2016 Fish Passage Plan

Chapter 8 – Little Goose Dam

Table of Contents

Chapter 8 - Little Goose Dam

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 Spillway Weir (SW) in Bay 1 w/ high crest (el. 622 ft) or low crest (el. 618 ft).
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)
Spillway Weir (SW)	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.

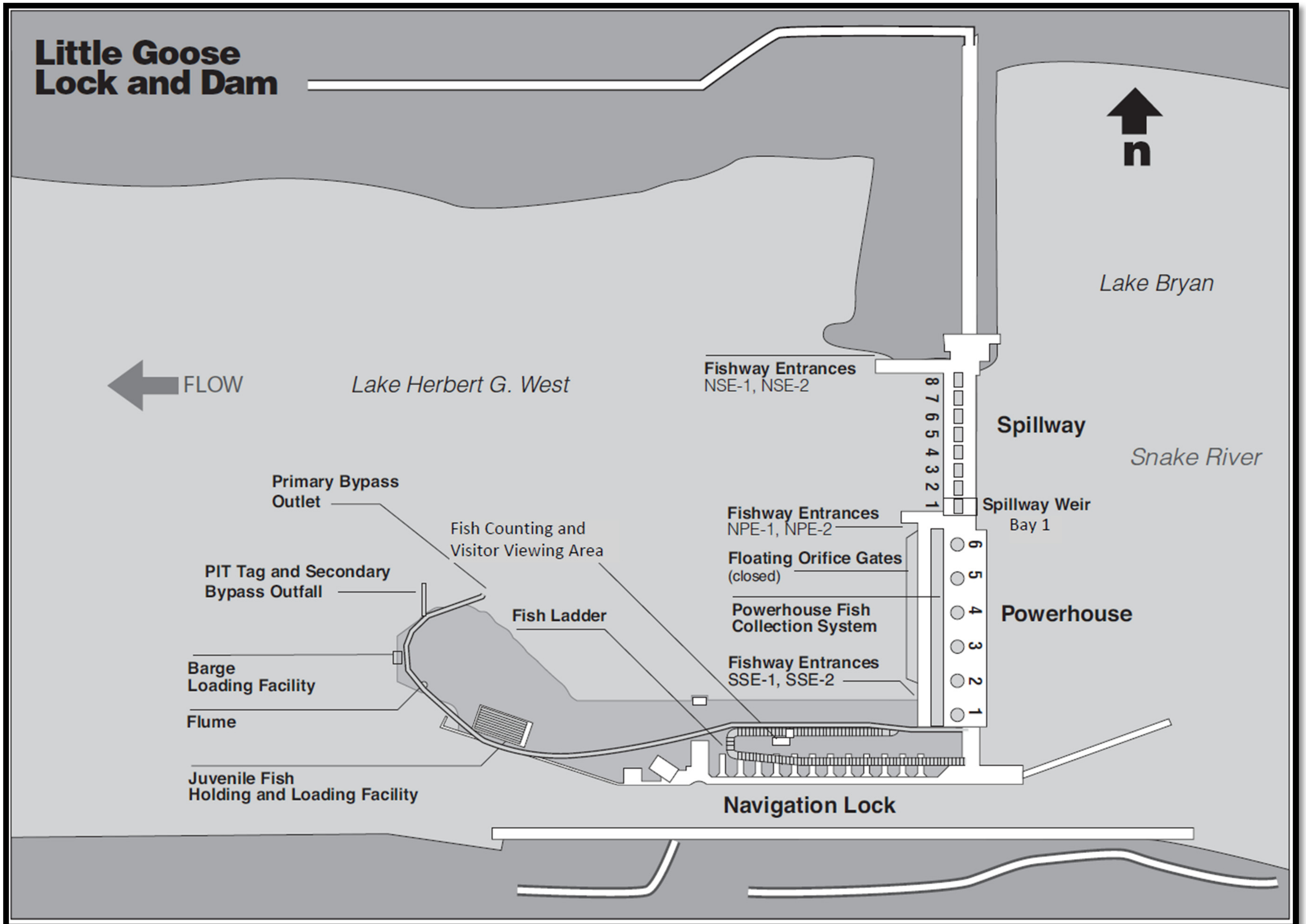
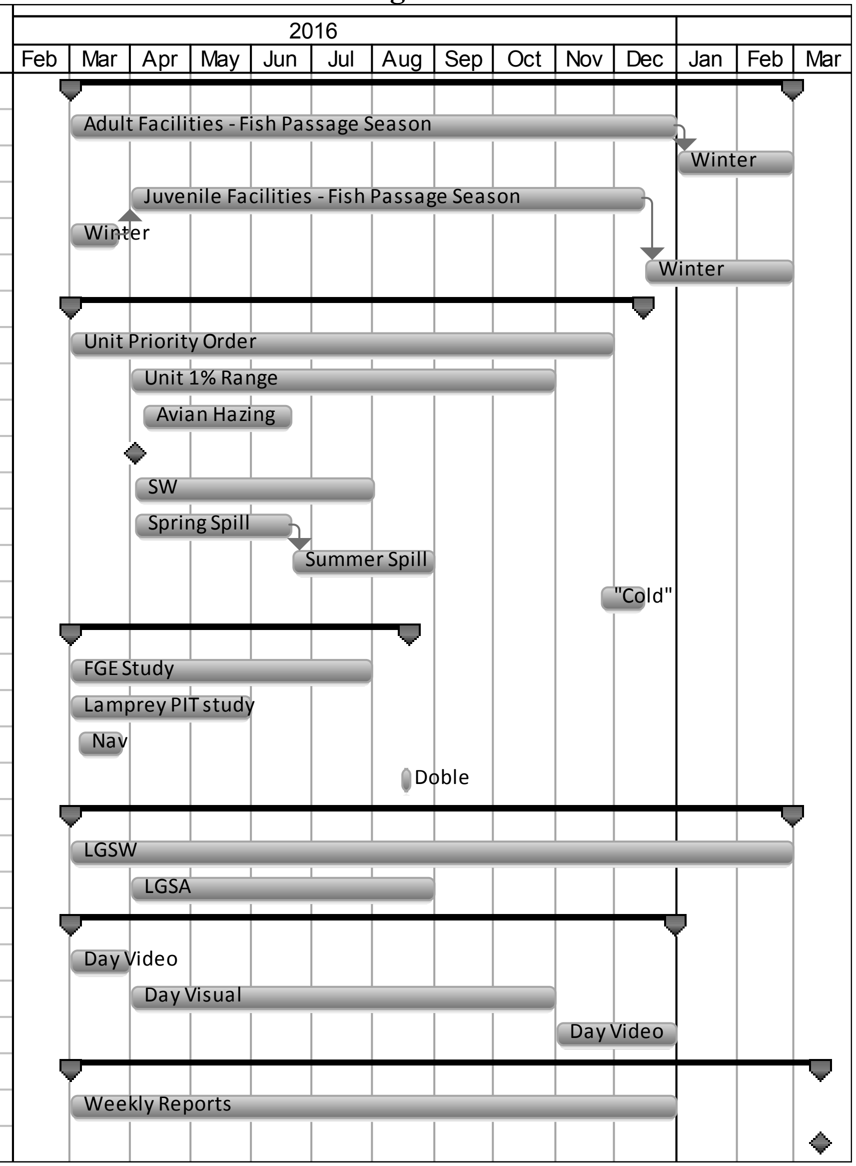


Figure LGS-1. Little Goose Lock & Dam General Site Plan.

Table LGS-1. Little Goose Dam Schedule of Operations and Actions Defined in the 2016 Fish Passage Plan.

Task Name	Start	End	FPP Section
FISH PASSAGE FACILITIES	**3/1/16**	**2/28/17**	
Fish Passage Season - Adult Facilities	3/1/16	12/31/16	2.4.2
Winter Maintenance - Adult Facilities	1/1/17	2/28/17	2.4.1
Fish Passage Season - Juvenile Facilities	4/1/16	12/15/16	2.3.3
Winter Maintenance - Juvenile Facilities	3/1/16	3/24/16	2.3.2
Winter Maintenance - Juvenile Facilities	12/16/16	2/28/17	2.3.2
PROJECT OPERATIONS FOR FISH PASSAGE	**3/1/16**	**12/15/16**	
Turbine unit priority order	3/1/16	11/30/16	Table LGS-5
Turbine unit 1% operating range	4/1/16	10/31/16	4.2
Avian hazing	4/7/16	6/20/16	Appendix L
Avian Wires installed NLT April 3	4/3/16	4/3/16	Appendix L
Spillway weir in service (end date approx)	4/3/16	8/1/16	2.3.3.6
Spring Spill	4/3/16	6/20/16	Appendix E
Summer Spill	6/21/16	8/31/16	Appendix E
STS removal during cold weather	11/24/16	12/15/16	2.3.3.2
SPECIAL OPS & STUDIES (Appendix A)	**3/1/16**	**8/19/16**	**Appendix A**
FGE Emergency Gate Closure Study	3/1/16	7/31/16	
Adult Lamprey PIT study	3/1/16	5/31/16	
Navigation Lock annual outage	3/5/16	3/26/16	
Doble testing	8/15/16	8/19/16	
TDG MONITORING	**3/1/16**	**2/28/17**	**2.2**
TDG Monitoring - Tailrace (year-round)	3/1/16	2/28/17	station LGSW
TDG Monitoring - Forebay	4/1/16	8/31/16	station LGSA
ADULT FISH COUNTING	**3/1/16**	**12/31/16**	**Table LGS-3**
Day Video 0400-2000 PST (0500-2100 DST)	3/1/16	3/31/16	
Day Visual 0400-2000 PST (0500-2100 DST)	4/1/16	10/31/16	
Day Video 0400-2000 PST	11/1/16	12/31/16	
REPORTS	**3/1/16**	**3/15/17**	**2.5**
Weekly Reports	3/1/16	12/31/16	
Annual Report due	3/15/17	3/15/17	



1. FISH PASSAGE INFORMATION

Little Goose Lock & Dam fish passage facilities and other structures are shown on the general site plan in **Figure LGS-1**. The schedule of Little Goose Dam operations that are described in the Fish Passage Plan (FPP) and Appendices is included in **Table LGS-1**.

1.1. Juvenile Fish Passage.

1.1.1. Juvenile Fish Facilities. The juvenile fish facilities at Little Goose Dam consist of a bypass system and juvenile transportation facilities. The bypass system consists of extended length submersible bar screens (ESBS) with flow vanes, vertical barrier screens (VBS), 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.

1.1.1.1. Maintenance of fish facilities that may impact fish or facility operation should be conducted during the winter maintenance period.

1.1.2. Juvenile Fish Migration Timing. Juvenile fish passage timing at Little Goose Dam (**Table LGS-2**) is based on collection data from the most recent 10-year period and does not reflect fish guidance efficiency (FGE) or passage via the spillway weir (SW) or spillway. From 2006–2009, fish collection at Little Goose Dam began later in the season and may have skewed the passage dates in the table. Salmon, steelhead, bull trout, lamprey, and other species are counted when they are observed in the juvenile monitoring facility.

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

Year	10%	50%	90%	# Days	10%	50%	90%	# Days
	Yearling Chinook				**Subyearling Chinook**			
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
2014	2-May	9-May	20-May	18	31-May	14-Jun	15-Jul	45
2015	24-Apr	7-May	12-May	18	30-May	19-Jun	13-Jul	44
10-Yr MEDIAN	**2-May**	**9-May**	**20-May**	**20**	**3-Jun**	**14-Jun**	**12-Jul**	**43**
10-Yr MIN	**23-Apr**	**6-May**	**12-May**	**11**	**24-May**	**7-Jun**	**30-Jun**	**29**
10-Yr MAX	**8-May**	**15-May**	**29-May**	**29**	**7-Jun**	**20-Jun**	**29-Jul**	**57**
	Unclipped Steelhead				**Clipped Steelhead**			
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
2014	2-May	11-May	27-May	25	22-Apr	7-May	26-May	34
2015	26-Apr	13-May	26-May	30	24-Apr	8-May	22-May	28
10-Yr MEDIAN	**2-May**	**20-May**	**29-May**	**30**	**24-Apr**	**10-May**	**24-May**	**30**
10-Yr MIN	**20-Apr**	**4-May**	**21-May**	**15**	**4-Apr**	**30-Apr**	**18-May**	**14**
10-Yr MAX	**11-May**	**22-May**	**8-Jun**	**36**	**10-May**	**20-May**	**7-Jun**	**46**
	Coho				**Sockeye (Wild & Hatchery)**			
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
2014	7-May	18-May	28-May	21	2-May	9-May	25-May	23
2015	7-May	17-May	26-May	19	14-May	18-May	21-May	7
10-Yr MEDIAN	**8-May**	**19-May**	**30-May**	**22**	**13-May**	**19-May**	**30-May**	**20**
10-Yr MIN	**5-May**	**15-May**	**22-May**	**12**	**14-Apr**	**9-May**	**21-May**	**5**
10-Yr MAX	**16-May**	**24-May**	**21-Jun**	**36**	**20-May**	**28-May**	**15-Jun**	**62**

1.2. Adult Fish Passage.

1.2.1. Adult Fish Facilities. 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.

1.2.1.1. Maintenance of adult fish facilities is scheduled for January–February to minimize impacts on upstream migrants.

1.2.2. Adult Fish Migration Timing & Counting. Upstream migrants are present throughout the year and adult fish facilities are operated year-round. Adult salmon, steelhead, shad, and lamprey are counted per the schedule in **Table LGS-3**, and data are posted daily at: www.nwp.usace.army.mil/Missions/Environment/Fishdata.aspx. 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*. Yearly counts are used to determine peak adult migration timing (**Table LGS-4**). Time-of-day (diel) distributions of adult salmonid activity at Little Goose Dam fishway entrances and exits are summarized in **Figure LGS-2**.

Table LGS-3. Adult Fish Counting Schedule at Little Goose Dam (3/1/16 – 2/29/17).

Count Period	Counting Method and Hours *
March 1 – March 30	Video 0400–2000 (PST)
April 1 – October 31	Visual 0400–2000 hours (PST)
November 1 – December 31	Video 0400–2000 (PST)

*All count hours in Pacific Standard Time (PST). NOTE: Daylight Saving Time (DST) is in effect Sunday, March 13 – Sunday, November 6, 2016, and 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 from 1970 through most recent count year).

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

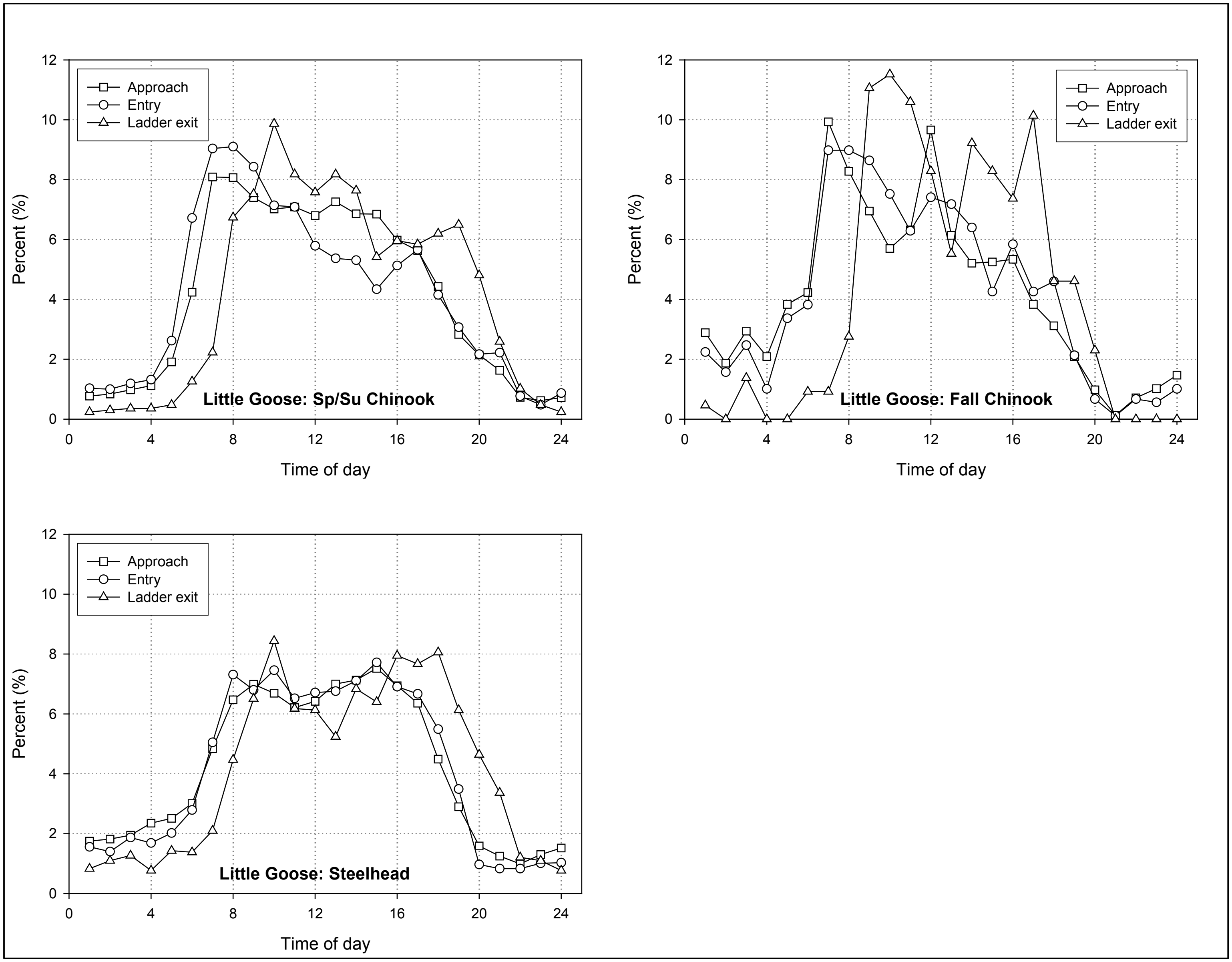


Figure LGS-2. Diel Distribution of Adult Salmonids at Little Goose Dam Fishway Entrances and Exits (*Keefer & Caudill 2008*).
www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/2013_FPOM_MEET/2013_JUN/

2. FISH FACILITIES OPERATIONS

2.1. General.

2.1.1. Research, non-routine maintenance activities and construction will not be conducted within 100' of any fishway entrance or exit, within 50' of any other part of the adult fishway, or directly in, above or adjacent to any fishway, unless coordinated by the Project, Walla Walla District (NWW) Operations and/or Planning or Construction office through FPOM or FFDRWG. Currently coordinated special operations related to research are described in *Special Project Operations & Studies* (**Appendix A**). These distances are approximate and will be updated after data are collected and analyzed to understand where the threshold for adversely impacting adult fish behavior occurs. Alternate actions will be considered by District and Project biologists in conjunction with the Regional fish agencies on a case-by-case basis.

2.1.2. Emergency situations should be dealt with immediately by the Project in coordination with the Project and/or District biologist. If unavailable, the biologists will be informed of steps taken to correct the situation immediately following the incident. All activities within boat restricted zones (BRZ) will be coordinated with the Project at least 2 weeks in advance, unless it is deemed an emergency (see also **FPP Chapter 1 - Overview** for coordination guidance). On a monthly basis, as appropriate, the Project Biologist will provide a summary of any emergency actions undertaken for review by FPOM.

2.2. Spill Management.

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

2.2.2. Spill at Little Goose shall be distributed in accordance with patterns defined in **Table LGS-8** through **LGS-11**. Special spill for juvenile fish passage will be provided as detailed in **Appendices A** and **E**.

2.2.3. Involuntary spill is the result of river flow above powerhouse capacity, insufficient load (lack of load), turbine unit outages (forced or scheduled), or failure of a key component of the juvenile fish passage facility which forces spill to provide juvenile fish passage.

2.2.4. During years when fish passage spill is provided at Little Goose, and Project Biologists or researchers observe 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 from 2000–2300 hours, for up to 50% of river flow during those hours, using a uniform spill pattern to minimize TDG.

2.2.5. Total dissolved gas (TDG) levels at all projects are monitored in accordance with the *TDG Monitoring Plan*, included in the *Water Management Plan* as Appendix 4 (online at: www.nwd-wc.usace.army.mil/tmt/documents/wmp/).

2.3. Operating Criteria – Juvenile Fish Facilities.

2.3.1. Operate from April 1 through October 31, for juvenile fish bypass, collection and transport, and November 1 through December 15 for adult fallbacks. Operate according to criteria defined below and in the *Corps of Engineers Juvenile Fish Transportation Plan* (**Appendix B**) for bypass, collection, and transport of juvenile salmonids. The transportation program may be revised in accordance with ESA Section 10 permit and the NOAA Fisheries Biological Opinion.

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

2.3.2.1. Forebay Area and Intakes.

i. Remove debris from forebay and gatewell slots.

ii. Rake trashracks just prior to the operating season.

iii. Measure drawdown in gatewell slots after cleaning trashracks with ESBSs installed.

iv. Inspect and repair gatewell dip net as needed.

2.3.2.2. ESBS, Flow Vanes, and VBS

i. After ESBSs are removed for winter maintenance, inspect for 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.

ii. Maintenance completed on all screens.

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

iv. Log results of trial run.

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

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

2.3.2.3. Collection Channel.

i. Water-up valve capable of operating when needed.

ii. Orifice lights operational.

iii. Orifices clean and valves operating correctly.

iv. Orifice cycling and air backflush system operational.

2.3.2.4. Transportation Facilities.

i. Flume switch gate maintained and in good operating condition.

ii. Flume interior smooth with no rough edges.

iii. Perforated plate smooth with no rough edges.

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

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

vi. Crowders maintained, tested, and operating correctly.

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

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

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

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

xi. 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.

xii. Mini- and midi-tanks maintained and in good operating condition.

2.3.2.5. Dewatering Structure and Flume.

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

ii. Cleaning brush and air burst systems maintained and operating correctly.

iii. Overflow weirs should be maintained, tested and operating correctly.

iv. All valves operating correctly.

v. Baffle boards under inclined screen in good condition.

vi. Flume interior should be smooth with no rough edges.

2.3.2.6. 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.

2.3.2.7. Maintenance Records. Record all maintenance and inspections.

2.3.3. Juvenile Fish Passage Season (April 1–December 15). Check and perform maintenance as required on the items listed below.

2.3.3.1. Forebay Area and Intakes.

i. Remove debris from forebay. All floating debris will be removed whenever two acres of debris accumulates in spring and one acre in summer or fall.

ii. Inspect gatewell slots daily (preferably early in day shift) for debris, fish buildup, and contaminating substances (particularly oil). Clean gatewells before they become 50% covered with debris. If the volume of debris precludes the ability to keep the gatewell at least 50% clear, they should be cleaned at least once daily. If orifice flow or fish conditions are observed that indicate an orifice may be obstructed with debris, the orifice will be closed and backflushed to remove the obstruction. If the obstruction cannot be removed, the orifice will be closed and the alternate orifice for that gatewell slot 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.

iii. If a visible accumulation of contaminating substances (e.g., oil) is detected in a gatewell and 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, and tie off with a rope for later disposal. Action should be taken as soon as possible to remove oil from the gatewell so the orifice can be reopened to allow fish to exit the gatewell. Orifices shall not be closed for longer than 48 hours.

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

v. Remove debris from forebay and trashracks as necessary to maintain less than 1' of additional drawdown in gate slots (relative to drawdown with a clean screen). Additional raking may be required when heavy debris loads are present in the river or when fish condition indicates an issue.

vi. Coordinate cleaning efforts with personnel operating juvenile collection facilities.

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

2.3.3.2. ESBS, VBS, and Operating Gates.

i. Operate ESBSs with flow vanes attached to screen.

ii. 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.

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

iv. 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.

v. 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.

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

vii. Inspect at least two VBSs in two different turbine units by means of underwater video between spring and summer. 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.

viii. If an ESBS is damaged or fails during juvenile fish passage season, follow procedures defined in **section 3.2.2**. In no case should a turbine unit be operated with a missing or a known non-operating or damaged ESBS, except as noted.

ix. Up to half of the ESBSs may be pulled after October 1 for maintenance as long as unscreened turbine units are not operated.

x. Make a formal determination at the end of the season as to the adequacy of ESBS bar screen panels and debris cleaner brushes, and replace components as necessary.

xi. Measure VBS head differentials at least once per week April 1–June 30 (more frequently if required) and biweekly for the remainder of the operating season. When a head differential of 1.5' is reached, the respective turbine unit should be operated at a reduced loading (≤ 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.

xii. Inspect at least two VBSs in two different turbine units between spring and summer. Both units should have been operated frequently in the spring. If debris accumulation is noted, inspect other VBSs and clean debris as necessary.

xiii. Turbine units are to be operated with raised operating gates when ESBSs are installed (April 1–December 15) to improve fish guidance efficiency (FGE), except as provided in **section 4.3**.

xiv. When extreme cold weather is forecasted to occur for an extended period of time (defined as forecasted temperatures <20°F for ≥24 hours) 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 FPOM of the action. NOAA's National Weather Service forecast for Little Goose Dam is available at: http://forecast.weather.gov/MapClick.php?lat=46.5874&lon=-118.0261

2.3.3.3. Collection Channel.

i. Orifices clean and operating. Operate at least one orifice per gatewell slot (preferably the north orifice). If the project is operating within the Minimum Operating Pool (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.

ii. 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.

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

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

v. Orifice valves are either fully open or closed.

vi. 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.

vii. 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.

viii. Water-up valve capable of operating when needed.

2.3.3.4. Transportation Facilities.

i. Operate wet separator and fish distribution system as designed.

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

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

iv. 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.

v. 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).

2.3.3.5. Dewatering Structure.

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

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

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

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

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

2.3.3.6. Avian Predation Areas (Forebay and Tailrace).

i. Bird wires and other avian deterrent devices should be monitored to ensure good condition, and any broken wires or devices replaced as soon as possible.

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

iii. 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.

2.3.3.7. Spillway Weir (SW).[1]

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

2.3.3.7.b. SW-Lo: When flow increases above 85 kcfs (i.e., during spring freshet), the SW will be changed to low crest elevation 618 msl (SW-Lo; approximate discharge 11 kcfs) and spill distributed in the "SW-Lo" patterns in **Table LGS-8**.

b.1. The change from SW-Hi to SW-Lo 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. The crest change will be further based on the following:

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.

b.2. Crest change will occur within 3 normal work days after RCC issues the teletype. During work to change the SW crest elevation, spill will be distributed in the "Alternate Uniform" patterns in **Table LGS-11** and Bay 2 will be closed to ensure worker safety in adjacent Bay 1.

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

2.3.3.7.c. Close SW: 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 SW will be closed for the remainder of the spill season and spill distributed in "Uniform" patterns with no SW (**Table LGS-10**). The SW will be closed within 3 normal work days after RCC issues the teletype and coordinated through CENWW-OD-T. During work to close the

[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.

SW, spill will be distributed in "Alternate Uniform" patterns (**Table LGS-11**) and Bay 2 will be closed to ensure worker safety in adjacent Bay 1.

c.1. The SW will be closed no earlier than August 1 to enhance subyearling migration even if the 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 SW prior to August 1 will be coordinated through FPOM by CENWW-OD-T.

2.3.3.8. Inspection and Record Keeping.

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

ii. Record all maintenance and inspections.

2.4. Operating Criteria - Adult Fish Facilities.

2.4.1. Winter Maintenance Period (January 1 – end of February). Check and perform maintenance as required on the items listed below.

2.4.1.1. Inspect all staff gauges and water level indicators; repair and/or clean as necessary.

2.4.1.2. 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.

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

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

2.4.1.5. Inspect all spill gates and ensure that they are operable.

2.4.1.6. Fish pumps maintained and ready for operation.

2.4.1.7. Inspect ladder netting and repair prior to fish passage season.

2.4.2. Adult Fish Passage Season (March 1 – December 31).

Note: Lower Monumental pool may be operated within MOP (forebay 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.

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

2.4.2.2. 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.

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

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

i. Operate both downstream gates.

ii. Weir depth: 6' or greater below tailwater.

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

i. Operate both downstream gates.

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

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

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

i. Operate both gates.

ii. Weir depth: 8' or greater below tailwater.

2.4.2.8. Channel Velocity. 1.5' – 4' per second.

i. 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 weekly and annual reports.

ii. 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.

iii. 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.

2.4.2.9. Tunnel Lights. Lights in the tunnel section under the spillway shall be on during fish passage season.

2.4.2.10. Head on Trashracks.

i. Ladder exit maximum head of 0.5'.

ii. Picketed leads maximum head of 0.3'.

iii. Trashrack and picketed leads installed correctly.

2.4.2.11. Staff Gauges and Water Level Indicators. All staff gauges should be readable at all water levels encountered during the fish passage period. Repair or clean as necessary.

2.4.2.12. Facility Inspections.

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

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

iii. 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).

iv. 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.

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

vi. Record all inspections.

2.5. Fish Facility Monitoring & Reporting.

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

2.5.2. Weekly Reports. Project Biologists shall prepare weekly reports March 1–December 31, summarizing project operations for Friday through Thursday and email to CENWW-OD-T by noon the following Monday. Reports shall provide an overview of how the project and fish passage facilities operated during the week and evaluate resulting fish passage conditions, and 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.

2.5.3. 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.

2.5.4. 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. FISH FACILITIES MAINTENANCE

3.1. Dewatering & Fish Handling.

3.1.1. 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 *Dewatering Guidelines and Fish Salvage Plans* (**Appendix F**). 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 **Appendix F**.

3.2. Maintenance - Juvenile Fish Facilities.

3.2.1. Scheduled Maintenance. Scheduled maintenance of juvenile facilities is conducted throughout the 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 (December 16–March 31). During fish passage season, parts of the facilities are maintained on a daily, weekly, or longer interval to keep them in proper operating condition.

3.2.2. Unscheduled Maintenance. Unscheduled maintenance is the correction of any situation that prevents facilities from operating according to criteria or that will impact fish passage or survival.

3.2.2.1. Notification/Reporting. Maintenance of facilities such as ESBSs, which sometimes break down during fish passage season, will be carried out as described below. In these cases, repairs will be made as prescribed and CENWW-OD-T will be notified as soon as possible after it becomes apparent that repairs are required. The Operations Manager has the authority to initiate work prior to notifying CENWW-OD-T if a delay of the work will result in an unsafe situation for people, property, or fish. Unscheduled maintenance that will have a significant impact on fish passage shall be coordinated with NOAA Fisheries and FPOM on a case-by-case basis by CENWW-OD-T. 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.

3.2.2.2. ESBS. 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.

3.2.2.2.a. If an ESBS screen cleaner fails after 1400 hours on a regular workday or any time on a weekend, and taking the unit out of service would result in spilling above TDG state standards, the unit may be operated with the failed screen cleaner up to a maximum of 110 MWs if there is evidence that the ESBS will not plug with debris (e.g., a lack of debris in the gatewell and along the face of the powerhouse). Project personnel will pull and replace the screen the next morning, weekday or weekend inclusive. If the screen cannot be pulled and repaired the next morning, the 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 flows are 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.

3.2.2.3. 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.

3.2.2.4. 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.

3.2.2.5. 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.

3.2.2.6. 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.

3.3. Maintenance - Adult Fish Facilities.

3.3.1. 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.

3.3.2. Unscheduled Maintenance.

3.3.2.1. Notification/Reporting. 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 (**section 3.2.2**). 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.

3.3.2.2. 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.

3.3.2.3. 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.

3.3.2.4. 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.

3.3.2.5. 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 (**section 3.2.2**). 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 Priority Order.

4.1.1. From March 1–November 30, turbine units will be operated in the order of priority defined in **Table LGS-5** in order to enhance adult and juvenile fish passage. If a turbine unit is out of service for maintenance or repair, the next unit in the priority order shall be operated.

4.1.2. Unit priority order may be coordinated differently to allow for fish research, construction, or project maintenance activities.

4.1.3. If more than one 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.

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

Season	Unit Priority
March 1 – November 30 Fish Passage Season	1[a], 2, 3, 4, 5, 6 *Maximize discharge through lowest numbered turbine units*
December 1 – end of February Winter Maintenance Period	Any Order

a. Unit 1 special operation (section 4.2.4): At total project outflow >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, Unit 1 may operate within full 1% range.

4.2. Turbine Unit Operating Range.

4.2.1. As defined in *BPA's Load Shaping Guidelines* (**Appendix C**), turbine units will be operated within ±1% of peak turbine efficiency (1% range) from April 1–October 31, in order to minimize mortality of juvenile fish passing through turbine units. Turbine unit discharge and power output at the lower and upper limits of the 1% range for various heads are defined in **Table 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 *Guidelines*. Operation outside of the 1% range may be necessary to:

i. Meet BPA load requirements. Load will be requested in accordance with BPA's policy, statutory requirements, and *Load Shaping Guidelines* (**Appendix C**);

ii. If turbine unit draft tube is to be dewatered, 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 a minimum of 15 minutes. This is to flush fish out of the scrollcase prior to installing stop logs;

iii. Operate a turbine unit solely to provide station service (speed-no-load); or

iv. Comply with other coordinated fish measures;

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

4.2.3. 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. The minimum generation range of a turbine unit is derived from the FPP 1% range tables and actual unit operations, as defined in the FOP Table 1 (**Appendix E**). During low flow, there may not be enough river flow to meet this generation requirement and required minimum spill. Under these circumstances the minimum generation requirement will take precedence over the minimum spill requirement. Actual attainable minimum generation levels may vary depending on project conditions.

4.2.4. Unit 1 Special Operation. During fish passage season when the spillway weir (SW) is operating in Bay 1 and total project outflow is greater than 38 kcfs, Unit 1will be operated in the upper 25% of the 1% range. Historically, the GDACS program tended to balance flow out of all units in operation. However, 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 to disrupt the eddy that forms along the south shore downstream of the powerhouse when the SW is operating in bay 1 in order to optimize tailrace conditions for both adult passage and juvenile egress. When the SW is removed from service during summer spill, the tailrace eddy is mostly non-existent and all turbine units may be operated within the full 1% range. When total project outflow is less than 38 kcfs, Unit 1 may be operated within the full 1% range as necessary to maintain MOP and spill operations in accordance with the FOP.

4.3. <u>Turbine Unit Maintenance.</u>

4.3.1. Maintenance Schedule.

4.3.1.1. Turbine unit maintenance schedules will be reviewed annually by Project and District Operations biologists for fish impacts.

4.3.1.2. Each turbine unit requires annual maintenance that may take from several days to three weeks, and is normally scheduled during the mid-July to late November time frame. Maintenance of priority units for adult passage is normally conducted in November-December, but can be conducted in mid-August.

4.3.1.3. Priority unit maintenance will be scheduled for winter maintenance period or when there are few fish passing the project, to the extent possible. Impacts to migrating adults should be minimized.

4.3.1.4. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator that may take over a year to accomplish.

4.3.1.5. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the 1% range. This work will be scheduled in compliance with the *BPA Load Shaping Guidelines* (**Appendix C**) to minimize impacts on juvenile fish.

4.3.2. Operational Testing.

4.3.2.1. Pre-Maintenance: Before units go into maintenance status, units may be operationally tested for up to 30 minutes by running at speed-no-load and various loads within the 1% range for pre-maintenance measurements and testing, and to allow all fish to move through the unit.

4.3.2.2. Post-Maintenance: After maintenance or repair, units may be operationally tested while remaining in maintenance or forced outage status by running the unit for up to a cumulative time of 30 minutes (within 1% range) before returning to operational status.

4.3.2.3. Operational testing of a unit under maintenance is in addition to a unit in run status required for power plant reliability. Operational testing may deviate from FPP priority order and may require water that would otherwise be used for spill if the unit running for reliability is at its 1% lower limit (i.e., minimum generation). Water for operational testing will be used from powerhouse allocation when possible, and diverted from spill only to the extent necessary to maintain generation system reliability.

4.3.3. Operating Gates.[2] Turbine units are to be operated with operating gates in the *raised* position to improve fish passage conditions when ESBSs are installed, except as provided below:

4.3.3.1. Operation of units with operating gates in the standard position shall be restricted to July 1–December 15, and shall not occur unless at least four other units are available for service. No more than one unit at a time shall be operated with operating gates in the standard operating position and the unit will be operated on last-on/first-off priority.

4.3.3.2. The Project Biologist will be notified when operating gates are set in the standard operating position, and will monitor the gatewells twice per day to observe fish condition while operating gates are in the standard position.

4.3.3.3. Operating gates are used to dewater units to facilitate annual maintenance. Unit outage periods will be minimized to the actual time required for maintenance by lowering operating gates in one unit to the standard operating position and connecting to hydraulic cylinders on the afternoon of the last regular workday (normally Thursday) prior to the start of the maintenance. The unit may be operated with operating gates in the standard position until 0700 hours the next regular workday (normally Monday) with generation loads restricted to 100 MWs or less.

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

4.3.3.4. After maintenance, the unit can be operated with operating gates in the standard operating position at 100 MWs or less until 0700 hours the first regular workday after maintenance is completed.

4.3.3.5. If unit maintenance or raising of the operating gates is delayed beyond the times stated above, the unit shall be immediately taken out of service until work can be completed.

4.3.4. Unwatering Units. Unwatering turbine units should be accomplished in accordance with Project Dewatering Plans. If the draft tube is to be dewatered, operate the 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 a 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 scrollcase must be dewatered at a later date without the unit being spun beforehand.

4.3.5. Doble Testing. See **Appendix A** for yearly test schedule. Transformer Doble testing is required every three years, or more frequently if there is a known problem with a transformer, and requires the associated turbine units to be out of service for 2–3 workdays. Doble testing is normally scheduled for August or early September in conjunction with other scheduled unit maintenance to minimize impacts on fish passage. To conduct testing, the distribution lines must be disconnected from the transformers and normal generation stopped. One turbine unit will operate at speed-no-load (approximately 5 kcfs) to provide project power and operation of fish passage facilities (station service). Spill may be provided to meet minimum required project discharge during testing. If Doble testing will impact priority units for fish passage, adult passage timing should be considered to minimize impacts to migrating adults. Available units will be operated in accordance with FPP priority order and within the 1% range.

4.3.6. Turbine Unit Outages during High Flows. During high spring flows, turbine unit outages for inspecting fish screens, repairing research equipment (e.g., hydroacoustic or radio-telemetry), and/or other fish items may cause increased spill in order to maintain reservoir levels within operating ranges. This may result in TDG 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.

4.3.6.1. At Little Goose, this special operation shall take place when flow is above 120 kcfs or when increasing spill will result in TDG exceeding standards. The activities covered under these operations will be coordinated with TMT whenever possible.

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

i. By 12:00 Tuesday of the week prior to the outage, Project personnel shall schedule unit outages through the approved outage scheduling procedure and notify CENWW-OD-T and RCC of the intended work.

ii. RCC will coordinate the work activities through TMT, then issue a teletype with instructions to Project and BPA for the scheduled work.

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

iv. During the work, additional spill will not be provided and the reservoir will be allowed to refill until the reservoir is 1' above MOP (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.)

v. After the work, the reservoir shall be drafted back down to MOP by increasing spill to one spillbay stop above passing inflow.

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

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

5. FOREBAY DEBRIS REMOVAL

5.1.1. Debris at projects can impact fish passage conditions by plugging or blocking trashracks, VBSs, gatewell orifices, dewatering screens, separators, or facility piping resulting in fish impingement, injuries and/or descaling. Removing forebay debris 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 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), or by passing 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.

5.1.2. Debris Spill Coordination. 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.

5.1.3. Emergency Debris Spill. 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-6. Little Goose Dam Turbine Units 1, 2, 3 Power (MW) & Flow (cfs) at Upper and Lower Limits of the 1% Peak Efficiency Operating Range. [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**

a. 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, 6 Power (MW) & Flow (cfs) at Upper and Lower Limits of the 1% Peak Efficiency Operating Range. [a, b]

	TURBINE UNITS 4, 5[b], 6							
Project Head (feet)	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**

a. Table based on the 2003 index test of U4 and the 1975 turbine model test.
b. Unit 5 restricted to operate in upper 1% range (approximately 16.2–19.2 kcfs) due to vibration issues below 120 MW (HDC Report 2/22/12). March 2012 SOP issued to start Unit 5 as quickly as possible and bring to base point of ≥ 130 MW to minimize excessive vibration at points below 120 MW and prevent damage to the unit.

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

Outflow [a]	Spill [b]		Turbine Unit Outflow (kcfs) [c]							SW-Lo Spill Patterns - # Gate Stops per Spillbay									
(kcfs)	(kcfs)	(%)	1 [d]	2	3	4	5	6	TOTAL	1 [e]	2	3	4	5	6	7	8	TOTAL	Comments (see footnotes)
37.3	11.2	30.0%	14.8	11.3					26.1	SW-Lo								0	Min. Q at SW-Lo
38.5	11.2	29.1%	16	11.3					27.3	SW-Lo								0	Min. Q w/ U1 in upper 1% [d]
43.2	13.0	30.1%	16	14.2					30.2	SW-Lo							1	1	
49.0	14.7	30.0%	17.2	17.1					34.3	SW-Lo	1						1	2	
49.7	14.7	29.6%	17.5	17.5					35	SW-Lo	1						1	2	Max. Q w/ 2 units + 2 stops = ~30% Spill
53.3	14.7	27.6%	16	11.3	11.3				38.6	SW-Lo	1						1	2	Min. Q w/ 3 units + 2 stops = ~28% Spill
55.4	16.6	30.0%	16	11.4	11.4				38.8	SW-Lo	1						2	3	
61.3	18.4	30.0%	16	13.5	13.4				42.9	SW-Lo	1		1				2	4	
67.1	20.1	30.0%	16	15.5	15.5				47	SW-Lo	1		1		1		2	5	
73.0	21.9	30.0%	17.1	17	17				51.1	SW-Lo	1	1	1		1		2	6	
74.4	21.9	29.4%	17.5	17.5	17.5				52.5	SW-Lo	1	1	1		1		2	6	Max. Q w/ 3 units + 6 stops = ~29% Spill
74.4	21.9	29.4%	16	11.3	11.3	13.9			52.5	SW-Lo	1	1	1		1		2	6	Min. Q w/ 4 units + 6 stops = ~29% Spill
78.9	23.7	30.0%	16	12.7	12.6	13.9			55.2	SW-Lo	1	1	1		1	1	2	7	
84.7	25.4	30.0%	16	14.5	14.4	14.4			59.3	SW-Lo	1	1	1	1	1	1	2	8	Spring flow trigger for SW crest change [e]
91.0	27.3	30.0%	16	15.9	15.9	15.9			63.7	SW-Lo	2	1	1	1	1	1	2	9	
97.4	29.2	30.0%	17.1	17.1	17	17			68.2	SW-Lo	2	1	2	1	1	1	2	10	
100.6	29.2	29.0%	17.5	17.5	17.5	18.9			71.4	SW-Lo	2	1	2	1	1	1	2	10	Max. Q w/ 4 units+10 stops = ~29% Spill
100.6	29.2	29.0%	16	13.9	13.8	13.8	13.9		71.4	SW-Lo	2	1	2	1	1	1	2	10	5 units + 10 stops = ~29% Spill
103.7	31.1	30.0%	16	14.2	14.2	14.1	14.1		72.6	SW-Lo	2	1	2	1	2	1	2	11	
110.0	33.0	30.0%	16	15.3	15.3	15.2	15.2		77	SW-Lo	2	2	2	1	2	1	2	12	
116.4	34.9	30.0%	16.3	16.3	16.3	16.3	16.3		81.5	SW-Lo	2	2	2	2	2	1	2	13	
122.7	36.8	30.0%	17.2	17.2	17.2	17.2	17.1		85.9	SW-Lo	2	2	2	2	2	2	2	14	
129.4	38.8	30.0%	16	15	14.9	14.9	14.9	14.9	90.6	SW-Lo	3	2	2	2	2	2	2	15	
136.0	40.8	30.0%	16	15.9	15.9	15.8	15.8	15.8	95.2	SW-Lo	3	3	2	2	2	2	2	16	
142.7	42.8	30.0%	16.7	16.7	16.7	16.6	16.6	16.6	99.9	SW-Lo	3	3	3	2	2	2	2	17	
149.3	44.8	30.0%	17.5	17.4	17.4	17.4	17.4	17.4	104.5	SW-Lo	3	3	3	3	2	2	2	18	
156.0	46.8	30.0%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	3	3	3	3	3	2	2	19	Max. PH capacity for 30% Spill [c]
158.0	48.8	30.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	3	3	3	3	3	3	2	20	
160.0	50.8	31.8%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	3	3	3	3	3	3	3	21	
162.0	52.8	32.6%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	4	3	3	3	3	3	3	22	

Outflow [a]	Spill [b]		Turbine Unit Outflow (kcfs) [c]							SW-Lo Spill Patterns - # Gate Stops per Spillbay									Comments (see footnotes)
(kcfs)	(kcfs)	(%)	1 [d]	2	3	4	5	6	TOTAL	1 [e]	2	3	4	5	6	7	8	TOTAL	
163.9	54.7	33.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	4	4	3	3	3	3	3	23	
165.9	56.7	34.2%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	4	4	4	3	3	3	3	24	
167.9	58.7	35.0%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	4	4	4	4	3	3	3	25	
169.8	60.6	35.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	4	4	4	4	4	3	3	26	
171.8	62.6	36.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	4	4	4	4	4	4	3	27	
173.8	64.6	37.2%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	4	4	4	4	4	4	4	28	
175.7	66.5	37.8%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	5	4	4	4	4	4	4	29	
177.7	68.5	38.5%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	5	5	4	4	4	4	4	30	
179.7	70.5	39.2%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	5	5	5	4	4	4	4	31	
181.6	72.4	39.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	5	5	5	5	4	4	4	32	
183.6	74.4	40.5%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	5	5	5	5	5	4	4	33	
185.6	76.4	41.2%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	5	5	5	5	5	5	4	34	
187.5	78.3	41.8%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	5	5	5	5	5	5	5	35	
189.5	80.3	42.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	6	5	5	5	5	5	5	36	
191.5	82.3	43.0%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	6	6	5	5	5	5	5	37	
193.4	84.2	43.5%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	6	6	6	5	5	5	5	38	
195.4	86.2	44.1%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	6	6	6	6	5	5	5	39	
197.3	88.1	44.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	6	6	6	6	6	5	5	40	
199.3	90.1	45.2%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	6	6	6	6	6	6	5	41	
201.3	92.1	45.8%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	6	6	6	6	6	6	6	42	
203.2	94.0	46.3%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	7	6	6	6	6	6	6	43	
205.1	95.9	46.8%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	7	7	6	6	6	6	6	44	
207.1	97.9	47.3%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	7	7	7	6	6	6	6	45	
209.0	99.8	47.8%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	7	7	7	7	6	6	6	46	
211.0	101.8	48.2%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	7	7	7	7	7	6	6	47	
212.9	103.7	48.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	7	7	7	7	7	7	6	48	
214.9	105.7	49.2%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	7	7	7	7	7	7	7	49	
216.8	107.6	49.6%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	8	7	7	7	7	7	7	50	
218.8	109.6	50.1%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	8	8	7	7	7	7	7	51	
220.8	111.6	50.5%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	8	8	8	7	7	7	7	52	
222.7	113.5	51.0%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Lo	8	8	8	8	7	7	7	53	

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

a. At Total Outflow >156 kcfs, spill is >30% due to PH at maximum capacity (~109 kcfs).

b. This table defines spill patterns in increments of one gate stop per row. Spill (kcfs) is calculated as a function of the total number of stops plus SW spill at forebay elevation 633.5 ft (in MOP range 633.0–634.0 ft).

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

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), Unit 1 may be operated within full 1% range as necessary (~11.3–17.5 kcfs).

e. SW operating criteria defined in **section 2.3.3.7**. 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.

Outflow [a]	Spill [b]		Turbine Unit Outflow (kcfs) [c]							SW-Hi Spill Patterns - # Gate Stops per Spillbay									
(kcfs)	(kcfs)	(%)	1 [d]	2	3	4	5	6	TOTAL	1 [e]	2	3	4	5	6	7	8	TOTAL	Comments (see footnotes)
23.9	7.2	30.1%	16.7						16.7	SW-Hi								0	Min. Q w/ SW-Hi
26.4	8.9	33.7%	17.5						17.5	SW-Hi							1	1	1 unit + 1 stop = ~34% Spill
31.5	8.9	28.3%	11.3	11.3					22.6	SW-Hi							1	1	2 units at min. 1% + 1 stop = ~28% Spill
35.0	10.7	30.6%	13	11.3					24.3	SW-Hi	1						1	2	Min. Q w/ SW-Hi per FPP [e]
35.6	10.7	30.1%	13.6	11.3					24.9	SW-Hi	1						1	2	
38.0	10.7	28.2%	16	11.3					27.3	SW-Hi	1						1	2	Min. Q w/ U1 in upper 1% [d]
41.9	12.6	30.1%	16	13.3					29.3	SW-Hi	1						2	3	
47.7	14.3	30.0%	17.5	15.9					33.4	SW-Hi	1		1				2	4	
51.1	16.1	31.5%	17.5	17.5					35	SW-Hi	1		1		1		2	5	2 units + 5 stops = ~31% Spill
54.7	16.1	29.4%	16	11.3	11.3				38.6	SW-Hi	1		1		1		2	5	3 units + 5 stops = ~29% Spill
59.6	17.9	30.0%	16	12.9	12.8				41.7	SW-Hi	1	1	1		1		2	6	
65.4	19.6	30.0%	16	14.9	14.9				45.8	SW-Hi	1	1	1		1	1	2	7	
71.3	21.4	30.0%	16.6	16.7	16.6				49.9	SW-Hi	1	1	1	1	1	1	2	8	
73.9	21.4	29.0%	17.5	17.5	17.5				52.5	SW-Hi	1	1	1	1	1	1	2	8	Max. Q w/ 3 units = ~29% Spill
73.9	21.4	29.0%	16	11.3	11.3	13.9			52.5	SW-Hi	1	1	1	1	1	1	2	8	Min. Q w/ 4 units = ~29% Spill
77.6	23.3	30.0%	16	12.2	12.2	13.9			54.3	SW-Hi	2	1	1	1	1	1	2	9	
83.9	25.2	30.0%	16	14.3	14.2	14.2			58.7	SW-Hi	2	1	2	1	1	1	2	10	
85.0	25.2	29.6%	16	14.6	14.6	14.6			59.8	SW-Hi	2	1	2	1	1	1	2	10	Spring flow trigger for SW crest change [e]
90.3	27.1	30.0%	16	15.8	15.7	15.7			63.2	SW-Hi	2	1	2	1	2	1	2	11	
96.6	29.0	30.0%	16.9	16.9	16.9	16.9			67.6	SW-Hi	2	2	2	1	2	1	2	12	
100.4	29.0	28.9%	17.5	17.5	17.5	18.9			71.4	SW-Hi	2	2	2	1	2	1	2	12	Max. Q w/ 4 units+12 stops = ~29% Spill
100.4	29.0	28.9%	16	13.9	13.8	13.8	13.9		71.4	SW-Hi	2	2	2	1	2	1	2	12	5 units + 12 stops = ~29% Spill
102.9	30.9	30.0%	16	14	14	14	14		72	SW-Hi	2	2	2	2	2	1	2	13	
109.3	32.8	30.0%	16	15.2	15.1	15.1	15.1		76.5	SW-Hi	2	2	2	2	2	2	2	14	
115.9	34.8	30.0%	16.3	16.2	16.2	16.2	16.2		81.1	SW-Hi	3	2	2	2	2	2	2	15	
122.6	36.8	30.0%	17.2	17.2	17.2	17.1	17.1		85.8	SW-Hi	3	3	2	2	2	2	2	16	
129.2	38.8	30.0%	16	14.9	14.9	14.9	14.9	14.8	90.4	SW-Hi	3	3	3	2	2	2	2	17	
135.9	40.8	30.0%	16	15.9	15.8	15.8	15.8	15.8	95.1	SW-Hi	3	3	3	3	2	2	2	18	
142.4	42.7	30.0%	16.7	16.6	16.6	16.6	16.6	16.6	99.7	SW-Hi	3	3	3	3	3	2	2	19	
149.1	44.7	30.0%	17.4	17.4	17.4	17.4	17.4	17.4	104.4	SW-Hi	3	3	3	3	3	3	2	20	

Outflow [a]	Spill [b]		Turbine Unit Outflow (kcfs) [c]							SW-Hi Spill Patterns - # Gate Stops per Spillbay									
(kcfs)	(kcfs)	(%)	1 [d]	2	3	4	5	6	TOTAL	1 [e]	2	3	4	5	6	7	8	TOTAL	Comments (see footnotes)
155.9	46.7	30.0%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	3	3	3	3	3	3	3	21	Max. PH capacity for 30% Spill. [c]
157.9	48.7	30.8%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	4	3	3	3	3	3	3	22	
159.9	50.7	31.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	4	4	3	3	3	3	3	23	
161.8	52.6	32.5%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	4	4	4	3	3	3	3	24	
163.8	54.6	33.3%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	4	4	4	4	3	3	3	25	
165.8	56.6	34.1%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	4	4	4	4	4	3	3	26	
167.8	58.6	34.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	4	4	4	4	4	4	3	27	
169.7	60.5	35.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	4	4	4	4	4	4	4	28	
171.7	62.5	36.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	5	4	4	4	4	4	4	29	
173.7	64.5	37.1%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	5	5	4	4	4	4	4	30	
175.6	66.4	37.8%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	5	5	5	4	4	4	4	31	
177.6	68.4	38.5%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	5	5	5	5	4	4	4	32	
179.6	70.4	39.2%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	5	5	5	5	5	4	4	33	
181.5	72.3	39.8%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	5	5	5	5	5	5	4	34	
183.5	74.3	40.5%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	5	5	5	5	5	5	5	35	
185.4	76.2	41.1%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	6	5	5	5	5	5	5	36	
187.4	78.2	41.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	6	6	5	5	5	5	5	37	
189.4	80.2	42.3%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	6	6	6	5	5	5	5	38	
191.3	82.1	42.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	6	6	6	6	5	5	5	39	
193.3	84.1	43.5%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	6	6	6	6	6	5	5	40	
195.2	86.0	44.1%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	6	6	6	6	6	6	5	41	
197.2	88.0	44.6%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	6	6	6	6	6	6	6	42	
199.1	89.9	45.2%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	7	6	6	6	6	6	6	43	
201.1	91.9	45.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	7	7	6	6	6	6	6	44	
203.0	93.8	46.2%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	7	7	7	6	6	6	6	45	
205.0	95.8	46.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	7	7	7	7	6	6	6	46	
206.9	97.7	47.2%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	7	7	7	7	7	6	6	47	
208.9	99.7	47.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	7	7	7	7	7	7	6	48	
210.8	101.6	48.2%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	7	7	7	7	7	7	7	49	
212.8	103.6	48.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	8	7	7	7	7	7	7	50	
214.7	105.5	49.1%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	SW-Hi	8	8	7	7	7	7	7	51	

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

a. At Total Outflow >156 kcfs, spill is >30% due to PH at maximum capacity (~109 kcfs).

b. This table defines spill patterns in increments of one gate stop per row. Spill (kcfs) is calculated as a function of the total number of stops plus SW spill at forebay elevation 633.5 ft (in MOP range 633.0–634.0 ft).

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

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), Unit 1 may be operated within full 1% range as necessary (~11.3–17.5 kcfs).

e. SW operating criteria defined in **section 2.3.3.7**. 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).

Outflow [a]	Spill [b]		Turbine Unit Outflow (kcfs) [c]							No SW Spill Patterns - # Gate Stops per Spillbay									
(kcfs)	(kcfs)	(%)	1 [d]	2	3	4	5	6	TOTAL	1 [e]	2	3	4	5	6	7	8	TOTAL	Comments (see footnotes)
11.3	0	0.0%	11.3						11.3	Close								0	Min. Q w/ Closed and no spill.
13.1	1.8	13.5%	11.3						11.3	Close							1	1	
14.8	3.5	23.8%	11.3						11.3	Close	1						1	2	
18	5.4	30.0%	12.6						12.6	Close	1						2	3	Min. Q w/ no SW and 30% spill.
24	7.2	29.9%	16.8						16.8	Close	1		1				2	4	
26.4	8.9	33.8%	17.5						17.5	Close	1		1		1		2	5	1 unit + 5 stops = ~34% spill
31.5	8.9	28.3%	11.3	11.3					22.6	Close	1		1		1		2	5	2 units + 5 stops = ~28% spill
35.7	10.7	30.0%	13.7	11.3					25	Close	1	1	1		1		2	6	
38	10.7	28.2%	16	11.3					27.3	Close	1	1	1		1		2	6	Min. Q w/ U1 in upper 1% [d]
41.6	12.5	30.0%	16	13.1					29.1	Close	1	1	1		1	1	2	7	
47.4	14.2	30.0%	16.6	16.6					33.2	Close	1	1	1	1	1	1	2	8	
51.1	16.1	31.5%	17.5	17.5					35	Close	2	1	1	1	1	1	2	9	2 units + 9 stops = ~31% spill
54.7	16.1	29.5%	16	11.3	11.3				38.6	Close	2	1	1	1	1	1	2	9	3 units + 9 stops = ~29% spill
60	18	30.0%	16	13	13				42	Close	2	1	2	1	1	1	2	10	
66.4	19.9	30.0%	16	15.3	15.2				46.5	Close	2	1	2	1	2	1	2	11	
72.7	21.8	30.0%	17	17	16.9				50.9	Close	2	2	2	1	2	1	2	12	
74.3	21.8	29.4%	17.5	17.5	17.5				52.5	Close	2	2	2	1	2	1	2	12	Max. Q w/ 3 units = ~29% spill
76.2	23.7	31.1%	16	11.3	11.3	13.9			52.5	Close	2	2	2	2	2	1	2	13	Min. Q w/ 4 units = ~31% spill
79	23.7	30.0%	16	12.7	12.7	13.9			55.3	Close	2	2	2	2	2	1	2	13	
85.4	25.6	30.0%	16	14.6	14.6	14.6			59.8	Close	2	2	2	2	2	2	2	14	
92	27.6	30.0%	16.1	16.1	16.1	16.1			64.4	Close	3	2	2	2	2	2	2	15	
98.7	29.6	30.0%	17.3	17.3	17.3	17.2			69.1	Close	3	3	2	2	2	2	2	16	
105.3	31.6	30.0%	16	14.5	14.4	14.4	14.4		73.7	Close	3	3	3	2	2	2	2	17	
112	33.6	30.0%	16	15.6	15.6	15.6	15.6		78.4	Close	3	3	3	3	2	2	2	18	
118.7	35.6	30.0%	16.7	16.6	16.6	16.6	16.6		83.1	Close	3	3	3	3	3	2	2	19	
125.1	37.6	30.1%	17.5	17.5	17.5	17.5	17.5		87.5	Close	3	3	3	3	3	3	2	20	
132	39.6	30.0%	16	15.3	15.3	15.3	15.3	15.2	92.4	Close	3	3	3	3	3	3	3	21	
138.6	41.6	30.0%	16.2	16.2	16.2	16.2	16.1	16.1	97	Close	4	3	3	3	3	3	3	22	
145.1	43.5	30.0%	17	17	16.9	16.9	16.9	16.9	101.6	Close	4	4	3	3	3	3	3	23	

Outflow [a]	Spill [b]		Turbine Unit Outflow (kcfs) [c]							No SW Spill Patterns - # Gate Stops per Spillbay									Comments (see footnotes)
(kcfs)	(kcfs)	(%)	1 [d]	2	3	4	5	6	TOTAL	1 [e]	2	3	4	5	6	7	8	TOTAL	
151.7	45.5	30.0%	17.5	17.5	17.5	17.9	17.9	17.9	106.2	Close	4	4	4	3	3	3	3	24	
156.7	47.5	30.3%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	4	4	4	4	3	3	3	25	Max. PH capacity for 30% Spill. [c]
158.6	49.4	31.2%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	4	4	4	4	4	3	3	26	
160.6	51.4	32.0%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	4	4	4	4	4	4	3	27	
162.6	53.4	32.8%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	4	4	4	4	4	4	4	28	
164.5	55.3	33.6%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	5	4	4	4	4	4	4	29	
166.5	57.3	34.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	5	5	4	4	4	4	4	30	
168.5	59.3	35.2%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	5	5	5	4	4	4	4	31	
170.4	61.2	35.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	5	5	5	5	4	4	4	32	
172.4	63.2	36.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	5	5	5	5	5	4	4	33	
174.4	65.2	37.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	5	5	5	5	5	5	4	34	
176.3	67.1	38.1%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	5	5	5	5	5	5	5	35	
178.3	69.1	38.8%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	6	5	5	5	5	5	5	36	
180.3	71.1	39.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	6	6	5	5	5	5	5	37	
182.2	73	40.1%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	6	6	6	5	5	5	5	38	
184.2	75	40.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	6	6	6	6	5	5	5	39	
186.1	76.9	41.3%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	6	6	6	6	6	5	5	40	
188.1	78.9	41.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	6	6	6	6	6	6	5	41	
190.1	80.9	42.5%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	6	6	6	6	6	6	6	42	
192	82.8	43.1%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	7	6	6	6	6	6	6	43	
193.9	84.7	43.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	7	7	6	6	6	6	6	44	
195.9	86.7	44.3%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	7	7	7	6	6	6	6	45	
197.8	88.6	44.8%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	7	7	7	7	6	6	6	46	
199.8	90.6	45.3%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	7	7	7	7	7	6	6	47	
201.7	92.5	45.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	7	7	7	7	7	7	6	48	
203.7	94.5	46.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	7	7	7	7	7	7	7	49	
205.6	96.4	46.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	8	7	7	7	7	7	7	50	
207.6	98.4	47.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	8	8	7	7	7	7	7	51	
209.6	100.4	47.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	8	8	8	7	7	7	7	52	
211.5	102.3	48.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	8	8	8	8	7	7	7	53	

Outflow [a]	Spill [b]		Turbine Unit Outflow (kcfs) [c]							No SW Spill Patterns - # Gate Stops per Spillbay									Comments (see footnotes)
(kcfs)	(kcfs)	(%)	1 [d]	2	3	4	5	6	TOTAL	1 [e]	2	3	4	5	6	7	8	TOTAL	
213.5	104.3	48.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	8	8	8	8	8	7	7	54	
215.5	106.3	49.3%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	8	8	8	8	8	8	7	55	
217.4	108.2	49.8%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	8	8	8	8	8	8	8	56	
219.4	110.2	50.2%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	9	8	8	8	8	8	8	57	
221.3	112.1	50.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	9	9	8	8	8	8	8	58	
223.2	114	51.1%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	9	9	9	8	8	8	8	59	
225.1	115.9	51.5%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	9	9	9	9	8	8	8	60	
227.1	117.9	51.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	9	9	9	9	9	8	8	61	
229	119.8	52.3%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	9	9	9	9	9	9	8	62	
230.9	121.7	52.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	9	9	9	9	9	9	9	63	
232.9	123.7	53.1%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	10	9	9	9	9	9	9	64	
235	125.8	53.5%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	10	10	9	9	9	9	9	65	
237	127.8	53.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	10	10	10	9	9	9	9	66	
239	129.8	54.3%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	10	10	10	10	9	9	9	67	
241	131.8	54.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	10	10	10	10	10	9	9	68	
243	133.8	55.1%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	10	10	10	10	10	10	9	69	
245	135.8	55.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	10	10	10	10	10	10	10	70	

a. At Total Outflow >156 kcfs, spill is >30% due to PH at maximum capacity (~109 kcfs).

b. This table defines spill patterns in increments of one gate stop per row. Spill (kcfs) is calculated as a function of the total number of stops at forebay elevation 633.5 ft (in MOP range 633.0–634.0 ft).

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

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), Unit 1 may be operated within full 1% range as necessary (~11.3–17.5 kcfs).

e. SW operating criteria defined in **section 2.3.3.7**. 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.

Outflow [a]	Spill [b]		Turbine Unit Outflow (kcfs) [c]							SW Change Spill Patterns - # Gate Stops per Spillbay									Comments (see footnotes)
(kcfs)	(kcfs)	(%)	1 [d]	2	3	4	5	6	TOTAL	1 [e]	2 [f]	3	4	5	6	7	8	TOTAL	
11.3	0	0.0%	11.3						11.3	Close	Close							0	Min. Q w/ no SW and no spill.
13.1	1.8	13.5%	11.3						11.3	Close	Close						1	1	
14.8	3.5	23.8%	11.3						11.3	Close	Close	1					1	2	
18	5.4	30.0%	12.6						12.6	Close	Close	1					2	3	Min. Q w/ no SW and 30% spill.
24	7.2	29.9%	16.8						16.8	Close	Close	1		1			2	4	
26.4	8.9	33.8%	17.5						17.5	Close	Close	1		1		1	2	5	1 unit + 5 stops = ~34% spill
31.5	8.9	28.3%	11.3	11.3					22.6	Close	Close	1		1		1	2	5	2 units + 5 stops = ~28% spill
35.7	10.7	30.0%	13.7	11.3					25	Close	Close	1	1	1		1	2	6	
38	10.7	28.2%	16	11.3					27.3	Close	Close	1	1	1		1	2	6	Min. Q w/ U1 in upper 1% [c]
41.6	12.5	30.0%	16	13.1					29.1	Close	Close	1	1	1	1	1	2	7	
47.6	14.4	30.2%	16.6	16.6					33.2	Close	Close	2	1	1	1	1	2	8	
51.3	16.3	31.7%	17.5	17.5					35	Close	Close	2	1	2	1	1	2	9	2 units + 9 stops = ~31% spill
54.9	16.3	29.6%	16	11.3	11.3				38.6	Close	Close	2	1	2	1	1	2	9	3 units + 9 stops = ~29% spill
60.2	18.2	30.2%	16	13	13				42	Close	Close	2	1	2	1	2	2	10	
66.6	20.1	30.1%	16	15.3	15.2				46.5	Close	Close	2	2	2	1	2	2	11	
72.9	22	30.1%	17	17	16.9				50.9	Close	Close	2	2	2	2	2	2	12	
74.5	22	29.5%	17.5	17.5	17.5				52.5	Close	Close	2	2	2	2	2	2	12	Max. Q w/ 3 units = ~29% spill
76.5	24	31.3%	16	11.3	11.3	13.9			52.5	Close	Close	3	2	2	2	2	2	13	Min. Q w/ 4 units = ~31% spill
79.3	24	30.2%	16	12.7	12.7	13.9			55.3	Close	Close	3	2	2	2	2	2	13	
85.8	26	30.3%	16	14.6	14.6	14.6			59.8	Close	Close	3	3	2	2	2	2	14	
92.3	27.9	30.3%	16.1	16.1	16.1	16.1			64.4	Close	Close	3	3	3	2	2	2	15	
99	29.9	30.2%	17.3	17.3	17.3	17.2			69.1	Close	Close	3	3	3	3	2	2	16	
105.6	31.9	30.2%	16	14.5	14.4	14.4	14.4		73.7	Close	Close	3	3	3	3	3	2	17	
112.3	33.9	30.2%	16	15.6	15.6	15.6	15.6		78.4	Close	Close	3	3	3	3	3	3	18	
119	35.9	30.2%	16.7	16.6	16.6	16.6	16.6		83.1	Close	Close	4	3	3	3	3	3	19	
125.4	37.9	30.2%	17.5	17.5	17.5	17.5	17.5		87.5	Close	Close	4	4	3	3	3	3	20	
132.2	39.8	30.1%	16	15.3	15.3	15.3	15.3	15.2	92.4	Close	Close	4	4	4	3	3	3	21	
138.8	41.8	30.1%	16.2	16.2	16.2	16.2	16.1	16.1	97	Close	Close	4	4	4	4	3	3	22	
145.4	43.8	30.1%	17	17	16.9	16.9	16.9	16.9	101.6	Close	Close	4	4	4	4	4	3	23	
152	45.8	30.1%	17.5	17.5	17.5	17.9	17.9	17.9	106.2	Close	Close	4	4	4	4	4	4	24	

Outflow [a]	Spill [b]		Turbine Unit Outflow (kcfs) [c]							SW Change Spill Patterns - # Gate Stops per Spillbay									Comments (see footnotes)
(kcfs)	(kcfs)	(%)	1 [d]	2	3	4	5	6	TOTAL	1 [e]	2 [f]	3	4	5	6	7	8	TOTAL	
156.9	47.7	30.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	5	4	4	4	4	4	25	Max. PH capacity for 30% Spill. [c]
158.9	49.7	31.3%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	5	5	4	4	4	4	26	
160.8	51.6	32.1%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	5	5	5	4	4	4	27	
162.8	53.6	32.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	5	5	5	5	4	4	28	
164.8	55.6	33.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	5	5	5	5	5	4	29	
166.7	57.5	34.5%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	5	5	5	5	5	5	30	
168.7	59.5	35.3%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	6	5	5	5	5	5	31	
170.7	61.5	36.0%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	6	6	5	5	5	5	32	
172.6	63.4	36.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	6	6	6	5	5	5	33	
174.6	65.4	37.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	6	6	6	6	5	5	34	
176.5	67.3	38.1%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	6	6	6	6	6	5	35	
178.5	69.3	38.8%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	6	6	6	6	6	6	36	
180.4	71.2	39.5%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	7	6	6	6	6	6	37	
182.4	73.2	40.1%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	7	7	6	6	6	6	38	
184.3	75.1	40.8%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	7	7	7	6	6	6	39	
186.3	77.1	41.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	7	7	7	7	6	6	40	
188.2	79	42.0%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	7	7	7	7	7	6	41	
190.2	81	42.6%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	7	7	7	7	7	7	42	
192.1	82.9	43.2%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	8	7	7	7	7	7	43	
194.1	84.9	43.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	8	8	7	7	7	7	44	
196.1	86.9	44.3%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	8	8	8	7	7	7	45	
198	88.8	44.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	8	8	8	8	7	7	46	
200	90.8	45.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	8	8	8	8	8	7	47	
202	92.8	45.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	8	8	8	8	8	8	48	
203.9	94.7	46.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	9	8	8	8	8	8	49	
205.8	96.6	46.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	9	9	8	8	8	8	50	
207.8	98.6	47.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	9	9	9	8	8	8	51	
209.7	100.5	47.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	9	9	9	9	8	8	52	
211.6	102.4	48.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	9	9	9	9	9	8	53	
213.5	104.3	48.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	9	9	9	9	9	9	54	
215.6	106.4	49.3%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	10	9	9	9	9	9	55	

Outflow [a]	Spill [b]		Turbine Unit Outflow (kcfs) [c]							SW Change Spill Patterns - # Gate Stops per Spillbay									Comments (see footnotes)
(kcfs)	(kcfs)	(%)	1 [d]	2	3	4	5	6	TOTAL	1 [e]	2 [f]	3	4	5	6	7	8	TOTAL	
217.6	108.4	49.8%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	10	10	9	9	9	9	56	
219.6	110.4	50.3%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	10	10	10	9	9	9	57	
221.6	112.4	50.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	10	10	10	10	9	9	58	
223.6	114.4	51.2%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	10	10	10	10	10	9	59	
225.6	116.4	51.6%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	10	10	10	10	10	10	60	
227.6	118.4	52.0%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	11	10	10	10	10	10	61	
229.6	120.4	52.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	11	11	10	10	10	10	62	
231.7	122.5	52.9%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	11	11	11	10	10	10	63	
233.7	124.5	53.3%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	11	11	11	11	10	10	64	
235.7	126.5	53.7%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	11	11	11	11	11	10	65	
237.7	128.5	54.1%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	11	11	11	11	11	11	66	
239.7	130.5	54.4%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	12	11	11	11	11	11	67	
241.8	132.6	54.8%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	12	12	11	11	11	11	68	
243.8	134.6	55.2%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	12	12	12	11	11	11	69	
245.8	136.6	55.6%	17.5	17.5	17.5	18.9	18.9	18.9	109.2	Close	Close	12	12	12	12	11	11	70	

a. At Total Outflow >156 kcfs, spill is >30% due to PH at maximum capacity (~109 kcfs).

b. This table defines spill patterns in increments of one gate stop per row. Spill (kcfs) is calculated as a function of the total number of stops at forebay elevation 633.5 ft (in MOP range 633.0–634.0 ft).

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

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), Unit 1 may be operated within full 1% range as necessary (~11.3–17.5 kcfs).

e. SW operating criteria defined in **section 2.3.3.7**. 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.