2014 Fish Passage Plan

Section 8 – Little Goose Dam

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Project Acronym*	LGS
River Mile (RM)	Snake River - RM 70.3
Reservoir	Lake Bryan
Minimum Instantaneous Flow (kcfs)	Dec–Feb: 0 kcfs \ Mar–Nov: 11.5 kcfs
Forebay Normal Operating Range (ft)	633’ – 638’
Tailrace Rate of Change Limit (ft)	1.5’/hr
Powerhouse Length (ft)	656’
Powerhouse Hydraulic Capacity (kcfs)	130 kcfs
Turbine Units (#)	6 (Units 1-3 BLH Kaplan; Units 4-6 Allis Chalmers Kaplan)
Turbine Generating Capacity (MW)	Rated: 810 MW (Units 1-6 @ 135 MW) \ Maximum: 930 MW (Units 1-6 @ 155 MW)
Gatewell Orifice Diameter (in)	35 gatewells w/ 12” orifice; 1 gatewell w/ 14” orifice
Spillway Length (ft)	512’
Spillway Hydraulic Capacity (kcfs)	850 kcfs
Spillbays (#)	8
Spillway Weirs (#)	1 (Bay 1)
Navigation Lock Length x Width (ft)	650’ x 84’ (Usable Space)
Navigation Lock Max. Lift (ft)	101’
FISH STRUCTURE/OPERATION START DATE	
Juvenile Bypass System (JBS)	1970 (1st Generation) \ 1989 (2nd Generation) \ 2010 Outfall Flume Relocation
Submersible Traveling Screens (STS)	1971 (Prototype Mesh) \ 1994 (Complete)
Extended-Length Submersible Bar Screens (ESBS)	1997
Transportation Research Program - NMFS	1971-1975
Juvenile Fish Transportation Program - Corps	1981 \ 1991 (3rd Generation)
Temporary Spillway Weir (TSW)	2009
Adult Fish Counts – South Shore	1970-1981; 1991-present

*Project acronym designated by US Army Corps of Engineers, Northwestern Division, Columbia Basin Water Management Division. Due to the large number of projects managed by NWD, this acronym may differ from other acronyms used in the region. For example, a common acronym for Little Goose is LGO. However, that acronym is assigned to another NWD project, thus the official Corps NWD acronym is LGS.

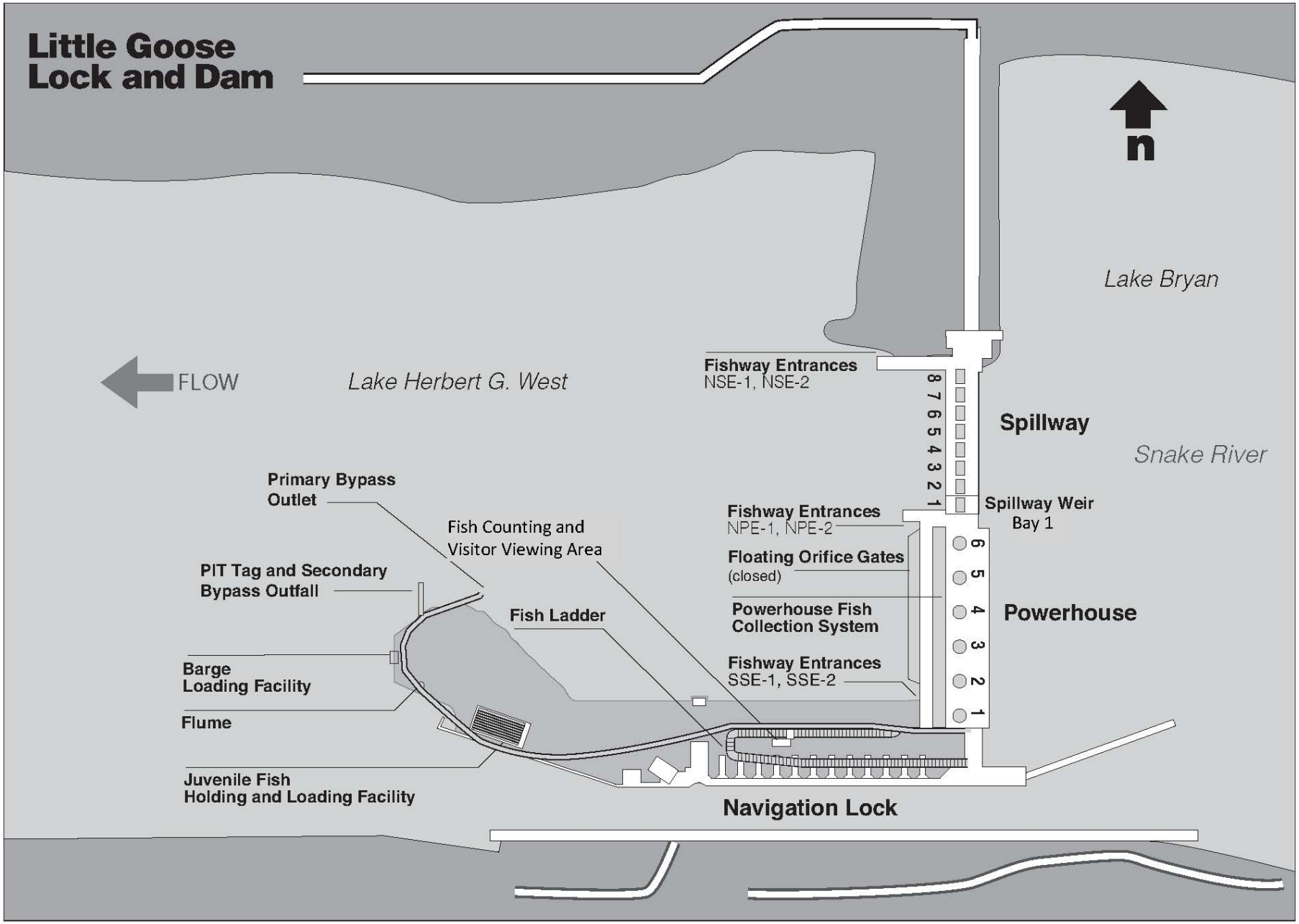
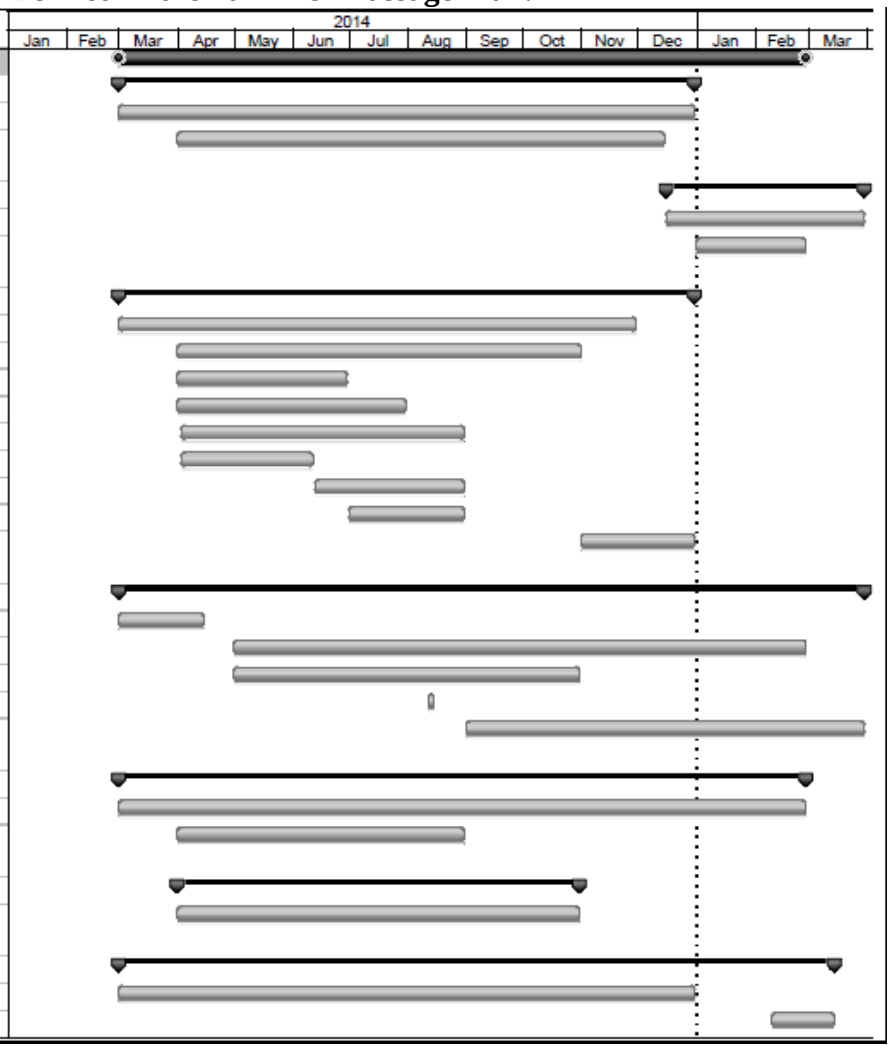


Figure LGS-1. Little Goose Lock & Dam General Site Plan.

Table LGS-1. Little Goose Dam Schedule of Operations and Actions Defined in the 2014 Fish Passage Plan.

Task Name	Start Date	End Date	FPP Reference
2014 FPP Operations & Actions - Little Goose	3/1/14	2/28/15	LGS
Fish Passage Facilities Operation	3/1/14	12/31/14	2.3.
Adult Fish Facilities	3/1/14	12/31/14	2.3.2.2
Juvenile Fish Facilities	4/1/14	12/15/14	2.3.1
Fish Passage Facilities Maintenance	12/16/14	3/31/15	2.3
Juvenile Fish Facilities Winter Maintenance	12/16/14	3/31/15	2.3.1.1
Adult Fish Facilities Winter Maintenance	1/1/15	2/28/15	2.3.2.1
Project Operations for Fish Passage	3/1/14	12/31/14	
Turbine operating priority order	3/1/14	11/30/14	4.1.1.
1% operating range - hard constraint	4/1/14	10/31/14	4.1.2.
Measure VBS head weekly (minimum)	4/1/14	6/30/14	2.3.1.2.b.11
Backflush orifices once per 8-hrs (minimum)	4/1/14	7/31/14	2.3.1.2.c.6.
Spillway Weir in service (close 8/1-8/31)	4/3/14	8/31/14	2.3.1.2.g.3.
Spring Spill Operations (end date approx)	4/3/14	6/12/14	FOP
Summer Spill Operations (dates approx)	6/13/14	8/31/14	FOP
Measure VBS head bi-weekly (minimum)	7/1/14	8/31/14	2.3.1.2.b.11
Priority turbine unit maintenance	11/1/14	12/31/14	4.2.3.
Special Operations & Studies (dates approximate)	3/1/14	3/31/15	Appendix A
Units 1, 2 Exciter Re-Commissioning	3/1/14	4/15/14	8.1.2.
Adult Salmon Studies	5/1/14	2/28/15	8.2.1
Adult Lamprey Passage Studies	5/1/14	10/31/14	8.2.2-3.
Coupling Capacitor Testing	8/12/14	8/15/14	8.1.4.
Steady State Model Validation Testing	9/1/14	3/31/15	8.1.5.
TDG Monitoring	3/1/14	2/28/15	2.2.
TDG Monitoring - Tailrace (year-round)	3/1/14	2/28/15	station LGSW
TDG Monitoring - Forebay	4/1/14	8/31/14	station LGSA
Adult Fish Counting	4/1/14	10/31/14	Table LGS-3
Daytime Visual 0400-2000 PST	4/1/14	10/31/14	
Reports	3/1/14	3/15/15	2.3.3.
Weekly Reports	3/1/14	12/31/14	
Annual Report	2/10/15	3/15/15	



1. FISH PASSAGE INFORMATION

Fish passage facilities and dam structures at Little Goose Dam are illustrated in **Figure LGS-1**. Dates of project operations for fish, research and other special operations are defined in **Table LGS-1**.

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description. The Little Goose Dam juvenile fish facilities (**Figure LGS-1**) consist of a bypass system and juvenile transportation facilities. The bypass system consists of extended length submersible bar screens (ESBSs) with flow vanes, vertical barrier screens (VBSs), one 14” and thirty-five 12" gatewell orifices, a bypass channel running the length of the powerhouse, a metal flume mounted on the face of the dam and the upper end of the fish ladder, a dewatering structure to eliminate excess water, two emergency bypass systems, and one corrugated metal flume to transport fish to either transportation facilities or the river. The transportation facilities include a separator structure, raceways for holding fish, a distribution system for distributing fish among raceways, a sampling and marking building, truck and barge loading facilities, and PIT-tag detection and diversion systems.

1.1.2. Juvenile Migration Timing. Juvenile migration timing at Little Goose Dam (**Table LGS-2**) is based on juvenile fish collection numbers for the most recent 10-year period and do not reflect fish guidance efficiency (FGE) or passage via the RSW or spillway. From 2006–2009, fish collection began later in the season and may have skewed the passage dates shown. Salmon, steelhead, bull trout, lamprey, and other species are counted when they are observed in the juvenile monitoring facility. Maintenance of fish passage facilities that may impact juvenile passage or facility operation should be conducted during the winter maintenance season.

Table LGS-2. Juvenile Salmonid Passage Timing at Little Goose Dam for Most Recent 10-Years (2004-2013) Based on Daily & Yearly Collection Data.

Year	10%	50%	90%	# Days	10%	50%	90%	# Days
	Yearling Chinook				Subyearling Chinook			
2004	24-Apr	5-May	18-May	24	9-Jun	21-Jun	17-Jul	38
2005	3-May	11-May	19-May	16	12-May	6-Jun	20-Jun	39
2006	23-Apr	6-May	20-May	27	24-May	9-Jun	4-Jul	41
2007	8-May	14-May	22-May	14	7-Jun	15-Jun	6-Jul	29
2008	5-May	15-May	28-May	23	4-Jun	20-Jun	23-Jul	49
2009	24-Apr	7-May	23-May	29	29-May	7-Jun	30-Jun	32
2010	2-May	15-May	29-May	27	6-Jun	12-Jun	8-Jul	32
2011	5-May	12-May	19-May	14	4-Jun	17-Jun	20-Jul	46
2012	30-Apr	7-May	21-May	21	4-Jun	16-Jun	12-Jul	38
2013	5-May	10-May	16-May	11	2-Jun	13-Jun	29-Jul	57
MEDIAN	**2-May**	**10-May**	**20-May**	**22**	**4-Jun**	**14-Jun**	**10-Jul**	**39**
MIN	**23-Apr**	**5-May**	**16-May**	**11**	**12-May**	**6-Jun**	**20-Jun**	**29**
MAX	**8-May**	**15-May**	**29-May**	**29**	**9-Jun**	**21-Jun**	**24-Jul**	**50**
	Unclipped Steelhead				Clipped Steelhead			
2004	25-Apr	11-May	2-Jun	38	27-Apr	10-May	1-Jun	35
2005	6-May	12-May	24-May	18	6-May	12-May	22-May	16
2006	20-Apr	5-May	23-May	33	21-Apr	4-May	20-May	29
2007	11-May	15-May	30-May	19	10-May	15-May	27-May	17
2008	8-May	18-May	1-Jun	24	1-May	12-May	23-May	22
2009	24-Apr	4-May	29-May	35	23-Apr	30-Apr	25-May	32
2010	3-May	22-May	8-Jun	36	2-May	20-May	7-Jun	36
2011	7-May	16-May	6-Jun	30	4-Apr	12-May	20-May	46
2012	30-Apr	17-May	2-Jun	33	25-Apr	9-May	26-May	31
2013	6-May	13-May	21-May	15	4-May	12-May	18-May	14
MEDIAN	**4-May**	**20-May**	**31-May**	**32**	**29-Apr**	**12-May**	**24-May**	**30**
MIN	**20-Apr**	**4-May**	**21-May**	**15**	**4-Apr**	**30-Apr**	**18-May**	**14**
MAX	**11-May**	**22-May**	**8-Jun**	**38**	**10-May**	**20-May**	**7-Jun**	**46**
	Coho				Sockeye (Wild & Hatchery)			
2004	19-May	30-May	19-Jun	31	3-May	25-May	11-Jun	39
2005	11-May	15-May	24-May	13	12-May	24-May	5-Jun	24
2006	5-May	22-May	1-Jun	27	22-Apr	20-May	27-May	35
2007	14-May	17-May	5-Jun	22	13-May	19-May	30-May	17
2008	12-May	22-May	30-May	18	20-May	26-May	6-Jun	17
2009	16-May	24-May	21-Jun	36	28-Apr	22-May	30-May	32
2010	15-May	22-May	7-Jun	23	20-May	28-May	8-Jun	19
2011	7-May	16-May	22-May	15	14-Apr	13-May	15-Jun	62
2012	5-May	20-May	31-May	26	13-May	23-May	3-Jun	21
2013	10-May	15-May	22-May	12	17-May	19-May	22-May	5
MEDIAN	**11-May**	**21-May**	**31-May**	**23**	**12-May**	**22-May**	**4-Jun**	**23**
MIN	**5-May**	**15-May**	**22-May**	**12**	**14-Apr**	**13-May**	**22-May**	**5**
MAX	**19-May**	**30-May**	**21-Jun**	**36**	**20-May**	**28-May**	**15-Jun**	**62**

1.2. Adult Fish Passage.

1.2.1. Facilities Description. Adult fish passage facilities at Little Goose Dam are comprised of one fish ladder on the south shore, two south shore entrances, a powerhouse collection system, north shore entrances with a transportation channel underneath the spillway to the powerhouse collection system, and auxiliary water supply system. The powerhouse collection system is comprised of two downstream facing entrances into the spillway basin on the north end of the powerhouse, and a common transportation channel. The north shore entrances are comprised of two downstream facing entrances into the spillway basin. The auxiliary water is supplied by three turbine-driven pumps that pump water from the tailrace into the distribution system for the diffusers. Additional water is supplied to the auxiliary water supply system from the juvenile fish facilities primary dewatering structure.

1.2.2. Adult Migration Timing. Upstream migrants are present at the project throughout the year and adult passage facilities are operated year-round. Maintenance of adult fish facilities is scheduled for January–February to minimize impacts on upstream migrants. Adult salmon, steelhead, shad and lamprey are counted (**Table LGS-3**) and daily data are posted online at: http://www.nwp.usace.army.mil/Missions/Environment/Fishdata.aspx. Yearly fish counts are used to determine peak adult migration timing (**Table LGS-4**). Sturgeon and bull trout are relatively infrequent and counts are posted online periodically during the passage season in *Miscellaneous Fish Counts* and summarized in the *Annual Fish Passage Report*.

Table LGS-3. Adult Fish Counting Schedule at Little Goose Dam (3/1/14-2/28/15).

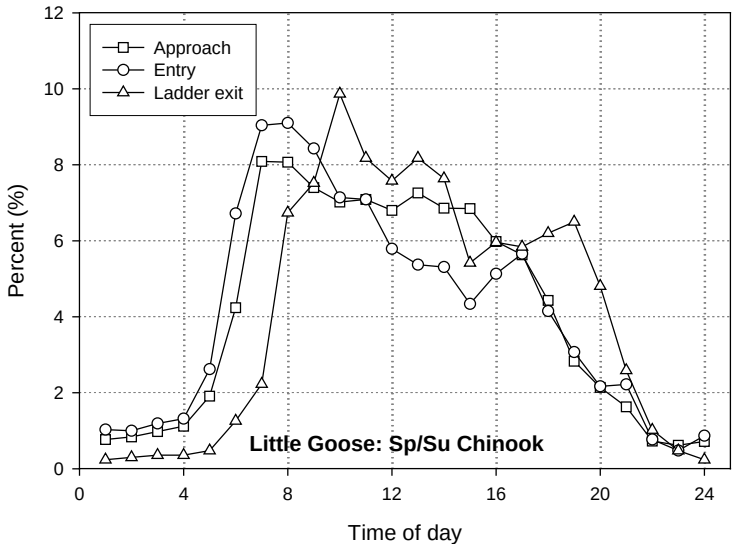
Count Period	Counting Method and Hours *
April 1 – October 31	Visual 0400–2000 hours (PST)

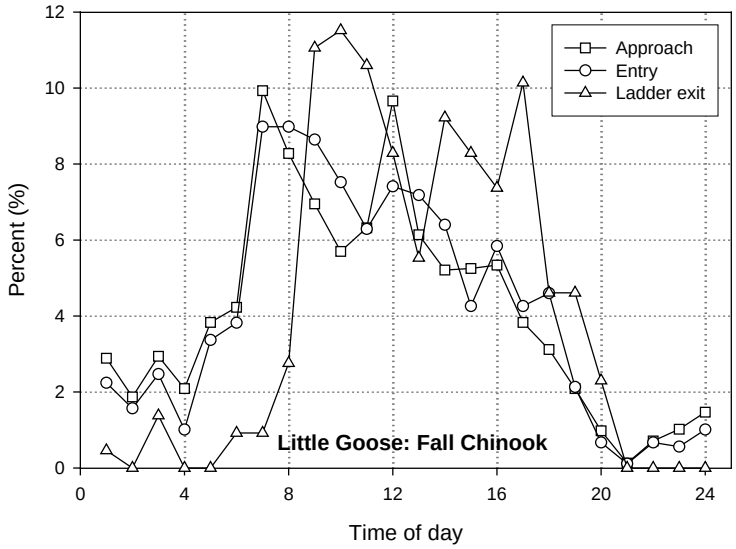
*All count hours are shown in Pacific Standard Time (PST). Note that during Daylight Saving Time (DST) from Mar 9–Nov 2, 2014, count hours will be one hour later (DST = PST+1).

Table LGS-4. Adult Fish Count Period and Peak Passage Timing at Little Goose Dam (based on yearly counts since 1970).

Species	Count Period	Earliest Peak	Latest Peak
Spring Chinook	Apr 1 – Jun 15	Apr 20	Jun 1
Summer Chinook	Jun 16 – Aug 15	Jun 16	Jul 12
Fall Chinook	Aug 16 – Oct 31	Sep 3	Sep 30
Steelhead	Apr 1 – Oct 31	Sep 6	Oct 14
Sockeye	Jun 15 – Oct 31	Jun 24	Jul 25
Lamprey	Apr 1 – Oct 31	Jul 6	Aug 20

1.2.2.1. Time-of-day (diel) distributions of adult salmonid activity at Little Goose Dam fishway entrances and exits are summarized in **Figure LGS-2** (see *Keefer & Caudill 2008* at: http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/2013_FPOM_MEET/2013_JUN/).





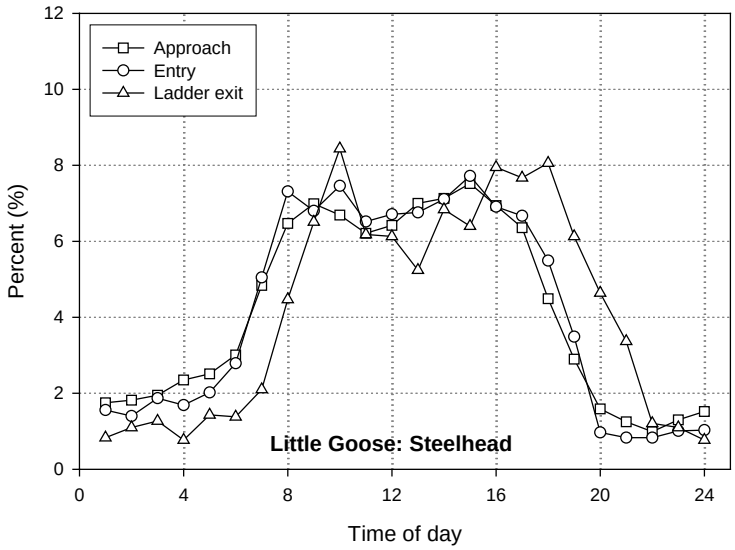


Figure LGS- 2. Diel Distribution of Adult Salmonids at Little Goose Dam Fishway Entrances and Exits (*Keefer & Caudill 2008*).

2. PROJECT OPERATIONS

2.1. Spill Management.

See the Fish Operations Plan (**Appendix E**) for more information.

2.1.1. Involuntary spill at Little Goose is the result of river flow exceeding powerhouse capacity, insufficient generation loads to pass the river flow, turbine unit outages (forced or scheduled), or the failure of a key component of the juvenile fish passage facility which forces the project to spill to provide juvenile fish passage. Spill at Little Goose shall be distributed in accordance with the spill pattern included at the end of this section, **Tables LGS-8 through LGS-11**. Special spills for juvenile fish passage will be provided as detailed in **Appendices A** and **E**.

2.1.2. Spill for Fish Passage. During years when fish passage spill is provided at Little Goose, and project biologists or researchers at Little Goose notice an extraordinary congregation of juvenile fish delaying in the forebay, they will notify NOAA Fisheries and CENWW to request a fish flush spill (FFS) that evening. The FFS request will be for up to three hours, 8 pm to 11 pm, and be up to 50% of river flow during those hours, using a uniform spill pattern to lessen dissolved gas entrainment.

2.2. Total Dissolved Gas (TDG) Management.

TDG levels at all projects are monitored in accordance with the *TDG Monitoring Plan*, included in the *Water Management Plan* as Appendix 4, and available online at: http://www.nwd-wc.usace.army.mil/tmt/documents/wmp/.

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. From April 1–October 31, operate for juvenile fish bypass, collection and transport and from November 1–December 15 to bypass adult fallbacks. Operate according to criteria listed below and in the *Juvenile Fish Transportation Program* (**Appendix B**) for bypass, collection, and transport. The transportation program may be revised in accordance with ESA Section 10 permit and the NOAA Fisheries Biological Opinion.

2.3.1.1. Winter Maintenance Period (December 16–March 31). Check and perform maintenance as required on the items listed below.

2.3.1.1.a. Forebay Area and Intakes.

a.1. Remove debris from forebay and gatewell slots.

a.2. Rake trashracks just prior to the operating season.

a.3. Measure drawdown in gatewell slots after cleaning trashracks with ESBSs in.

a.4. Inspect and repair gatewell dip net as needed.

2.3.1.1.b. ESBSs, Flow Vanes and VBSs.

b.1. After ESBSs are removed at the end of the season, inspect them for the presence of juvenile salmonid mortalities and all other incidental fish mortalities. Inspect ESBSs within a week after removal, or as soon as practical. All mortalities are to be counted, or otherwise estimated, for each ESBS and reported to CENWW-OD-T.

b.2. Maintenance completed on all screens.

b.3. Inspect ESBSs prior to installation and operate debris cleaner (dogged off on deck) to ensure proper operation.

b.4. Log results of trial run.

b.5. Inspect VBSs with an underwater video camera at least 1x/year; repair as needed.

b.6. Inspect flow vanes to make sure they are in good condition and all surfaces smooth. Repair as needed.

2.3.1.1.c. Collection Channel.

c.1. Water-up valve capable of operating when needed.

c.2. Orifice lights are operational.

c.3. Orifices clean and valves operating correctly.

c.4. Orifice cycling and air backflush system works correctly.

2.3.1.1.d. Dewatering Structure and Flume.

d.1. Inclined screen clean and in good condition with no gaps between screen panels or damaged panels.

d.2. Cleaning brush and air burst systems maintained and operating correctly.

d.3. Overflow weirs should be maintained, tested and operating correctly.

d.4. All valves should be operating correctly.

d.5. Baffle boards under inclined screen in good condition.

d.6. Flume interior should be smooth with no rough edges.

2.3.1.1.e. Transportation Facilities.

e.1. Flume switch gate maintained and in good operating condition.

e.2. Flume interior smooth with no rough edges.

e.3. Perforated plate smooth with no rough edges.

e.4. Wet separator and fish distribution system maintained and ready for operation as designed.

e.5. Brushes and screens on crowders in good condition with no holes in screens or rough edges.

e.6. Crowders maintained, tested, and operating correctly.

e.7. All valves, slide gates, and switch gates maintained and in good operating condition.

e.8. Retainer screens in place with no holes in screens or sharp wires protruding.

e.9. Barge and truck loading pipes free of debris, cracks, or blockages and barge loading boom maintained and tested.

e.10. All sampling equipment should be maintained and in good operating condition prior to watering up the facilities.

e.11. Maintain juvenile PIT-tag system as required (see "Columbia Basin PIT-tag Information System, General Gate Maintenance and Inspection, Walla Walla District", February 2003). Coordinate with PSMFC.

e.12. Mini- and midi-tanks maintained and in good operating condition.

2.3.1.1.f. Avian Predation Areas (Forebay and Tailrace). Inspect bird wires, water cannon, and other deterrent devices and repair or replace as needed. Where possible, install additional bird wires or other deterrent devices to cover areas of known avian predation activity. Prepare avian abatement contract as needed.

2.3.1.1.g. Maintenance Records. Record all maintenance and inspections.

2.3.1.2. Juvenile Fish Passage Period (April 1–December 15).

2.3.1.2.a. Forebay Area and Intakes.

a.1. Remove debris from forebay. All floating debris will be removed whenever 2 acres of debris accumulates in the spring and 1 acre in the summer and fall.

a.2. Log drawdown differentials in bulkhead slots at least once a week.

a.3. Remove debris from forebay and trashracks as required to maintain less than 1' of additional drawdown in gate slots. Additional raking may be required when heavy debris loads are present in the river or when fish condition requires it.

a.4. Inspect gatewell slots daily (preferably early in day shift) for debris, fish buildup, and contaminating substances (particularly oil). Clean gatewells before they become

half covered with debris. If, due to the volume of the debris, it is not possible to keep the gatewell at least half clear, they should be cleaned at least once daily. If flow through an orifice, or fish conditions give indications that an orifice may be partially obstructed with debris, the orifice will be closed and backflushed to remove the obstruction. If the obstruction cannot be removed, the orifice shall be closed and the alternate orifice for that gatewell slot shall be operated. If both orifices become obstructed or plugged with debris the turbine unit will not be operated until the gatewell and orifices are cleared of debris.

a.5. If a visible accumulation of contaminating substances (such as oil) is detected in a gatewell and it cannot be removed within 24 hours, the gatewell orifices shall be closed immediately and the turbine unit shut down within one hour until the material has been removed and any problems corrected. A preferred method for removing oil from the water surface is to install absorbent (not adsorbent) socks, booms, or pads capable of encapsulating the material, tied off with a rope for later disposal. Action should be taken as soon as possible to remove the oil from the gatewell so the orifice can be reopened to allow the fish to exit the gatewell. Orifices shall not be closed for longer than 48 hours.

a.6. Coordinate cleaning efforts with personnel operating juvenile collection facilities.

a.7. Dip bulkhead gatewell slots to remove fish prior to installing bulkhead for dewatering a bulkhead slot.

2.3.1.2.b. ESBSs, VBSs and Operating Gates.

b.1. Operate ESBSs with flow vanes attached to screen.

b.2. Operate ESBSs with debris cleaners in automatic mode. Set cleaning frequency as required to maintain clean screens and good fish passage condition. Change cleaning frequency as needed.

b.3. Monitor ESBS operating status regularly throughout work shifts via the ESBS operating computer display located in the control room.

b.4. Inspect ESBS, cleaning brush control panels located in the orifice gallery for cleaning brush failures (trouble lights) at least once per day throughout the entire fish passage season.

b.5. Manually operate ESBS cleaning brush monthly during the fish passage season April through December 15 (more frequently if required) to verify proper and complete up-and-down brush travel and to monitor and record amperage draws.

b.6. Inspect ESBS by underwater video during turbine unit annual maintenance (more frequently if required). Thoroughly inspect VBSs at the same time.

b.7. Inspect at least 2 VBSs in 2 different turbine units by means of underwater video between the spring and summer migration periods. Both turbine units should have

been operated frequently during the spring. If a debris accumulation is noted, inspect other VBSs and clean debris as necessary.

b.8. If an ESBS is damaged or fails during the juvenile fish passage season, follow procedures detailed under unscheduled maintenance of ESBSs (see **section 3.1.2.1**). In no case should a turbine unit be operated with a missing or a known non-operating or damaged ESBS, except as noted.

b.9. One-half of the ESBSs may be pulled after October 1 for maintenance as long as unscreened turbine units are not operated.

b.10. Make formal determination at end of season as to adequacy of ESBS bar screen panels and debris cleaner brushes and replace components as necessary.

b.11. Measure head differentials across VBSs at least once per week from April 1 through June 30 (more frequently if required) and biweekly for the remainder of the operating season. Clean VBS when head differentials reach 1.5'. When a head differential of 1.5' is reached, the respective turbine unit should be operated at a reduced loading, not more than 110 MW, to minimize loading on the VBS and potential fish impingement until the VBS can be cleaned. Clean VBSs as soon as possible after a 1.5' head differential is reached.

b.12. Inspect at least 2 VBSs in 2 different turbine units between spring and summer migration periods. Both units should have been operated frequently during spring. If debris accumulation is noted, inspect other VBSs and clean debris as necessary.

b.13. Turbine units are to be operated with raised operating gates to improve fish guidance efficiency when ESBSs are installed (April 1 through December 15), except as provided for in **Section 4.3.,** Turbine Unit Maintenance.

b.14. When cold weather is forecasted for an extended period of time between Thanksgiving and December 15, ESBSs and STSs may be removed. The project will first request special permission from CENWW-OD-T. CENWW-OD-T will inform NOAA Fisheries and other FPOM participants. "Cold weather" is defined as: forecasted daily high temperature below 32°F or daily low temperatures below 20°F as forecasted for the Little Goose Dam area by NOAA's National Weather Service at: http://www.weather.gov.

2.3.1.2.c. Collection Channel.

c.1. Orifices clean and operating. Operate at least one orifice per gatewell slot (preferably the north orifice). If the project is operating at MOP, additional orifices may be operated to maintain a full collection channel. If orifices must be closed to repair any part of the facility, do not close orifices in operating turbine units with ESBSs in place for longer than 5 hours. If possible, keep to less than 3 hours. Reduce turbine unit loading to the lower end of the 1% efficiency range if deemed necessary by the project biologist. Monitor fish conditions in gatewells hourly or more frequently during orifice closure periods.

c.2. Orifice lights operational and operating on open orifices. Orifice lights and area lights may be turned off the evening before channel is dewatered at end of season (dewatering occurs on December 16 or later) to encourage fish to exit the channel volitionally. Area lights can be turned on briefly for personnel access if necessary.

c.3. Replace all burned out orifice lights within 24 hours of notification. Orifice lights shall remain lighted 24 hours/day.

c.4. Orifice jets hitting no closer than 3' from back wall, collection channel full.

c.5. Orifice valves are either fully open or closed.

c.6. Backflush orifices at least once per day and more frequently if required. During periods of high fish and debris passage, April 1 through July 31, orifices should be inspected and backflushed once per 8-hour shift or more frequently as determined by the project biologist, to keep orifices clean. If debris is causing continual orifice plugging problems in a particular turbine unit gatewell, the respective turbine unit generation may be restricted to the lower end of the 1% turbine efficiency range to minimize orifice plugging problems.

c.7. If utilizing the automatic orifice backflush system, inspect as determined by the project biologist (but at least once per 8-hour shift unless coordinated differently) to ensure that the orifices are opening and closing correctly and are clear of debris. The project biologist will determine the frequency of automatic orifice cycling and back-flushing to maintain clear orifices.

c.8. Water-up valve capable of operating when needed.

2.3.1.2.d. Dewatering Structure.

d.1. Trash sweep and air burst systems operating correctly. The frequency of screen cleaning should be set as necessary to maintain a clean screen.

d.2. Hand clean trapezoidal section as often as required to maintain in clean condition, with a minimum of once per day.

d.3. Check overflow weirs to make sure they are operating correctly, perform maintenance as required.

d.4. There should be no gaps between screen panels or damaged panels in the inclined screen. Screen panels in place and tightly secured.

d.5. Lights at the dewatering structure should be turned off at night, unless needed for personnel access, to encourage fish to move downstream volitionally.

2.3.1.2.e. Transportation Facilities.

e.1. Operate wet separator and fish distribution system as designed.

e.2. Crowder screen brushes should be maintained in good operating condition with no holes or sharp edges on crowder screens.

e.3. Inspect raceway and tank retainer screens to make sure they are clean with no holes or protruding wires.

e.4. Barge and truck loading pipes and related equipment free of debris, cracks, or blockages and in good condition. Barge loading boom in good operating condition.

e.5. Inform PSMFC, in advance if possible, of situations that cause the PIT-tag system to become inoperable (e.g. power outages) or that could result in confounding the interpretation of PIT-tag data (e.g. bypassing fish from raceways to the river, operating in primary bypass mode without an operational full-flow detector, emergency dewaterings).

2.3.1.2.f. Avian Predation Areas (Forebay and Tailrace).

f.1. Bird wires and other avian deterrent devices should be monitored to ensure they are in good condition, and any broken wires or devices replaced as soon as possible.

f.2. Harassment program in place to deter avian predation in areas actively used by birds and not covered by bird wires or other devices.

f.3. Project biologists shall routinely monitor project areas to determine areas of active avian predation and, if possible, adjust harassment program to cover these areas or install bird wires or other deterrent devices to discourage avian predation activities.

2.3.1.2.g. Temporary Spillway Weir (TSW).[1]

g.1. SW-Hi: Spring spill for fish passage will start with the TSW deployed in Bay 1 in the high crest elevation 622 msl (SW-Hi; approximate discharge 7 kcfs) and spill will be distributed in the "SW-Hi" pattern in **Table LGS-9**. SW-Hi will be maintained the entire spill season unless conditions described in paragraph **g.2** below are met.

g.2. SW-Lo: When flow increases above 85 kcfs (i.e., during the spring freshet), the TSW will be changed to low crest elevation 618 msl (SW-Lo; approximate discharge 11 kcfs) and spill will be distributed in the "SW-Lo" pattern in **Table LGS-8**. The crest change will occur 3 normal work days prior to the date on which the most recent STP forecasts daily average flow above 85 kcfs for at least 7 consecutive days, or if actual flow indicates that flow will exceed 85 kcfs before the next STP forecast is issued, as determined by NWW Water Management staff. The crest change will be further based on the following:

[1] Spillway weirs provide surface passage routes via spillbay(s). Temporary, or Top, Spillway Weirs (*TSW*s) at Little Goose, McNary and John Day dams can be installed, uninstalled and moved between bays using the gantry crane. Removable Spillway Weirs (*RSW*s) at Lower Granite, Lower Monumental and Ice Harbor dams are "removed" by controlled descent to the bottom of the forebay.

i. Review of juvenile fish passage at Lower Granite and Little Goose dams to prevent crest change during a peak in outmigration;

ii. Coordination with regional fish managers.

The crest change will occur within 3 normal work days after RCC issues the teletype. During the work to change the crest elevation, spill will be distributed in the "Alternate Uniform" pattern (**Table LGS-11**) and bay 2 will be closed to ensure worker safety in the adjacent bay.

When flow drops below 85 kcfs and forecasts indicate flow below 85 kcfs for at least 7 consecutive days, the TSW will be changed back to SW-Hi (**Table LGS-9**). The crest change will be further based on the criteria defined in paragraphs **i** and **ii** above, and will occur within 3 normal work days after RCC issues the teletype. During the work to change the crest elevation, spill will be distributed in the "Alternate Uniform" pattern (**Table LGS-11**) and bay 2 will be closed to ensure worker safety in the adjacent bay. *The TSW will not be changed back to SW-Lo for the rest of the season even if river flow subsequently increases above 85 kcfs.*

g.3. Close TSW: On or after August 1, when daily average discharge drops below 35 kcfs and forecasts indicate flow below 35 kcfs for at least 3 days, the TSW will be closed for the remainder of the spill season and spill will be distributed in the "Uniform" pattern with no spillway weir (**Table LGS-10**). The TSW will be closed within 3 normal work days after RCC issues the teletype and coordinated through CENWW-OD-T. During the work to close the TSW, spill will be distributed in the "Alternate Uniform" pattern (**Table LGS-11**) and bay 2 will be closed to ensure worker safety in the adjacent bay.

i. The TSW will be closed no earlier than August 1 to enhance subyearling migration even if low flow criteria (daily average discharge below 35 kcfs) is achieved prior to August 1, unless an adult passage delay is observed or if necessary due to turbine unit operational constraints at low flow. Closing the TSW prior to August 1 will be coordinated through FPOM by CENWW-OD-T.

2.3.1.2.h. Inspection and Record Keeping.

h.1. Inspect fish facilities at least once every 8 hours. Inspect all facilities according to fish facilities monitoring program.

h.2. Record all maintenance and inspections.

2.3.2. Adult Fish Passage Facilities.

2.3.2.1. Winter Maintenance Period (January 1–February 28).

2.3.2.1.a. Inspect all staff gages and water level indicators; repair and/or clean as necessary.

2.3.2.1.b. Dewater the ladder and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the ladder. The fish ladder exit trashrack must have smooth surfaces where fish pass, and must have downstream edges that are adequately rounded or padded. A spare trashrack should be on hand for use as necessary. Inspect all diffuser gratings and chambers, and the fallout fence, annually by dewatering or by using divers or video inspection techniques. All diffuser gratings and chambers are to be dewatered and physically inspected at least every 3 years. Repair deficiencies.

2.3.2.1.c. Inspect for and clean debris from the fish ladder exit. The trashrack and picketed leads must be clean and installed correctly.

2.3.2.1.d. Calibrate all water level measuring devices as necessary for proper facility operations.

2.3.2.1.e. Inspect all spill gates and ensure that they are operable.

2.3.2.1.f. Fish pumps maintained and ready for operation.

2.3.2.1.g. Inspect ladder netting and repair prior to fish passage season.

2.3.2.2. Adult Fish Passage Period (March 1–December 31).

***Note*:** Lower Monumental pool may be operated at minimum operating pool (MOP) elevation range 537'–538' msl as part of the Corps' efforts to improve migration conditions for juvenile salmonids. This may result in some of the Little Goose adult fishway entrances bottoming out on their sills prior to reaching criteria depths. Continuous operation at MOP may also result in increased pumping head on the auxiliary water supply pumps, decreasing the amount of water pumped.

2.3.2.2.a. Fishway Ladder. Water depth over weirs: 1' to 1.3'.

2.3.2.2.b. Counting Window. The Little Goose counting window slot is fixed at a width of no less than 18". All equipment should be maintained and in good condition. The counting window and backboard should be cleaned as needed to maintain good visibility.

2.3.2.2.c. Fishway Entrance Head. Head range: 1' – 2' at all entrances.

2.3.2.2.d. North Shore Entrances (NSE 1&2). Top of gate elev. on sill = 529'.

d.1. Operate both downstream gates.

d.2. Weir depth: 6' or greater below tailwater.

2.3.2.2.e. North Powerhouse Entrances (NPE 1&2). Top of gate elev. on sill = 532'.

e.1. Operate both downstream gates.

e.2. Weir Depth: 7' or greater below tailwater (tailwater permitting). At tailwater below elevation 539', entrance weirs should be on sill.

2.3.2.2.f. Floating Orifice Gates (FOGs). No FOGs will be operated. Inspect fish fallout fence for debris buildup, holes, etc.

2.3.2.2.g. South Shore Entrances (SSE 1&2). Top of gate elev. on sill = 529'.

g.1. Operate both gates.

g.2. Weir depth: 8' or greater below tailwater.

2.3.2.2.h. Channel Velocity. 1.5' – 4' per second.

h.1. Adult collection channel water velocities must flow between 1.5’ and 4’ per second. This velocity is optimum criteria for returning adult salmon and steelhead to migrate upstream through the fishway. Velocity readings will be included in required fishway inspections and reported in the weekly and annual reports.

h.2. Surface water velocities will be measured in the open access area near the south shore weir / fish entrance. The surface velocity will be measured using a piece of woody debris (stick, bark) or water bubble timed over a marked fixed distance. The measurement of the water velocity at this location typifies the velocity conditions throughout the length of the channel.

h.3. Subsurface water velocity will be measured and reported once per month using an underwater flowmeter. The average velocity will be calculated using several measurements taken at various depths across the width of the channel that best represents the average subsurface flow. The measurements will be taken at a location in the channel that represents the overall flow characteristic.

2.3.2.2.i. Tunnel Lights. Lights in the tunnel section under the spillway shall be on during fish passage period.

2.3.2.2.j. Head on Trashracks.

j.1. Ladder exit maximum head of 0.5'.

j.2. Picketed leads maximum head of 0.3'.

j.3. Trashrack and picketed leads installed correctly.

2.3.2.2.k. Staff Gages and Water Level Indicators. All staff gages should be readable at all water levels encountered during the fish passage period. Repair or clean as necessary.

2.3.2.2.l. Facility Inspections.

l.1. Powerhouse operators shall inspect facilities once per day shift and check computer monitor information at least once during each back shift.

l.2. Project biologists shall inspect facilities three times per week. Inspect all facilities according to fish facilities monitoring program.

l.3. Picketed leads shall be checked during all inspections to ensure they are clean and in the correct position (all the way down and vanes in line with flow).

l.4. Project personnel shall check calibration of fishway control system twice per month to ensure that it is kept within calibration. This may be done as part of routine fishway inspections.

l.5. Inspect fishways daily for foreign substances (particularly oil). If substances are found, corrective actions should be undertaken immediately.

l.6. Record all inspections.

2.3.3. Juvenile & Adult Fish Facility Monitoring and Reporting.

2.3.3.1. Project biologists shall inspect fish passage facilities at frequencies listed in the juvenile and adult fish facilities operating criteria sections.

2.3.3.2. Weekly Reports. March 1–December 31, Project Biologists shall prepare weekly reports summarizing project operations. The weekly reports provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENWW-OD-T by noon the following Monday via electronic mail. The reports shall include:

i. Any out-of-criteria situations observed and corrective actions taken;

i. Any equipment malfunctions, breakdowns or damage along with a summary of resulting repair activities;

ii. Adult fishway control calibrations;

iii. ESBS and VBS inspections;

iv. Any unusual activities at the project that may have affected fish passage.

2.3.3.3. Annual Reports. Project biologists shall prepare a draft annual report by February 10 and a final report by March 15 summarizing the operation of the project fish passage facilities for the previous year. The annual report shall also include a description of all actions taken to discourage avian predation at the project, with an overview of the effectiveness of the activities in discouraging avian predation.

2.3.3.4. Project Inspections. Project biologists also inspect project facilities once per month and during dewaterings for the presence of zebra and Quagga mussels. Biologists shall provide a report to CENWW-OD-T on a monthly basis summarizing mussel inspections.

3. PROJECT MAINTENANCE

Project biologists should be present to provide technical guidance at all project activities that may involve fish handling. All dewaterings shall be accomplished in accordance with approved project dewatering and fish handling plans. *When river temperatures reach 70°F or greater, all adult fish handling will be coordinated through CENWW-OD-T.* Dewatering and fish handling plans were reviewed and revised in 2011 to ensure that they comply with the *Guidelines for Dewatering and Fish Handling Plans* (**Appendix F**).

3.1. Juvenile Fish Passage Facilities Maintenance.

3.1.1. Scheduled Maintenance. Scheduled maintenance of juvenile facilities is conducted during the entire year. Long-term maintenance or modifications of facilities that require them to be out of service for extended periods of time are conducted during the winter maintenance period from December 16–March 31. During the fish passage season parts of the facilities are maintained on a daily, weekly, or longer interval to keep them in proper operating condition.

3.1.2. Unscheduled Maintenance. Unscheduled maintenance is the correction of any situation that prevents the facilities from operating according to criteria or that will impact fish passage or survival. Maintenance of facilities such as ESBSs, which sometimes break down during the fish passage season, will be carried out as described below. In these cases, repairs will be made as prescribed and CENWW-OD-T notified for further coordination. Unscheduled maintenance that will have a significant impact on juvenile fish passage shall be coordinated with NOAA Fisheries and other FPOM participants on a case-by-case basis by CENWW-OD-T. CENWW-OD-T will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Operations Manager has the authority to initiate work prior to notifying CENWW-OD-T when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWW-OD-T includes:

i. Description of the problem;

ii. Type of outage required;

iii. Impact on facility operation;

iv. Length of time for repairs;

v. Expected impacts on fish passage and proposed measures to mitigate them.

3.1.2.1. Extended-length Submersible Bar Screens (ESBSs). The ESBSs are inspected periodically throughout the juvenile migration season with a video monitoring system. If a screen is found damaged or malfunctions at any time it will be removed and either replaced with a spare ESBS or repaired and returned to service. A turbine unit shall not be operated during the juvenile bypass season with a missing, known damaged or non-operating ESBS (except as detailed below). If an ESBS fails on a weekend or at night when maintenance

crews are not available, the respective turbine unit will be shut down and generation switched to another fully screened unit. If all screened turbine units are in service, water may be spilled until the effected ESBS can be removed and repaired or replaced.

During the spring runoff when river flow is at the level where taking a unit out of service will result in spill above TDG limits, project personnel may operate a turbine unit at 110 MWs or less with a failed screen cleaner if there is evidence that the ESBS will not plug with debris. Evidence of this is a lack of debris accumulation in the gatewell and along the face of the powerhouse. This will only happen if an ESBS screen cleaner fails after 1400 hours on a regular workday or any time on a weekend. Project personnel will pull and replace the screen the next morning, weekday or weekend inclusive. If the screen cannot be pulled and repaired first thing the next morning, the turbine unit will be removed from service until the screen can be repaired. If there is evidence that fish are being injured under this operation, by either observing injured fish in the gatewells or injured fish appearing on the separator, the turbine unit will be removed from service immediately. This operation will not take place when daily average river flow is less than total powerhouse capacity and the turbine unit will not be operated during power peaking operations where turbine units are being turned on and off.

3.1.2.2. Gatewell Orifices. Each gatewell has two 12" orifices (gatewell slot 1A has one 14" test orifice) with air operated valves to allow fish to exit the gatewell. Under normal operation, at least one orifice per gatewell is operated. To minimize blockage from debris, orifices should be backflushed every day. If an air valve fails, the valve should be closed and the alternate orifice and air valve for that gatewell operated until repairs can be made. If both orifices are blocked with debris, damaged, or must be kept closed, the turbine unit will be taken out of service until repairs can be made. If repairs are to take longer than 48 hours, juvenile fish will be dipped from the gatewell with a gatewell dip basket.

3.1.2.3. Dewatering Structure. The dewatering structure acts as a transition from the collection channel to the corrugated metal flume. An inclined screen allows excess water to be bled off, with all fish and remaining water transitioning into the corrugated metal flume. The excess water can be either discharged into the river or added to the adult passage facilities auxiliary water supply system, and is also used as the water supply for the transportation facilities. The dewatering structure contains a trash sweep for cleaning the inclined screen of impinged debris. If the trash sweep breaks and interferes with juvenile fish passage through the structure or if the inclined screen is damaged, an emergency bypass system at the upstream end of the dewatering structure can be used, if required, to bypass juveniles while repairs are made. Operation of the emergency bypass system requires the juvenile bypass system to be dewatered and stoplogs inserted at the upstream end of the inclined screen. During this setup process, turbine units may be operated at the lower end of the 1% efficiency range. The emergency bypass is then opened and the bypass system operated with six gatewell orifices open. Orifices will then need to be routinely rotated, at a minimum of every 2 hours, to allow juveniles to emigrate from all of the gatewells. During any orifice closure, gatewells shall be monitored hourly by project personnel for signs of fish problems or mortality. Orifices shall not be closed for longer than 5 hours in an operating turbine unit with ESBSs in place. During periods of high fish passage, orifice closure times may need to be less than 5 hours depending on fish numbers and condition. If orifices are

closed, gatewells shall be monitored hourly. Spill may be used as an alternative avenue for fish passage during a collection channel outage.

3.1.2.4. Bypass Flume. The corrugated metal flume transports juveniles to either the transportation facilities or to the river below the project. If there is a problem with the flume that interferes with its operation, an emergency bypass system at the upper end of the flume can be opened and all of the fish in the bypass system diverted to the river below the project through a 30" pipe while repairs are made.

3.1.2.5. Transportation Facilities. Transportation facilities can be operated either to collect and hold juveniles for the transportation program or to bypass fish back to the river. If part of the facility malfunctions or is damaged, efforts will first be made to bypass fish around the damaged area. If this is not possible, fish will be bypassed around the transportation facility.

3.2. Adult Fish Passage Facilities Maintenance.

3.2.1. Scheduled Maintenance. Scheduled maintenance that requires a facility to be dewatered or maintenance that may have a significant effect on fish passage will be done during the winter maintenance period (January–February). Maintenance of facilities that will have no effect on fish passage may be conducted at any time. When facilities are not being maintained during the winter maintenance period, they will be operated according to normal criteria unless otherwise coordinated with NOAA Fisheries and other FPOM participants.

3.2.2. Unscheduled Maintenance. Unscheduled maintenance that will significantly affect the operation of a facility will be coordinated with NOAA Fisheries and other FPOM participants. Coordination procedures for unscheduled maintenance of adult facilities are the same as for juvenile facilities (see section 3.1.2.). If part of a facility malfunctions or is damaged during the fish passage season and the facility can still be operated within criteria without any detrimental effects on fish passage, repairs may not be conducted until the winter maintenance period or until fewer numbers of fish are passing the project. If part of a facility is damaged or malfunctions that may significantly impact fish passage, it will be repaired as soon as possible.

3.2.2.1. Fish Ladder and Counting Station. If any part of the ladder fails or is blocked with debris during the fish passage season, efforts will first be made to correct the problem without dewatering the ladder. Trashracks, picket leads, and counting stations can sometimes be repaired or maintained without dewatering the ladder. The decision to dewater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after coordination with the fish agencies and tribes.

3.2.2.2. Auxiliary Water Supply (AWS). Three turbine-driven pumps on the south shore supply auxiliary water for the fish ladder and the powerhouse collection system. All three pumps are required for normal operation. Approximately 150–180 cfs of excess water from the juvenile fish passage facilities is also added to the auxiliary water supply system. If one, two, or all three pumps fail, the fishway will be adjusted in the following manner to get the best fish passage conditions possible until repairs can be made: first, increase the speed of the operable pump(s). As necessary, then close NSE 2 and NPE 2 and operate NPE 1 to provide the required 1' to 2' head differential. If the desired head differential cannot be maintained at

a depth of 5' or greater, then NSE 1 should be raised until a depth of 5' below tailwater is reached. If the head differential cannot be maintained at this point, SSE 1 and 2 should be raised at 1' increments until 6' below tailwater is reached. If the head differential still cannot be maintained, the transportation channel to the north shore should be bulkheaded off at the end of the powerhouse collection channel. Next, NPE 1 should be closed and the powerhouse collection channel bulkheaded off at the junction pool. SSE 1 and 2 should then be operated as deep as possible to maintain the head, but not shallower than 6' regardless of the head.

3.2.2.3. Fishway Entrances. The fishway entrances consist of main entrance weirs with hoists and automatic controls. If any of the automatic controls malfunction, the weirs can be operated manually by project personnel and kept within criteria. If there is a further failure which prevents an entrance from being operated manually, the weirs can usually be left in a lowered position while repairs are being conducted or the entrance closed and the water redistributed to other entrances while repairs are made.

3.2.2.4. Diffuser Gratings. Diffuser chambers for providing auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally checked during the winter maintenance period to ensure they are in place. These inspections are done either by dewatering and physically inspecting the diffuser gratings, or by using underwater video cameras, divers, or other methods. Diffuser gratings may come loose during the fish passage season due to a variety of reasons. Daily inspections of fish ladders and collection systems should include looking for any flow changes that may indicate problems with diffuser gratings. If a diffuser grating is known or suspected to have moved, creating an opening into a diffuser chamber, efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway. Coordination of the problems should begin immediately through the established unscheduled maintenance coordination procedure (see section 3.1.2). If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffuser gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless otherwise coordinated.

4. TURBINE UNIT OPERATION & MAINTENANCE

4.1. Turbine Unit Operation.

4.1.1. From March 1–November 30, turbine units will be operated to enhance adult and juvenile fish passage in the priority order defined in **Table LGS-5**. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. If more than one turbine unit is operating, discharge will be maximized (i.e., operated at the 1% upper limit) through the southernmost turbine units starting with Unit 1 to the extent possible without exceeding 1% limits. If a turbine unit is taken out of service for maintenance or repair, the next unit in the priority order shall be operated.

Table LGS-5. Turbine Unit Operating Priority for Little Goose Dam. *

Season	Time of Day	Unit Priority
Fish Passage Season March 1 – November 30	24 hours/ day	1*, 2, 3, 4, 5, 6 *Maximize discharge through lowest numbered turbine units*
Winter Maintenance Period December 1 – February 28	24 hours/ day	Any Order

***See section 4.1.2.2. below.** At river flow >38 kcfs, Unit 1 is manually restricted to operate in the upper 25% of the 1% range at 115–125 MW (~16.0-17.5 kcfs). Assume other units will operate approximately uniformly within their full 1% ranges. When other units are operating at <16.0 kcfs, assume Unit 1 is at the lower end of the 1% upper range (~16.0 kcfs). When average unit discharge is >16.0 kcfs, assume all units operating uniformly. At low river flow <38 kcfs with only Unit 1 operating, Unit 1 may operate within the full 1% range.

4.1.2. Turbine Unit Operating Ranges. From April 1–October 31, turbine units will be operated within ±1% of peak turbine efficiency (1% range), as specified in *BPA's Load Shaping Guidelines* (**Appendix C**). Turbine unit output and discharge at the lower and upper 1% limits (with and without ESBSs) for various heads are defined in **Tables LGS-6** (Units 1-3) and **LGS-7** (Units 4-6). If operation outside the 1% range is necessary, Project personnel shall record the information and provide to BPA on a weekly basis according to the load shaping guidelines. Operation outside of the 1% range may be necessary to:

i. Meet BPA load requirements. Load requests will be made in accordance with BPA's policy, statutory requirements and load shaping guidelines (**Appendix C**);

ii. If the turbine unit draft tube is to be dewatered, the unit will be operated at full load (>1%) for a minimum of 15 minutes prior to installing tail logs. If not possible to load, the unit will be run at speed-no-load (<1%) for minimum of 15 minutes. This is to reduce the number of fish in the scrollcase prior to installing stop logs;

iii. Operate a turbine unit solely to provide station service; or

iv. Comply with other coordinated fish measures;

v. From November 1–March 31, turbine units will continue to be operated within the 1% efficiency range except when BPA load requests require the units to be operated outside the 1% range.

4.1.2.2. Unit 1 Special Operation. During fish passage season when the spillway weir (TSW) is operating in spillbay 1, Turbine Unit 1will operate in the upper 25% of the 1% range. Historic operation within the GDACS program tended to balance flow out of any units in operation. This operation will, at times, result in an unbalanced operation where more flow is passing through Unit 1 than other operating units. Physical modeling has indicated that a higher flow out of Unit 1 is very important in disrupting the eddy that forms along the south shore downstream of the powerhouse. Disrupting the eddy optimizes the tailrace conditions for both adult passage and juvenile egress with the SW is operating in spillbay 1. When the TSW is removed from service during summer spill and low flow criteria are achieved (<38 kcfs), the tailrace eddy is mostly non-existent and all turbine units may be operated within the full 1% range.

4.1.3. Minimum Generation. All of the lower Snake River powerhouses may be required to keep one generating turbine unit online at all times to maintain power system reliability. During low flow, there may not be enough river flow to meet this generation requirement and required minimum spill. Under these circumstances the power generation requirement will take precedence over the minimum spill requirement. At Little Goose Dam, minimum generation requirements are 11.3–13.1 kcfs for turbine units 1, 2 and 3 and 13.5–14.5 kcfs for turbine units 4, 5 and 6. Actual attainable minimum generation levels may vary depending on project conditions.

4.1.4. Turbine Unit Outages during High River Flow. During high spring flow, turbine unit outages for inspecting fish screens, repairing research equipment such as hydroacoustic or radio telemetry equipment, and other fish items may cause increased spill at a project in order to maintain reservoir levels within operating levels. This may result in TDG levels exceeding standards. It is important that this work be conducted when scheduled to ensure that facilities are working correctly and not injuring migrating fish, and that important fish research data are collected. To facilitate this work, reservoir storage may be utilized to minimize impacts from taking turbine units out of service and increasing spill. At Little Goose, this special operation shall take place when river flow is above 120 kcfs or when increasing spill levels will result in TDG levels exceeding standards. The activities covered under these operations will be coordinated with and approved by the TMT whenever possible.

4.2. Turbine Unit Maintenance.

4.2.1. Scheduled Maintenance. For scheduled inspection or repair of research equipment, reservoirs shall be drafted to MOP and allowed to fill to 1' above the 1’ MOP operating range as the work is accomplished. After the work, reservoirs will be drafted back to the MOP operating range. When inspection or repair work can be scheduled ahead of time, the following process will be followed:

i. Project personnel shall schedule unit outages through the approved outage scheduling procedure by noon of the Tuesday of the week prior to the outage.

ii. Project personnel shall also contact CENWW-OD-T and RCC by the same time period and inform them of the intended work.

iii. RCC will coordinate the work activities through TMT.

iv. After coordination with the TMT, RCC shall issue a teletype through the CBTT issuing instructions to project and BPA personnel for the scheduled work.

v. Spill will be increased by one spillbay stop setting (about 1.7 kcfs) above passing inflow to slowly lower the level of Little Goose pool to MOP prior to the scheduled work taking place.

vi. When the work takes place, additional spill will not be provided and the reservoir will be allowed to refill until the reservoir is 1' above the normal MOP range (a 2' pondage from where the pool was when work started). At this point, screen inspections shall stop. (At Snake River projects, this should allow about one normal workday for the scheduled work.)

vii. At the conclusion of the work, the reservoir shall be drafted back down to the MOP range utilizing a one spillbay stop increase in spill above passing inflow.

viii. If work is not finished (e.g., screen inspections), project personnel shall schedule another unit outage for a date where it can be implemented again.

4.2.2. Emergency Maintenance. If the work that needs to be done is of an emergency nature that does not normally require the turbine unit to be taken out of service (such as a failed hydroacoustic transducer versus a failed fish screen) and cannot wait for the above process to be implemented, project personnel shall notify CENWW-OD-T and RCC to get approval to do the work. If approval to do the work is given, the turbine unit shall be taken out of service and the reservoir level allowed to increase until it reaches 1' above the MOP operating range. At this point, the turbine unit must be returned to service and the reservoir will be drafted back to the MOP range using one spillbay stop setting above passing inflow.

Table LGS-6. Little Goose Dam Turbine Units 1, 2 and 3 Output (MW) & Discharge (cfs) Per Unit at Upper and Lower Limits of the 1% Peak Efficiency Operating Range with and without ESBSs. [1]

Project Head (feet)	TURBINE UNITS 1, 2, 3							
	With ESBS				No ESBS			
	1% Lower Limit		1% Upper Limit		1% Lower Limit		1% Upper Limit	
	MW	cfs	MW	cfs	MW	cfs	MW	cfs
85	**69.6**	**11,396**	**111.5**	**18,269**	**70.5**	**11,320**	**124.5**	**20,006**
86	70.3	11,381	113.7	18,402	71.3	11,305	127.0	20,152
87	71.1	11,366	115.9	18,531	72.0	11,290	129.5	20,293
88	71.9	11,351	118.1	18,657	72.8	11,276	131.9	20,431
89	72.6	11,336	120.3	18,779	73.6	11,262	134.4	20,566
90	**73.4**	**11,322**	**122.5**	**18,898**	**74.4**	**11,247**	**136.9**	**20,696**
91	74.3	11,313	122.9	18,717	75.3	11,239	137.3	20,499
92	75.1	11,304	123.2	18,540	76.1	11,230	137.7	20,306
93	76.0	11,295	123.6	18,367	77.0	11,221	138.0	20,116
94	76.9	11,285	123.9	18,197	77.9	11,212	138.4	19,931
95	**77.7**	**11,276**	**124.3**	**18,031**	**78.7**	**11,203**	**138.8**	**19,750**
96	78.8	11,294	124.4	17,841	79.8	11,222	139.0	19,541
97	79.8	11,312	124.6	17,654	80.9	11,240	139.1	19,338
98	80.9	11,329	124.7	17,472	81.9	11,257	139.3	19,138
99	81.9	11,346	124.8	17,293	83.0	11,274	139.4	18,942
100	**82.9**	**11,361**	**125.0**	**17,117**	**84.0**	**11,290**	**139.6**	**18,751**
101	83.8	11,363	126.6	17,163	84.9	11,291	141.4	18,801
102	84.7	11,364	128.3	17,207	85.8	11,293	143.3	18,850
103	85.6	11,365	129.9	17,250	86.7	11,294	145.1	18,897
104	86.5	11,367	131.6	17,293	87.6	11,295	147.0	18,944
105	**87.4**	**11,367**	**133.2**	**17,334**	**88.5**	**11,296**	**148.8**	**18,989**

1. Table based on the 2003 index test of U3 and the 1962 turbine model test.

Table LGS-7. Little Goose Dam Turbine Units 4, 5 and 6 Output (MW) & Discharge (cfs) Per Unit at Upper and Lower Limits of the 1% Peak Efficiency Operating Range with and without ESBSs. [1]

Project Head (feet)	TURBINE UNITS 4, 5, 6							
	With ESBS				No ESBS			
	1% Lower Limit		1% Upper Limit		1% Lower Limit		1% Upper Limit	
	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)
85	**87.1**	**13,880**	**119.6**	**19,076**	**86.4**	**13,479**	**122.2**	**19,052**
86	88.2	13,890	121.3	19,102	87.6	13,488	123.9	19,078
87	89.3	13,899	122.9	19,127	88.7	13,497	125.6	19,104
88	90.5	13,908	124.6	19,151	89.8	13,506	127.2	19,128
89	91.6	13,916	126.3	19,174	91.0	13,514	128.9	19,151
90	**92.8**	**13,924**	**127.9**	**19,196**	**92.1**	**13,522**	**130.6**	**19,174**
91	93.9	13,925	129.4	19,193	93.2	13,523	132.1	19,171
92	95.0	13,925	130.9	19,190	94.3	13,524	133.7	19,168
93	96.1	13,926	132.4	19,186	95.4	13,524	135.2	19,165
94	97.2	13,926	133.9	19,183	96.5	13,525	136.7	19,162
95	**98.3**	**13,926**	**135.3**	**19,179**	**97.6**	**13,525**	**138.2**	**19,158**
96	99.2	13,898	135.8	19,038	98.4	13,498	138.7	19,018
97	100.0	13,871	136.3	18,900	99.3	13,472	139.2	18,880
98	100.9	13,844	136.8	18,765	100.2	13,446	139.7	18,745
99	101.8	13,818	137.3	18,633	101.1	13,420	140.2	18,613
100	**102.7**	**13,791**	**137.8**	**18,503**	**101.9**	**13,395**	**140.7**	**18,484**
101	103.9	13,821	139.1	18,503	103.2	13,423	142.1	18,484
102	105.2	13,849	140.5	18,503	104.4	13,451	143.5	18,484
103	106.4	13,878	141.9	18,503	105.7	13,478	144.9	18,484
104	107.7	13,905	143.3	18,503	106.9	13,505	146.3	18,484
105	**108.9**	**13,932**	**144.6**	**18,503**	**108.1**	**13,532**	**147.7**	**18,484**

1. Table based on the 2003 index test of U4 and the 1975 turbine model test.

4.2.3. Maintenance Schedule. The project turbine unit maintenance schedule will be reviewed annually by project and Operations Division biologists for fish impacts. If possible, maintenance of priority units will be scheduled for non-fish passage periods, or when there are low numbers of fish passing the project. Each turbine unit requires annual maintenance that may take from several days to three weeks. Annual maintenance of all turbine units is normally scheduled during the mid-July to late November time frame. The maintenance of priority units for adult passage is normally conducted in November or December, but can be conducted in mid-August. Impacts to migrating adults should be minimized. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the one percent peak efficiency range. This work will be scheduled in compliance with BPA load shaping guidelines (**Appendix C**) to minimize impacts on juvenile fish. Transformers are Doble tested every 3 years. Testing may need to be more frequent if there is a known problem with a transformer. These tests normally take 2 to 3 workdays. To conduct the testing, the transmission lines have to be disconnected from the transformers and normal generation stopped. One turbine unit will operate in a speed-no-load condition to provide project power and operation of fish passage facilities. Spill may be provided to meet minimum required project discharges during the testing hours. The Doble tests are normally scheduled for the August or early September time period to minimize impacts on adult and juvenile fish passage. If Doble testing impacts priority units for adult fish passage, adult passage timing should be considered. Impacts to migrating adults should be minimized.

4.2.4. Turbine units are to be operated with raised operating gates to improve fish passage conditions when ESBSs are installed, except as provided below. [2] To facilitate annual maintenance, operating gates are used to dewater the turbine units. To minimize turbine outage periods to the actual time required for maintenance (during the July 1 through December 15 time period), operating gates in one turbine unit may be lowered to the standard operating position and connected to hydraulic cylinders on the afternoon of the last regular workday (normally Thursday) prior to the start of the maintenance. With the operating gates in the standard operating position, the turbine unit may be operated until 0700 hours of the next regular workday (normally Monday) with generation loads restricted to 100 MWs or less. On the completion of maintenance, the turbine unit can be operated with the operating gates in the standard operating position at 100 MWs or less until 0700 hours of the first regular workday after the maintenance is completed. The project biologist will be notified when the operating gates are set in the standard operating position. The gatewells will be monitored 2 times per day to observe fish condition while the operating gates are in the standard operating position. If turbine maintenance or the raising of the operating gates to the raised operating position is delayed after the time periods stated above, the turbine unit shall be immediately taken out of service until the work can be accomplished. Operation of turbine units with operating gates in the standard operating position shall be restricted to the July 1 through December 15 time period, and shall not occur unless at least 4 other turbine units are available for service. No more than 1 turbine unit at a time shall be operated with operating gates in the standard operating position and the turbine unit will be operated on last on, first off operating priority.

[2] Operating gates may also be referred to as "head" gates at some projects. The terms are interchangeable.

4.2.5. Unwatering turbine units should be accomplished in accordance with project dewatering plans. If the turbine unit draft tube is to be dewatered, operate unit with full load for a minimum of 15 minutes prior to installing tail logs. If not possible to load, run unit at speed-no-load for minimum of 15 minutes. This is to reduce the number of fish in the scrollcase prior to installing stop logs. If a turbine unit is out of service for maintenance for an extended period of time without tailrace stoplogs in place, efforts should be made to not open the wicket gates if the scroll case must be dewatered at a later date without the unit being spun beforehand.

4.2.6. Units may be operationally tested for up to 30 minutes before going into maintenance status by running the unit at speed no load and various loads within the 1% criteria to allow pre-maintenance measurements and testing AND TO ALLOW ALL FISH TO MOVE THROUGH THE UNIT. Units may be operationally tested after maintenance or repair while remaining in maintenance or forced outage status. Operational testing may consist of running the unit for up to a cumulative time of 30 minutes (within 1% criteria) before it is returned to operational status. Operational testing OF UNIT UNDER MAINTENANCE is in addition to a unit in run status (E.G. MINIMUM GENERATION) required for power plant reliability. Operational testing may deviate from fish priority units and may require water that would otherwise be used for spill if the running unit for reliability is at its 1% minimum load. Water will be used from the powerhouse allocation if possible, and water diverted from spill for operational testing will be minimized to that necessary to maintain and assure generation system reliability.

5. FOREBAY DEBRIS REMOVAL

Debris at projects can impact fish passage conditions. Debris can plug or block trashracks, VBSs, gatewell orifices, dewatering screens, separators, and facility piping resulting in fish impingement, injuries and/or descaling. Removing debris from the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation and other project activities. Debris can be removed from the forebay by physical removal (e.g., using boats to encircle the debris with log booms and tow it to shore where it can be removed with a crane, or using a crane and scoop from the top of the dam to remove forebay debris) or by passing the debris through the spillway with special spill and/or powerhouse operations. The preferred option is to physically remove debris when possible to avoid passing debris to the next downstream project. However, this is not always possible as some projects do not have forebay debris removal capability. In this case, the only viable alternative is to pass the debris via the spillway.

5.1. Debris Spill Coordination.

5.1.1. All special spills (other than normal spill patterns for ongoing spill operations) and project operations for passing debris will be coordinated prior to the operations taking place. Each project shall contact CENWW-OD-T at least two workdays prior to the day they want the special project operations for spilling to pass debris. Project personnel shall provide CENWW-OD-T the reason for the debris spill request including an explanation of project facilities impacted by debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. Using information provided by the project, CENWW-OD-T shall coordinate the special operations with RCC, NOAA Fisheries and FPOM.

When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

5.2. Emergency Debris Spill.

5.2.1. Emergency spills may be implemented if necessary to pass woody debris that are accumulating in front of the spillbay weir(s), compromising the safe, unobstructed passage of fish. The operating project will immediately spill the woody debris to remove the obstructions to fish passage. The operating project will notify CENWW-OD-T of the emergency spill as soon as possible to provide notification to RCC, NOAA Fisheries, and other FPOM participants.

Table LGS-8. [*pg 1 of 3*] Little Goose Dam Spill Patterns with Spillway Weir in Low Crest (SW-Lo) Elevation 618 ft. ***See notes at end of table.***

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						SW-Lo Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
37.3	26.1	11.2	30.0%	14.8	11.3					SW-Lo								0	Min. Q at SW-Lo
38.5	27.3	11.2	29.1%	16.0	11.3					SW-Lo								0	Min. Q w/ U1 in upper 1% [d]
43.2	30.2	13.0	30.1%	16.0	14.2					SW-Lo							1	1	
49.0	34.3	14.7	30.0%	17.2	17.1					SW-Lo	1						1	2	
49.7	35.0	14.7	29.6%	17.5	17.5					SW-Lo	1						1	2	Max. Q w/ 2 units + 2 stops = ~30% Spill
53.3	38.6	14.7	27.6%	16.0	11.3	11.3				SW-Lo	1						1	2	Min. Q w/ 3 units + 2 stops = ~28% Spill
55.4	38.8	16.6	30.0%	16.0	11.4	11.4				SW-Lo	1						2	3	
61.3	42.9	18.4	30.0%	16.0	13.5	13.4				SW-Lo	1		1				2	4	
67.1	47.0	20.1	30.0%	16.0	15.5	15.5				SW-Lo	1		1		1		2	5	
73.0	51.1	21.9	30.0%	17.1	17.0	17.0				SW-Lo	1	1	1		1		2	6	
74.4	52.5	21.9	29.4%	17.5	17.5	17.5				SW-Lo	1	1	1		1		2	6	Max. Q w/ 3 units + 6 stops = ~29% Spill
74.4	52.5	21.9	29.4%	16.0	11.3	11.3	13.9			SW-Lo	1	1	1		1		2	6	Min. Q w/ 4 units + 6 stops = ~29% Spill
78.9	55.2	23.7	30.0%	16.0	12.7	12.6	13.9			SW-Lo	1	1	1		1	1	2	7	
84.7	59.3	25.4	30.0%	16.0	14.5	14.4	14.4			SW-Lo	1	1	1	1	1	1	2	8	Spring flow trigger for SW crest change [e]
91.0	63.7	27.3	30.0%	16.0	15.9	15.9	15.9			SW-Lo	2	1	1	1	1	1	2	9	
97.4	68.2	29.2	30.0%	17.1	17.1	17.0	17.0			SW-Lo	2	1	2	1	1	1	2	10	
100.6	71.4	29.2	29.0%	17.5	17.5	17.5	18.9			SW-Lo	2	1	2	1	1	1	2	10	Max. Q w/ 4 units+10 stops = ~29% Spill
100.6	71.4	29.2	29.0%	16.0	13.9	13.8	13.8	13.9		SW-Lo	2	1	2	1	1	1	2	10	5 units + 10 stops = ~29% Spill
103.7	72.6	31.1	30.0%	16.0	14.2	14.2	14.1	14.1		SW-Lo	2	1	2	1	2	1	2	11	
110.0	77.0	33.0	30.0%	16.0	15.3	15.3	15.2	15.2		SW-Lo	2	2	2	1	2	1	2	12	
116.4	81.5	34.9	30.0%	16.3	16.3	16.3	16.3	16.3		SW-Lo	2	2	2	2	2	1	2	13	
122.7	85.9	36.8	30.0%	17.2	17.2	17.2	17.2	17.1		SW-Lo	2	2	2	2	2	2	2	14	
129.4	90.6	38.8	30.0%	16.0	15.0	14.9	14.9	14.9	14.9	SW-Lo	3	2	2	2	2	2	2	15	
136.0	95.2	40.8	30.0%	16.0	15.9	15.9	15.8	15.8	15.8	SW-Lo	3	3	2	2	2	2	2	16	
142.7	99.9	42.8	30.0%	16.7	16.7	16.7	16.6	16.6	16.6	SW-Lo	3	3	3	2	2	2	2	17	
149.3	104.5	44.8	30.0%	17.5	17.4	17.4	17.4	17.4	17.4	SW-Lo	3	3	3	3	2	2	2	18	
156.0	109.2	46.8	30.0%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	3	3	3	3	3	2	2	19	Max. PH capacity for 30% Spill [c]
158.0	109.2	48.8	30.9%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	3	3	3	3	3	3	2	20	

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						SW-Lo Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
160.0	109.2	50.8	31.8%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	3	3	3	3	3	3	3	21	
162.0	109.2	52.8	32.6%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	4	3	3	3	3	3	3	22	
163.9	109.2	54.7	33.4%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	4	4	3	3	3	3	3	23	
165.9	109.2	56.7	34.2%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	4	4	4	3	3	3	3	24	
167.9	109.2	58.7	35.0%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	4	4	4	4	3	3	3	25	
169.8	109.2	60.6	35.7%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	4	4	4	4	4	3	3	26	
171.8	109.2	62.6	36.4%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	4	4	4	4	4	4	3	27	
173.8	109.2	64.6	37.2%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	4	4	4	4	4	4	4	28	
175.7	109.2	66.5	37.8%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	5	4	4	4	4	4	4	29	
177.7	109.2	68.5	38.5%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	5	5	4	4	4	4	4	30	
179.7	109.2	70.5	39.2%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	5	5	5	4	4	4	4	31	
181.6	109.2	72.4	39.9%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	5	5	5	5	4	4	4	32	
183.6	109.2	74.4	40.5%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	5	5	5	5	5	4	4	33	
185.6	109.2	76.4	41.2%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	5	5	5	5	5	5	4	34	
187.5	109.2	78.3	41.8%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	5	5	5	5	5	5	5	35	
189.5	109.2	80.3	42.4%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	6	5	5	5	5	5	5	36	
191.5	109.2	82.3	43.0%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	6	6	5	5	5	5	5	37	
193.4	109.2	84.2	43.5%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	6	6	6	5	5	5	5	38	
195.4	109.2	86.2	44.1%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	6	6	6	6	5	5	5	39	
197.3	109.2	88.1	44.7%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	6	6	6	6	6	5	5	40	
199.3	109.2	90.1	45.2%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	6	6	6	6	6	6	5	41	
201.3	109.2	92.1	45.8%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	6	6	6	6	6	6	6	42	
203.2	109.2	94.0	46.3%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	7	6	6	6	6	6	6	43	
205.1	109.2	95.9	46.8%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	7	7	6	6	6	6	6	44	
207.1	109.2	97.9	47.3%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	7	7	7	6	6	6	6	45	
209.0	109.2	99.8	47.8%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	7	7	7	7	6	6	6	46	
211.0	109.2	101.8	48.2%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	7	7	7	7	7	6	6	47	
212.9	109.2	103.7	48.7%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	7	7	7	7	7	7	6	48	
214.9	109.2	105.7	49.2%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	7	7	7	7	7	7	7	49	

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						SW-Lo Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
216.8	109.2	107.6	49.6%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	8	7	7	7	7	7	7	50	
218.8	109.2	109.6	50.1%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	8	8	7	7	7	7	7	51	
220.8	109.2	111.6	50.5%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	8	8	8	7	7	7	7	52	
222.7	109.2	113.5	51.0%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	8	8	8	8	7	7	7	53	
224.7	109.2	115.5	51.4%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	8	8	8	8	8	7	7	54	
226.7	109.2	117.5	51.8%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	8	8	8	8	8	8	7	55	
228.6	109.2	119.4	52.2%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	8	8	8	8	8	8	8	56	
230.6	109.2	121.4	52.6%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	9	8	8	8	8	8	8	57	
232.5	109.2	123.3	53.0%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	9	9	8	8	8	8	8	58	
234.4	109.2	125.2	53.4%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	9	9	9	8	8	8	8	59	
236.3	109.2	127.1	53.8%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	9	9	9	9	8	8	8	60	
238.3	109.2	129.1	54.2%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	9	9	9	9	9	8	8	61	
240.2	109.2	131.0	54.5%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	9	9	9	9	9	9	8	62	
242.1	109.2	132.9	54.9%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	9	9	9	9	9	9	9	63	
244.1	109.2	134.9	55.3%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	10	9	9	9	9	9	9	64	
246.2	109.2	137.0	55.6%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	10	10	9	9	9	9	9	65	
248.2	109.2	139.0	56.0%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	10	10	10	9	9	9	9	66	
250.2	109.2	141.0	56.4%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	10	10	10	10	9	9	9	67	
252.2	109.2	143.0	56.7%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	10	10	10	10	10	9	9	68	
254.2	109.2	145.0	57.0%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	10	10	10	10	10	10	9	69	
256.2	109.2	147.0	57.4%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Lo	10	10	10	10	10	10	10	70	

a. Spill and PH flows calculated based on average forebay elevation 633.5 ft (within MOP range 633.0–634.0 ft).

b. Units operated in priority order 1→6 (**Table LGS-5**) within 1% (**Tables LGS-6, -7**). *Unit outflows are estimates of how Unit 1 special operation will work, not precise requirement.*

c. Total Outflow >156 kcfs = Total Spill >30% due to PH at maximum capacity (~109 kcfs).

d. Unit 1 manually restricted to upper 1% range (115–125 MW; ~16.0–17.5 kcfs) to disrupt tailrace eddy that forms during spill through SW in Bay 1. Assume Unit 1 is at lower end of the upper 1% range if other units operating uniformly at <16.0 kcfs. Assume all units operating uniformly if average unit discharge is >16.0 kcfs. During low flows (<~38 kcfs) with only one unit operating, Unit 1 may be operated within full 1% range as necessary (~11.3–17.5 kcfs).

e. SW operating criteria are defined in section 2.3.1.2.g. Flow >85 kcfs = SW-Lo / Flow 35-85 kcfs = SW-Hi / Flow <35 kcfs = SW close.

Table LGS-9. [*pg 1 of 3*] Little Goose Dam Spill Patterns with Spillway Weir in High Crest (SW-Hi) Elevation 622 ft. [a]

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						SW-Hi Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
23.9	16.7	7.2	30.1%	16.7						SW-Hi								0	Min. Q w/ SW-Hi
26.4	17.5	8.9	33.7%	17.5						SW-Hi							1	1	1 unit + 1 stop = ~34% Spill
31.5	22.6	8.9	28.3%	11.3	11.3					SW-Hi							1	1	2 units at min. 1% + 1 stop = ~28% Spill
35.0	24.3	10.7	30.6%	13.0	11.3					SW-Hi	1						1	2	Min. Q w/ SW-Hi per FPP [e]
35.6	24.9	10.7	30.1%	13.6	11.3					SW-Hi	1						1	2	
38.0	27.3	10.7	28.2%	16.0	11.3					SW-Hi	1						1	2	Min. Q w/ U1 in upper 1% [d]
41.9	29.3	12.6	30.1%	16.0	13.3					SW-Hi	1						2	3	
47.7	33.4	14.3	30.0%	17.5	15.9					SW-Hi	1		1				2	4	
51.1	35.0	16.1	31.5%	17.5	17.5					SW-Hi	1		1		1		2	5	2 units + 5 stops = ~31% Spill
54.7	38.6	16.1	29.4%	16.0	11.3	11.3				SW-Hi	1		1		1		2	5	3 units + 5 stops = ~29% Spill
59.6	41.7	17.9	30.0%	16.0	12.9	12.8				SW-Hi	1	1	1		1		2	6	
65.4	45.8	19.6	30.0%	16.0	14.9	14.9				SW-Hi	1	1	1		1	1	2	7	
71.3	49.9	21.4	30.0%	16.6	16.7	16.6				SW-Hi	1	1	1	1	1	1	2	8	
73.9	52.5	21.4	29.0%	17.5	17.5	17.5				SW-Hi	1	1	1	1	1	1	2	8	Max. Q w/ 3 units = ~29% Spill
73.9	52.5	21.4	29.0%	16.0	11.3	11.3	13.9			SW-Hi	1	1	1	1	1	1	2	8	Min. Q w/ 4 units = ~29% Spill
77.6	54.3	23.3	30.0%	16.0	12.2	12.2	13.9			SW-Hi	2	1	1	1	1	1	2	9	
83.9	58.7	25.2	30.0%	16.0	14.3	14.2	14.2			SW-Hi	2	1	2	1	1	1	2	10	
85.0	59.8	25.2	29.6%	16.0	14.6	14.6	14.6			SW-Hi	2	1	2	1	1	1	2	10	Spring flow trigger for SW crest change [e]
90.3	63.2	27.1	30.0%	16.0	15.8	15.7	15.7			SW-Hi	2	1	2	1	2	1	2	11	
96.6	67.6	29.0	30.0%	16.9	16.9	16.9	16.9			SW-Hi	2	2	2	1	2	1	2	12	
100.4	71.4	29.0	28.9%	17.5	17.5	17.5	18.9			SW-Hi	2	2	2	1	2	1	2	12	Max. Q w/ 4 units+12 stops = ~29% Spill
100.4	71.4	29.0	28.9%	16.0	13.9	13.8	13.8	13.9		SW-Hi	2	2	2	1	2	1	2	12	5 units + 12 stops = ~29% Spill
102.9	72.0	30.9	30.0%	16.0	14.0	14.0	14.0	14.0		SW-Hi	2	2	2	2	2	1	2	13	
109.3	76.5	32.8	30.0%	16.0	15.2	15.1	15.1	15.1		SW-Hi	2	2	2	2	2	2	2	14	
115.9	81.1	34.8	30.0%	16.3	16.2	16.2	16.2	16.2		SW-Hi	3	2	2	2	2	2	2	15	
122.6	85.8	36.8	30.0%	17.2	17.2	17.2	17.1	17.1		SW-Hi	3	3	2	2	2	2	2	16	
129.2	90.4	38.8	30.0%	16.0	14.9	14.9	14.9	14.9	14.8	SW-Hi	3	3	3	2	2	2	2	17	
135.9	95.1	40.8	30.0%	16.0	15.9	15.8	15.8	15.8	15.8	SW-Hi	3	3	3	3	2	2	2	18	

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						SW-Hi Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
142.4	99.7	42.7	30.0%	16.7	16.6	16.6	16.6	16.6	16.6	SW-Hi	3	3	3	3	3	2	2	19	
149.1	104.4	44.7	30.0%	17.4	17.4	17.4	17.4	17.4	17.4	SW-Hi	3	3	3	3	3	3	2	20	
155.9	109.2	46.7	30.0%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	3	3	3	3	3	3	3	21	Max. PH capacity for 30% Spill. [c]
157.9	109.2	48.7	30.8%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	4	3	3	3	3	3	3	22	
159.9	109.2	50.7	31.7%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	4	4	3	3	3	3	3	23	
161.8	109.2	52.6	32.5%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	4	4	4	3	3	3	3	24	
163.8	109.2	54.6	33.3%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	4	4	4	4	3	3	3	25	
165.8	109.2	56.6	34.1%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	4	4	4	4	4	3	3	26	
167.8	109.2	58.6	34.9%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	4	4	4	4	4	4	3	27	
169.7	109.2	60.5	35.7%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	4	4	4	4	4	4	4	28	
171.7	109.2	62.5	36.4%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	5	4	4	4	4	4	4	29	
173.7	109.2	64.5	37.1%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	5	5	4	4	4	4	4	30	
175.6	109.2	66.4	37.8%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	5	5	5	4	4	4	4	31	
177.6	109.2	68.4	38.5%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	5	5	5	5	4	4	4	32	
179.6	109.2	70.4	39.2%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	5	5	5	5	5	4	4	33	
181.5	109.2	72.3	39.8%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	5	5	5	5	5	5	4	34	
183.5	109.2	74.3	40.5%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	5	5	5	5	5	5	5	35	
185.4	109.2	76.2	41.1%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	6	5	5	5	5	5	5	36	
187.4	109.2	78.2	41.7%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	6	6	5	5	5	5	5	37	
189.4	109.2	80.2	42.3%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	6	6	6	5	5	5	5	38	
191.3	109.2	82.1	42.9%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	6	6	6	6	5	5	5	39	
193.3	109.2	84.1	43.5%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	6	6	6	6	6	5	5	40	
195.2	109.2	86.0	44.1%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	6	6	6	6	6	6	5	41	
197.2	109.2	88.0	44.6%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	6	6	6	6	6	6	6	42	
199.1	109.2	89.9	45.2%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	7	6	6	6	6	6	6	43	
201.1	109.2	91.9	45.7%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	7	7	6	6	6	6	6	44	
203.0	109.2	93.8	46.2%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	7	7	7	6	6	6	6	45	
205.0	109.2	95.8	46.7%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	7	7	7	7	6	6	6	46	
206.9	109.2	97.7	47.2%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	7	7	7	7	7	6	6	47	

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						SW-Hi Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
208.9	109.2	99.7	47.7%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	7	7	7	7	7	7	6	48	
210.8	109.2	101.6	48.2%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	7	7	7	7	7	7	7	49	
212.8	109.2	103.6	48.7%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	8	7	7	7	7	7	7	50	
214.7	109.2	105.5	49.1%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	8	8	7	7	7	7	7	51	
216.7	109.2	107.5	49.6%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	8	8	8	7	7	7	7	52	
218.7	109.2	109.5	50.1%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	8	8	8	8	7	7	7	53	
220.6	109.2	111.4	50.5%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	8	8	8	8	8	7	7	54	
222.6	109.2	113.4	50.9%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	8	8	8	8	8	8	7	55	
224.6	109.2	115.4	51.4%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	8	8	8	8	8	8	8	56	
226.5	109.2	117.3	51.8%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	9	8	8	8	8	8	8	57	
228.4	109.2	119.2	52.2%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	9	9	8	8	8	8	8	58	
230.4	109.2	121.2	52.6%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	9	9	9	8	8	8	8	59	
232.3	109.2	123.1	53.0%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	9	9	9	9	8	8	8	60	
234.2	109.2	125.0	53.4%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	9	9	9	9	9	8	8	61	
236.2	109.2	127.0	53.8%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	9	9	9	9	9	9	8	62	
238.1	109.2	128.9	54.1%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	9	9	9	9	9	9	9	63	
240.1	109.2	130.9	54.5%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	10	9	9	9	9	9	9	64	
242.1	109.2	132.9	54.9%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	10	10	9	9	9	9	9	65	
244.1	109.2	134.9	55.3%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	10	10	10	9	9	9	9	66	
246.1	109.2	136.9	55.6%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	10	10	10	10	9	9	9	67	
248.1	109.2	138.9	56.0%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	10	10	10	10	10	9	9	68	
250.1	109.2	140.9	56.3%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	10	10	10	10	10	10	9	69	
252.2	109.2	143.0	56.7%	17.5	17.5	17.5	18.9	18.9	18.9	SW-Hi	10	10	10	10	10	10	10	70	

a. Spill and PH flows calculated based on average forebay elevation 633.5 ft (within MOP range 633.0–634.0 ft).

b. Units operated in priority order 1→6 (**Table LGS-5**) within 1% (**Tables LGS-6, -7**). *Unit outflows are estimates of how Unit 1 special operation will work, not precise requirement.*

c. Total Outflow >156 kcfs = Total Spill >30% due to PH at maximum capacity (~109 kcfs).

d. Unit 1 manually restricted to upper 1% range (115–125 MW; ~16.0–17.5 kcfs) to disrupt tailrace eddy that forms during spill through SW in Bay 1. Assume Unit 1 is at lower end of the upper 1% range if other units operating uniformly at <16.0 kcfs. Assume all units operating uniformly if average unit discharge is >16.0 kcfs. During low flows (<~38 kcfs) with only one unit operating, Unit 1 may be operated within full 1% range as necessary (~11.3–17.5 kcfs).

e. SW operating criteria are defined in section **2.3.1.2.g**. Flow >85 kcfs = SW-Lo / Flow 35-85 kcfs = SW-Hi / Flow <35 kcfs = SW close.

Table LGS-10. [*pg 1 of 3*] Little Goose Dam Uniform Spill Patterns with No Spillway Weir (Bay 1 Closed). [a]

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						No SW Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
11.3	11.3	0.0	0.0%	11.3						Closed								0	Min. Q w/ Closed and no spill.
13.1	11.3	1.8	13.5%	11.3						Closed							1	1	
14.8	11.3	3.5	23.8%	11.3						Closed	1						1	2	
18.0	12.6	5.4	30.0%	12.6						Closed	1						2	3	Min. Q w/ Closed and 30% spill.
24.0	16.8	7.2	29.9%	16.8						Closed	1		1				2	4	
26.4	17.5	8.9	33.8%	17.5						Closed	1		1		1		2	5	1 unit + 5 stops = ~34% spill
31.5	22.6	8.9	28.3%	11.3	11.3					Closed	1		1		1		2	5	2 units + 5 stops = ~28% spill
35.7	25.0	10.7	30.0%	13.7	11.3					Closed	1	1	1		1		2	6	
38.0	27.3	10.7	28.2%	16.0	11.3					Closed	1	1	1		1		2	6	Min. Q w/ U1 in upper 1% [d]
41.6	29.1	12.5	30.0%	16.0	13.1					Closed	1	1	1		1	1	2	7	
47.4	33.2	14.2	30.0%	16.6	16.6					Closed	1	1	1	1	1	1	2	8	
51.1	35.0	16.1	31.5%	17.5	17.5					Closed	2	1	1	1	1	1	2	9	2 units + 9 stops = ~31% spill
54.7	38.6	16.1	29.5%	16.0	11.3	11.3				Closed	2	1	1	1	1	1	2	9	3 units + 9 stops = ~29% spill
60.0	42.0	18.0	30.0%	16.0	13.0	13.0				Closed	2	1	2	1	1	1	2	10	
66.4	46.5	19.9	30.0%	16.0	15.3	15.2				Closed	2	1	2	1	2	1	2	11	
72.7	50.9	21.8	30.0%	17.0	17.0	16.9				Closed	2	2	2	1	2	1	2	12	
74.3	52.5	21.8	29.4%	17.5	17.5	17.5				Closed	2	2	2	1	2	1	2	12	Max. Q w/ 3 units = ~29% spill
76.2	52.5	23.7	31.1%	16.0	11.3	11.3	13.9			Closed	2	2	2	2	2	1	2	13	Min. Q w/ 4 units = ~31% spill
79.0	55.3	23.7	30.0%	16.0	12.7	12.7	13.9			Closed	2	2	2	2	2	1	2	13	
85.4	59.8	25.6	30.0%	16.0	14.6	14.6	14.6			Closed	2	2	2	2	2	2	2	14	
92.0	64.4	27.6	30.0%	16.1	16.1	16.1	16.1			Closed	3	2	2	2	2	2	2	15	
98.7	69.1	29.6	30.0%	17.3	17.3	17.3	17.2			Closed	3	3	2	2	2	2	2	16	
105.3	73.7	31.6	30.0%	16.0	14.5	14.4	14.4	14.4		Closed	3	3	3	2	2	2	2	17	
112.0	78.4	33.6	30.0%	16.0	15.6	15.6	15.6	15.6		Closed	3	3	3	3	2	2	2	18	
118.7	83.1	35.6	30.0%	16.7	16.6	16.6	16.6	16.6		Closed	3	3	3	3	3	2	2	19	
125.1	87.5	37.6	30.1%	17.5	17.5	17.5	17.5	17.5		Closed	3	3	3	3	3	3	2	20	
132.0	92.4	39.6	30.0%	16.0	15.3	15.3	15.3	15.3	15.2	Closed	3	3	3	3	3	3	3	21	
138.6	97.0	41.6	30.0%	16.2	16.2	16.2	16.2	16.1	16.1	Closed	4	3	3	3	3	3	3	22	

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						No SW Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
145.1	101.6	43.5	30.0%	17.0	17.0	16.9	16.9	16.9	16.9	Closed	4	4	3	3	3	3	3	23	
151.7	106.2	45.5	30.0%	17.5	17.5	17.5	17.9	17.9	17.9	Closed	4	4	4	3	3	3	3	24	
156.7	109.2	47.5	30.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	4	4	4	4	3	3	3	25	Max. PH capacity for 30% Spill. [c]
158.6	109.2	49.4	31.2%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	4	4	4	4	4	3	3	26	
160.6	109.2	51.4	32.0%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	4	4	4	4	4	4	3	27	
162.6	109.2	53.4	32.8%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	4	4	4	4	4	4	4	28	
164.5	109.2	55.3	33.6%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	5	4	4	4	4	4	4	29	
166.5	109.2	57.3	34.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	5	5	4	4	4	4	4	30	
168.5	109.2	59.3	35.2%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	5	5	5	4	4	4	4	31	
170.4	109.2	61.2	35.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	5	5	5	5	4	4	4	32	
172.4	109.2	63.2	36.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	5	5	5	5	5	4	4	33	
174.4	109.2	65.2	37.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	5	5	5	5	5	5	4	34	
176.3	109.2	67.1	38.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	5	5	5	5	5	5	5	35	
178.3	109.2	69.1	38.8%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	6	5	5	5	5	5	5	36	
180.3	109.2	71.1	39.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	6	6	5	5	5	5	5	37	
182.2	109.2	73.0	40.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	6	6	6	5	5	5	5	38	
184.2	109.2	75.0	40.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	6	6	6	6	5	5	5	39	
186.1	109.2	76.9	41.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	6	6	6	6	6	5	5	40	
188.1	109.2	78.9	41.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	6	6	6	6	6	6	5	41	
190.1	109.2	80.9	42.5%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	6	6	6	6	6	6	6	42	
192.0	109.2	82.8	43.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	7	6	6	6	6	6	6	43	
193.9	109.2	84.7	43.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	7	7	6	6	6	6	6	44	
195.9	109.2	86.7	44.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	7	7	7	6	6	6	6	45	
197.8	109.2	88.6	44.8%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	7	7	7	7	6	6	6	46	
199.8	109.2	90.6	45.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	7	7	7	7	7	6	6	47	
201.7	109.2	92.5	45.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	7	7	7	7	7	7	6	48	
203.7	109.2	94.5	46.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	7	7	7	7	7	7	7	49	
205.6	109.2	96.4	46.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	8	7	7	7	7	7	7	50	
207.6	109.2	98.4	47.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	8	8	7	7	7	7	7	51	

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						No SW Gate Stops per Spillbay								Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
209.6	109.2	100.4	47.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	8	8	8	7	7	7	7	52	
211.5	109.2	102.3	48.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	8	8	8	8	7	7	7	53	
213.5	109.2	104.3	48.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	8	8	8	8	8	7	7	54	
215.5	109.2	106.3	49.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	8	8	8	8	8	8	7	55	
217.4	109.2	108.2	49.8%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	8	8	8	8	8	8	8	56	
219.4	109.2	110.2	50.2%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	9	8	8	8	8	8	8	57	
221.3	109.2	112.1	50.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	9	9	8	8	8	8	8	58	
223.2	109.2	114.0	51.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	9	9	9	8	8	8	8	59	
225.1	109.2	115.9	51.5%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	9	9	9	9	8	8	8	60	
227.1	109.2	117.9	51.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	9	9	9	9	9	8	8	61	
229.0	109.2	119.8	52.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	9	9	9	9	9	9	8	62	
230.9	109.2	121.7	52.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	9	9	9	9	9	9	9	63	
232.9	109.2	123.7	53.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	10	9	9	9	9	9	9	64	
235.0	109.2	125.8	53.5%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	10	10	9	9	9	9	9	65	
237.0	109.2	127.8	53.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	10	10	10	9	9	9	9	66	
239.0	109.2	129.8	54.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	10	10	10	10	9	9	9	67	
241.0	109.2	131.8	54.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	10	10	10	10	10	9	9	68	
243.0	109.2	133.8	55.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	10	10	10	10	10	10	9	69	
245.0	109.2	135.8	55.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	10	10	10	10	10	10	10	70	

a. Spill and PH flows calculated based on average forebay elevation 633.5 ft (within MOP range 633.0–634.0 ft).

b. Units operated in priority order 1→6 (**Table LGS-5**) within 1% (**Tables LGS-6, -7**). *Unit outflows are estimates of how Unit 1 special operation will work, not precise requirement.*

c. Total Outflow >156 kcfs = Total Spill >30% due to PH at maximum capacity (~109 kcfs).

d. Unit 1 manually restricted to upper 1% range (115–125 MW; ~16.0–17.5 kcfs) to disrupt tailrace eddy that forms during spill through SW in Bay 1. Assume Unit 1 is at lower end of the upper 1% range if other units operating uniformly at <16.0 kcfs. Assume all units operating uniformly if average unit discharge is >16.0 kcfs. During low flows (<~38 kcfs) with only one unit operating, Unit 1 may be operated within full 1% range as necessary (~11.3–17.5 kcfs).

e. SW operating criteria are defined in section **2.3.1.2.g**. Flow >85 kcfs = SW-Lo / Flow 35-85 kcfs = SW-Hi / Flow <35 kcfs = SW close.

Table LGS-11. [*pg 1 of 3*] Little Goose Dam ALTERNATE UNIFORM Spill Patterns for use during Spillway Weir Crest Change. [a, f]

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						SW Crest Change (Bays 1 & 2 closed) [f] Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2 [f]	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
11.3	11.3	0.0	0.0%	11.3						Closed	Closed							0	Min. Q w/ no SW and no spill.
13.1	11.3	1.8	13.5%	11.3						Closed	Closed						1	1	
14.8	11.3	3.5	23.8%	11.3						Closed	Closed	1					1	2	
18.0	12.6	5.4	30.0%	12.6						Closed	Closed	1					2	3	Min. Q w/ no SW and 30% spill.
24.0	16.8	7.2	29.9%	16.8						Closed	Closed	1		1			2	4	
26.4	17.5	8.9	33.8%	17.5						Closed	Closed	1		1		1	2	5	1 unit + 5 stops = ~34% spill
31.5	22.6	8.9	28.3%	11.3	11.3					Closed	Closed	1		1		1	2	5	2 units + 5 stops = ~28% spill
35.7	25.0	10.7	30.0%	13.7	11.3					Closed	Closed	1	1	1		1	2	6	
38.0	27.3	10.7	28.2%	16.0	11.3					Closed	Closed	1	1	1		1	2	6	Min. Q w/ U1 in upper 1% [c]
41.6	29.1	12.5	30.0%	16.0	13.1					Closed	Closed	1	1	1	1	1	2	7	
47.6	33.2	14.4	30.2%	16.6	16.6					Closed	Closed	2	1	1	1	1	2	8	
51.3	35.0	16.3	31.7%	17.5	17.5					Closed	Closed	2	1	2	1	1	2	9	2 units + 9 stops = ~31% spill
54.9	38.6	16.3	29.6%	16.0	11.3	11.3				Closed	Closed	2	1	2	1	1	2	9	3 units + 9 stops = ~29% spill
60.2	42.0	18.2	30.2%	16.0	13.0	13.0				Closed	Closed	2	1	2	1	2	2	10	
66.6	46.5	20.1	30.1%	16.0	15.3	15.2				Closed	Closed	2	2	2	1	2	2	11	
72.9	50.9	22.0	30.1%	17.0	17.0	16.9				Closed	Closed	2	2	2	2	2	2	12	
74.5	52.5	22.0	29.5%	17.5	17.5	17.5				Closed	Closed	2	2	2	2	2	2	12	Max. Q w/ 3 units = ~29% spill
76.5	52.5	24.0	31.3%	16.0	11.3	11.3	13.9			Closed	Closed	3	2	2	2	2	2	13	Min. Q w/ 4 units = ~31% spill
79.3	55.3	24.0	30.2%	16.0	12.7	12.7	13.9			Closed	Closed	3	2	2	2	2	2	13	
85.8	59.8	26.0	30.3%	16.0	14.6	14.6	14.6			Closed	Closed	3	3	2	2	2	2	14	
92.3	64.4	27.9	30.3%	16.1	16.1	16.1	16.1			Closed	Closed	3	3	3	2	2	2	15	
99.0	69.1	29.9	30.2%	17.3	17.3	17.3	17.2			Closed	Closed	3	3	3	3	2	2	16	
105.6	73.7	31.9	30.2%	16.0	14.5	14.4	14.4	14.4		Closed	Closed	3	3	3	3	3	2	17	
112.3	78.4	33.9	30.2%	16.0	15.6	15.6	15.6	15.6		Closed	Closed	3	3	3	3	3	3	18	
119.0	83.1	35.9	30.2%	16.7	16.6	16.6	16.6	16.6		Closed	Closed	4	3	3	3	3	3	19	
125.4	87.5	37.9	30.2%	17.5	17.5	17.5	17.5	17.5		Closed	Closed	4	4	3	3	3	3	20	
132.2	92.4	39.8	30.1%	16.0	15.3	15.3	15.3	15.3	15.2	Closed	Closed	4	4	4	3	3	3	21	
138.8	97.0	41.8	30.1%	16.2	16.2	16.2	16.2	16.1	16.1	Closed	Closed	4	4	4	4	3	3	22	

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						SW Crest Change (Bays 1 & 2 closed) [f] Gate Stops per Spillbay								Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2 [f]	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
145.4	101.6	43.8	30.1%	17.0	17.0	16.9	16.9	16.9	16.9	Closed	Closed	4	4	4	4	4	3	23	
152.0	106.2	45.8	30.1%	17.5	17.5	17.5	17.9	17.9	17.9	Closed	Closed	4	4	4	4	4	4	24	
156.9	109.2	47.7	30.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	5	4	4	4	4	4	25	Max. PH capacity for 30% Spill. [c]
158.9	109.2	49.7	31.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	5	5	4	4	4	4	26	
160.8	109.2	51.6	32.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	5	5	5	4	4	4	27	
162.8	109.2	53.6	32.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	5	5	5	5	4	4	28	
164.8	109.2	55.6	33.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	5	5	5	5	5	4	29	
166.7	109.2	57.5	34.5%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	5	5	5	5	5	5	30	
168.7	109.2	59.5	35.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	6	5	5	5	5	5	31	
170.7	109.2	61.5	36.0%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	6	6	5	5	5	5	32	
172.6	109.2	63.4	36.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	6	6	6	5	5	5	33	
174.6	109.2	65.4	37.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	6	6	6	6	5	5	34	
176.5	109.2	67.3	38.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	6	6	6	6	6	5	35	
178.5	109.2	69.3	38.8%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	6	6	6	6	6	6	36	
180.4	109.2	71.2	39.5%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	7	6	6	6	6	6	37	
182.4	109.2	73.2	40.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	7	7	6	6	6	6	38	
184.3	109.2	75.1	40.8%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	7	7	7	6	6	6	39	
186.3	109.2	77.1	41.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	7	7	7	7	6	6	40	
188.2	109.2	79.0	42.0%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	7	7	7	7	7	6	41	
190.2	109.2	81.0	42.6%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	7	7	7	7	7	7	42	
192.1	109.2	82.9	43.2%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	8	7	7	7	7	7	43	
194.1	109.2	84.9	43.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	8	8	7	7	7	7	44	
196.1	109.2	86.9	44.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	8	8	8	7	7	7	45	
198.0	109.2	88.8	44.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	8	8	8	8	7	7	46	
200.0	109.2	90.8	45.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	8	8	8	8	8	7	47	
202.0	109.2	92.8	45.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	8	8	8	8	8	8	48	
203.9	109.2	94.7	46.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	9	8	8	8	8	8	49	
205.8	109.2	96.6	46.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	9	9	8	8	8	8	50	
207.8	109.2	98.6	47.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	9	9	9	8	8	8	51	

Outflow [a]				Turbine Unit Outflow [b] (kcfs)						SW Crest Change (Bays 1 & 2 closed) [f] Gate Stops per Spillbay									Comments (see footnotes)
Project (kcfs)	PH (kcfs)	Spill (kcfs)	Spill [c] (%)	Unit 1 [d]	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Bay 1 [e]	Bay 2 [f]	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Total Stops	
209.7	109.2	100.5	47.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	9	9	9	9	8	8	52	
211.6	109.2	102.4	48.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	9	9	9	9	9	8	53	
213.5	109.2	104.3	48.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	9	9	9	9	9	9	54	
215.6	109.2	106.4	49.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	10	9	9	9	9	9	55	
217.6	109.2	108.4	49.8%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	10	10	9	9	9	9	56	
219.6	109.2	110.4	50.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	10	10	10	9	9	9	57	
221.6	109.2	112.4	50.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	10	10	10	10	9	9	58	
223.6	109.2	114.4	51.2%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	10	10	10	10	10	9	59	
225.6	109.2	116.4	51.6%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	10	10	10	10	10	10	60	
227.6	109.2	118.4	52.0%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	11	10	10	10	10	10	61	
229.6	109.2	120.4	52.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	11	11	10	10	10	10	62	
231.7	109.2	122.5	52.9%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	11	11	11	10	10	10	63	
233.7	109.2	124.5	53.3%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	11	11	11	11	10	10	64	
235.7	109.2	126.5	53.7%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	11	11	11	11	11	10	65	
237.7	109.2	128.5	54.1%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	11	11	11	11	11	11	66	
239.7	109.2	130.5	54.4%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	12	11	11	11	11	11	67	
241.8	109.2	132.6	54.8%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	12	12	11	11	11	11	68	
243.8	109.2	134.6	55.2%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	12	12	12	11	11	11	69	
245.8	109.2	136.6	55.6%	17.5	17.5	17.5	18.9	18.9	18.9	Closed	Closed	12	12	12	12	11	11	70	

a. Spill and PH flows calculated based on average forebay elevation 633.5 ft (within MOP range 633.0–634.0 ft).

b. Units operated in priority order 1→6 (**Table LGS-5**) within 1% (**Tables LGS-6, -7**). *Unit outflows are estimates of how Unit 1 special operation will work, not precise requirement.*

c. Total Outflow >156 kcfs = Total Spill >30% due to PH at maximum capacity (~109 kcfs).

d. Unit 1 manually restricted to upper 1% range (115–125 MW; ~16.0–17.5 kcfs) to disrupt tailrace eddy that forms during spill through SW in Bay 1. Assume Unit 1 is at lower end of the upper 1% range if other units operating uniformly at <16.0 kcfs. Assume all units operating uniformly if average unit discharge is >16.0 kcfs. During low flows (<~38 kcfs) with only one unit operating, Unit 1 may be operated within full 1% range as necessary (~11.3–17.5 kcfs).

e. SW operating criteria are defined in section **2.3.1.2.g**. Flow >85 kcfs = SW-Lo / Flow 35-85 kcfs = SW-Hi / Flow <35 kcfs = SW close.

f. This "*Alternate Uniform*" pattern applies when changing the SW crest. Bay 2 is closed to ensure safety of workers at Bay 1.