	15-MAR-17:01	Forebay work
	03-APR-23:00	05-APR-08:20	Problem with PLC for digital gov
	18-APR-13:39	18-APR-16:08	Trash raking
	01-MAY-11:06	01-MAY-12:02	VBS inspection
	19-MAY-13:15	19-MAY-15:35	Trash raking
	29-MAY-13:20	29-MAY-15:35	Trash raking
	12-JUN-09:05	12-JUN-17:00	VBS inspection/Trash raking
	12-JUN-17:00	22-JUN-11:30	Torn VBS “C” slot
	28-JUN-06:56	28-JUN-15:51	Line outage to repair BRK supply to fish facility
	16-JUL-08:25	16-JUL-11:30	ESBS/VBS inspections
	06-AUG-05:20	09-AUG-19:10	Doble Testing
	05-SEP-11:45	05-SEP-15:00	Spillway inspection
	10-SEP-07:30	27-SEP-15:39	Annual outage
	10-OCT-06:58	12-OCT-19:18	All units OOS to de-energize line and open T1 disconnects. 15KV ground on unit 1.
	15-OCT-12:08	17-OCT-19:10	De-energized line to isolate T1 so unit 1 could be tied to XFMR
Unit 5	14-APR-2017-07:00		Spider and upper guide bearing repair

Unit 6	10-JAN-09:00	10-JAN-10:40	Boats and diving in forebay
	12-JAN-09:00	12-JAN-10:00	Boats and diving in forebay
	22-JAN-07:05	22-JAN-16:20	Boats and diving in forebay
	05-FEB-09:46	05-FEB-17:14	Shear boom install
	06-FEB-07:14	06-FEB-17:50	Shear boom install
	08-FEB-07:32	08-FEB-16:35	Shear boom install
	09-FEB-08:21	09-FEB-17:20	Shear boom install
	14-FEB-10:15	14-FEB-12:30	Shear boom install
	16-FEB-07:10	16-FEB-12:00	Shear boom install
	20-FEB-07:10	20-FEB-15:10	Shear boom install
	15-MAR-08:01	15-MAR-17:01	Forebay work
	29-MAR-07:02	29-MAR-18:14	Trash shear boom work
	19-APR-07:20	19-APR-16:30	Trash raking
	01-MAY-09:04	01-MAY-10:22	VBS inspection
	08-MAY-07:09	08-MAY-07:30	Loss of TURB BRG oil level sensor caused trip
	14-MAY-08:27	14-MAY-08:44	PH switching would cause trip due to loss of TURB BRG oil level sensor caused trip
	19-MAY-15:45	19-MAY-16:40	Trash raking
	29-MAY-14:43	29-MAY-16:48	Trash raking
	05-JUN-09:10	05-JUN-09:17	S/D during switching to prevent auto trip
	06-JUN-07:25	06-JUN-07:33	S/D during switching to prevent auto trip
	12-JUN-12:10	12-JUN-15:30	VBS inspection/Trash raking
	28-JUN-06:56	28-JUN-07:05	Line outage to repair BRK supply to fish facility
	28-JUN-15:43	28-JUN-15:51	Line outage to repair BRK supply to fish facility
	09-JUL-07:38	02-AUG-07:38	Annual maintenance
	06-AUG-05:20	06-AUG-17:01	Doble testing
	07-AUG-04:59	07-AUG-16:20	Doble testing
	08-AUG-05:00	08-AUG-16:17	Doble testing
	09-AUG-05:06	09-AUG-19:10	Doble testing
	05-SEP-11:45	05-SEP-15:00	Spillway inspection
	10-OCT-06:58	10-OCT-07:30	Line outage to isolate T1 and unit 1 due to 15KV ground for troubleshooting
	11-OCT-09:28	11-OCT-17:04	Line outage for T1 Unit 1 15KV ground work
	12-OCT-07:01	12-OCT-19:18	Line outage for T1 Unit 1 15KV ground work
	15-OCT-12:08	15-OCT-12:20	Line outage for T1 Unit 1 15KV ground work
	17-OCT-07:34	17-OCT-19:10	Line outage for T1 Unit 1 15KV ground work

Extended-Length Submersible Bar Screens (ESBS)

All ESBS performed satisfactorily for the majority of the season. Fish screen 3C failed on March 01 due to a faulty cleaning brush motor. All screens were removed for the end of fish passage season during the week of December 17. Drawdown inspections across trashracks and ESBS/VBS were performed according to the FPP. All inspections measured within criteria throughout the season. Video inspections and manual operation inspections showed all screens in good operating condition.

Vertical Barrier Screens (VBS)

Inspections of all VBS were performed by underwater video camera per FPP requirements. Underwater camera inspections occurred on March 12 and 14 for all Units except Unit 5 in conjunction with trash raking. Unit 5 ESBS screens are stored in a position that does not allow underwater inspections. Underwater inspections also occurred on June 12 and found VBS damage in 4C. Additional inspections were conducted during Unit annual maintenance. Worn screens were repaired or replaced. Screens will continue to be replaced with new during Unit annual maintenance.

Gatewells

Gatewells were checked for debris and oil contamination daily. As needed, debris was removed using a dip basket or grappling hook. In 2018, the occasional oil films were observed on the water surface in several gatewells similar to previous years. Some oil films appeared to be petroleum based and may have been produced, in part, from rain-washed oil/grease residue associated with mechanical equipment and vehicles. Fish salvages occurred in gatewells 4C and 6C for VBS repairs during 2018.

Orifices and Collection Channel

The collection channel was operated throughout the season with 18 to 22 open orifices depending on forebay elevations. Orifices were inspected and/or back-flushed two to five times per day. All orifice operations were manually performed throughout the year.

The collection channel was dewatered and removed from service on December 19. Fish salvage operations during the dewatering included releasing approximately 100 adult steelhead, 10 juvenile Chinook salmon, 10 juvenile steelhead and 18 juvenile lamprey back to the river. An additional 2 juvenile lamprey mortalities were observed.

Primary Dewaterer/Primary Bypass Pipe

The primary dewatering structure and components functioned adequately throughout the season. Inspection of the primary dewaterer and manual operation of the cleaning brushes was performed twice daily. As in past years, the excess water was diverted to the adult fish channel pump chamber throughout the season to improve adult fish attraction and migration.

Bypass Flume/Pipe

The primary bypass flume functioned satisfactorily in 2018. During winter maintenance 2010, the flume outfall was relocated from near shore to mid channel. The relocation extended the release site approximately 400 feet north into the river mid-channel. This new section of outfall is made of 36 inch corrugated metal pipe. The new point of release returns bypassed fish farther from the shoreline and in an area of higher velocity to reduce exposure to piscivorous predation. The flume was inspected during the winter maintenance period and observed in overall good condition and found free of obstructions and rough edges.

Separator

The separator was operated similar to previous years. The water level was kept about one to two inches above the downstream end of the B-side separator bars. During the winter maintenance period, the interior and exterior surfaces of the separator were cleaned and refurbished. There was one separator cleanout in 2018. On June 06 from 12:00 to 14:15, fish were routed to the river and debris was removed from the separator.

Sample System/PIT Tag System

The PIT tag detection and diversion systems at the lower Snake and Columbia River dams are maintained and operated by the Pacific States Marine Fisheries Commission. PIT tagged salmonids have been monitored for migration in the Columbia and Snake rivers since 1987. At Little Goose Dam, there are 11 PIT tag monitors located throughout the JFF.

In previous years, the state of the Divert During Sample (DDS) system was manually changed by USACE project biologists and technicians based upon fish passage and sample rates. However, in 2012, the DDS system was upgraded during the winter maintenance period to allow for automatic changes of operational mode per entry of the sample rate. However, the system still retains the ability to override the automation and change the system manually.

At low sample rates ($\leq$20%), when large numbers of fish are passing through the system, the DDS setting is deactivated. When the DDS is deactivated, the PIT tag slide gate will not open when the sampling system is engaged. This setting helps avoid potential sample bias caused by diverting large numbers of untagged fish, along with the targeted PIT tagged fish, away from the sample during a sampling event. At sample rates greater than or equal to 20%, (low numbers of fish passing through system), the potential for sample bias is lower and the DDS system is set to "On" or activated.

DDS settings for the A and B side sample tanks followed recommendations for most of the season. Minute deviations (hundredths of a second) typically occur daily at approximately 0700 as a result of equipment operation as the facility prepares for a new 24 hour sampling period. In addition, deviations from the recommended settings occur when debris removal is conducted at the separator. During a separator clean out, large volumes of fish and debris are flushed from the separator and thus it becomes essential to turn the DDS off. Only one separator cleanout was conducted this year on June 06. The facility was placed into primary bypass between 12:00 and 14:15 for the cleanout. The sample rate was less than 20%, so the DDS system was off and did not need adjustment. There were no problems with the DDS system in 2018.

Pit Tag Detections

The Passive Integrated Transponder (PIT) tag detection system records data on PIT tagged salmonids as they pass through the juvenile collection system. The PTAGIS database categorized all PIT tag detections based upon species, race, and clip/rearing type. An additional "orphan" category was used for detections of PIT tags for which the database contained no record of tagging and release. Fish dispositions were categorized based upon exit monitor detections: 1) to the river, 2) to transport holding areas, 3) to the smolt monitoring sample, and 4) unknown. This last category included final detections of PIT tagged fish at locations that did not constitute an exit from the facility.

From March 01 through November 01, 2018, a total of 144,200 PIT-tagged fish were detected within the juvenile collection/bypass system: 71,192 Chinook salmon, 66,417 steelhead, 4,168 sockeye salmon, 1,857 coho salmon, 565 orphans of unknown species/rearing type and 1 Pacific lamprey (*Entosphenus tridentatus)*. Of the total number of detections, 65.8%, or 94,849 fish, were routed to the river, and 35.5%, or 48,336 fish, were routed to transport areas. PIT-tagged fish in the subsample were treated as the other fish in the sample and were either routed back to the river, if the facility was operating in secondary bypass mode, or routed to a transport holding area when the facility was operating in collection mode. Approximately 0.6% of the PIT-tagged fish detected at LGS, or 920 PIT-tagged smolts, were last detected in the sample; 85.0% (782) were transported and 15.0% (138) were returned to the river during pre-transport operations or while operating in secondary bypass mode. Prior to the start of the transportation season, all PIT-tagged fish were bypassed to the river. Approximately 23.8%, or 34,282, of the total PIT-tagged fish detected were detected prior to the start of collection for transportation.

Avian Predation Deterrence

USDA Animal and Plant Health Inspection Service (APHIS) began bird hazing activities in 1999. In 2018, APHIS bird hazing activities at Little Goose took place from April 2 through June 23. The hazing schedule included 8 hours per day, 7 days per week of land based hazing and 8 hours per day, 3 days a week of boat based hazing from April 02 through June 23. Additionally, a second 8 hour per day shift was conducted from April 15 through May 26. Bird hazing took place in the areas of the juvenile bypass outfall, spillway and powerhouse discharge areas, and areas where birds congregate or feed, ranging from about 2,000 feet upstream of the dam to as much as 1 mile downstream of the dam.

USACE Biologists and personnel from Anchor QEA conducted bird counts extending from the immediate tailrace and forebay to approximately one half mile upstream and downstream of Little Goose Dam and were broken into two zones; tailrace (T1) and forebay (FB1). Additional zones were monitored to include the newly installed trash shear boom, floating forebay debris, boat barrier and modified boat barrier. The modified boat barrier had buoy weights and bird spikes removed to allow debris to pass more easily.

Counts were conducted using binoculars 2 to 3 times daily from April 1 through October 31, 2018. Bird counts also monitored foraging and non-foraging activities of gulls, cormorants and terns. Maximum daily bird counts were utilized to tabulate weekly and annual reporting.

Avian counts did not reach the maximum thresholds allowed per the Fish Passage Plan from April 01 to August 31. However, gull counts exceeded the 100 bird threshold 1 time throughout the bird counting season, April through October. Of these occurrences, gulls counts never exceeded the threshold while APHIS personnel were actively hazing and only 1 time outside of the active hazing activities. Cormorant counts never exceeded the 50 bird threshold throughout the bird counting season. Lethal take was implemented with 76 gulls and 5 cormorant sacrificed during the 2018 season. Additional hazing by project personnel utilized bird scare products including propane scare cannons, bird bangers and bird screamers deployed intermittently throughout the remainder of the fish passage season. The water cannon located at the bypass outfall was used continuously throughout the season. Little Goose continued to use passive bird deterrent devices to include needle strips, bird wires and visual scare devices.

Total Counts

The maximum total daily bird count of 173 birds occurred on October 21 and consisted of gulls and cormorants. The average daily total count was 25.5 birds. A total of 5,558 birds were counted in 2018. Of the total birds counted, 3,324 were in the forebay, 1,896 were in the tailrace, 306 on the trash shear boom and 32 on forebay debris. No birds were seen on the boat barrier or modified boat barrier.

Gull Counts

The maximum total daily number of 154 gulls counted occurred on October 21. The average daily total count was 18.3 gulls. The maximum daily count in the forebay was 153 gulls and occurred on October 21 with a daily average of 11.3 gulls. The maximum daily count in the tailrace was 89 gulls and occurred on April 24 with a daily average of 7.3 gulls.

Double Crested Cormorant Counts

The maximum total daily number of 47 cormorants occurred on October 26. The average daily total count was 5.5 cormorants. The maximum daily count in the forebay was 38 cormorants and occurred on October 22 with a daily average of 4.7 cormorants. The maximum daily count in the tailrace was 38 cormorants and occurred on October 26 with a daily average of 0.9 cormorants.

Caspian Tern Counts

The maximum total daily number of 1 tern occurred on May 28. The average daily total count was 0 terns. The maximum daily count in the forebay was 1 tern and occurred on May 28 with a daily average of 0 terns. The maximum daily count in the tailrace was 0 terns and with a daily average of 0 terns.

Other Piscivorous Bird Counts

The maximum total daily number of 52 grebes occurred on October 07. The average daily total count was 1.5 grebes. The maximum total daily number of 9 pelicans occurred on September 13. The average daily total count was 0.2 pelicans.

Avian Foraging Behavior

Foraging behavior was monitored and recorded for gulls, cormorants and Caspian terns. Caspian terns had the highest overall percent of observed foraging behavior (100.0%) followed by gulls (37.4%) and cormorants (18.4%). Cormorants had the highest percent of feeding behavior in the tailrace (68.7%) followed by gulls (48.6%). Terns had the highest percent of feeding behavior in the forebay (100.0%) followed by gulls (30.4%) and cormorants (8.5%). Caspian terns were only observed one time at Little Goose and were only observed feeding in the forebay. The majority of all avian foraging occurs in the tailrace with resting, loafing and perching occurring in the forebay.

Facility Modifications

Several modifications and repairs were made prior to, during and after the 2018 season.

1. Adjusted the 36” butterfly valve in valve box B.
2. Repaired and replaced PIT tag gate components per requirements.
3. Repaired PIT tag pipe hangers.
4. Replace barge loading hose.
5. Repaired separator and resurfaced and painted various sections.
6. Repaired/replaced multiple ESBS screen cleaning motors.
7. Replaced foam between incline screen sections in the primary dewatering structure.
8. An Adjustable Spillway Weir (ASW) replaced the older Temporary Spillway Weir (TSW) during the 2017-2018 in water work period.
9. The trash shear boom was replaced and a boat barrier installed during the 2017-2018 in water work period.

Juvenile Facility Recommendations

1. Continue to write revisions and updates to the operations maintenance manual pertaining to new equipment and facility collection and transport procedures
2. Repair the trash/shear boom.
3. Continue to rebuild orifice valve cylinders.
4. Repair or replace corroded outer steel orifice pipe with stainless steel.
5. Review protocols yearly to ensure effective communication between all parties during truck/barge loading, dewatering events, separator cleanouts, etc. This will ensure that fish are properly routed, flush water is available for fish transfer, and that there is sufficient water in holding tanks
6. Continue to remove scale and rough edges in the facility flumes, tanks, and transition areas.

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