CENWW-OD-DL HOLDREN (1130) March 2022

MEMORANDUM THRU:
Robert Lustig, Operations Manager Lower Granite Dam

FOR Chief, Operations Division
ATTN: Chris Peery

SUBJECT: Submission of 2021 Adult and Juvenile Fish Facility Monitoring Report, Lower Granite Dam.

1. Enclosed find the 2021 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

2021

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Project Lead Supervisory Fisheries Biologist

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, 2021. 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 "2021 Juvenile Fish Collection and Bypass Report, Lower Granite Juvenile Fish Facility".

River Conditions

The average daily river flow did not exceed 100 kcfs during the 2021 season. Total river flow averaged 37.3 kcfs this season. Highest daily average flow for the March 2-November 1 collection season was 89.4 kcfs May 19. Lowest daily average flow for the season was 14.2 kcfs October 22. Spill for fish passage occurred for 152 days from April 3 through midnight on August 31. LWG spilled up to the 125% gas cap for at least 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. To facilitate spillway PIT tag detection the RSW remained in operation after average total outflow dropped below 30 kcfs (August 16-31). Spill was distributed according to FPP Table LWG-7 and LWG-8. Average season flow through spillways was 25.7 kcfs with a maximum daily average of 57.9 kcfs May 19 and a minimum daily average of 5.7 kcfs August 29. The RSW was open from 0500-0900 hours on Sundays, Tuesdays, and Thursdays from October 1 to November 15 for passage of adult steelhead overshoot. River temperatures collected as part of the daily condition sample averaged 57.0° F for the season and ranged from 39.0° F March 2-4 to 67.5° F August 4.

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 four out of ten floating orifice gates (FOGs) operating, #1, #4, #7, and

#10. The three electric AWS pumps supply additional water from tailrace intakes through the lower ladder and collection channel diffusers.

Facility Modifications

1. Replaced supply valves for anesthetic sample tanks.
2. Updated adult fish trap dewatering standard operation procedure.
3. Developed a protocol for emergency flushing procedures for clearing shad mortalities from the adult trap return channel.
4. Repaired fall out fence.
5. Filled/repaired fish ladder expansion joints.
6. Replace NSE-1 and NSE-2 gate operating systems.

Operations and Maintenance

Fish Ladder and Collection Channel

The adult fish ladder was in service throughout 2021 apart from the winter maintenance season from January 4-January 21. 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 was 1 juvenile steelhead and 1 juvenile Chinook rescued in the upper section of the ladder during the dewatering process 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 $4/10^{th}$ 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. Fish recovered from the powerhouse section of the collection channel January 6 included 4 unclipped adult steelhead, 1 adult Coho, 2 juvenile unclipped Chinook, 3 juvenile unclipped steelhead, 5 juvenile lamprey, 5 scuplin, 1 peamouth, and 1 catfish. The spillway section was not dewatered during this winter maintenance period. 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 18 for annual maintenance. Annual maintenance consists of general mechanical and electrical inspection, and repairs. AWS pump 1 and 2 were returned to service February 18 and AWS pump 3 was kept offline for lower guide bearing replacement. Due to Covid-19, guide bearing work on pump 3 was postponed until the 2020-2021 outage. AWS pump 3 was returned to service April 7 in standby mode. July 13, AWS pump 2 was removed from service to bring pump 3 online for operational testing. AWS pumps 1 and 3 remained in service until AWS 1 was forced out of service October 25 due to blown disconnect fuses and a coil fire. After several attempts to repair pump 1, AWS pump 2 was started October 27 and 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, 2021*

Affected Pump(s)	Dates	Reason for Outage/Comments
1, 2	Jan 1 – Feb 18	Annual maintenance
3	Jan 1 – Apr 7	Annual maintenance/lower guide bearing
2	Apr 7 – Oct 27	On Standby
1	Oct 25 – Dec 31	Blown disconnect fuses and burned up coil

*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 that are listed above. 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 2021 – 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 the number of walleye in the fish ladder during the 2021 adult passage season. There were 1,877 adult walleye counted between April 19 and October 31 with the majority of them being counted in September and October (Table 3). Counts were conducted 16 hours per day from 0400-2000 hours PST. Walleye counts likely excludes some fish that traveled downstream outside of normal fish count hours.

Table 3. Walleye Counts at Lower Granite Adult Fish Count Station in 2021

April	May	June	July	August	September	October
60	58	19	19	92	464	1165

Adult Fish Trap Operations

Lower Granite adult fish trap was operated March 1 to November 18 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 most of the season except for August 3 to August 9 when the trap was shut down until water temperatures were below 70°F. The maximum adult trap water temperature during 2021 was 70.8°F on August 4. The adult trap total collection for the season was 33,334 fish, including 273 sockeye, 4,938 Coho, 8,704 steelhead, 10,149 spring/summer Chinook, 9,266 fall Chinook, 2 pink, and 2 bull trout.

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. Natural origin adult steelhead were PIT tagged to estimate headwater tributary escapement.

Steelhead collection totaled 8,704 (6,113 clipped, 2,591 unclipped) with 2,401 having genetic and scale samples taken, and 2,358 having genetic samples only taken. Of the 8,704 fish sampled, 2,401 were PIT tagged and 77 were Floy tagged. There were 135 recaptured PIT tagged fish.

Spring/Summer Chinook collection totaled 10,149 (3,446 clipped, 2,703 unclipped) with 2,541 having genetic and scale samples taken, and 3,758 having only genetic samples taken. Of the 10,149 fish sampled, 2,541 were PIT tagged. There were 141 recaptured PIT tagged fish. Fall Chinook collection for broodstock transport began August 17. Of the 9,266 fall Chinook handled at the adult trap, 3,276 were transported (genetic samples taken) and 5,990 were released. Washington Department of Fish and Wildlife (WDFW) fall Chinook broodstock transport to Lyons Ferry Hatchery began August 18 and ended September 29 when collection goals were met. WDFW transported 2,484 (1,977 adults and 507 jacks) fall Chinook. Nez Perce Tribe collection for transport to Cherry Lane/Dworshak hatcheries began July 27 and ended September 27 when broodstock goals were met. Nez Perce Tribe transported 792 (775 adults and 17 jacks) fall Chinook.

Broodstock collection of Coho for the Nez Perce Tribe occurred from September 28 to October 20. Coho ≥ 55 cm in length were collected. Of the 4,938 Coho collected at the adult trap, 811 were transported and 4,127 were returned to the fish ladder. There were 47 recaptured PIT tagged fish.

Genetic samples were taken from all 76 of the 273 adult sockeye collected in the trap. Emergency trap and transport of adult sockeye for IDFG was conducted July 6 to July 29 due to increasing in river water temperatures and record ambient temperatures. All sockeye collected prior to July 6 and after July 29 were returned to the fish ladder.

There was 2 adult lamprey incidentally trapped this year.

There were 72 adult walleye collected and euthanized at the adult trap this season. Biological samples taken included otoliths, dorsal spines, gonads, and stomachs. This data will be used to determine future actions to manage the establishment of walleye in the Snake River and its

tributaries in Idaho. As a threat to juvenile salmonids, the expanding walleye population needs to be monitored as they continue to spread upstream of Lower Granite.

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

Special Operations for Adult Ladder Water Temperature

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 3 through September 23.

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 are 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 2021 fish passage season, 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 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 3.8 inspections per week were performed (167 inspections /44 weeks) in 2021. 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 2021 was 72.8% compared to 77.4% in 2020. 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 98.2% of the inspections. Out of criteria readings included 2 at 0.01-0.1 feet below criteria and 1 at 0.11-0.2 feet below criteria.

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 89.8% of inspections. Out of criteria readings included 13 at 0.01-0.1 feet below criteria, 2 at 0.11-0.2 feet below criteria, and 2 at 0.2 feet below criteria.

NPE-1 & 2 head differentials were in criteria on 60.5% of inspections. Out of criteria readings included 25 at 0.01-0.1 feet below criteria, 12 at 0.11-0.2 feet below criteria, and 29 at >0.2 feet below criteria.

NSE-1 & 2 head differentials were in criteria on 25.1% of inspections compared to 85.5% in 2020. Historically AWS pump operation was unable to maintain both head differentials and weir depths when tailrace was at minimum operating pool (MOP). Weir motors and winches were replaced during the 2021 adult fishway outage. Both weir gates were fully operational throughout the season. Head differential readings were out of criteria (criteria 1.0-2.0 feet) on 122 inspections in 2021. Out-of-criteria readings included 26 at 0.1 feet below criteria, 27 at 0.2 feet below criteria, and 71 greater than 0.2 feet below criteria. Out-of-criteria readings also included 2 readings greater than 0.2 feet above criteria and 1 at 0.11-0.2 feet above 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 spill operations and at MOP.

Entrance Gate Depths

SSE-1 weir gate was in depth or sill criteria on 73.1% of inspections (73.1% depth, 0.0 % sill) compared to 70.5% in 2020. Out of criteria readings included 24 at 7.9 feet, 14 at 7.8 feet, and 7 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 70.7% of inspections (70.7% depth, 0.0 % sill) compared to 74.0% in 2020. Out of criteria readings included 21 at 7.9 feet, 17 at 7.8 feet, and 11 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 95.2% of inspections (32.9% depth, 62.3% sill) compared to 86.8% in 2020. Out of criteria readings included 2 at 7.9 feet and 6 at 7.7 feet or less.

NPE-2 weir gate was in depth criteria or sill on 95.8% of inspections (32.9% depth, 62.9% sill) compared to 88.5% in 2020. Out of criteria readings included 2 at 7.9 feet and 5 at 7.7 feet or less.

NSE-1 weir gate hoist was replaced during the winter maintenance period. NSE-1 weir gate was in depth or sill criteria on 82.6% of inspections (82.6% depth, 0.0 % sill) compared to 65.3% in 2020. Out of criteria readings included 5 at 6.9 feet, 11 at 6.8 feet, and 20 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 hoist was replaced during the winter maintenance period and was fully operational for the 2021 season. NSE-2 had been out of service and suspended with a chain fall hoist since the 2011 season. NSE-2 weir gate was in depth or sill criteria on 81.4% of inspections (81.4% depth, 0.0 % sill). Out of criteria readings included 9 at 6.9 feet, 7 at 6.8 feet, and 22 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 98.8% of inspections (criteria: 1.5-4.0 ft/s) compared to 49.7% in 2020. 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.

Recommendations

1. Replace fish ladder/adult trap turnpool diversion 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. Resolve adult fish ladder automatic control system programing issues.
5. Replace/relocate staff gauges that are difficult to read.
6. Label adult fish trap valves (identifying their function) and develop updated O&M manual.
7. Replace and relocate the north powerhouse velocity meter.
8. Relocate SSE fish ladder control system tailwater elevation sensor to a location that represent the actual tailrace elevation not the anomaly at that location.

Table 4. Summary of adult fishway inspections at Lower Granite Dam, 2021 [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	165 *** 167	98.8 ***	*** ***	*** ***	*** ***	*** ***	*** ***	*** ***
Differentials								
Ladder Exit	167 *** 167	100.0 ***	*** ***	*** ***	*** ***	0 0.0	0 0.0	0 0.0
Ladder Weirs	164 *** 167	98.2 ***	2 1.2	1 0.6	0 0.0	0 0.0	0 0.0	0 0.0
Counting Station	167 ***	100.0 ***	*** ***	*** ***	*** ***	0 0.0	0 0.0	0 0.0

	167							
South Shore	150 *** 167	89.8 ***	13 7.8	2 1.2	2 1.2	0 0.0	0 0.0	0 0.0
North Powerhouse	101 *** 167	60.5 ***	25 15.0	12 7.2	29 17.4	0 0.0	0 0.0	0 0.0
North Shore	42 *** 167	25.1 ***	26 15.6	27 16.2	71 42.5	0 0.0	1 0.6	2 1.2
Weir Depths								
SSE-1	122 0 167	73.1 0.0	24 14.4	14 8.4	7 4.2	*** ***	*** ***	*** ***
SSE-2	118 0 167	70.7 0.0	21 12.6	17 10.2	11 6.6	*** ***	*** ***	*** ***
NPE-1	55 104 167	32.9 62.9	2 1.2	0 0.0	6 3.6	*** ***	*** ***	*** ***
NPE-2	55 105 167	32.9 62.9	2 1.2	0 0.0	5 3.0	*** ***	*** ***	*** ***
NSE-1	138 0 167	82.6 0.0	5 3.0	11 6.6	20 12.0	*** ***	*** ***	*** ***
NSE-2	136 0 167	81.4 0.0	9 5.4	7 4.2	22 13.2	*** ***	*** ***	*** ***

[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 2021 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 air compressor conex 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 to prevent fry and juvenile lamprey passage.

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 2021.

Table 5. Lower Granite turbine unit outages, 2021.

Unit	Date OOS	Reason out of service
Units 1 – 6	Monthly Mar-Nov	ESBS/VBS inspection
Units 1 – 6	Feb 8-10	Trash rack raking
Units 1 – 6	Feb 23-25	ESBS Installation
Units 1 – 4	Aug 5	Line Outage
Units 1 – 6	Aug 9-12 & Aug 17	Doble Testing
Units 2 – 6	Nov 30-Dec 2	ESBS Removal
Unit 1 – 6	May 4	300G Line Relay Program Settings
Unit 1	Mar 3	Swap direct current busses
	Oct 4	DC feed swap to bus 2
	Nov 29-Feb 2022	Annual Maintenance
Unit 2	Feb 9	300 G Relay Issues
	Mar 17	PSS Model Validation Testing
	May 20-26	Governor Processing Card Failure
	July 1-14	Oil/Water Separator Install
	Nov 1-17	Annual Maintenance
Unit 3	Mar 3	Swap direct current busses
	Mar 16	PSS Model Validation Testing
	Mar 17	PSS Model Validation Testing
	Apr 7-8	Regulator issues – Will not build voltage
	May 12	Turbine Guide Bearing Control Circuit Failure
	June 24	Exciter Breaker Circuit Issues
	Oct 4-20	Annual Maintenance
	Nov 22	SQ1 Switchgear Change out
Unit 4	Sept 13-29	Annual Maintenance and Bearing Indication Work
	Nov 22	SQ1 Switchgear Change out
Unit 5	April 1	Replace ESBS/VBS
	Apr 12-May 6	SU5/S5/Gov Oil Pump Replacement
	June 3	Turbine Bearing Oil Low Device Failure
	July 12-20	SQ2 Wire Upgrade
	Oct 25-28	5A Prototype Weir Decommissioning Prework
Unit 6	Mar 1-Apr 8	Replace SU6
	July 26-Sept 21	6 Year Maintenance Overhaul

Debris/Trash Racks

Trash racks were raked February 8-10. Trash rack raking was not required during the fish passage season.

Extended-length Submersible Bar Screens (ESBSs)

Extended Length Submersible Bar Screens (ESBSs) were inspected and tested prior to installation. ESBSs were installed February 23-25. Brush cleaning cycle was set to operate every two hours this season.

Vertical Barrier Screens (VBSs)

VBSs were video inspected in conjunction with ESBSs during the 2021 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 at 1028 hours February 22 to support early juvenile collection facility operation. Orifice operation was determined by collection channel flow and forebay elevation during the 2021 season. 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 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 at 1028 hours February 22 to support the request of regional fisheries managers to obtain information on early juvenile salmonid outmigration. Primary dewaterer floor screen brushes, side screen brushes, and the pneumatic screen cleaners were intermittently operated in 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. Adjustments in flume flow were made to reduce fish holding in the transport flume and under the separator. Porosity control valve modifications made during the 2018-2019 winter outage distributed flow evenly across the porosity. These modifications to the porosity control unit balanced water across the plate and enabled adequate dewatering prior to entering the separator however they did not address all the issues. An additional modification was added to the porosity control unit during the 2019-2020 outage to smooth the downstream flow. 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.

Barge Loading Operations

Barge loading operations occurred from April 24 through June 20. Loading from the raceways went smoothly this season. Direct loading did not occur.

Truck Loading Operations

Truck transport started July 4 due to high in-river temperatures combined with record high air temperatures. Truck transport continued through November 1. LWG transported fish from LGS July 14, July 16, July 18, August 5, August 7, and August 9.

Avian Predation

Injuries associated with predators include wounds inflicted by other fish, birds, and lamprey. Predator wounds were observed on 1.0% of the smolts examined. Predator marks caused by birds, characterized by a distinct V-shaped descaling pattern on both sides of a fish were the most common predator mark at 51.9% compared to 28.0% caused by lamprey and 20.1% caused by fish. Predator marks were highest on clipped sockeye salmon (2.0%), unclipped steelhead (1.8%), clipped steelhead (1.5%) and unclipped subyearling fall Chinook salmon (1.0%).

Control Measures

Areas of avian monitoring included: the forebay, turbine and spillway discharge, and the JFF bypass outfall. Deterrent measures included: bird wires across the tailrace of the powerhouse and hazing (April 1 through June 30) under the animal control contract (APHIS). Two shift hazing coverage (daylight to dusk) occurred from April 19 through June 2. This appeared to be effective at reducing the number of gulls returning to feed. Hazing efforts included the use of 15 mm pyrotechnics, long-range rockets, and fused rope salutes. Due to safety concerns, propane canons were not utilized at Lower Granite. Lethal take was implemented this season with 21

gulls removed. Lower Granite biologist binocular monitoring of piscivorous bird presence and foraging behavior occurred from March 1 through October 31.

Gull Counts

Lower Granite biologists made binocular gull counts in the tailrace extending from immediately below the dam to about ½ mile downstream and in the forebay to about ½ mile upstream of the dam. Daily biologist count observations were made after sunrise and just before sunset from March 1 through October 31. During the counting period 1,413 gulls were counted with an average daily count of 5.8 and a maximum of 65 counted May 16.

Double Crested Cormorants

Daily count observations were made after sunrise and just before sunset from March 1 through October 31. During the counting period 1,617 cormorants were counted with an average daily count of 6.6 and a maximum of 40 counted October 18.

American White Pelicans

White pelicans were observed foraging in Lower Granite tailrace from April 1 through July 3 with a maximum of 54 counted in the tailrace June 4. Additional pelicans were commonly observed resting on the island adjacent to Boyer Park Marina during this period. Hazing of pelicans did not occur at Lower Granite.

Avian Foraging Behavior

Foraging behavior was recorded for gulls, cormorants, and Caspian terns. Gulls had the highest percent of foraging behavior observed (30.9%) followed by cormorants (9.7%).

Cooling Water Strainer Counts

Turbine unit cooling water strainers were examined for biologic content once per month from January through July and the end of December during operating year 2021. Timing of the lamprey entry into the strainers represents migration timing coupled with susceptibly of being drawn into the cooling water system. Unit run time totaled 9,643 hours and 927 lamprey were recovered from cooling water strainers during the 8 months that the strainers were examined. Juvenile lamprey were most abundant in January (435) and May (401).

Invasive Species:

No zebra/Quagga muscles were observed in the trap substrate this season. Siberian prawn numbers continue to rise with an estimated 369,104 removed from the condition sample this season compared to 128,075 in 2020 and 52,330 in 2019. The expanded estimated Siberian prawn count for 2021 was 1,179,365. The abundance of prawns in raceways impacted loading and transport operations requiring modified loading procedures and additional tank monitoring. From mid-July through August, Siberian prawns were removed by net from raceways prior to loading fish into the transport tanks to minimize prawns from obstructing the overflow screen

and recirculation system. All Siberian prawns removed from raceways and the condition sample were euthanized and disposed of according to WDFW protocol.

Recommendations

1. Complete Phase 1a modifications and resolve programming issues.
2. Replace PDW emergency bypass exit hatch.
3. Operate the PDW flume outflow between 35-40 cfs to reduce delays in system.
4. Rebuild raceway tailscreens to reduce weight for personnel safety.
5. Continue rebuilding motors on the 2000 series barges.
6. Replace barge bumper cable and tire system with bumpers.
7. Paint hulls on 8000 series barges.
8. Install electronic operators for all raceway supply knife gate valves.
9. Install ballast material in barges 4394 and 4382 voids to eliminate use of river water.
10. Improve/modify SHT anesthetic chamber separation door operation.
11. Permanently close the collection channel 5A research weir that is becoming a safety concern.
12. Ensure all researcher working at LGW are accountable for anesthetic waste disposal in compliance with the EPA Clean Water Act.
13. Modify PDW side screen cleaners for reliability and ability to operate system in auto mode.
14. Replace electrical cables, control, and hoist for upstream raceway fish crowder.

APPENDIX