CENWW-ODG Snyder 14 March 2024

MEMORANDUM THRU:
Justin Stegal, Operations Project Manager, Little Goose Dam

FOR Chief, Operations Division
ATTN: Chris Peery

SUBJECT: Submission of 2023 Juvenile and Adult Fish Passage Report, Little Goose Dam.

1. Enclosed find the 2023 Juvenile and Adult Fish Passage Report for Little Goose Dam as requested.

2. If you have any questions contact Deb Snyder at Little Goose Dam, (509) 404-3263.

Deborah L. Snyder
Supervisory Fisheries Biologist, Little Goose Dam

Enclosure

2023 Juvenile and Adult Fish Passage Report
Little Goose Dam

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and

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Environmental Assessment Services

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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, 2023, to December 31, 2023. The adult fishway was in service from February 23, 2023, to January 3, 2024. Fish counting activities took place from April 01 to October 31, 2023. A total of 137 fishway inspections were conducted by U.S. Army Corps of Engineers (USACE), Environmental Assessment Services (EAS) 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 fallout 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 pull water from the tailrace to the intake chamber, which then gravity feeds various floor diffusers in the powerhouse channel and at the base of the fish ladder. Additional gravity-fed water 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 Four Peaks Environmental, under contract with the Corps, took place from March through December.

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 Little Goose Dam (LGS) in 2023. The data represented in this report was collected from March 26 through November 01, 2023 by USACE, EAS, 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

Below average winter precipitation, cool temperatures in early spring, and above average precipitation in late spring resulted in flows that were 96.6% of the 5-year average. Monthly flows were below the 5-year average in April, June, July, and August, above average in May and September, and close to the average in October. (Table 1). During the 2023 juvenile fish passage

Table 1. Comparisons of average monthly flow and spill in kcfs at Little Goose Dam JFF 2018-2023.

Month	2018	2019	2020	2021	2022	2023	2018 to 2022 Average
Flows (kcfs)							
March	57.3	--	--	--	--	34.1	--
April	91.8	117.0	54.5	45.6	39.3	51.6	69.64
May	133.8	118.3	105.2	61.7	80.2	132.2	99.84
June	80.8	93.2	93.3	52.6	130.0	68.1	89.98
July	37.6	38.5	46.9	26.8	44.4	34.6	38.84
August	28.5	28.3	28.6	22.5	27.9	25.5	27.16
September	21.8	24.5	22.5	18.7	19.6	22.4	21.42
October	17.8	21.3	19.5	15.9	14.6	17.7	17.82
Spill (kcfs)							
March	0.0	--	--	--	--	1.6	--
April	31.8	48.3	31.3	24.0	22.3	30.2	31.54
May	50.7	49.3	64.3	39.0	48.9	64.9	50.44
June	27.9	39.5	50.0	30.5	64.9	31.3	42.56
July	11.4	11.6	14.3	8.3	13.3	11.3	11.78
August	10.5	10.6	9.0	7.2	11.8	8.8	9.82
September	0.2	0.4	0.8	1.0	0.8	0.7	0.64
October	0.3	0.0	0.5	0.6	0.5	0.5	0.38

season—March 26 to November 1—the average daily flow was 49.9 kilo cubic feet per second (kcfs). The maximum average daily flow of 174.6 kcfs occurred on May 22, and the minimum average daily flow of 14.6 kcfs occurred on October 22 (Figure 1).

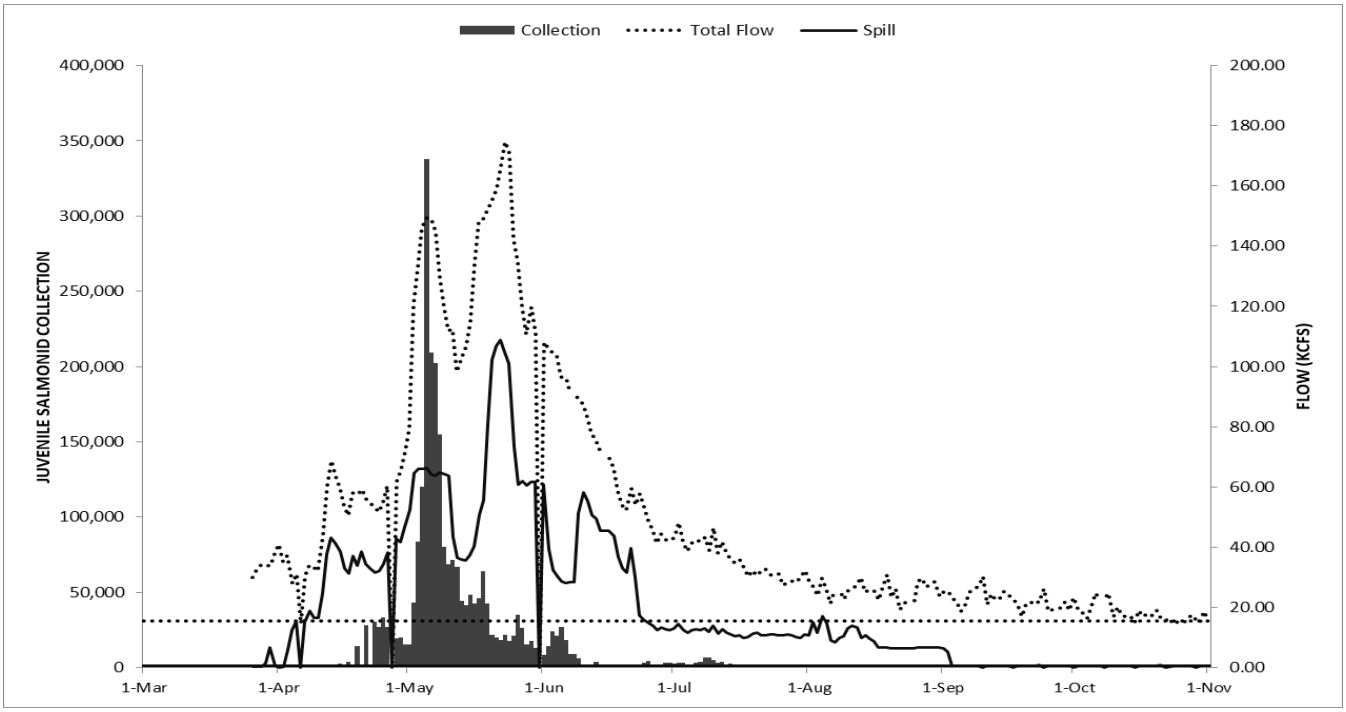

Figure 1. Total river flow, spill, and number of juvenile salmonids collected at Little Goose Dam during the fish collection and transport season, 2023

Spill to aid juvenile fish passage occurred from April 3 to August 31, in accordance with the 2023 FPP. In the years before 2018, the spill target was 30% of total flow from April 3 to August 31. Starting in 2018 and continuing through 2023, during the spring passage season (April 3 to June 20), spill at all four projects on the lower Snake River increased due to either court mandates or regional coordination under the Flex Spill Agreement (*NWF v. NMFS* 2018). In 2020, the spring spill total dissolved gas (TFG) water quality maximum allowed in the tailrace ("gas cap" spill) was increased from 120% to 125%. The spring spill operation was 16 hours per day of gas cap spill, and for the remaining 8 hours per day, spill could be reduced to 30%. Target spill remained 30% of total flow during the summer passage season (June 21 to August 31). In 2023, the target of 30% was not met for 10 days between June 21 and August 31 because of high flow. The adjustable spillway weir (ASW) was operated in Spillbay 1 on April 3 for spring spill operations and was closed on August 1 in conjunction with the FPP due to daily average outflow falling below 35 kcfs. Spill through the ASW started up again October 1 through November 15 for adult steelhead overshoot fallback, in compliance with the 2020 National Oceanic and Atmospheric Administration (NOAA) Fisheries Columbia River System Biological Opinion (NOAA 2020). Spill through the ASW occurred at least three times each week on nonconsecutive days for 4 hours in the morning (typically between 5:00 a.m. and 9:00 a.m.).

To enhance fish migration and comply with the 2020 NOAA Fisheries Columbia River System Biological Opinion (NOAA 2020), the forebay elevation was at minimum operating pool (633 to 634.5 feet MSL) from April 3 to August 31. The forebay elevation was increased to minimum operating pool +2 (634 to 636 feet MSL) after September 1, 2023, when spill to aid fish passage ended. Beginning in late September, operations were under compliance with the 2020 NOAA Fisheries Columbia River System Biological Opinion (NOAA 2020). All deviations from the FPP were coordinated through the Fish Passage Operations and Management Workgroup, as necessary, to meet real-time operational requirements.

River Temperature

River temperature was recorded daily at approximately 0700 hours in the JFF. The average daily river temperature during the 2023 fish passage season was 61.3°F. Average monthly water temperatures were cooler than the 5-year average during April, warmer than the 5-year average in May, June, July, and October and close to the 5-year average in August and September (Table 2). The maximum river temperature of 70.9°F was recorded on August 20 and was 0.2°F higher than the 5-year average maximum of 70.7°F. The 2023 minimum river temperature of 42.6°F was recorded on March 26, which was 3.3°F lower than the 5-year average minimum of 45.9°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 3 and ended on August 31, averaging 10.4 kcfs at 43.6°F for the month of July, and 8.7 kcfs at 45.6°F for the month of August (Columbia Basin Research 2023). Water temperatures recorded daily in the LGS JFF averaged 68.6°F in July, 69.1°F in August, and 67.2°F in September.

Table 2: Average monthly river temperatures (°F) at Little Goose Dam, 2018 to 2023.

Month	2018	2019	2020	2021	2022	2023	2018 to 2022 Average
Temperature (°F)							
April	49.2	48.2	49.4	50.6	46.9	46.9	48.86
May	53.7	53.3	52.5	57.1	51.7	54.3	53.66
June	61.6	61.7	59.4	60.3	55.3	63.0	59.66
July	68.1	67.6	66.8	68.7	64.4	68.6	67.12
August	69.3	69.0	69.4	69.4	68.4	69.1	69.1
September	66.2	68.3	67.8	65.8	67.0	67.2	67.02
October	60.7	59.6	63.7	61.4	56.9	63.1	60.46
Minimum	**44.7**	**45.4**	**46.4**	**47.7**	**45.5**	**44.2**	**45.94**
Maximum	**70.9**	**70.0**	**70.7**	**72.0**	**70.0**	**70.9**	**70.72**

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 to September 9, 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 125.0% saturation in the project tailwater in the spring, as measured throughout 12 consecutive hours. The summer TDG criteria is at or below 120% in the immediate tailrace at Little Goose Dam and 115% in the forebay of Lower Monumental Dam.

The average daily TDG level in the LGS forebay from March 29 to September 5 was 111.6% saturation. TDG saturation ranged from 101.3% on September 5 to 121.2% on May 26.

The TDG level in the LGS tailrace was 94.5% on October 30 (low) and 127.5% on May 23 (high), averaging 114.9% during the spill to aid fish passage season (April 3 to August 31). Tailwater mean TDG percent exceeded 125% a total of 6 days for the year.

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 19 to June 25, with measurements ranging between 2.0 and 4.9 feet and averaging 3.4 feet. The highest Secchi disk readings occurred from June 28 to November 2, with measurements ranging from 5.0 to 6.0 feet and averaging 5.8 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 dewatering 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 2023, 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

Monitoring Activities

In 2023, a total of 152,531 salmonids were visually counted passing upstream through the adult fish ladder. The species counts were: 93,674 Chinook adults; 17,209 Chinook jacks; 63,662 steelhead; 1,803 sockeye; 12,962 coho adults; 1,161 coho jacks; and 1 pink salmon *O. gorbuscha* adult. Additionally, 365 adult Pacific lamprey *Entosphenus tridentatus* were counted migrating upstream at the adult fish counting window.

Several monitoring activities involving the use of the adult fishway were in progress in 2023. These included:

- From 0500 to 2100 hours Four Peaks Environmental conducted visual fish counting activities 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.

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

Operations and Maintenance

The fishway was in service from February 23, 2023 to January 3, 2024. The in-water work maintenance period occurred from January 9 to February 15, 2024.

The fish ladder functioned mostly 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. The cooling water pump went in service on June 7, 2023, due to the river reaching the temperature threshold but failed on June 29, 2023, and was out of operation for the remainder of the summer. Subsequent investigation found the motor inspection port was completely filled with water. A new pump was ordered for the 2024 fish passage 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. Incremental repairs took place in 2018 and 2019 with remaining sections planned for future winter maintenance periods.

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 used again in 2023 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. Average subsurface velocity measurements ranged from 2.0 to 3.1 feet per second (fps) with an average of 2.4 fps. 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 1.4 to 3.9 feet per second (fps) near the NPE's and 1.6 to 3.3 fps near the NSE's. Auxiliary water supply (AWS) system operated with three fish pumps for the majority of 2023.

The adult fishway was removed from service on January 10, 2023, when the ladder was dewatered. Fish ladder maintenance included inspecting weirs, removing debris, cleaning the picketed leads, cleaning lamp lenses, cleaning viewing windows, removal of metal grating upstream of adult counting window, and the forebay intake screen for diffuser 13. Collection channel maintenance included inspecting diffuser grating and supporting beams, removing debris, and repairing the fallout 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. The picketed leads were showing serious wear in 2023, and alternative designs are being considered in 2024.

Adult Fishway Inspections

Adult fishway inspections during the 2023 fish passage season were conducted by USACE, EAS, 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 EAS 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

Inspections of the adult fish ladder section of the fishway include measuring differentials at the ladder exit, ladder weirs, and counting station. The ladder weirs met differential criteria 97.8% of the time while the counting station met criteria 99.3% of the time (Table 3). 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 the 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 (1-2 ft) was met during 92.0% or better of inspections at all locations throughout the season. Weir depth criteria (6-8 ft) was met at least 93.8% of the time at NSE, 23.4% of the time at NPE and 89.8% of the time at SSE. NPE weirs were on sill for at least 75.2% of all inspections and was either on sill or in criteria 98.6% of the time (Table 3). Low tailwater elevations will cause NPE weirs to bottom-out on its sill elevation at 532 feet elevation.

Surface water velocities met criteria (1.5 – 4.0 fps) 99.3% of the time near the NPE and 96.0% of the time near the NSE (Tables 3 and 4).

Table 3. Summary of results from adult fishway inspections at Little Goose Dam, 2023.

LITTLE GOOSE			----------Not Enough Depth----------				---------Too Much Depth---------		
Criteria and Locations	**No. in Criteria/ No. on Sill/ No. of Inspections**	**% In Criteria/ % On Sill**	**No./% Weir raised or Closed**	**No./% Within 0.01-0.1 Foot**	**No./% Within 0.11-0.2 Foot**	**No./% >0.2 Foot**	**No./% Within 0.01-0.1 Foot**	**No./% Within 0.11-0.2 Foot**	**No./% >0.2 Foot**
Channel Velocities (NPE)	134	99.3	***	***	***	***	***	***	***
	***	***	***	***	***	***	***	***	***
	135								
Channel Velocities (NSE)	119	96.0	***	***	***	***	***	***	***
	***	***	***	***	***	***	***	***	***
	124								
Differentials									
Ladder Exit (staff)	137	100.0	***	***	***	***	0	0	0
On Sill	***	***	***	***	***	***	0.0	0.0	0.0
	137								
Ladder Weirs (staff)	134	97.8	***	0	3	0	0	0	0
On Sill	***	***	***	0.0	2.2	0.0	0.0	0.0	0.0
	137								
Counting Station (staff)	136	99.3	***	***	***	***	0	0	0
On Sill	***	***	***	***	***	***	0.0	0.0	0.0
	137								
South Shore (FSC)	132	96.4	***	2	0	3	0	0	0
On Sill	***	***	***	1.5	0.0	2.2	0.0	0.0	0.0
	137								
North Pwrhse (FSC)	134	97.8	***	1	0	2	0	0	0
On Sill	***	***	***	0.7	0.0	1.5	0.0	0.0	0.0
	137								
North Shore (FSC)	126	92.0	***	4	1	5	0	1	0
On Sill	***	***	***	2.9	0.7	3.6	0.0	0.7	0.0
	137								
Weir Depths									
SSE-1 (FSC)	123	89.8	0	3	3	7	***	***	***
On Sill	1	0.7	0.0	2.2	2.2	5.1	***	***	***
	137								
SSE-2 (FSC)	125	91.2	0	2	2	7	***	***	***
On Sill	1	0.7	0.0	1.5	1.5	5.1	***	***	***
	137								
NPE-1 (FSC)	32	23.4	0	0	0	2	***	***	***
On Sill	103	75.2	0.0	0.0	0.0	1.5	***	***	***
	137								
NPE-2 (FSC)	32	23.4	0	0	0	2	***	***	***
On Sill	103	75.2	0.0	0.0	0.0	1.5	***	***	***
	137								
NSE-1 (FSC)	108[2]	95.6					***	***	***
On Sill	0	0.0					***	***	***
	113[2]								
NSE-2 (FSC)	106[2]	93.8					***	***	***
On Sill	0	0.0					***	***	***
	113[2]								

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

[2] Inspections where physical weir height calculations were not able to be taken were omitted due to discrepancy between physical weir height and measurements from the FSC board, hence lower total number of inspections and omission of percentage

Table 4. Little Goose Dam collection channel in-criteria rates 2019-2023.[1]

Location	Collection Channel Success Rates (%) - Annual Comparison				
	2019	2020	2021	2022	2023
Channel Surface Water Velocities					
North Powerhouse Entrance (NPE)	96.0	97.1	100.0	100	99.3
North Shore Entrance (NSE)	98.1	98.5	97.4	95.5	96.0
Channel Head Differentials					
SSE	96.1	97.8	99.2	97.8	96.4
NPE	100.0	100.0	99.2	98.5	97.8
NSE	88.4	84.8	88.0	95.3	92.0
Channel Weir Depths					
SSE1	92.1	91.3	88.6	89.6	89.8
SSE2	92.9	91.3	89.4	91.1	91.2
NPE1 without on-sill criteria	46.5	57.2	24.2	34.8	23.4
NPE1 with on-sill criteria	98.4	99.3	100.0	97.8	98.6
NPE2 without on-sill criteria	33.8	55.8	23.5	31.9	23.4
NPE2 with on-sill criteria	100.0	99.3	100.0	97.8	98.6
NSE1	95.4	89.0	80.3	85.7	95.6
NSE2	94.6	82.7	81.1	85.7	93.8

[1] Data compiled from Appendix 1, previous monitoring report appendixes and inspection forms for the years 2019-2023.

Average tailrace elevations in 2023 were lower than the 5-year average at all locations (Table 5). Per the FPP, 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 feet elevation, 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 from physical staff gage measurements. The variations are caused by the upwelling of water being released from the turbine draft tube and the number of and/or sequence of turbine units operating in juxtaposition to staff gage location.

Table 5. Little goose Dam average tailrace water elevations, 2018-2023.[1]

Location	Average Tailrace Water Elevations						
	2018	2019	2020	2021	2022	2023	2018 – 2022 Average
SSE	538.50	538.71	538.83	538.45	538.45	538.45	538.588
NPE	538.40	538.59	538.73	538.37	538.37	538.35	538.492
NSE	538.46	538.61	538.75	538.32	538.32	538.16	538.492

[1] Data compiled from Appendix 1 and previous monitoring report appendixes for years 2018-2022.

Average channel-to-tailwater head differentials in 2023 were slightly lower than the 5-year average at SSE, NPE, and NSE locations. NPE3 and NSE3 were permanently sealed with concrete in February 2011.
Average entrance weir depths at SSE and NSE were in criteria for all of 2023 (Table 6). The NPE entrance was on-sill or in criteria for the majority of 2023. Average entrance weir depths at SSE and NSE locations were close to the 5-year average while the NPE average dropped further below the 7 foot over weir criteria. New FSC software was placed into operation in 2016 but continued to fail maintaining fishway criteria while operating in automatic mode and the system was returned to manual operation. The 2023 season FSC board issues were attributed to a faulty hydro-ranger component. Impacts included lack of NSE weir, channel, and tailwater readings in 24 of 137 inspections. Manual operations utilized physical measurements in conjunction with electronic data for maintenance, reporting, and inspection purposes.

Table 6. Little Goose Dam adult fishway average differentials and weir depths 2018-2023.[1]

Location	Average Differential or Depth in Feet						
Channel to Tailwater Differential	2018	2019	2020	2021	2022	2023	2018 to 2022 average
SSE	1.42	1.42	1.41	1.39	1.46	1.37	1.42
NPE	1.62	1.57	1.51	1.57	1.58	1.52	1.57
NSE	1.16	1.21	1.19	1.22	1.24	1.21	1.204
Weir Depth							
SSE-1	8.72	8.72	8.60	8.65	8.51	8.59	8.64
SSE-2	8.71	8.78	8.60	8.68	8.52	8.60	8.658
NPE-1	6.50	6.93	7.02	6.47	6.63	6.46	6.71
NPE-2	6.50	6.77	6.99	6.47	6.58	6.49	6.662
NSE-1	6.85	6.59	6.61	6.43	6.51	6.27	6.598
NSE-2	6.77	6.55	6.57	6.44	6.65	6.26	6.596

[1] Data compiled from Appendix 1 and previous monitoring report appendixes for years 2018-2023.

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 2023 season.

Adult Fish Facility Recommendations

1. Implement more permanent fix for picketed leads vibrations/deterioration
2. Replace NSE-2 weir target
3. Repair growing cracks in the adult channel
4. Replace all lightbulbs in adult channel, ideally with LEDs or other longer lasting bulbs
5. Investigate NSE weir sensor issues
6. Replace NSE tailwater staff gage
7. Move Forebay staff gage to avoid spray

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 below Bonneville Dam by truck and barge. 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 March 21. Every other day collection for sampling began at 0700 on March 26. A total of 2,480,761 smolts were collected during the 2023 season through November 1 (Table 7). Of those, 1,579,127 were transported, 898,637 were bypassed, and 2,997 were mortalities (separator, raceway, or sample).

Transportation

Collection for transport by barge began at 0700 on April 23 and continued through June 19. The JFF operated in secondary bypass between June 20 and August 1, and collection for transport by truck occurred from August 2 through November 1. An estimated total of 2,430,699 smolts were collected between April 23 and November 1 (note, not the same date range as for all fish collected above). Of this total, 1,573,072 smolts were barged, 6,055 were trucked, 848,617 were bypassed, and 2,955 were facility mortalities.

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 2023.

Table 7. Annual collection, bypass, and transport activity at Little Goose Dam JFF, 2018-2023.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye		Total
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	
Collection											
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
2019	909,931	248,210	126,440	196,296	1,335,165	367,506	12,697	43,213	27,714	3,236	3,270,408
2020	319,868	94,808	134,826	221,775	325,285	73,310	17,900	29,511	8,044	531	1,225,858
2021	80,728	18,119	61,200	160,352	97,559	23,131	2,100	6,121	1,255	3,022	453,587
2022	437,051	111,810	141,533	199,511	438,686	114,284	11,225	17,620	7,117	1,979	1,480,816
2023	1,062,416	208,409	120,814	230,235	574,235	208,506	18,257	39,918	15,295	2,676	2,480,761
Bypass											
2018	163,625	142,644	342	1,387	534,670	77,151	7	447	9	7,711	927,993
2019	147,664	65,018	3,190	13,055	574,953	99,844	10	3,052	10	30	906,826
2020	6,435	2,265	45,796	79,884	38,475	4,418	471	128	4	4	177,880
2021	1,486	665	24,725	48,070	22,128	2,954	484	88	0	124	100,724
2022	1,634	2,008	29,105	58,423	7,468	1,866	1,261	359	0	199	102,323
2023	451,741	71,003	24,629	73,010	189,711	78,461	1,129	8,925	0	28	898,637
Truck											
2018	0	0	370	4,163	2	6	0	2	4	13	4,560
2019	1	1	3,888	18,583	122	17	10	2	20	1	22,645
2020	1	0	2,642	30,354	3	2	1	10	1	1	33,015
2021	9	3	12,625	82,224	429	315	140	73	1	9	95,828
2022	0	4	1,719	19,053	5	2	9	7	0	1	20,800
2023	1	1	278	5,771	2	1	0	0	0	1	6,055
Barge											
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
2019	760,457	182,729	119,157	164,092	759,935	267,573	12,644	40,086	27,537	3,187	2,337,397
2020	313,202	92,482	86,278	110,924	286,712	68,866	17,413	29,342	7,941	523	1,013,683
2021	79,094	17,431	23,749	29,497	74,904	19,850	1,451	5,939	1,245	2,866	256,026
2022	435,024	109,638	110,018	121,152	431,118	112,378	9,887	17,202	7,098	1,691	1,355,206
2023	609,136	137,009	95,733	151,094	384,371	130,015	17,104	30,897	15,115	2,598	1,573,072
Total Transport											
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
2019	760,458	182,730	123,045	182,675	760,057	267,590	12,654	40,088	27,557	3,188	2,360,042
2020	313,203	92,482	88,920	141,278	286,715	68,868	17,414	29,352	7,942	524	1,046,698
2021	79,103	17,434	36,374	111,721	75,333	20,165	1,591	6,012	1,246	2,875	351,854
2022	435,024	109,642	111,737	140,205	431,123	112,380	9,896	17,209	7,098	1,692	1,376,006
2023	609,137	137,010	96,011	156,865	384,373	130,016	17,104	30,897	15,115	2,599	1,579,127

A total of 1,579,127 juvenile salmonids were transported from LGS in 2023 through November 1; 1,573,072 of them (99.6%) were transported by barge (Table 7). The estimated species composition and clip type of the fish transported by barge was as follows: 38.7% clipped yearling Chinook salmon, 24.4% clipped steelhead, 9.6% unclipped subyearling Chinook salmon, 8.7% unclipped yearling Chinook salmon, 8.3% unclipped steelhead, 6.1% clipped subyearling Chinook salmon, 2.0% unclipped coho salmon, 1.1% clipped coho salmon, 1.0% clipped sockeye salmon, and 0.2% unclipped sockeye salmon.

Of the 1,579,127 juvenile salmonids transported from LGS, 6,055 (0.4% of the total) were transported by truck through November 1. The species composition of salmonids transported by truck was as follows: <0.1% clipped yearling Chinook salmon, <0.1% unclipped yearling Chinook salmon, 4.6% clipped subyearling Chinook salmon, 95.3% unclipped subyearling Chinook salmon, <0.1% clipped steelhead, <0.1% unclipped steelhead, and <0.1% unclipped sockeye salmon.

The maximum daily estimated collection of 338,037 fish occurred on May 5 and accounted for 13.6% of total collection (Table 8). Total counts are provided in Table 9. The composition of the collection for that date was as follows: clipped yearling Chinook salmon (57.9%), clipped steelhead (22.4%), unclipped steelhead (9.2%), unclipped yearling Chinook salmon (8.8%), unclipped coho salmon (1.2%), and unclipped subyearling Chinook salmon (0.4%).

Table 8. Peak passage dates and totals by species group at Little Goose Dam JFF, 2018-2023.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	All Species
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		
2018	10-May	21-April	29-May	29-May	9-April	3-May	20-May	19-May	13-May	9-April
	87,294	26,408	28,966	34,245	167,390	19,400	8,712	1,009	10,404	212,443
2019	24-April	16-April	7-June	7-June	24-April	24-April	19-May	19-May	18-May	24-April
	57,647	19,209	9,355	14,212	244,404	76,801	7,022	402	3,801	394,474
2020	16-May	16-May	15-June	15-June	26-April	2-May	16-May	26-May	1-June	16-May
	25,103	6,802	16,544	16,993	32,901	6,801	1,803	100	3,175	44,508
2021	10-May	11-May	26-Jun	27-Jun	6-May	7-May	12-May	3-May	6-May	10-May
	8,217	1,325	6,460	8,003	6,216	1,625	200	380	645	13,881
2022	13-May	14-May	16-Jun	16-Jun	9-May	9-May	18-May	19-Jun	9-May	9-May
	48,020	8,604	13,103	11,637	75,803	16,001	1,600	400	1,605	126,661
2023	5-May	5-May	4-Jun	4-Jun	5-May	5-May	17-May	9-May	5-May	5-May
	195,743	29,830	9,704	14,100	75,853	31,208	4,250	400	4,202	338,037

Bypass

From March 26 to April 22, the facility was rotated between primary bypass (fish are routed directly to the river) and secondary bypass (fish are routed through the fish facility) 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 50,062

Table 9. Total annual adult salmonid fallbacks at Little Goose Dam JFF, 2018-2023

Year	Chinook Adults		Chinook Jacks		Steelhead		Sockeye		Coho	Total
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		
2018	232	142	91	116	909	666	2	1	0	2159
2019	233	201	92	84	524	427	2	11	29	1603
2020	217	265	707	196	321	337	2	85	31	2161
2021	141	217	309	116	126	149	18	13	130	1219
2022	358	301	191	123	570	486	26	6	175	2236
2023	340	280	196	44	455	499	32	8	119	1973

smolts entered the facility on sampling days between March 26 to April 22. Of this total, 50,020 smolts were bypassed and 42 were facility mortalities. There are no passage estimates for the 14 non-sample days during the months of March and April.

Fish bypassed during the transportation season—April 23 to June 19 and August 2 to November 1—included 442 Chinook salmon fry that were bypassed for continued growth. Another 76,219 salmonids were bypassed during non-transport operations between June 20 and August 1. The species composition of salmonids during that period was as follows: 0.1% clipped yearling Chinook salmon, 0.1% unclipped yearling Chinook salmon, 32.3% clipped subyearling Chinook salmon, 65.6% unclipped subyearling Chinook salmon, 0.7% clipped steelhead, 0.2% unclipped steelhead, 0.3% clipped coho salmon, 0.7% unclipped coho salmon, and >0.1% unclipped sockeye salmon. No clipped sockeye salmon were bypassed between June 20 and August 1. A total of 898,637 salmonids were bypassed for the season.

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 1,973 adult salmon and steelhead fallbacks occurred in 2023 (Table 9).

There were 524 adult steelhead fallbacks from March-June (Table 10). 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 kelts. Table 11 lists the numbers of fish by species and condition.

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

Table 10. Monthly totals of fallbacks bypassed from separator at Little Goose Dam, 2023.

Month	Chinook Adults		Chinook Jacks		Steelhead		Sockeye		Coho	Total
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		
Mar*	1	0	1	1	10	6	0	0	0	19
Apr*	0	0	0	0	22	22	0	0	0	44
May	19	2	4	2	157	242	0	0	0	426
Jun	79	17	9	1	9	56	0	0	0	171
Jul*	24	20	5	9	3	4	25	0	0	90
Aug	15	22	6	2	8	11	5	7	0	76
Sep	101	108	42	9	159	102	2	1	49	573
Oct	100	109	126	20	87	56	0	0	66	564
Nov*	1	2	3	0	0	0	0	0	4	10
Total	340	280	195	44	445	499	32	8	119	1973

*Started sampling March 26, ended Nov 1. Every other day sampling March 26 to April 23, and July 11 to August 1

Table 11. Condition of adult salmonids released at Little Goose Dam, 2023.

Fish Condition	Chinook Adults		Chinook Jacks		Steelhead		Sockeye		Coho	Total
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		
Good	315	249	191	42	364	358	20	6	108	1653
Fair	21	26	5	2	64	92	10	2	8	230
Poor	14	5	0	0	25	45	2	0	3	84
Dead	0	0	0	0	2	4	0	0	0	6
Total	340	280	195	44	455	499	32	8	119	1973

end of the separator (A-side). Larger fish—primarily steelhead smolts—are expected to enter through the wider bars on the downstream end of the separator (B-side). Table 12 gives efficiency expressed as the percentage of each group, passing through the desired side of the separator, for 2018 to 2023. Efficiency rates are based on expanded sample counts. Separator efficiency was highest for clipped steelhead and clipped yearling Chinook, with 77.8% of clipped steelhead entering on B-side and 77.0% of clipped yearling Chinook entering on A-side. Separator efficiency was lowest for clipped coho salmon, with 19.0% entering on A-side. (Table 12).

Sampling

The fish sampling system operated without incident throughout the 2023 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 transmitted by ODFW personnel to the Fish Passage Center database daily, in support of the Smolt Monitoring Program (SMP).

Table 12. Annual juvenile salmonid separator efficiency (%) at Little Goose Dam JFF, 2018-2023.

	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye	
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip
Year	A-side	A-side	A-side	A-side	B-side	B-side	A-side	A-side	A-side	A-side
2018	69.7%	71.5%	55.8%	52.0%	81.1%	62.6%	31.8%	33.2%	24.0%	13.7%
2019	69.1%	72.0%	61.5%	60.6%	84.9%	55.7%	21.3%	31.2%	34.3%	25.4%
2020	52.0%	54.9%	43.1%	43.2%	88.3%	78.4%	15.0%	21.3%	11.2%	10.2%
2021	50.5%	46.8%	39.5%	37.3%	81.2%	70.9%	19.5%	42.9%	19.7%	17.3%
2022	66.2%	57.0%	43.1%	44.7%	70.7%	60.1%	19.4%	32.2%	43.6%	44.3%
2023	77.0%	71.1%	60.2%	64.6%	77.8%	59.8%	19.0%	28.3%	30.2%	27.6%

Note: Counts do not include sample mortalities.

Sample rates were set by USACE project biologists. To obtain the target sample of 300 to 500 smolts, sample rates varied between 0.25% and 100.0% as fish migration numbers fluctuated. The percentage of each species sampled was dependent on their migration timing, project operations, and the overall sample rate in effect at that time of their arrival (Table 13).

Table 13. Annual sample rate percentages of juvenile salmonids collected per species and clip type that were sampled at Little Goose Dam JFF, 2018-2023[1].

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	All	Total
2018	0.5%	0.7%	3.1%	5.8%	0.7%	0.7%	0.8%	1.9%	0.7%	1.1%
2019	0.7%	0.7%	8.4%	14.3%	0.6%	0.6%	1.3%	1.9%	1.5%	1.8%
2020	1.2%	1.3%	6.8%	16.3%	1.9%	1.6%	0.7%	1.7%	1.3%	4.8%
2021	5.9%	6.7%	11.1%	11.6%	7.2%	7.6%	6.9%	7.6%	8.0	9.1
2022	1.1%	1.8%	4.5%	9.1%	1.6%	1.5%	1.1%	3.0%	2.1%	2.7%
2023	0.9%	1.1%	6.2%	7.4%	1.2%	1.0%	2.5%	1.5%	1.1%	2.8%

Note: 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 Lyons Ferry Hatchery fall Chinook salmon. All unclipped salmon were scanned for coded wire tags. Chinook, sockeye, and coho salmon fry were defined by length (less than 60 millimeters) and were bypassed for continued growth. Fry are not examined for fish condition or descaling.

None of the 2023 hatchery releases above LGS were marked with elastomer eye tags.
Fish condition data were collected from a random subsample of 100 fish of each species present in the daily sample when possible. Data collected included weight, length, descaling, injury,

disease, predation, and other monitored conditions, including pink fin, fin hemorrhage, fin discoloration, popeye (exophthalmos), and eye hemorrhage. Injury and descaling data were used by managers to assess passage conditions at the dam.

Number of fish per pound was calculated from the weights taken during fish condition sampling and the species composition from the entire sample and was provided to the USACE from March 26 to November 1 as needed for adherence to raceway and transportation vehicle fish-holding density criteria.

A total of 46,550 fish were sampled during the 2023 season. Of these, 1,532 were removed from the separator during GBT monitoring and 44,409 were examined for descaling (salmonid fry and sample mortalities were not examined) (Table 14).

Fish Condition

Fish condition was monitored daily by EAS 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, 2023 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 LGS have been recorded.

The highest rates of injury this year were observed in unclipped subyearling chinook salmon (8.0%), followed by clipped subyearling chinook salmon (7.5%) and unclipped yearling Chinook salmon (6.6%; Table 15).

The majority of injuries involved damage to fins (74.2%), followed by operculum injury (11.4%), body injury (10.4%), head injury (2.0%), and eye injury (1.9%). A detailed list of individual injury types and injury rates by species and clip type is provided in Table 16.

Descaling

All live smolts in the sample were examined for descaling. A smolt was considered descaled if 20% or more 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 44,409 smolts were examined for descaling in 2023. Smolts examined for descaling include live smolts in the sample and do not include smolts examined for GBT, sample

Table 14. Weekly sample as percent of collection total and sample totals at LGS JFF, 2023.

Week Ending	Weekly Sampled (percent)	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	Totals[1]
		Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	All	
30-Mar	100.0%	4	33	0	0	4	13	0	0	0	54
6-Apr	100.0%	41	56	0	0	6	20	0	0	0	123
13-Apr	59.8%	422	76	0	0	401	31	0	0	2	932
20-Apr	8.5%	848	283	0	1	531	84	0	0	1	1,748
27-Apr	1.2%	520	212	0	0	1,103	182	0	0	9	2,026
4-May	1.2%	1,190	340	0	0	1,818	305	0	0	27	3,680
11-May	0.5%	3,325	520	0	78	1,189	498	3	1	89	5,703
18-May	1.0%	1,973	389	36	68	616	312	123	3	112	3,632
25-May	1.6%	785	272	283	396	324	245	31	11	263	2,610
1-Jun	2.8%	239	107	858	1,561	352	232	3	27	234	3,613
8-Jun	2.8%	58	48	1,108	1,525	173	152	0	11	75	3,150
15-Jun	23.4%	16	15	1,383	1,252	53	46	1	10	22	2,798
22-Jun	35.3%	6	11	898	1,096	49	34	0	7	109	2,210
29-Jun	16.7%	5	8	1,312	1,739	50	17	0	2	69	3,202
6-Jul	10.0%	0	0	760	1,199	11	6	0	1	20	1,997
13-Jul	7.0%	0	0	520	1,462	6	0	0	0	6	1,994
20-Jul	15.1%	0	0	72	411	0	0	0	0	0	483
27-Jul	45.8%	1	0	59	818	1	0	0	0	0	879
3-Aug	90.7%	0	0	23	735	0	0	0	0	0	758
10-Aug	99.9%	1	0	27	790	0	1	0	0	0	819
17-Aug	86.0%	0	0	52	1,313	1	0	0	0	0	1,366
24-Aug	59.9%	0	0	40	711	0	0	0	0	0	751
31-Aug	71.6%	0	1	28	668	0	0	0	0	0	697
7-Sep	99.7%	0	0	12	292	0	0	0	0	0	304
14-Sep	99.2%	0	0	13	244	0	0	0	1	0	258
21-Sep	100.0%	0	0	16	187	0	0	0	0	0	203
28-Sep	100.0%	0	0	6	73	0	0	0	0	0	79
5-Oct	100.0%	0	0	3	49	0	0	0	0	0	52
12-Oct	100.0%	0	0	1	12	0	0	0	0	0	13
19-Oct	100.0%	0	0	16	80	0	0	0	0	0	96
26-Oct	100.0%	0	0	15	173	0	0	0	1	0	189
2-Nov	100.0%	0	0	3	128	0	0	0	0	0	131
Total Sampled		9,434	2,371	7,544	17,061	6,688	2,178	161	75	1,038	46,550
Total Sample Collection[2]		10,372	2,594	7,646	17,211	6,721	2,184	302	106	1,113	48,249
Percent of Sample		20.3%	5.1%	16.2%	36.7%	14.4%	4.7%	0.3%	0.2%	2.2%	100.0%
Percent of Collection		0.4%	0.1%	0.3%	0.7%	0.3%	0.1%	<0.1%	<0.1%	<0.1%	1.9%

[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.

Table 15. Annual injury rates (%) for salmonids examined at Little Goose Dam, 2018-2023.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Years	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	All	Total
2018	10.0%	13.3%	14.0%	14.1%	3.3%	4.7%	10.1%	15.1%	7.3%	10.7%
2019	9.0%	13.3%	17.1%	16.4%	3.9%	3.9%	9.9%	8.5%	7.5%	12.1%
2020	9.3%	10.8%	10.3%	11.5%	2.8%	4.1%	9.1%	11.1%	7.4%	9.4%
2021	7.8%	6.7%	8.6%	10.6%	2.2%	2.4%	16.9%	10.7%	4.9%	7.6%
2022	6.8%	8.9%	8.4%	10.7%	3.1%	3.0%	35.7%	7.8%	5.3%	8.1%
2023	4.9%	6.6%	7.5%	8.0%	4.3%	4.3%	5.0%	5.3%	3.6%	6.3%

mortalities, or fry. The overall rate of descaling was 1.9% (863 fish descaled), which is slightly higher than the 5-year average of 1.4% (Table 17). Of the 44,409 smolts examined for descaling 21,291 (47.9%) smolts 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 2.7% (566 smolts descaled). Of the 566 descaled smolts observed in the condition subsample, descaling associated with dam passage was 55.8% of the condition descale total, and the rate of descaling on fish with predation marks present was 44.2% of the condition descale total. The rate of descaling observed in the non-condition sample was 1.3% (297 smolts descaled) from a sample size of 23,118 salmon. Descaling recorded from the non-condition sample does not differentiate between descaling as a result of passage and descaling as a result of predators.

For fish in the condition subsample, in addition to descaling of 20% or greater, partial descaling of 3% to 19% above background levels was also recorded. The rate of partial descaling was 4.8% of the 21,291 smolts examined for condition in 2023.

Annual descaling rates per species and clip types are listed in Table 17. The average weekly descaling rate ranged from 0.0% to 10.0% (Table 18).

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, bacterial kidney disease (BKD), body parasites, deformity, and other diseases such as cysts or tumors. The year 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), dwarfism, or truncated body, were also documented.

A total of 546 smolts (2.6%) of the total condition subsample were observed with one or more symptoms of disease (Table 16). Of the 546 individual signs of disease observed this year, Columnaris was the most prevalent at 34.1% of the total, followed by parasite (26.6%), fungus (17.9%), deformity (15.9%), presumed BKD (4.6%), and other (0.9%). In 2015, several subyearling fall Chinook salmon smolt mortalities were observed with rotted caudal fins or

Table 16. Percent of fish examined that were injured, had predation marks, or had signs of disease by species and clip type at Little Goose Dam, 2023.

	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye		
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Total[1]
Injuries											
Eye	0.4%	0.2%	0.0%	0.0%	0.1%	0.2%	0.0%	0.2%	0.0%	1.3%	0.1%
Operculum	0.9%	0.8%	0.2%	0.1%	2.1%	1.4%	0.7%	0.7%	3.1%	1.3%	0.7%
Head	0.1%	0.1%	0.2%	0.1%	0.3%	0.2%	0.0%	0.0%	0.0%	0.0%	0.1%
Body	0.4%	0.7%	0.6%	0.6%	0.9%	1.2%	0.7%	0.2%	0.6%	0.0%	0.7%
Fin	3.3%	5.2%	6.5%	7.3%	0.9%	1.4%	1.4%	3.2%	1.3%	2.7%	4.8%
Total Injury	**4.9%**	**6.6%**	**7.5%**	**8.0%**	**4.3%**	**4.3%**	**2.7%**	**4.3%**	**5.0%**	**5.3%**	**6.3%**
Disease											
Fungus	0.7%	0.8%	0.1%	0.1%	1.1%	0.5%	0.5%	0.9%	1.9%	4.0%	0.5%
Columnaris	0.0%	0.0%	0.8%	2.0%	0.0%	0.0%	0.5%	0.0%	0.0%	1.3%	0.9%
BKD	0.3%	0.8%	0.1%	<0.1%	<0.1 %	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Parasites	0.4%	1.0%	0.6%	0.2%	0.8%	3.1%	0.5%	2.0%	0.0%	0.0%	0.7%
Deformity	0.3%	0.3%	0.7%	0.4%	0.4%	0.4%	0.0%	0.5%	0.6%	0.0%	0.4%
Disease Other	<0.1%	0.0%	0.0%	<0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	<0.1%
Total Disease	**1.7%**	**2.8%**	**2.3%**	**2.7%**	**2.4%**	**4.0%**	**1.4%**	**3.2%**	**2.5%**	**5.3%**	**2.4%**
Predation											
Bird	1.3%	1.7%	0.2%	0.4%	2.5%	2.9%	1.4%	0.7%	4.4%	0.0%	1.1%
Fish	1.5%	1.1%	2.7%	5.6%	0.9%	0.9%	3.9%	1.8%	5.7%	0.0%	3.1%
Lamprey	0.5%	0.5%	0.5%	0.3%	0.3%	0.2%	0.2%	0.2%	0.6%	0.0%	0.4%
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	**3.3%**	**3.3%**	**3.4%**	**6.3%**	**3.7%**	**4.0%**	**5.5%**	**2.7%**	**4.0%**	**10.7%**	**4.6%**
Miscellaneous Conditions											
Popeye	0.2%	0.0%	<0.1 %	<0.1%	0.1%	0.1%	0.2%	0.0%	0.0%	0.0%	0.1%
Fin Hemorrhage	2.7%	5.5%	10.7%	11.1%	1.3%	1.6%	2.7%	0.9%	5.0%	4.0%	6.7%
Pink Fin	2.3%	3.8%	12.8%	18.6%	1.2%	0.4%	0.0%	1.4%	0.0%	0.0%	9.4%
Fin Discoloration	1.1%	1.1%	0.1%	1.0%	0.5%	0.4%	0.0%	0.0%	0.0%	0.0%	0.7%
Eye Hemorrhage	0.8%	0.1%	0.1%	<0.1%	0.2%	0.3%	0.2%	0.0%	0.6%	0.0%	0.2%
Total Miscellaneous Conditions	**6.8%**	**9.5%**	**21.2 %**	**26.8%**	**3.1%**	**2.7%**	**3.0%**	**2.1%**	**5.7%**	**4.0%**	**15.2%**
Total Sample Size	**3,358**	**1,145**	**2,780**	**7,907**	**3,184**	**1,686**	**437**	**559**	**159**	**75**	**21,291**

[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.

Table 17. Annual descaling rates for salmonids examined at Little Goose Dam JFF, 2018-2023.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	Totals
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	All	
2018	**1.7%**	**0.8%**	**1.2%**	1.0%	**1.3%**	**1.9%**	**1.1%**	**4.6%**	**1.9%**	**1.2%**
2019	2.3%	1.7%	1.5%	1.2%	2.0%	1.7%	2.3%	3.4%	3.1%	1.5%
2020	1.5%	2.0%	0.6%	0.9%	1.0%	1.9%	3.6%	0.0%	1.5%	1.0%
2021	1.5%	1. 7%	0.5%	0.9%	1.9%	2.1%	1.2%	1.8%	2.2%	1.2%
2022	1.7%	1.5%	1.0%	1.7%	2.0%	2.2%	0.0%	0.7%	2.4%	1.7%
2023	2.1%	2.2%	1.0%	1.7%	2.8%	2.6%	10.1	0.0%	3.8%	1.9%

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

smolts with symptoms of abdominal distention similar to BKD, which prompted ODFW personnel to collect a specimen for the ODFW Fish Health Laboratory in La Grande, Oregon. 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, from 2015 to 2022. In 2023, most smolts with these symptoms were reported as BKD.

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 981 smolts were observed with one or more predatory wounds, for an overall rate of 4.6% of the total condition subsample. The majority of marks observed in the subsample were indicative of attempted predation by fish at 67.2% of the 982 total individual bite marks recorded, followed by bird (24.7%) and lamprey bites (8.0%). No mammalian bite marks were observed this year. The highest rate of predatory attempts was observed on clipped sockeye salmon (10.7%), unclipped subyearling Chinook salmon (6.3%), and clipped coho salmon (5.5%) (Table 16).

The overall rate of bird bite marks was slightly higher than the 5-year average of 0.9% (Table 19). The highest prevalence of bird bite marks was observed on clipped sockeye salmon (7 bird marks on 159 fish examined) and unclipped steelhead (49 bird marks on 1686 fish examined).

Other Miscellaneous Conditions

The other miscellaneous conditions category included popeye (exophthalmos), hemorrhaged fin, pink fin, discolored fin, and hemorrhaged eye. There were 3,234 smolts with one or more miscellaneous conditions, for an overall miscellaneous condition rate of 15.2% of the total condition subsample (Table 16). A total of 3,642 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 fin constituted most of the observations in this category at 54.8% of the individual miscellaneous conditions total, followed by hemorrhaged fins (39.3%), fin discoloration (4.2%), eye hemorrhage (1.3%), and popeye (exophthalmos) (0.4%). Subyearling fall Chinook salmon had the highest rates in this condition category at 26.8% for unclipped and 21.2% for clipped.

Table 18. Weekly descaling rates for salmonids examined at Little Goose Dam JFF, 2023.

Week Ending	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	Total
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	All	
30-Mar	0.00%	9.38%	--	--	0.00%	0.00%	--	--	--	5.66%
6-Apr	0.00%	0.00%	--	--	0.00%	0.00%	--	--	--	0.00%
13-Apr	2.62%	5.48%	--	--	0.75%	0.00%	--	--	0.00%	1.94%
20-Apr	1.26%	0.82%	--	--	1.55%	3.57%	--	--	0.00%	1.41%
27-Apr	1.05%	1.53%	--	--	2.08%	2.82%	--	--	0.00%	1.83%
4-May	2.65%	3.96%	--	--	2.88%	3.62%	--	--	3.70%	2.98%
11-May	1.77%	0.98%	--	--	3.15%	3.05%	0.00%	0.00%	2.25%	2.10%
18-May	2.45%	2.36%	0.00%	0.00%	4.64%	2.34%	8.20%	0.00%	1.79%	2.91%
25-May	2.88%	3.36%	0.00%	0.83%	4.33%	1.30%	19.35%	0.00%	3.80%	2.63%
1-Jun	1.83%	0.00%	0.60%	1.04%	2.72%	1.80%	0.00%	0.00%	5.13%	1.43%
8-Jun	1.82%	0.00%	0.28%	0.84%	3.05%	2.13%	--	0.00%	5.41%	0.93%
15-Jun	0.00%	7.14%	0.98%	1.36%	0.00%	2.27%	0.00%	0.00%	0.00%	1.16%
22-Jun	0.00%	0.00%	1.38%	1.33%	4.65%	5.88%	--	0.00%	3.74%	1.60%
29-Jun	0.00%	0.00%	0.65%	1.31%	4.44%	0.00%	--	0.00%	4.41%	1.15%
6-Jul	--	--	1.32%	0.84%	0.00%	0.00%	--	0.00%	5.26%	1.06%
13-Jul	--	--	0.87%	1.22%	16.67%	--	--	--	0.00%	1.18%
20-Jul	--	--	0.00%	1.23%	--	--	--	--	--	1.03%
27-Jul	0.00%	--	3.51%	0.91%	0.00%	--	--	--	--	1.09%
3-Aug	--	--	0.00%	1.70%	--	--	--	--	--	1.65%
10-Aug	0.00%	--	16.00%	2.54%	--	--	--	--	--	2.95%
17-Aug	--	--	9.62%	2.92%	0.00%	--	--	--	--	3.18%
24-Aug	--	--	5.00%	1.85%	--	--	--	--	--	2.02%
31-Aug	--	0.00%	3.70%	2.34%	--	--	--	--	--	2.40%
7-Sep	--	--	8.33%	4.23%	--	--	--	--	--	4.39%
14-Sep	--	--	0.00%	2.09%	--	--	--	0.00%	--	1.98%
21-Sep	--	--	0.00%	2.76%	--	--	--	--	--	2.54%
28-Sep	--	--	0.00%	2.74%	--	--	--	--	--	2.53%
5-Oct	--	--	0.00%	0.00%	--	--	--	--	--	0.00%
12-Oct	--	--	0.00%	0.00%	--	--	--	--	--	0.00%
19-Oct	--	--	6.25%	3.75%	--	--	--	--	--	4.17%
26-Oct	--	--	13.33%	6.40%	--	--	--	0.00%	--	6.91%
2-Nov	--	--	66.67%	8.66%	--	--	--	--	--	10.00 %
Total Exam.	**9,084**	**2,275**	**7,238**	**16,000**	**6,436**	**2,112**	**159**	**75**	**1,030**	**44,409**
Percent Desc.	**2.06%**	**2.15%**	**1.04%**	**1.65%**	**2.78%**	**2.56%**	**10.06%**	**0.00%**	**3.79%**	**1.94%**

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

Table 19. Annual bird bite rates for salmonids examined at Little Goose Dam, 2018-2023

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	Total
	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	All	
2018	0.8%	0.5%	0.2%	0.3%	1.8%	2.0%	0.6%	0.6%	0.6%	0.8%
2019	0.8%	0.5%	0.2%	0.3%	2.1%	1.6%	0.3%	0.0%	0.7%	0.8%
2020	0.8%	0.5%	<0.1%	0.3%	2.8%	2.8%	3.6%	0.0%	1.0%	0.8%
2021	1.3%	1.4%	0.3%	0.4%	2.9%	2.7%	1.2%	0.4%	0.8%	1.1%
2022	1.0%	0.3%	0.2%	0.2%	2.9%	1.7%	2.9%	3.9%	0.9%	0.8%
2023	1.3%	1.7%	0.2%	0.4%	2.5%	2.9%	4.4%	0.7%	1.0%	1.1%

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.

The total facility mortality rate this year (0.1%) was lower than the 5-year average rate, 0.2%, with 2,997 total facility mortalities out of 2,480,761 total collected fish (Table 20). The average weekly total facility mortality rate ranged from 0.0% to 4.1% (Table 21). Increased mortality rates later in the collection season occurred when total collection numbers decreased and disease and injury rates increased, presumably due to warmer river temperatures. The average monthly total facility mortality rate was highest in September, at a rate of 2.9%, with 25 total facility mortalities from a collection total of 872 smolts.

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 20 and 22). The lamprey ammocoete total mortality rate in 2023 was 0.1%, from a total collection count of 12,756 lamprey ammocoetes. The total mortality rate for Pacific lamprey macropthalmia this year was <0.1%, from a collection total number of 409,627 Pacific lamprey macropthalmia. No notable peak in total facility mortality for either life stage of juvenile lamprey was observed.

Table 20. Annual total facility mortality as a percentage of total collection at Little Goose Dam JFF 2018-2023.

Year	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	Total[1]	Pacific lamprey	
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip			Ammocoete	Macropthalmia
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%
2019	0.2%	0.2%	0.2%	0.3%	<0.1%	<0.1%	0.5%	0.6%	0.2%	0.1%	0.5%	0.2%
2020	0.1%	0.1%	0.1%	0.3%	<0.1%	<0.1%	1.2%	0.6%	0.1%	0.1%	0.1%	0.1%
2021	0.2%	0.1%	0.2%	0.3%	0.1%	<0.1%	0.7%	0.8%	0.6%	0.2%	0.5%	0.8%
2022	0.1%	0.1%	0.5%	0.4%	<0.1%	<0.1%	0.3%	4.4%	0.4%	0.2%	0.4%	0.1%
2023	0.1%	0.2%	0.1%	0.2%	<0.1%	<0.1%	1.2%	1.8%	0.2%	0.1%	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 21. Weekly total facility mortality in percent at Little Goose Dam JFF, 2023.

Week Ending	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	Total
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	All	
30-Mar	0.0%	3.0%	--	--	0.0%	0.0%	--	--	--	1.9%
6-Apr	0.0%	0.0%	--	--	0.0%	0.0%	--	--	--	0.0%
13-Apr	0.2%	2.3%	--	--	0.0%	0.0%	--	--	50.0%	0.4%
20-Apr	0.1%	0.7%	--	0.0%	0.0%	0.0%	--	--	0.0%	0.1%
27-Apr	0.1%	0.2%	--	100.0%	0.0%	0.0%	--	--	0.1%	0.0%
4-May	0.2%	0.2%	--	--	0.0%	0.0%	--	--	0.4%	0.1%
11-May	0.1%	0.1%	--	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
18-May	0.3%	0.3%	2.0%	0.9%	0.0%	0.0%	1.0%	2.6%	0.3%	0.3%
25-May	0.1%	0.1%	0.2%	0.2%	0.1%	0.0%	1.5%	2.3%	0.2%	0.2%
1-Jun	0.2%	0.2%	0.1%	0.1%	0.0%	0.0%	16.3%	2.5%	0.2%	0.1%
8-Jun	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	--	0.5%	0.1%	0.0%
15-Jun	1.9%	0.9%	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.8%	0.1%
22-Jun	5.0%	0.0%	0.2%	0.1%	0.7%	0.0%	--	0.0%	1.1%	0.2%
29-Jun	0.0%	0.0%	0.1%	0.1%	0.8%	1.2%	--	11.1%	0.3%	0.1%
6-Jul	--	--	0.1%	0.1%	0.0%	0.0%	--	0.0%	2.0%	0.1%
13-Jul	--	--	0.1%	0.1%	0.0%	--	--	--	2.8%	0.1%
20-Jul	--	--	0.0%	0.1%	--	--	--	--	--	0.1%
27-Jul	0.0%	--	0.0%	0.5%	0.0%	--	--	--	--	0.5%
3-Aug	--	--	0.0%	0.9%	--	--	--	--	--	0.8%
10-Aug	0.0%	--	7.4%	0.6%	--	0.0%	--	--	--	0.9%
17-Aug	--	--	1.8%	1.2%	0.0%	--	--	--	--	1.3%
24-Aug	--	--	0.0%	1.3%	--	--	--	--	--	1.3%
31-Aug	--	0.0%	2.6%	4.2%	--	--	--	--	--	4.1%
7-Sep	--	--	0.0%	3.4%	--	--	--	--	--	3.3%
14-Sep	--	--	0.0%	3.3%	--	--	--	0.0%	--	3.1%
21-Sep	--	--	0.0%	3.7%	--	--	--	--	--	3.4%
28-Sep	--	--	0.0%	0.0%	--	--	--	--	--	0.0%
5-Oct	--	--	0.0%	2.0%	--	--	--	--	--	1.9%
12-Oct	--	--	0.0%	0.0%	--	--	--	--	--	0.0%
19-Oct	--	--	0.0%	0.0%	--	--	--	--	--	0.0%
26-Oct	--	--	0.0%	0.6%	--	--	--	100.0%	--	1.1%
2-Nov	--	--	0.0%	0.8%	--	--	--	--	--	0.8%
Total Collected.	**1,062,416**	**208,409**	**120,814**	**230,235**	**574,235**	**208,506**	**15,295**	**2,676**	**58,175**	**2,480,761**
Percent Mort.	**0.14%**	**0.19%**	**0.14%**	**0.16%**	**0.03%**	**0.01%**	**1.18%**	**1.83%**	**0.21%**	**0.12%**
Median	**0.11%**	**0.21%**	**0.00%**	**0.36%**	**0.00%**	**0.00%**	**1.02%**	**0.53%**	**0.30%**	**0.19%**

[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 22. Annual sample mortality as percent of total sample at Little Goose Dam JFF, 2018-2023.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye				Pacific Lamprey	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Coho	Total	Ammocoetes	Macropthalmia
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%
2019	0.5%	0.6%	0.4%	0.8%	0.1%	0.2%	1.9%	1.7%	1.2%	0.6%	3.6%	5.8%
2020	0.4%	0.2%	0.7%	1.0%	0.1%	0.1%	3.5%	<0.1%	1.0%	0.8%	2.3%	2.1%
2021	0.7%	0.3%	0.1%	0.5%	0.5%	0.1%	4.6%	2.2%	1.4%	0.5%	3.2%	4.3%
2022	0.5%	0.6%	0.4%	0.6%	0.0%	0.5%	2.7%	11.7%	4.0%	1.8%	7.4%	3.1%
2023	0.5%	1.0%	0.2%	0.7%	0.1%	0.1%	1.2%	<0.1%	0.8%	0.5%	0.1%	<0.1%

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.

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 (*Exopalaemon modestus*) and juvenile American shad (*Alosa sapidissima*). When numbers of Siberian prawn and juvenile American shad were too large to practically count, a weekly fish-per-pound calculation was obtained for these species. The result was then multiplied by the total 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 prawns. For the sixteenth consecutive season, all Siberian prawns that occurred in the sample were humanely euthanized per the directive issued by Washington Department of Fish and Wildlife on July 24, 2007. In past years, all Siberian prawns from the sample were frozen and returned to the river. Starting in 2017, and continuing through 2023, they were frozen and put in a landfill.

When the sample rate was less than 100%, incidental species were inadvertently collected and transported along with smolts. When the sample rate was at 100%, all incidental species were removed from collection and returned to the river, with the exception of Siberian prawns, which were disposed of after euthanizing.

Incidental collections totaled 730,552 fish. This included an expanded sample count of 494,558 fish and 49,656 Siberian prawn, plus 186,338 fish from the separator, 246,557 of which were juvenile American shad (Table 23). Not shown in Table 23 is one clipped Chinook mini-jack salmon.

Collection numbers of American shad, walleye (*Sander vitreus*), Pacific lamprey (*Entosphenus tridentatus*) ammocoete, and Pacific lamprey macropthalmia were much higher than the 2018 to 2022 average. Smallmouth bass (*Micropterus dolomieu*) and crappie (*Pomoxis* sp.) numbers were much lower than the 2018 to 2022 average, while numbers of most other species were similar to the 2018 to 2022 average. (Tables 23 and 24).

Table 23. Collection of incidental species at Little Goose Dam, 2023.

Common Name	Scientific Name	Expanded Sample	Separator	Total Collection[1]
American shad	*Alosa sapidissima*	67,050	179,743	246,793
Banded killifish	*Fundulus diaphanus*	1	0	1
Bass, smallmouth	*Micropterus dolomieu*	701	100	801
Bass, largemouth	*M. salmoides*	0	0	0
Bullhead	*Ameiurus sp.*	205	0	205
Bull trout	*Salvelinus confluentus*	0	2	2
Channel catfish	*Ictalurus punctatus*	232	38	270
Chiselmouth	*Acrocheilus alutaceus*	25	3	28
Common carp	*Cyprinus carpio*	7	29	36
Crappie	*Pomoxis sp.*	195	2,591	2,786
Dace	*Rhinichthys sp.*	1	0	1
Goldfish	*Carassius auratus*	0	0	0
Kokanee	*Oncorhynchus nerka*	147	5	152
Lamprey adult, Pacific[2]	*Entosphenus tridentatus*	109	169	278
Lamprey ammocoete, Pacific	*E. tridentatus*	12,755	1	12,756
Lamprey macropthalmia, Pacific	*E. tridentatus*	409,627	0	409,627
Mountain whitefish	*Prosopium williamsoni*	349	15	364
Northern pikeminnow	*Ptychocheilus oregonensis*	0	6	6
Peamouth	*Mylocheilus caurinus*	196	194	390
Rainbow trout[3]	*O. mykiss*	1	1,944	1,945
Redside shiner	*Richardsonius balteatus*	0	0	0
Sand roller	*Percopsis transmontana*	62	47	109
Sculpin	*Cottus sp.*	722	0	722
Siberian prawn	*Exopalaemon modestus*	49,656	0	49,656
Sucker	*Catostomus sp.*	318	80	398
Sunfish[4]	*Lepomis sp.*	270	25	295
Tadpole madtom	*Noturus gyrinus*	0	0	0
Walleye	*Stizostedion vitreum*	1,003	1,137	2,140
White sturgeon	*Acipenser transmontanus*	0	15	15
Yellow perch	*Perca flavescens*	528	194	722
Other[5]		54	0	54
Total		**544,214**	**186,338**	**730,552**

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 separator and from raceways.
3. Includes all juvenile *O. mykiss* too large to fit through the separator bars.
4. Sunfish collection total includes 294 bluegill/pumpkinseed.
5. "Other" fish include expanded counts of live unidentified non-salmonid and unidentifiable/decomposed non-salmonid.

Adult Pacific lamprey collections totaled 278 in 2023—169 actual count from the separator and raceways and 109 expanded count from the sample. The actual number of adult lamprey removed from the sample totaled 67, and when extrapolated with the corresponding sample rate calculated to the expanded total of 109. The first adult Pacific lamprey of the season was collected on May 5 and the last on October 26. Upriver adult migrants were most frequently observed falling back into the collection system from July to September. For the nineth consecutive year, USACE transported all adult Pacific lamprey captured at the facility

Table 24. Numbers of incidental species collected at Little Goose Dam JFF, 2018-2023.

Common Name	Scientific Name	2018[1]	2019	2020	2021	2022	2023	Average
American shad	*Alosa sapidissima*	136,814	91,725	81,366	56,253	34,858	246,793	80,203
Banded killifish	*Fundus diaphanous*	1	0	0	0	0	1	0
Bass, smallmouth	*Micropterus dolomieu*	8,977	2,939	4,896	5,933	5,098	801	5,569
Bass, largemouth	*M. salmoides*	5	28	2	4	10	0	10
Bullhead	*Ameiurus* sp.	1,263	574	403	202	409	205	570
Bull trout	*Salvelinus confluentus*	1	0	1	0	3	2	1
Channel catfish	*Ictalurus punctatus*	91	99	118	73	139	270	104
Chiselmouth	*Acrocheilus alutaceus*	3	57	71	10	1	28	28
Common carp	*Cyprinus carpio*	296	103	61	12	143	36	123
Crappie	*Pomoxis* sp.	38,778	3,807	1,043	3,015	2,021	2,786	9,733
Dace	*Rhinichthys* sp.	6	3	4	0	2	1	3
Goldfish	*Carassius auratus*	0	0	0	0	0	0	0
Kokanee	*Oncorhynchus nerka*	4	0	0	2,027	1,113	152	629
Pacific lamprey adult	*Entosphenus tridentatus*	232	137	66	54	98	278	117
Lamprey ammocoete	*E. tridentatus*	5,157	4,794	2,674	184	5,794	12,756	3,721
Lamprey macropthalmia	*E. tridentatus*	2,431	31,332	22,010	4,992	30,082	409,627	18,169
Mountain whitefish	*Prosopium williamsoni*	973	3,189	1,744	172	380	364	1,292
Northern pikeminnow	*Ptychocheilus oregonensis*	106	0	9	25	9	6	30
Peamouth	*Mylocheilus caurinus*	4,687	707	624	776	172	390	1,393
Rainbow trout[2]	*O. mykiss*	25	336	1,483	272	3,256	1,945	1,074
Redside shiner	*Richardsonius balteatus*	0	0	0	0	0	0	0
Sand roller	*Percopsis transmontana*	559	138	71	86	274	109	226
Sculpin	*Cottus* sp.	199	2,908	5,786	389	630	722	1,982
Siberian prawn	*Exopalaemon modestus*	31,668	11,159	36,217	131,109	63,664	49,656	54,763
Sucker	*Catostomus* sp.	1,225	797	1,345	676	384	398	885
Sunfish[3]	*Lepomis* sp.	1,182	736	123	79	182	294	460
Tadpole madtom	*Noturus gyrinus*	1	1	0	0	0	0	0
Walleye	*Stizostedion vitreum*	110	170	101	743	634	2,140	352
White sturgeon	*Acipenser transmontanus*	4	20	45	48	15	15	26
Yellow perch	*Perca flavescens*	77	120	92	98	1,376	722	353
Other[4]		0	11	21	0	0	55	6
Total		**234,875**	**155,890**	**160,376**	**207,232**	**150,747**	**730,552**	**181,822**

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.

approximately 1 mile above the dam, releasing them at Little Goose Landing. Any adult Pacific lamprey found in the sample tanks were removed by USACE, ODFW, and EAS personnel prior to SMP sampling to avoid exposure to sampling anesthesia.

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 2023.

Kelt Reconditioning and Reproductive Success Evaluation Research

USACE staff collected 195 steelhead kelts from the Little Goose juvenile separator from April 19 to June 30 for the Nez Perce Tribe (NPT). The purpose of the study is to evaluate steelhead kelt physiology and endocrinology for rehabilitating post-spawned steelhead. NPT personnel took genetic samples, PIT-tagged, and returned to the tailrace 106 unclipped steelhead collected at LGS that did not meet their criteria. Of the kelts collected, 89 steelhead were transported to Dworshak National Fish Hatchery for acclimation and feeding studies.

Gas Bubble Trauma Monitoring

GBT monitoring was performed by ODFW biologists from Little Goose Dam. When juvenile salmonid numbers permitted, a maximum of 104 fish were examined. Sampling occurred weekly from April 15 to August 2, and GBT monitoring ended for the season the week of August 3 due to small numbers of fish. 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. All fish examined for GBT in 2023 were collected from the separator.

A total of 1,586 fish were handled for GBT monitoring by ODFW in 2023. Of the 54 fish handled and enumerated but not examined for GBT, 21 were coho salmon, 4 were yearling Chinook salmon, 14 were subyearling Chinook salmon, 7 were steelhead, 3 were clipped sockeye, and 5 were unclipped sockeye salmon. A total number of 1,532 fish were examined for GBT. Of those, 55.8% were subyearling Chinook salmon, 20.0% were steelhead smolts, and 24.2% were yearling Chinook salmon. Of those examined, 25 (1.6%) showed signs of GBT. Of the 1,586 fish handled for GBT, there was 1 unclipped subyearling Chinook salmon mortality for a mortality rate of 0.06%.

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 20 and 22). The lamprey ammocoete total mortality rate in 2023 was 0.1%, from a total collection count of 3,721 lamprey ammocoetes. The total mortality rate for Pacific lamprey macropthalmia this year was <0.1%, from a collection total number of 18,169 Pacific lamprey 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 quagga 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 quagga mussels observed during the 2023 season.

Turbine Strainers

USACE monitored turbine unit strainers for the fourteenth consecutive year. Strainers are 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 from mid-December until mid-June. Strainers are inspected for any fish entrapment, particularly juvenile lamprey. If 10 or more lampreys are collected during the last sample date an additional month of inspections is made. Results were reported throughout the season in the USACE and EAS weekly report.

Avian Predation and Behavior

Avian activity was monitored and reported by USACE and EAS. Protocols documenting bird behavior were updated 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 out-migration.

EAS personnel conducted avian surveys daily from April 1 to November 1, 2023. Surveys were typically conducted between 1100 hours and 1400 hours during the juvenile collection system inspection. Only two specific bird behaviors were recorded this year—foraging and nonforaging—compared to the loafing/resting (on land or water), flyby, scavenging, and predating behaviors previously recorded. Piscivorous birds present in 2023 included seagulls, double crested cormorants, American white pelicans, western grebe, great blue heron, Caspian turns, and osprey. The number of piscivorous birds remained relatively low between March and mid-July, ranging from 0 to 18 birds per day. Numbers increased late in the season when the number of juvenile American shad entering the facility increased. The maximum number of birds counted was 246 on October 30: 192 gulls, 34 cormorants, and 20 grebes.

Juvenile Facility Operations & Maintenance

The juvenile fish bypass system was inspected daily during the fish passage season. The juvenile bypass system and the collection facility were not significantly impacted by debris during the 2023 fish passage season.

Forebay Debris/Trashracks

The surface area covered by debris and its location in the forebay was estimated daily by EAS personnel during juvenile collection 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. This year, all forebay debris was recorded as outside trash sheer boom, inside trash sheer boom, in front of the spillway, and in front of the Removable Spillway Weir. All debris passed through the project via spill, turbine intakes, or the juvenile collection system. High accumulations of woody debris of approximately 4,050 to 19,250 square feet were present in the forebay from March 20 to 22. Two orifice blockages occurred in 2023, both of which occurred in March. The highest amount of forebay debris was also observed during March. Increased orifice rotations were necessary to decrease debris accumulations within the juvenile collection system this year. Forebay debris decreased to minimal to moderate amounts after March 22, averaging 143 square feet per day from March 23 to November 2.

Spillway Weir

The ASW operated four hours in the morning, three days a week in spring and fall to provide passage for adult steelhead overshoots. This operation began March 1 with the ASW positioned in Hi-Crest (622 ft) through commencement of spring spill on April 2. Spring spill operations began April 3, and on May 2 the ASW was repositioned to Lo-Crest (618 ft). Adult Steelhead overshoot spill resumed October 1 and continued through November 15.

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 25.

Extended-Length Submersible Bar Screens (ESBS)

All ESBS were installed on March 13 and 14 and performed satisfactorily for the entire season. All screens were removed for the end of fish passage season on December 11 and 12. 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.

Table 25. Little Goose turbine unit outages, 2023.

Turbine Unit	Date OOS	Time	Date RTS	Time	Description
Unit 1	10/17/22	15:30	1/20/23	17:00	Oil leak investigation, nose cone fix
	2/13/23	8:00	2/23/23	14:45	500kV line, T-1 & 2 NRG'd (20LGS16MOC)
	3/8/23	10:16	3/8/23	11:15	Over Gen Shutdown during U6 testing
	3/29/23	6:20	3/29/23	12:55	BPA line to ground fault, 500 kV line loss
	4/13/23	12:00	4/13/23	16:47	BPA Outage - Doghouse cover removal
	4/26/23	12:08	4/26/23	22:36	Unit 5 Shaft Reassembly
	6/14/23	14:55	6/14/23	16:35	VBS inspection
	7/31/23	5:00	8/10/23	17:27	Daily hours only - Doble Testing
	10/4/23	7:45	10/4/23	11:55	Brush Rigging Carbon Buildup Cleaning
	12/4/23	9:25	12/7/23	17:42	Planned Line Outage
	11/20/23	5:00	12/14/23	15:58	Unit Annual Maintenance
Unit 2	1/23/23	7:53	2/10/23	12:35	Annual Maintenance
	2/13/23	8:00	2/23/23	14:45	500kV line, T-1 & 2 NRG'd (20LGS16MOC)
	3/29/23	6:20	3/29/23	12:55	BPA line to ground fault, 500 kV line loss
	4/13/23	12:00	4/13/23	16:47	BPA Outage - Doghouse cover removal
	4/26/23	12:08	4/26/23	22:36	Unit 5 Shaft Reassembly
	6/14/23	12:30	6/14/23	14:50	VBS inspection
	7/31/23	5:00	8/10/23	17:27	Daily hours only - Doble Testing
	10/11/23	11:29	12/1/23	13:20	Unit Annual, Cavitation Repair
	12/4/23	9:25	12/7/23	17:42	Planned Line Outage
Unit 3	2/13/23	8:00	2/23/23	14:45	500kV line, T-1 & 2 NRG'd (20LGS16MOC)
	3/29/23	6:20	3/29/23	12:55	BPA line to ground fault, 500 kV line loss
	4/13/23	12:00	4/13/23	16:47	BPA Outage - Doghouse cover removal
	4/26/23	12:08	4/26/23	22:36	Unit 5 Shaft Reassembly
	5/18/23	19:53	5/22/23	0:00	T1C Dissolved Gas Analyzer Threshold
	5/28/23	3:56	5/28/23	7:40	Governor: no thrust bearing oil pressure data
	6/13/23	12:30	6/13/23	15:50	VBS inspection
	3/14/00	5:00	8/10/23	17:27	Daily hours only - Doble Testing
	9/11/23	6:00	9/28/23	13:05	Unit Annual
	11/28/23	3:53	11/28/23	10:03	emergency line outage
	12/4/23	9:25	12/7/23	17:42	Planned Line Outage
Unit 4	2/13/23	8:00	2/23/23	14:45	500kV line, T-1 & 2 NRG'd (20LGS16MOC)
	3/29/23	6:20	3/29/23	12:55	BPA line to ground fault, 500 kV line loss
	4/13/23	12:00	4/13/23	16:47	
	4/26/23	12:08	4/26/23	22:36	Unit 5 Shaft Reassembly
	5/18/23	19:53	5/25/22	0:00	T1C Dissolved Gas Analyzer Threshold
	6/13/23	7:30	6/13/23	11:20	VBS inspection
	7/31/23	5:00	8/10/23	17:00	Daily hours only, Doble Testing
	8/10/23	7:10	9/6/23	16:19	Converted to Unit Annual, no RTS
	9/14/23	11:33	9/14/23	16:00	Forced outage - fish screen failure, screen swap
	12/4/23	9:25	12/7/23	17:42	Planned Line Outage
Unit 5	4/14/17	14:11	2/1/24	1700	Spider arm and upper guide bearing replacement
	6/12/23		6/12/23		VBS Inspection
Unit 6	4/18/22	5:10	2/22/23	ERTS	Roof top repair / BUS work / 6 yr overhaul
	2/13/23	8:00	2/23/23	14:45	Speed no load, 20 LGS 16 MOC finalized
	2/23/23	17:58	2/28/23	15:30	Forced outage, NEXUS meter failure
	3/29/23	6:20	3/29/23	12:55	BPA line to ground fault, 500 kV line loss
	3/29/23	13:20	3/31/23	16:40	Wicket gate packing, flooded turbine bearing
	4/13/23	12:00	4/13/23	16:47	BPA Outage - Doghouse cover removal
	4/26/23	12:08	4/26/23	22:36	Unit 5 Shaft Reassembly
	6/12/23	8:20	6/12/23	11:30	VBS inspection
	7/10/23	7:45	7/27/23	16:56	Unit Annual Maintenace
	7/31/23	5:00	8/10/23	17:27	Daily station svc only - Doble Testing
	12/4/23	9:25	12/7/23	17:42	Planned Line Outage

Vertical Barrier Screens (VBS)

Inspections of all VBS were performed by underwater video camera per FPP requirements. Underwater camera inspections occurred on June 12-14 for all Units except Unit 5. Unit 5 ESBS screens are stored in a position that does not allow underwater inspections

In conjunction with ESBS/VBS underwater video camera inspections, orifice liners were also inspected. The orifice liners were all in good working order during the 2023 inspection.

Gatewells

Gatewells were checked for debris and oil contamination daily. As needed, debris was removed using a dip basket or grappling hook. In 2023, 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 salvage operations occurred on August 10 in gatewell 4A, on September 11 in gatewell 3A, and on October 10 in gatewell 2A. No salmonids were recovered. 24 Siberian prawns were recovered from 4A, 27 juvenile shad were recovered from 3A, and 201 juvenile shad were recovered from 2A. All three gatewells were dewatered for unit annual maintenance.

Orifices and Collection Channel

The collection channel was operated throughout the season with 17 to 23 open orifices depending on forebay elevations. Orifices were inspected and/or back-flushed two to three times per day. All orifice operations were manually performed throughout the year.

The collection channel was dewatered and removed from service on December 21. Fish salvage operations during the dewatering included releasing approximately 71 adult steelhead, adult Chinook salmon, 10 adult Coho, 54 adult lamprey, 2 juvenile lamprey, 4 juvenile sculpin, and 1 dead juvenile sculpin. All fish were released to the tailrace via the emergency release pipe except for the adult lamprey in the channel, which were released in the forebay. 31 of the adult lamprey were in the safety reservoir and were therefore also released into the tailrace due to personnel safety concerns. Inspection underneath the Johnson bar screen the next day led to the recovery of 191 living juvenile lamprey, 22 dead juvenile lamprey, 6 living juvenile sculpin, and 4 juvenile bullhead catfish.

Primary Dewaterer/Primary Bypass Pipe

The primary dewatering structure and components functioned adequately throughout the season. Weirs were adjusted manually when needed. 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 2023. 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 as needed.

Sample System/PIT Tag System

On September 3, 2023, a component of PIT tag gate A broke, leaking air, at 10:30. The A side system was shut down until the component was replaced the next day, September 4, 2023, at 14:00.

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. The only separator cleanout occurred just after 0700 on November 1 to ensure all fish had exited the separator to be

accounted for in the last sample of the year. There were no problems with the DDS system in 2023.

Pit Tag Detections

The PIT-tag detection system records data on PIT-tagged salmonids as they pass through the juvenile collection system. The PIT-Tag Information System database categorized all PIT-tag detections based on 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 as follows 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 26 to November 1, a total of 65,084 PIT-tagged fish were detected within the juvenile collection/bypass system: 38,651 Chinook salmon, 24,499 steelhead, 1,103 sockeye salmon, 728 coho salmon, 13 Pacific lamprey, 2 bull trout (*Salvelinus confluentus*), 1 white sturgeon (*Acipenser transmontanus*), and 87 orphans of unknown species/rearing type. Of the total number of detections, 33,602 (51.6%) were routed to the river and 31,482 (48.4%) were routed to transport areas. PIT-tagged fish in the sample were treated as the other fish in the sample and were either released to the river—if the facility was operating in secondary bypass mode—or transported—when the facility was operating in collection mode. Approximately 217 (0.3%) of the PIT-tagged fish detected at LGS were last detected in the sample, and of these, 67 (30.9%) were transported and 150 (69.1%) were returned to the river during pre-transport operations or while operating in secondary bypass mode. Prior to the start of the transportation season, and between June 20 and August 1, all PIT-tagged fish were bypassed to the river. Approximately 4,526 (7.0%) of the total PIT-tagged fish detected were detected prior to the start of collection for transportation, or between June 20 and August 1 when no transport was taking place.

Avian Predation Deterrence

USDA Animal and Plant Health Inspection Service (APHIS) began bird hazing activities in 1999. In 2023, APHIS bird hazing activities at Little Goose took place from March 29 through June 18. 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 March 29 through June 18. 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 EAS 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).

Counts were conducted using binoculars 2 to 3 times daily from March 25 through October 31, 2023. 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 reports.

Avian counts reached the maximum threshold allowed per the Fish Passage Plan from April 01 to August 31 once, with a gull count of 103 on July 30. Gull counts exceeded the 100-bird threshold 6 more times throughout the bird counting season, all within the month of October. Cormorant counts never exceeded the 50-bird threshold throughout the bird counting season. Lethal take was implemented with 127 gulls sacrificed during the 2023 season. There were 25 cormorants lethally taken in 2023. 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.

Gull Counts

The maximum total daily number of 192 gulls counted occurred on October 3. The average daily total count was 12.96 gulls. The maximum daily count in the forebay was 110 gulls and occurred on October 30. There was with a daily average of 7.0 gulls in the forebay. The maximum daily count in the tailrace was 105 gulls and occurred on October 29. There was a daily average of 6.0 gulls in the tailrace.

Double Crested Cormorant Counts

The maximum total daily number of 34 cormorants occurred on October 27. The average daily total count was 2.14 cormorants. The maximum daily count in the forebay was 31 cormorants and occurred on October 30. The maximum daily count in the tailrace was 30 cormorants and occurred on October 27.

Caspian Tern Counts

There were 6 terns observed during the 2023 season. The maximum daily count was 4 on May 14, observed in the tailrace. Terns were not observed in the forebay. The average daily count was 0.03.

Other Piscivorous Bird Counts

The maximum total daily number of 19 grebes occurred on October 18. The average daily total count was 0.51 grebes. The maximum total daily number of 18 pelicans occurred on June 15. The average daily total count was 1.04 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 (83.3% based upon a small sample size of 6 birds) followed by gulls (45.8%), and cormorants (27.4%). Terns had the highest percent of feeding behavior in the tailrace (83.3%) followed by cormorants (70.0%), and gulls (68.3%). Gulls had the highest percent of feeding behavior in the forebay (25.8%) followed by cormorants (18.6%). Caspian terns were not observed in the forebay in 2023. 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 2023 season.

In February 2023 new knife gates were installed for raceway 1 and 7 discharge pipes for more efficient opening and closing. In the same month, raceway dropbox “collars” were cut and installed along with foam for each of the 10 raceways to create a tighter seal. The gaskets eliminated any gapping around the raceway’s dropbox to ensure no fish can become entrapped.

In March 2023, a temporary pipe repair was made to the emergency fish release pipe located underneath the primary dewater structure. The 36” pipe had multiple pinhole leaks that were sealed with epoxy, wrapped with a rubber patch, and tightened with pipe clamps. The pipe is used annually during the dewatering process of the juvenile bypass system to release fish from the flume to the tailrace.

In April 2023 a stretch of replacement piping on the A side collection was installed. This piece is located at the barge junction box. The old piping had started coming apart before replacement. All work was performed on days when the facility was in primary bypass.

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. Install permanent fix for the 36” emergency release pipe underneath the primary dewatering structure.
3. Prioritize truck platform to barge dock fish transport pipe replacement and upgrades to mitigate pipe separation and migration issues due to aged and repeated weather conditions causing multiple expansion and contraction stresses.

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