CENWW-OD-DL HOLDREN (1130) January 2023

MEMORANDUM THRU:
Robert Lustig, Operations Project Manager Lower Granite Dam

FOR Chief, Operations Division
ATTN: Chris Peery

SUBJECT: Submission of 2022 Adult and Juvenile Fish Facility Monitoring Report, Lower Granite Dam.

1. Enclosed find the 2022 Adult and Juvenile Fish Facility Monitoring Report Lower Granite Dam, as requested.

2. If you have any questions contact Elizabeth Holdren at Lower Granite Dam, (509) 843-2263

ELIZABETH HOLDREN
Lead Supervisory Fisheries Biologist,
Lower Granite Dam

Enclosure

ADULT AND JUVENILE FISH FACILITY MONITORING REPORT

LOWER GRANITE DAM

2022

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And

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Lower Granite Dam

U.S. Army Corps of Engineers

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INTRODUCTION

The following report on fishway activities at Lower Granite Dam is required under the Endangered Species Act consultation on the operation of the Federal Columbia River Power System and its associated fish passage facilities. This report summarizes the operation and maintenance of adult fish passage facilities at Lower Granite Dam, including the results of visual inspections of the fishway conducted by fisheries biological staff during the adult fish passage period of March 1 to December 31, 2022. Inspection readings are provided in Appendix 1. Recommendations are provided for correcting problems found. This report also contains a synopsis of juvenile fish facility operations. Additional information on juvenile fish collection and transportation activities at Lower Granite Dam can be found in the "2022 Juvenile Fish Collection and Bypass Report, Lower Granite Juvenile Fish Facility".

River Conditions

Average daily river flows exceeded 100 kcfs 34 days during the 2022 season with an average total river flow of 53.20 kcfs. The highest daily average flow for the March 25-November 1 collection season was 205.3 kcfs June 14. This is the latest peak flow recorded at LWG since 1985. Lowest daily average flow for the season was 13.3 kcfs October 19. Spill for juvenile fish passage occurred for 152 days from April 3 through midnight on August 31. LWG spilled up to the 125% gas cap for 16 hours a day and performance standard spill (20 kcfs) for up to 8 hours per day during the spring spill season (April 3-June 20). Summer spill of 18 kcfs began at 0001 hours on June 21 and ended at 2400 hours August 31. RSW only operation began after average total outflow dropped below 30 kcfs (August 16-31). Spill was distributed according to the Fish Passage Plan (FPP) Table LWG-7 and LWG-8. Average season flow through spillways was 32.9 kcfs with a maximum daily average of 99.0 kcfs June 14 and a minimum daily average of 9.3 kcfs August 29. Adult steelhead trout overshoot spill through the RSW occurred from 0500-0900 hours on Sundays, Tuesdays, and Thursdays March 1 to March 30 and from September 1 to November 15. This operation was modified to 2-hour blocks 6 days per week September 22 to October 12 in response of TDG levels exceeding 110%. River temperatures collected as part of the daily condition sample averaged 57.4^{o} F for the season and ranged from 43.2° F April 20 to 66.7° F July 21.

ADULT FISH FACILITY

Facility Description

Adult fish passage facilities at Lower Granite Dam consist of one south shore adult fish ladder. The upper fish ladder extends from the forebay to tailwater. The fish ladder includes forebay temperature control system with pumps to supply cooling water, one fish ladder exit, slotted weirs control section, upper diffuser, overflow weirs with orifices, and a fish counting station with picketed leads. Auxiliary water is supplied from the forebay through diffuser 14 to maintain flow over the upper ladder weirs. Lower Granite fish trap is located at the turnpool area just upstream from the fish count station. The lower ladder contains a powerhouse collection channel, three electric auxiliary water supply pumps (AWS), collection channel diffusers, a transport channel under the spillway, and ladder entrances. There are six main fish ladder entrances: two north shore entrances (NSE-1 and NSE-2), two north powerhouse entrances (NPE-1 and NPE-2), and two south shore entrances (SSE-1 and SSE-2). The powerhouse collection channel has ten floating orifice gates (FOGs) with gates 1, 4, 7, and 10 operating.

AWS pumps draw water from the tailrace that is distributed through the lower ladder and collection channel diffusers to provide attraction flow.

Facility Modifications

1. Replaced supply valves for adult trap anesthetic and sample tanks.
2. Repaired fall out fence.
3. Filled/repaired fish ladder expansion joints.
4. Replaced adult fish trap brail barrier grating.
5. Built cover for NSE gate operators.
6. Reconfigured fish ladder exit temperature control supply.
7. Upgraded forebay, tailwater, and fish ladder temperature monitoring system.

Operations and Maintenance

Fish Ladder and Collection Channel

The adult fish ladder was in service throughout 2022 apart from the winter maintenance season from January 4-January 26. During the winter annual outage, the upper fish ladder is dewatered for maintenance activities including debris removal, diffuser grate and structural support inspections, picketed lead, staff gauge, and fish counting window cleaning, maintenance of count station window cleaning mechanisms, and packing of leaks in expansion joints. A minimum of 24 hours prior to dewatering, the auxiliary water is shut off to discourage newly arriving fish from starting up the ladder. A bulkhead is then placed in the fish ladder exit, any exit pool fish are removed and released to the forebay, and the upper ladder is partially dewatered. Diffuser 14 is gradually closed to allow fish to move through the orifices to the tailrace. The drain for diffuser 14 is closed to maintain a minimal amount of water in the ladder while remaining fish are flushed down the ladder. Biologists and maintenance personnel descend the ladder through orifices to remove debris, inspect the ladder, and move remaining fish to the tailrace. There were no fish observed in the exit or upper ladder during the dewatering January 4. All diffuser grating passed inspection.

The lower ladder is typically dewatered to a depth of one foot providing a holding pool for fish. Once the target depth is obtained, maintenance personnel and biologists inspect entrance weirs, diffuser grates, fallback fence, and exposed diffuser gate operating equipment. Staff gauges are then cleaned, and debris is removed. Water is lowered to 4/10th of a foot for visual inspection of grating and fish recovery. When dewatering for repair is necessary; fish are crowded to the entrance pools, netted, and placed in fish only transport containers. Fish in the containers are raised from the collection channel with the crane and transported to the tailrace or forebay for release. Salmonids recovered from the powerhouse and spillway sections of the collection channel January 6 included 5 unclipped adult steelhead trout, 5 adult Coho salmon, 15 juvenile unclipped Chinook salmon, and 35 juvenile unclipped steelhead trout. Incidental species included about 350 adult carp, 15 suckers, 10 peamouth, 10 whitefish, 15 walleye, and 1 smallmouth bass. No problems were observed during the inspection of the north powerhouse channel.

Auxiliary Water Supply

AWS fish pumps were out of service (OOS) from January 1 to February 8 for annual maintenance. Annual maintenance consists of general mechanical and electrical inspection and repairs. AWS pump 2 and 3 were returned to service February 8 and AWS pump 1 was remained offline for lower guide bearing replacement. AWS pumps 2 and 3 remained in service through the end of the season. Significant pump outages are summarized in Table 1.

Table 1. Fish pump outages at Lower Granite Dam, 2022*

Affected Pump(s)	Dates	Reason for Outage/Comments
2 and 3	Jan 1 – Feb 8	Annual maintenance
1	Jan 1 – Apr 19	Annual maintenance/lower guide bearing

*Only outages involving two or more calendar days are included.

Adult Fish Passage and Fish Counts

Lower Granite adult fish ladder was operated in fish passage plan compliance March 1 through December 31. During the season there were brief interruptions in auxiliary water supply pump (AWS) operation related to non-routine maintenance and powerhouse outages as part of Doble testing and 500kV line outages. Visual and video fish counts occurred throughout the adult fish passage season (Table 2). Adult salmonid, shad, and lamprey counts can be found at DART Adult Passage Daily Counts for All Species | Columbia Basin Research (washington.edu).

Table 2. Lower Granite Dam Adult Fish Counting Schedule March 2022 – Feb 2022.

Count Period	Counting Method and Hours *
March 1–31	Day Video 0400–2000 hours (PST)
April 1 – October 31	Day Visual 0500–2100 hours (PDT)
June 15 – September 30	Night Video 2100–0500 hours (PDT)
November 1 – December 30	Day Video 0400–2000 hours (PST)

*PST = Pacific Standard Time; PDT = Pacific Daylight Time, in effect during daylight saving time 3/14/21–11/7/21.

There has been concerns raised about the increase in walleye abundance observed recently in the adult fish ladder. Fish count personnel assisted the project biologist in quantifying walleye passing the adult fish ladder during the 2021 and 2022 adult passage season. In 2022 there were 5,064 walleye counted from April thru October 31 with the majority of them being counted in September and October (Table 3). This was an increase from the 1,877 walleye counted during the same timeframe in 2021. Walleye counts were conducted as outlined in the fish count schedule above.

Table 3. Walleye Counts at Lower Granite Adult Fish Count Station in 2022

Year	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	---	60	58	19	19	92	464	1165	---	---
2022	---	68	252	399	783	464	1526	1572	---	---

Fish Ladder Temperature Control

Electronic temperature probes were used to monitor fish ladder water temperatures at the ladder exit, diffuser 14, turn pool, and the junction pool throughout the fish passage season. Real-time fish ladder temperature data along with that for four additional Project temperature monitoring stations can be found online at: http://www.nwd-wc.usace.army.mil/dd/nww/fl_temps/www/index.html. The permanent fish ladder temperature control system has been operational since 2016. Forebay fish ladder auxiliary water supply pumps 1 and 2 were modified to intake cooler water from an elevation of 667.0 feet (66.0 feet below MOP) and supply the spray bar in front of the fish ladder exit. Gravity flow then distributes the cooler water from the forebay down the ladder. The system also includes a chimney structure that drafts cold water from an elevation of 667.0 feet into diffuser 14 intake. Water from diffuser 14 cools the ladder as it flows down the overflow sections of the ladder and is the main supply for the adult fish trap. Forebay ladder temperature control system pumps operated June 27 through October 13.

During the 2021-2022 maintenance season the orientation of the fish ladder temperature control pumps was reconfigured. Pump 1 was returned to its historical position to provide direct supply into the fish ladder exit channel and pump 2 remained tied into the exit shower (Laughery's Shower). Spring Chinook salmon were observed jumping exit pool and seemed to be holding in the upper section of the ladder. Two adult Chinook salmon jumped out of the ladder at that location and were reported in MFR 22 LWG 09. As the fall run picked up, Chinook salmon again appeared to be holding in the ladder exit pool and there was concern about what seemed to be an increase in salmonid mortalities observed at the adult trap. Project biologist requested that the operator remove pump 1 from operation September 11. Fish ladder water temperatures did not impact adult fish trapping operations this season.

Adult Fishway Inspections

Methods

The automated fishway control system consists of a computer in the control room that interfaces with process level controllers that receive information from remote terminal units. The terminal units are fed by sensors detecting entrance weir gate positions, collection channel and tailwater elevations, and upper diffuser pool levels. Lower Granite automated fishway control system programing continues to be adjusted as needed to maintain fish ladder operational compliance. The system's digital touch screen displays located in the control room and the third floor of the powerhouse with gates remotely operated from the control room. The control system "biologist snapshot" of fish ladder operation is printed concurrent with ladder inspections to compare physical readings and identify calibration issues. Collection channel temperatures and velocities are measured with sensors in the south powerhouse and the north shore channels as part of the automatic system. Powerhouse electricians manually calibrate fish ladder gates to ensure the control system program operates in criteria parameters following winter maintenance. During the 2022 fish passage season, the fish ladder control system was unable to consistently maintain depth over the weirs and channel/tailwater head differential at the north shore during spill operations at MOP elevation. NSE depth over the weir criteria was sacrificed to achieve channel/tailwater head differentials.

Operating criteria involve normal and special operating conditions. Normally NSE-1 and NSE-2 are operated to meet criteria of at least 7 feet (depth criteria) or be on sill if less than 7 feet (sill criteria), NPE-1, NPE-2, SSE-1 and SSE2 weir gates are operated to meet criteria of at least 8 feet or be on sill if less than 8 feet (sill criteria), and two floating orifice gates (1 and 10) are operated in the powerhouse collection channel. Normal operating criteria for the rest of the ladder include maximums of 0.5-foot head at the exit, maximum 0.3 feet head at the picketed leads, 1.0-1.3 feet of water over the ladder weirs, 1.5-4.0 feet per second collection channel velocity, and 1.0-2.0 feet of head differential at all fishway entrances. Special operating conditions are used if normal criteria cannot be met. The fish ladder control system continued to have issues maintaining depth over the weirs and operating gates within the same depth range based on tailwater elevation at induvial entrances.

Adult fishway inspections consist of observing facility operating conditions and recording visual readings from staff gauges, weir gate selsyns, and electronic meters. Inspections by fisheries staff are normally conducted three or more times per reporting week with day and times randomized. An average of 3.7 inspections per week were performed (163 inspections /44 weeks) in 2022. Depths and head differentials that were out of criteria, as well as other problems, were reported to maintenance staff and/or powerhouse shift operators for correction. Anchor (SMP contractor) biologists performed a minimum of two ladder inspections each week while on Project. Lower Granite biologist staff typically performed 2 to 3 inspections per week. Inspections were also conducted by Oregon Department of Fish and Wildlife personnel once a month.

Inspection Results

Visual readings of staff gauges and weir gate depths were recorded and compared with automated control system readings to check for calibration problems. High variability between wave crests and troughs created by spill reduced the accuracy of biologists' staff gauge readings in the tailrace. The automatic fish ladder control system was upgraded to the Automation Direct PLC and HMI Configuration Software (C-More Programming Software) in 2016. The control system program is unable to consistently maintain both depth over the weir and channel/tailwater head differential at the north shore during spill operations. Calibrations to the automatic control system were made throughout the passage season. Entrance gates found out of criteria during ladder inspections due to fish ladder control system problems were manually adjusted to depth or sill criteria and left in manual mode until electricians completed diagnostics and made calibrations. Electricians continue to troubleshoot control system internal functioning errors in the program. Data from fishway inspections were entered into an Excel spreadsheet (Appendix 1). The average compliance of all criteria points in 2022 was 79.5% compared to 72.8% in 2021. The fish ladder control system programming issues were the most common reason for out-of-criteria readings. LWG electrical team is working with the Project Biologist to find a permanent solution to this ongoing problem. A summary of fish ladder performance and variability is provided in Table 2.

Ladder Exits

Ladder exit head differentials were in criteria on 100% of the inspections.

Ladder Weirs

The depths over the fish ladder weirs were within criteria on 100% of the inspections.

Counting Stations

The head differential across the counting station picketed leads was in criteria on 100% of inspections.

Entrance Head Differentials

SSE-1 & 2 head differentials were in criteria on 97.5% of inspections. Out of criteria readings included 3 at 0.2 feet below criteria and 1 at 0.11-0.2 feet above criteria.

NPE-1 & 2 head differentials were in criteria on 90.2% of inspections. Out of criteria readings included 2 at 0.01-0.1 feet below criteria, 4 at 0.11-0.2 feet below criteria, and 10 at >0.2 feet below criteria.

NSE-1 & 2 head differentials were in criteria on 59.5% of inspections compared to 25.1% in 2021. Head differential readings were out of criteria (criteria 1.0-2.0 feet) on 66 inspections in 2022. Out-of-criteria readings included 33 at 0.1 feet below criteria, 20 at 0.2 feet below criteria, and 13 greater than 0.2 feet below criteria. NSE channel/tailwater head differentials were likely out of criteria due to the fish ladder control system being unable to consistently maintain both depth over the weir and channel/tailwater head differential at the north shore during current spill volumes and at MOP.

Entrance Gate Depths

SSE-1 weir gate was in depth or sill criteria on 70.5% of inspections (69.9% depth, 0.6% sill) compared to 73.1% in 2021. Out of criteria readings included 11 at 7.9 feet, 10 at 7.8 feet, and 27 at 7.7 feet or less. SSE-1 and SSE-2 reading at the gate have consistently been reading higher than the electronic reading on the fish ladder control system.

SSE-2 weir gate was in criteria on 71.2% of inspections (70.6% depth, 0.6 % sill) compared to 70.7% in 2021. Out of criteria readings included 11 at 7.9 feet, 7 at 7.8 feet, and 29 at 7.7 feet or less. SSE-1 and SSE-2 reading at the gate were consistently reading higher than the electronic reading on the fish ladder control system.

NPE-1 weir gate was in depth or sill criteria on 98.2% of inspections (41.1% depth, 57.1% sill) compared to 95.2% in 2021. Out of criteria readings included 1 at 7.9 feet, 1 at 7.8 feet, and 1 at 7.7 feet or less.

NPE-2 weir gate was in depth criteria or sill on 97.6% of inspections (40.5% depth, 57.1% sill) compared to 95.8% in 2021. Out of criteria readings included 1 at 7.8 feet and 3 at 7.7 feet or less.

NSE-1 weir gate was in depth or sill criteria on 82.8% of inspections (82.8% depth, 0.0 % sill) compared to 82.6% in 2021. Out of criteria readings included 11 at 6.9 feet, 10 at 6.8 feet, and 7 at 6.7 feet or less. The fish ladder control system was unable to consistently maintain both depth over the weir and channel/tailwater head differential at the north shore during spill operations.

Depth over the weirs at the north shore entrance was maintained well but the channel/tailwater head differential could not be maintained.

NSE-2 weir gate was in depth or sill criteria on 82.8% of inspections (82.8% depth, 0.0 % sill) compared to 81.4% in 2021. Out of criteria readings included 13 at 6.9 feet, 7 at 6.8 feet, and 8 at 6.7 feet or less. The fish ladder control system continued to be unable to consistently maintain both depth over the weir and channel/tailwater head differential at the north shore during spill operations at MOP elevation. Depth over the weirs at the north shore entrance was maintained well but the channel/tailwater head differential could not be maintained.

Collection Channel Velocity

Velocities were in criteria on 99.4% of inspections (criteria: 1.5-4.0 ft/s) compared to 98.8% in 2021. The collection channel velocity meter was upgraded to a Teladyne Signature Flowmeter as part of the fish ladder control system. The sensor also provides water temperature and is located in the powerhouse collection channel between the transition pool and unit 1. A Signature Laser Sensor was also installed above the north shore collection channel that measures channel elevation and surface velocity.

Adult Fish Trap Operations

Lower Granite adult fish trap was operated March 2 to November 15 by NOAA Fisheries and Idaho Department of Fish and Game (IDFG). Sample rates were adjusted with adult passage to meet collection and research needs. The adult ladder temperature control system sustained adult trap temperatures below 70°F for trapping operations for the season. The maximum adult trap water temperature during 2022 was 68.7°F on September 5.
The adult trap total collection for the season was 44,628 fish, including 388 Sockeye salmon, 4,503 Coho salmon, 14,381 steelhead, 14,130 spring/summer Chinook salmon, 11,224 fall Chinook salmon, and 2 bull trout. There was 1 adult lamprey incidentally trapped this season.

Idaho Department of Fish and Game (IDFG) assisted NOAA in sampling throughout the trapping season. Sampling included scale collection, genetic sample, sex determination, fork length, adipose fin clipped/unclipped, and evaluating non-adipose clipped hatchery fish run proportion. Unclipped adult steelhead were PIT tagged to estimate headwater tributary escapement.

Research

Sampling of Steelhead, Chinook salmon, and Sockeye salmon by the Idaho Department of Fish and Game (IDFG) and NOAA Fisheries for Biological data collection:
The goal is to collect fish scales, genetics tissue, sex and length, wild/hatchery composition, and non-adipose clipped hatchery fish assessment of 5-20% of adult steelhead, spring/summer Chinook salmon, and Sockeye salmon ascending the ladder. Natural origin adult steelhead and spring/summer Chinook salmon will be PIT tagged to estimate headwater tributary escapement. Sockeye salmon may be PIT tagged in the future to estimate metrics regarding conversion rates.

Some steelhead and spring/summer Chinook salmon may be radio-tagged or spaghetti-tagged. This information provides status information used in several forums.

Steelhead collection totaled 14,381 (10,745 clipped, 3,636 unclipped) with 3,538 having genetic and scale samples taken, and 2,256 having genetic samples only taken. Of the 14,381 fish sampled, 3,460 were PIT tagged. There were 447 recaptured PIT tagged steelhead.

Spring/Summer Chinook salmon collection totaled 14,130 (10,205 clipped, 3,925 unclipped) with 3,850 having genetic and scale samples taken, and 2,544 having only genetic samples taken. Of the 14,130 fish sampled, 3,715 were PIT tagged. There were 398 recaptured PIT tagged fish. Fall Chinook salmon broodstock collection began August 18. Of the 11,224 fall Chinook salmon handled at the adult trap, 3,236 were transported (genetic samples taken) and 7,988 were released.

WDFW Broodstock Collection and Transport:
Washington Department of Fish and Wildlife (WDFW) fall Chinook salmon broodstock transport to Lyons Ferry Hatchery began August 18 and ended November 7 when collection goals were met. WDFW transported 2,418 (2,028 adults and 390 jacks) fall Chinook salmon.

Nez Perce Tribe Broodstock Collection and Transport:
Collection for transport to Cherry Lane/Dworshak hatcheries began August 20 and ended September 27 when broodstock goals were met. Nez Perce Tribe transported 818 (804 adults and 14 jacks) fall Chinook salmon.

PIT Tagging Adult Coho Salmon for NPT:
Adult Coho salmon were PIT tagged at the adult trap for the first time this during adult fish passage season. The goal was to PIT tag 300 adipose clipped adult Coho Salmon. There were 293 adult Coho salmon PIT tagged at the LWG adult trap this season. Broodstock collection of Coho salmon for the Nez Perce Tribe did not occur this season.

IDFG Genetic Sampling and Collection of adult Sockeye salmon:
Genetic samples were taken from 385 of the 388 adult Sockeye salmon collected in the trap. Emergency trap and transport of adult Sockeye salmon for IDFG was not conducted this season. All Sockeye salmon collected were returned to the fish ladder.

PIT Tagging and Genetic Sample Collection from Bull Trout for USFWS:
Bull trout were collected as part of the normal adult trap daily sample and using the adult sort by code system to recapture previously PIT tagged fish. Two untagged bull trout were PIT tagged, fin clipped for genetic analysis, and had morphometric data collected. Fin clips were sent to USFWS to determine the fish's origin. No previously PIT tagged bull trout were collected in the adult trap. All fish were be released back into the adult fish ladder. There were two adult bull trout collected at the adult fish facility this season. Both fish were PIT and had genetic samples collected prior to being returned to the ladder.

IDFG Investigation into the biological characteristics of walleye captured at LWG Fish Trap:
The objective is to collect age, diet, sex, and gonadal condition data to understand potential of walleye to establish upstream of Lower Granite. There were 73 adult walleyes trapped and euthanized this season. This is the high for walleye collection at LWG adult trap.

For additional information on data collected at Lower Granite adult trap contact Darren Ogden (NOAA; darren.ogden@noaa.gov) or Tiffani Marsh (NOAA; tiffani.marsh@noaa.gov).

Recommendations

1. Replace fish ladder turnpool gate with hoist operated picketed lead system.
2. Replace adult trap braille/recovery pool gate.
3. Replace all entrance weir gates and operating systems.
4. Replace fish ladder automatic control system to permanently address continuing issues.
5. Replace and relocate staff gauges that are difficult to read.
6. Replace and relocate the north powerhouse velocity meter.
7. Relocate SSE fish ladder tailwater elevation sensor to a location that represent the actual tailrace elevation not the anomaly at that location.
8. Relocate velocity sensor currently ran through conduit on the collection channel floor.
9. Add a PIT tag array at the adult trap return gate.

Table 4. Summary of adult fishway inspections at Lower Granite Dam, 2022 [1]

LOWER GRANITE			Not Enough Depth			Too Much Depth		
Criteria & Locations	No. In Criteria / No. On Sill / No. of Inspections	% In Criteria / % On Sill	No. / % Within 0.01-0.1 Foot	No. / % Within 0.11-0.2 Foot	No. / % >0.2 Foot	No. / % Within 0.01-0.1 Foot	No. / % Within 0.11-0.2 Foot	No. / % >0.2 Foot
Channel Velocities	162 *** 163	99.4 ***	*** ***	*** ***	*** ***	*** ***	*** ***	*** ***
Differentials								
Ladder Exit	163 *** 163	100.0 ***	*** ***	*** ***	*** ***	0 0.0	0 0.0	0 0.0
Ladder Weirs	163 *** 163	100.0 ***	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
Counting Station	163 *** 163	100.0 ***	*** ***	*** ***	*** ***	0 0.0	0 0.0	0 0.0
South Shore	159 *** 163	97.5 ***	0 0.0	0 0.0	3 1.8	0 0.0	1 0.6	0 0.0
North Powerhouse	147 *** 163	90.2 ***	2 1.2	4 2.5	10 6.1	0 0.0	0 0.0	0 0.0
North Shore	97 *** 163	59.5 ***	33 20.2	20 12.3	13 8.0	0 0.0	0 0.0	0 0.0
Weir Depths								
SSE-1	114 1 163	69.9 0.6	11 6.7	10 6.1	27 16.6	*** ***	*** ***	*** ***
SSE-2	115 1 163	70.6 0.6	11 6.7	7 4.3	29 17.8	*** ***	*** ***	*** ***
NPE-1	67 93 163	41.1 57.1	1 0.6	1 0.6	1 0.6	*** ***	*** ***	*** ***
NPE-2	66 93 163	40.5 57.1	0 0.0	1 0.6	3 1.8	*** ***	*** ***	*** ***
NSE-1	135 0 163	82.8 0.0	11 6.7	10 6.1	7 1.8	*** ***	*** ***	*** ***
NSE-2	135 0 163	82.8 0.0	13 8.0	7 4.3	8 4.9	*** ***	*** ***	*** ***

[1] Data from Appendix 1.
[2] "On sill" means the weir gate is resting on its sill and meets "on sill" criteria at this location.

SYNOPSIS OF JUVENILE FISH FACILITY OPERATION

Facility Description

Juvenile fish facilities at Lower Granite Dam consist of extended-length submersible bar screens (ESBSs), vertical barrier screens, ten and fourteen inch orifices, a collection channel, a primary dewaterer, emergency and primary bypass, fish separator, fish distribution system that includes PIT tag bypass and sort by code, sampling system with lab, holding facilities distribution, and barge and truck loading.

ESBS's guide fish in the forebay away from the turbine units into one of the 18 gatewell slots that contain two orifices for diverting fish into the collection channel. South orifices are 14-inches and north orifices are 10-inches in diameter. The collection channel typically operates with the 14-inch orifices open in each gatewell slot of operating units. Lights are directed at each open orifice to enhance fish passage into the collection channel. Fish in the collection channel are transported into an above ground flume and are either bypassed to the river via the outfall pipe or directed to the collection facility juvenile separator. Once in the separator, adult and larger non-target fish are released to the river and juvenile fish pass below separator bars and enter the distribution system. Collected fish are then routed directly to a barge, bypassed back to the river, held in a raceway for later transport, utilized for research, or become part of the sample.

Facility Modifications

The following modifications were made to the JFF prior to or during the 2022 fish collection season:

1. Installed safety guards on PDW overflow weirs operating shafts.
2. Completed facility air compressor installation.
3. Received 3500-gallon tank semi-trailer.
4. Replaced fish hold water supply pumps for barges 4394 and 8105.
5. Completed front void structural support repairs in barge 8105.
6. Completed replacing aerators biological balls on fish transport barges.
7. Completed upgrading facility pneumatic system including adding condensation drains, new air lines, valves, and valve operators.
8. Install electronic operators for all raceway release knife gate valves.
9. Install cabinet for all raceway supply and exit valve operating controls.
10. Improved sample recovery truck loading pipe slope to eliminate fish stranding in pipe.
11. Installed TDG monitoring equipment on all barges.
12. Installed air conditioning unit in facility HV system to reduce excess heat during summer months.
13. Installed pneumatic release valves on the sample holding tank.
14. Installed backflush air valve and slide gate on the sample transport line to assist with dislodging debris.
15. Replace hydraulic system for the barge loading boom.
16. Continued replacing old mesh on raceway supply headbox screens.
17. Continued to install anodes on barge fish hold supply pump to prevent electrolysis corrosion.

18. Continued rebuilding ESBSs and replacing VBS mesh as time permits.
19. Installed PIT tag detection array on the barge load line.

Operation and Maintenance

Turbine Operations

Efforts were made to operate all turbine units within one percent of the peak efficiency from April 1 to October 31. Deviations were infrequent and brief or required by BPA. Table 17 contains unit outages during 2022.

Table 5. Lower Granite turbine unit outages, 2022.

Unit	Date OOS	Reason out of service
Units 1 – 6	Feb 21-24	Trash rack raking
Units 1 – 6	Mar 21-23 and Mar 29	ESBS Installation
Units 1 – 6	Monthly Mar-Nov	VBS/ESBS Inspection
Units 1 – 6	Aug 8-11	Doble Testing
Units 1-4 & 6	Nov 14-17	ESBS Removal
Unit 5	Nov 23	ESBS Removal
Units 1 – 6	Nov 14-Nov 18	500 KV Line Outage – Line 1
Unit 1	Nov 29, 2021-Feb 10, 2022	Annual Maintenance
	Mar 3	Tripped offline Regulator Trouble
	Apr 11-Apr 22	T1 transformer oil leak
	June 10	VBS Inspection to find source of torn VBS screen
	Dec 1-22	Annual Maintenance
Unit 2	Mar 14-Apr 7	DCLV Switchgear
	Apr 11-Apr 22	T1 transformer oil leak
	June 26-June 29	ESBS/VBS Inspection – Repairs needed to 2B VBS
	Oct 31-Nov 21	Annual Maintenance
Unit 3	Feb 14-Mar 10	Annual Maintenance, DCLV, and Bearing Temp Upgrade
	Apr 11-Apr 22	T1 transformer oil leak
	Sept 20	Repair excessive Wicket Gate Leakage
	Oct 3-20	Annual Maintenance
	Nov 21	Excitation Problems
Unit 4	Apr 11-May 10	SU/CE/Gov oil pump replacement
	July 11-28	Annual Maintenance
	Sept 22	Inspect Gatewell 5A Stop Logs
	Nov 21, 2022-Feb 2, 2023	Thrust Bearing & Bearing Indication Upgrades
Unit 5	April 19	Add oil to T1 transformer
	April 21-22	Doble Testing T1
	Aug 22-Oct 5	Annual Maintenance/Overhaul
Unit 6	April 19	Add oil to T1 transformer
	April 21	Doble Testing T1
	April 22	Doble Testing T1
	Aug 1-18	Annual Maintenance
	Oct 19	Shear Boom Inspection

Debris/Trash Racks

Trashracks were raked February 21-24. Trashrack raking was not required during the fish passage season.

Extended-length Submersible Bar Screens (ESBSs)

ESBSs were inspected and tested prior to installation on March 21-23. Unit 2 ESBSs were installed March 29 prior to being returned to service. Brush cleaning cycle was set to operate automatically every two hours this season.

Vertical Barrier Screens (VBSs)

VBSs were video inspected in conjunction with ESBSs during the 2022 fish passage season. Detailed inspections were performed during the June ESBS inspection. VBS screen panel mesh has the potential to deteriorate and become brittle over time. VBS panels for screens that pass underwater camera inspection but showed potential for deterioration continue to be replaced/repaired during unit annual outages or during winter maintenance as time permits.

Gatewells

Gatewells were normally less than 1% covered with debris and did not exceed the 50% debris surface coverage criterion. Turbulence in gatewells with ESBSs causes debris to tumble around and exit through the orifices rather than accumulate on the gatewell surfaces. Surface debris was removed from individual gatewells with a hand dipping basket during initial water-up in late March and continued throughout the season. Occasional oil sheens were dealt with by floating oil absorbent pads in the affected gatewells.

Orifices/Collection Channel

The orifice gallery was watered up March 15. Orifice operation was determined by collection channel flow and forebay elevation. When the forebay is raised above MOP, 10" orifices in gatewells of non-priority units (typically units 4 & 5) are used to maintain acceptable flow to the PDW. Orifices were inspected as often as every three hours and back-flushed with air as needed to remove debris March 1-May 25. Orifices were inspected and back flushed twice a shift May 25-November 1 when river debris loads were minimal. Orifice operation programming issues continue to be a problem. The facility was operated by two biological technicians to monitor the orifice gallery and the operation of the relatively new system during the spring freshet. Orifice lights were checked during daily inspections.

Primary Dewaterer

The primary bypass system was watered up in bypass mode March 15. Primary dewaterer floor screen brushes, side screen brushes, and the pneumatic screen cleaners were intermittently operated in auto and manual mode by powerhouse operators and JFF staff due to mechanical and programing issues with the system. Operational changes in response to programming, mechanical, and structural issues with the PDW continue as needed.

Wet Separator/Distribution and Sampling Systems

Water levels in the separator varied with the forebay elevation and PDW operations requiring adjustment in porosity control valves and separator exit gates. Biological technicians adjusted porosity dewatering valves and exit gate positions in response to separator water elevation changes related to PDW weir operation. Separator exit gates were adjusted to improve PIT tag detection efficiencies as coordinated with PSMFC technicians. There were minimal debris obstructions.

Barge Loading Operations

Barge loading operations occurred from April 24 through June 19. Loading from the raceways went smoothly this season. Direct loading did not occur.

Truck Loading Operations

Truck transport started as scheduled August 1 and continued with the last truck departing November 1.

Research

Corps biological staff supported 10 research projects at LWG at the juvenile fish facility this season. Five agencies participated in six research projects with juvenile salmonids collected at LWG juvenile facility. Additional support was provided collecting kelts off the separator, juvenile lamprey studies conducted, NOAA and USGS PIT tag efficiency evaluations, and the Ocean and Estuary study. A total of 328,649 smolts (12.9% of the total collection) were collected and handled by research groups during the 2022 season compared.

Recommendations

1. Complete Phase 1a modifications and resolve programming issues.
2. Operate the PDW flume outflow between 35-40 cfs to reduce delays in system.
3. Continue rebuilding motors on the 2000 series barges.
4. Replace barge bumper cable and tire system with bumpers.
5. Paint hulls on 8000 series barges.
6. Install ballast material in barges 4394 and 4382 voids to eliminate use of river water.
7. Improve/modify sample holding tank anesthetic chamber separation door operation.
8. Ensure all researcher working at LGW are accountable for anesthetic waste disposal in compliance with the EPA Clean Water Act.
9. Modify PDW side screen cleaners for reliability and ability to operate system in auto mode.
10. Replace electrical cables, control, and hoist for upstream raceway fish crowder.
11. Replace PVC sample line with a 12-inch flume.
12. Replace sample PIT array with new upgraded flume PIT array.
13. Install inline fish counter into the sample line pipe to test as an alternative method to enumerate fish.
14. Replace PDW floor brushes.

APPENDIX