2023 Fish Passage Plan

Chapter 8 – Little Goose Dam

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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’/hour
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 Adjustable Spillway Weir (ASW) 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)
Adjustable Spillway Weir (ASW)	2009 \ 2018 (replaced with Adjustable Spillway Weir)
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, so the official Corps NWD acronym is **LGS**.

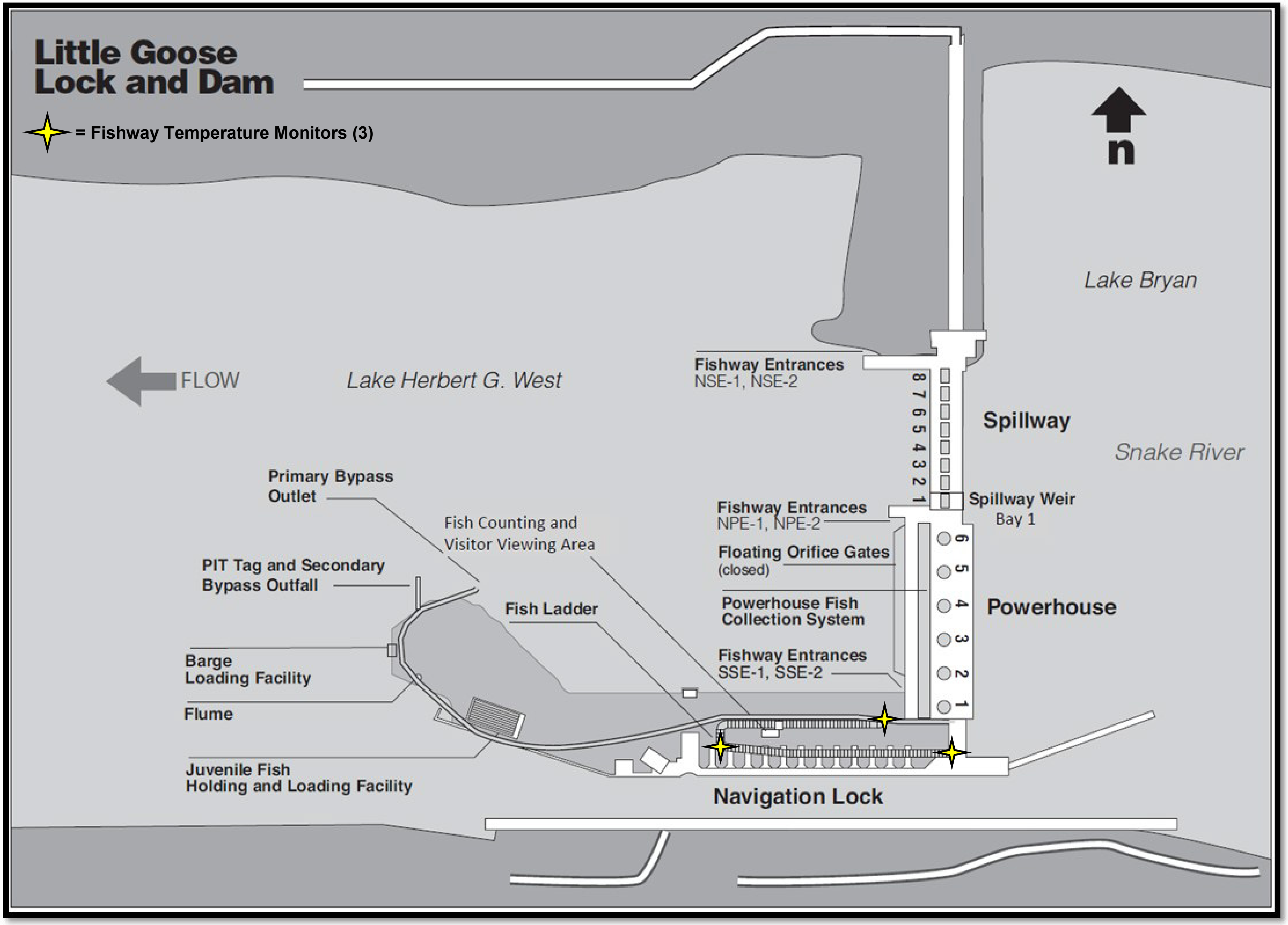
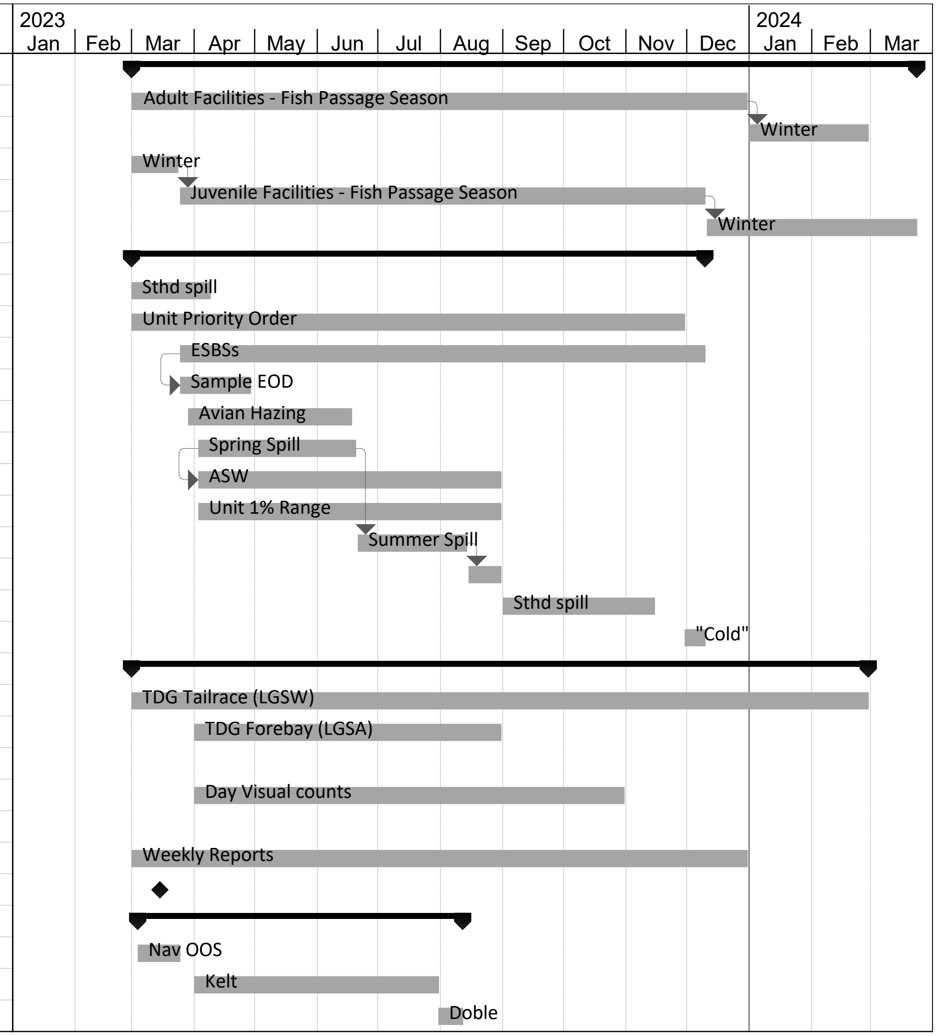


Figure LGS-1. Little Goose Lock & Dam General Site Plan.

Table LGS-1. Little Goose Dam Schedule of Operations and Actions Defined in the 2023 Fish Passage Plan.

Task Name	Start	End
FISH PASSAGE FACILITIES	**Wed 3/1/23**	**Sun 3/24/24**
Adult Facilities - Fish Passage Season	Wed 3/1/23	Sun 12/31/23
Adult Facilities - Winter Maintenance	Mon 1/1/24	Thu 2/29/24
Juvenile Facilities - Winter Maintenance	Wed 3/1/23	Fri 3/24/23
Juvenile Facilities - Fish Passage Season	Sat 3/25/23	Sun 12/10/23
Juvenile Facilities - Winter Maintenance	Mon 12/11/23	Sun 3/24/24
PROJECT OPERATIONS FOR FISH PASSAGE	**Wed 3/1/23**	**Sun 12/10/23**
ASW Spill for Adult Steelhead	Wed 3/1/23	Sun 4/9/23
Turbine unit priority order	Wed 3/1/23	Thu 11/30/23
ESBSs	Sat 3/25/23	Sun 12/10/23
Condition Sample every other day (end date TBD)	Sat 3/25/23	Sat 4/29/23
Avian hazing	Wed 3/29/23	Sun 6/18/23
Spring Spill	Mon 4/3/23	Tue 6/20/23
ASW open (end date approx)	Mon 4/3/23	Thu 8/31/23
Turbine unit 1% operating range	Mon 4/3/23	Thu 8/31/23
Summer Spill	Wed 6/21/23	Mon 8/14/23
Late Summer Spill	Tue 8/15/23	Thu 8/31/23
ASW Spill for Adult Steelhead	Fri 9/1/23	Wed 11/15/23
ESBS removal during cold weather	Thu 11/30/23	Sun 12/10/23
TDG MONITORING	**Wed 3/1/23**	**Thu 2/29/24**
TDG Monitoring - Tailrace (LGSW)	Wed 3/1/23	Thu 2/29/24
TDG Monitoring - Forebay (LGSA)	Sat 4/1/23	Thu 8/31/23
ADULT FISH COUNTING	**Sat 4/1/23**	**Tue 10/31/23**
Day Visual 0500-2100 PDT	Sat 4/1/23	Tue 10/31/23
REPORTS	**Wed 3/1/23**	**Sun 12/31/23**
Weekly Reports	Wed 3/1/23	Sun 12/31/23
Annual Reports due (for previous year)	Wed 3/15/23	Wed 3/15/23
SPECIAL OPS & STUDIES (Appendix A)	**Sat 3/4/23**	**Sat 8/12/23**
Navigation Lock annual outage	Sat 3/4/23	Sat 3/25/23
Kelt Collection & Reconditioning	Sat 4/1/23	Mon 7/31/23
Doble Testing T1 (Units 1-4)	Mon 7/31/23	Sat 8/12/23



1. FISH PASSAGE INFORMATION

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

1.1. Juvenile Fish Facilities and Migration Timing.

1.1.1. Juvenile Fish Facilities. The juvenile fish facilities at Little Goose Dam consist of a bypass system and juvenile transportation facilities. Maintenance of fish facilities that may impact fish or facility operation should be conducted during the winter maintenance period.

i. 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 upper end of the fish ladder, a dewatering structure to drain excess water, two emergency bypass systems, and one corrugated metal flume to transport fish to either transportation facilities or the river.

ii. The transportation facilities include a separator structure, raceways for holding fish, a distribution system for distributing fish among raceways, a sampling and marking building, truck and barge loading facilities, and PIT-tag detection and diversion systems.

1.1.2. Juvenile Fish Migration Timing. Juvenile fish passage timing at Little Goose Dam is shown in **Table LGS-2**, based on collection data from the most recent 10-year period (does not reflect fish guidance efficiency or passage via the spillway weir 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 (wild & hatchery)				Subyearling Chinook (wild & hatchery)			
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
2016	16-Apr	30-Apr	10-May	24	4-Jun	13-Jun	4-Jul	30
2017	16-Apr	28-Apr	15-May	29	30-May	8-Jun	12-Jul	43
2018*	17-Apr	6-May	16-May	29	28-May	3-Jun	6-Jul	39
2019	18-Apr	30-Apr	18-May	30	22-May	7-Jun	13-Jul	52
2020	30-Apr	13-May	22-May	22	1-Jun	17-Jun	31-Jul	60
2021	29-Apr	9-May	19-May	20	8-Jun	29-Jun	8-Aug	61
2022	4-May	14-May	26-May	22	1-Jun	15-Jun	23-Jul	52
10-Yr MEDIAN	**26-Apr**	**8-May**	**17-May**	**22**	**31-May**	**13-Jun**	**14-Jul**	**49**
10-Yr MIN	**16-Apr**	**28-Apr**	**10-May**	**11**	**22-May**	**3-Jun**	**4-Jul**	**30**
10-Yr MAX	**5-May**	**14-May**	**26-May**	**30**	**8-Jun**	**29-Jun**	**8-Aug**	**61**
	Unclipped Steelhead				Clipped Steelhead			
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
2016	16-Apr	2-May	19-May	33	18-Apr	28-Apr	13-May	25
2017	16-Apr	28-Apr	25-May	39	14-Apr	26-Apr	15-May	31
2018*	17-Apr	5-May	22-May	35	9-Apr	29-Apr	14-May	35
2019	14-Apr	26-Apr	17-May	33	12-Apr	24-Apr	10-May	28
2020	26-Apr	6-May	26-May	30	22-Apr	2-May	23-May	31
2021	20-Apr	7-May	23-May	33	16-Apr	3-May	17-May	31
2022	5-May	14-May	4-Jun	30	28-Apr	9-May	25-May	27
10-Yr MEDIAN	**23-Apr**	**9-May**	**24-May**	**32**	**20-Apr**	**2-May**	**17-May**	**30**
10-Yr MIN	**14-Apr**	**26-Apr**	**17-May**	**15**	**9-Apr**	**24-Apr**	**10-May**	**14**
10-Yr MAX	**6-May**	**28-Apr**	**4-Jun**	**39**	**4-May**	**12-May**	**26-May**	**35**
	Coho (wild & hatchery)				Sockeye (wild & hatchery)			
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
2016	30-Apr	9-May	21-May	21	17-May	22-May	28-May	11
2017	5-May	19-May	31-May	26	22-Apr	20-May	30-May	38
2018*	4-May	13-May	28-May	24	21-Apr	20-May	25-May	34
2019	25-Apr	17-May	2-Jun	38	18-May	20-May	24-May	6
2020	5-May	22-May	1-Jun	27	16-May	18-May	22-May	6
2021	4-May	12-May	19-Jun	46	3-May	11-May	25-May	22
2022	8-May	29-May	17-Jun	40	15-May	18-May	5-Jun	21
10-Yr MEDIAN	**5-May**	**17-May**	**29-May**	**25**	**14-May**	**18-May**	**25-May**	**16**
10-Yr MIN	**25-Apr**	**9-May**	**21-May**	**12**	**21-Apr**	**9-May**	**21-May**	**5**
10-Yr MAX	**10-May**	**29-May**	**19-Jun**	**46**	**18-May**	**22-May**	**5-Jun**	**38**

*2018 passage data include the early start of Little Goose sampling on March 1st.

1.2. Adult Fish Facilities and Migration Timing.

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. Maintenance is scheduled for January–February to minimize impacts on upstream migrants.

1.2.2. Adult Fish Migration Timing & Counting.

1.2.2.1. Upstream migrants are present throughout the year and adult facilities are operated year-round. Adult salmon, steelhead, bull trout, shad, and lamprey are counted per the schedule in **Table LGS-3** and data are posted daily at www.fpc.org. The presence of other species (i.e., sturgeon, grass carp, Atlantic salmon, etc.) are recorded as comments and reported in the *Annual Fish Passage Report*.

1.2.2.2. Yearly counts through the most recent passage year are used to determine the earliest and latest dates of peak adult fish passage defined in **Table LGS-4**.

1.2.2.3. . Time-of-day (diel) distributions of adult salmonids at Little Goose Dam fishway entrances and exits are shown in **Figure LGS-2**.

Table LGS-3. Little Goose Dam Adult Fish Counting Schedule March 2023 – Feb 2024.

Count Period	Counting Method and Hours *
April 1 – October 31	Day Visual 0500–2100 hours (PDT)

*PST = Pacific Standard Time; PDT = Pacific Daylight Time, in effect during daylight saving time 3/13/22–11/6/22.

Table LGS-4. Little Goose Dam Adult Fish Count Period and Peak Passage Timing (based on yearly counts from 1970 through the most recent count year).

Species	Count Period	Earliest Peak	Latest Peak
Spring Chinook	Apr 1 – Jun 15	Apr 20	Jun 3
Summer Chinook	Jun 16 – Aug 15	Jun 16	Jul 12
Fall Chinook	Aug 16 – Oct 31	Sep 2	Sep 30
Steelhead	Apr 1 – Oct 31	Sep 6	Oct 14
Sockeye	Jun 15 – Oct 31	Jun 24	Aug 3
Lamprey	Apr 1 – Oct 31	Jul 5	Aug 20

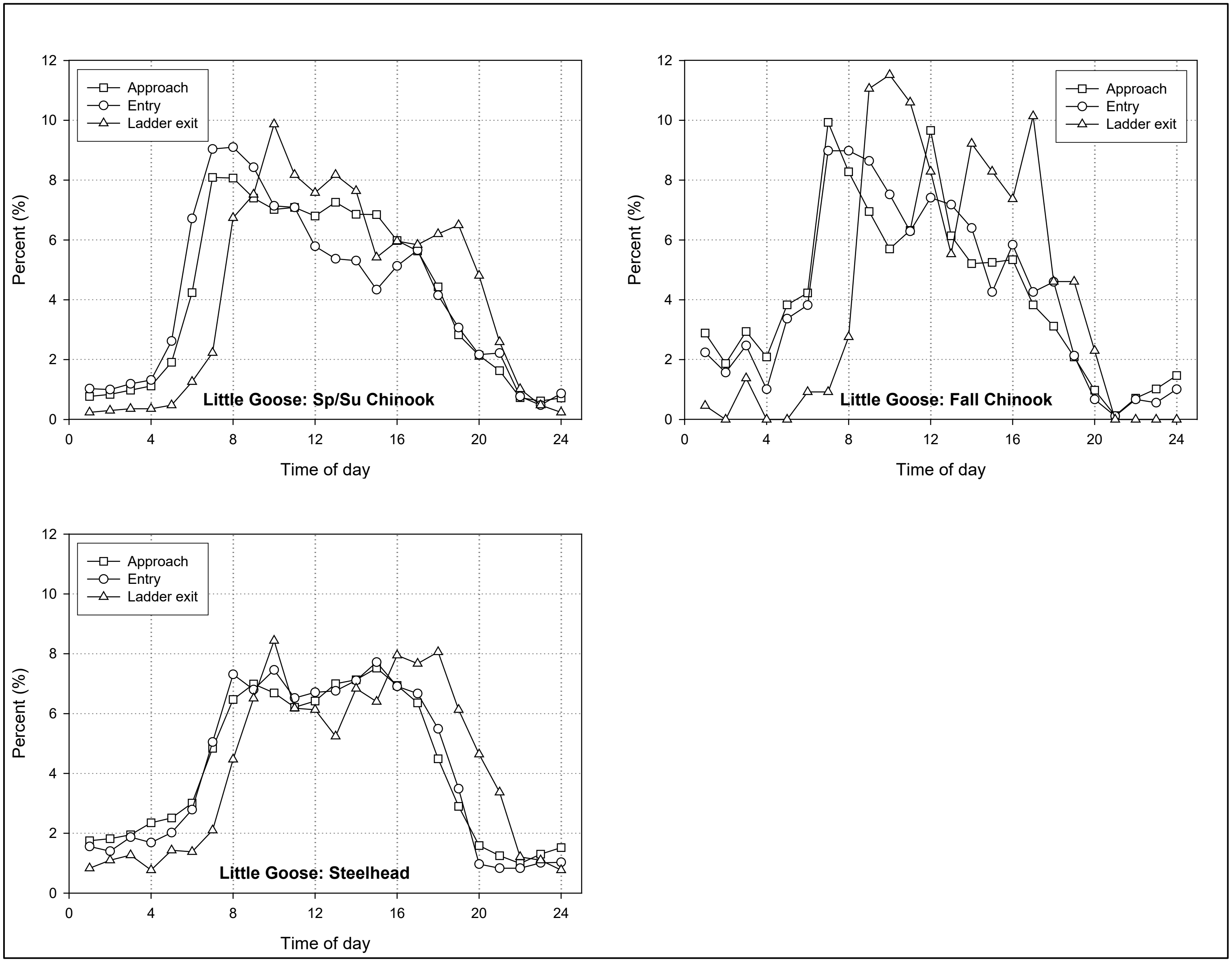


Figure LGS-2. Diel Distribution of Adult Salmonids at Little Goose Dam Fishway Entrances and Exits (*Keefer & Caudill 2008*). Report and summary letter available online at: pweb.crohms.org/tmt/documents/FPOM/2010/2013_FPOM_MEET/2013_JUN/

2. FISH FACILITIES OPERATIONS

2.1. General.

2.1.1. Yearly special operations related to research are described as currently coordinated in **Appendix A - Special Project Operations & Studies**.

2.1.2. 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 with FPOM or FFDRWG by the Project, District Operations and/or Planning or Construction office. These distances are approximate and will be updated after data are collected and analyzed to determine the threshold for adverse impacts to adult fish behavior. Alternate actions will be considered by District and Project biologists in conjunction with the regional fish agencies on a case-by-case basis.

2.1.3. 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 immediately following the incident of steps taken to correct the situation. On a monthly basis, as necessary, the project biologist will provide FPOM a summary of any emergency actions undertaken.

2.1.4. All activities within boat restricted zones (BRZ) will be coordinated with the Project at least two weeks in advance unless deemed an emergency, per coordination guidance in **FPP Chapter 1 - Overview**.

2.2. Spill Management.

2.2.1. Spring and summer spill operations for juvenile fish passage are defined in the *Fish Operations Plan* (FOP), included in the Fish Passage Plan as **Appendix E**. Spill at Little Goose will be distributed in spill patterns defined in **Table LGS-8** through **LGS-10**.

2.2.2. Spill for Adult Steelhead Overshoots. Surface spill will be implemented at McNary and the four lower Snake River dams as a means of providing non-powerhouse downstream passage for adult steelhead that overshoot natal tributaries prior to spawning or that strive to repeat a subsequent reproduction cycle (iteroparity). This operation is pursuant to non-discretionary terms and conditions in the 2020 NOAA Fisheries Columbia River System (CRS) Biological Opinion[1], which calls for surface spill via the spillway weir at each of the five projects **March 1–30 and October 1–November 15, three times each week on non-consecutive days for four hours in the morning** (generally between 05:00 and 11:00). This operation is also considered in the 2020 USFWS CRS Biological Opinion[2] as a means of providing safe and effective downstream passage for adult steelhead and other fish.

[1] NOAA CRS BiOp, section 2.17.4.G, "*Reduce Take of Overshoot Adult Steelhead*": https://www.fisheries.noaa.gov/webdam/download/109136871
[2] USFWS CRS BiOp, section 5.7.4, "*Off-season Surface Spill for Downstream Passage of Adult Steelhead*": https://ecos.fws.gov/tails/pub/document/17101031

i. At Little Goose Dam, off-season surface spill will occur with the spillway weir in "high crest" (approximately 7 kcfs spill).

ii. In 2023, spring surface spill will continue through the start of spring spill for juvenile fish on April 10, and fall surface spill will begin on September 1, to comply with the Agreement for short-term operations of the Columbia River System.[3] As such, in 2023, surface spill for adult steelhead will occur at the four Lower Snake River dams **March 1–April 2 and September 1–November 15, three times each week on non-consecutive days for four hours in the morning**.

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. Total dissolved gas (TDG) is monitored at Little Goose Dam during the periods defined in **Table LGS-1**, pursuant to the Corps' annual *TDG Management Plan* and current *Dissolved Gas Monitoring Plan of Action*.[4]

2.2.5. 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.

2.3. Operating Criteria – Juvenile Fish Facilities.

2.3.1. Juvenile Facilities - Winter Maintenance Period (3rd week of December–March 24).

2.3.1.1. 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.

2.3.1.2. ESBS, Flow Vanes, and VBS.

i. Removal of ESBSs may begin Monday of the third week of December. Within a week after ESBSs are removed for winter maintenance (or as soon as practical), inspect for juvenile salmonid mortalities and all other incidental fish mortalities.

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[3] Stay Agreement: pweb.crohms.org/tmt/JointMotion_TermSheet_CourtOrder_and_Extensions_2023_0831.pdf

[4] TDG Management Plan (Appendix 4 of the WMP): pweb.crohms.org/tmt/documents/wmp/
TDG Monitoring Plan of Action: www.nwd.usace.army.mil/Missions/Water/Columbia/Water-Quality

Count all mortalities (or best estimate) for each ESBS and report to CENWW-OD-T.

ii. Complete maintenance on all screens.

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

iv. Inspect VBSs with underwater video camera at least once/year. Repair as needed.

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

2.3.1.3. Collection Channel.

i. Maintain water-up valve capable of operating when needed.

ii. Maintain orifice lights operational.

iii. Maintain orifices clean and valves operating correctly.

iv. Maintain orifice cycling and air backflush system operating correctly.

2.3.1.4. Transportation Facilities.

i. Maintain flume switch gate in good operating condition.

ii. Maintain flume interior smooth with no rough edges.

iii. Maintain perforated plate smooth with no rough edges.

iv. Maintain wet separator and fish distribution system ready for operation.

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

vi. Maintain and test crowders to ensure operating correctly.

vii. Maintain all valves, slide gates, and switch gates in good operating condition.

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

ix. Maintain barge and truck loading pipes free of debris, cracks, or blockages. Test and maintain barge loading boom.

x. Maintain all sampling equipment 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. Maintain mini- and midi-tanks in good operating condition.

2.3.1.5. Dewatering Structure and Flume.

i. Clean and maintain inclined screen in good condition with no gaps between screen panels or damaged panels.

ii. Maintain cleaning brush and air burst systems operating correctly.

iii. Maintain and test overflow weirs to ensure operating correctly.

iv. Maintain all valves operating correctly.

v. Maintain baffle boards under inclined screen in good condition.

vi. Maintain flume interior smooth with no rough edges.

2.3.1.6. Record all maintenance and inspections.

2.3.1.7. 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. For information on avian management at Little Goose Dam, see the *Predation Monitoring and Deterrence Action Plans* in **Appendix L** (Table 2 and section 9).

2.3.2. <u>Juvenile Facilities – Fish Passage Season (March 25 – 3rd week of December).</u>

Operate according to criteria below March 25–October 31 for juvenile bypass, collection, and transport, and November 1 until Monday of the 3rd week of December for adult fallbacks. Also operate according to criteria in the *Corps of Engineers Juvenile Fish Transportation Plan* in **Appendix B**. The transportation program may be revised in accordance with the ESA Section 10 permit and NOAA Fisheries Biological Opinion.

2.3.2.1. Inspect fish facilities at least once every 8 hours. Inspect all facilities according to the fish facilities monitoring program. Record all maintenance and inspections and include in reports as described in **section 2.5**.

2.3.2.2. 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, clean at least once daily. If orifice flow or fish conditions are observed that indicate an orifice may be obstructed with debris, close and backflush the orifice to remove the obstruction. If the obstruction cannot be removed, close the orifice and operate the alternate orifice for that gatewell slot. If both orifices become obstructed or plugged with debris, do not operate the turbine unit 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 that cannot be removed within 24 hours, immediately close the gatewell orifices and shut down the turbine unit within one hour until the material has been removed and all 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. Take action as soon as possible to remove oil from the gatewell so the orifice can be reopened to allow fish to exit the gatewell. Do not close orifices for longer than 48 hours.

iv. Log drawdown differentials in bulkhead slots at least once per week through June 30 and once every two weeks (biweekly) for the remainder of the operating season.

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 staff operating juvenile collection facilities.

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

2.3.2.3. ESBSs and VBSs.

i. Install ESBSs in all operating turbine units by March 24.

ii. Operate ESBSs with flow vanes attached to screen.

iii. 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.

iv. Monitor ESBS operating status regularly throughout work shifts via the ESBS operating computer display located in the control room. ESBS cleaning brushes are monitored real-time via PLC in the control room each time a brush cycles.

v. 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. Little Goose staff check cleaning brush trouble lights during orifice inspections multiple times during a 24-hour shift.

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

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

viii. Log VBS head differentials at least once per week through June 30 (more frequently if required) and once every two weeks (biweekly) for the remainder of the operating season. When a head differential of 1.5' is reached, operate the respective turbine unit 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.

ix. Between spring and summer, use underwater video to inspect at least two VBSs in two different turbine units that were operated frequently in the spring. If debris accumulation is noted, inspect other VBSs and clean debris as necessary.

x. After October 1, up to half of the ESBSs may be pulled for maintenance as long as unscreened turbine units are not operated.

xi. Between Thanksgiving and the Monday of the 3rd week of December, if the National Weather Service forecast for Little Goose Dam[5] is below 20°F for 24 hours or longer, screens may be removed. Prior to removing screens, request special permission from CENWW-OD-T, who will then inform NOAA Fisheries and FPOM.

xii. At the end of the season, make a formal determination on the adequacy of ESBS bar screen panels and debris cleaner brushes. Replace components as necessary.

2.3.2.4. Collection Channel.

i. Ensure orifices are 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, see **section 3.2.2.4**. to determine if the unit must be shut down and if fish must be dipped from the gatewell(s).

ii. Ensure orifice lights are functioning and operating on open orifices 24 hrs/day. Replace all burned out orifice lights within 24 hours of notification. Orifice lights

[5] NWS weather forecast for Little Goose Dam: forecast.weather.gov/MapClick.php?lat=46.5874&lon=-118.0261

and area lights may be turned off the evening before dewatering the channel at the end of season (Monday of the 3rd week of December or later) to encourage fish to exit the channel volitionally. Area lights can be turned on briefly for personnel access if necessary.

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

iv. Orifice valves are either fully open or closed.

v. Backflush orifices at least once per day and more frequently if required. During periods of high fish and debris passage, March 25 through July 31, inspect and backflush orifices three times per 24 hours 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, restrict the respective turbine unit to the lower end of the 1% turbine efficiency range to minimize orifice plugging problems. Little Goose does not currently have an automatic backflush system in operation.

vi. Ensure the water-up valve is capable of operating when needed.

2.3.2.5. Transportation Facilities.

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

ii. Maintain crowder screen brushes 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. Maintain barge and truck loading pipes and related equipment free of debris, cracks, or blockages, and in good condition. Maintain the 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).

2.3.2.6. Dewatering Structure.

i. Ensure the trash sweep and air burst systems are operating correctly. Set the frequency of screen cleaning as necessary to maintain a clean screen.

ii. Hand clean trapezoidal section at least once per day or more as often as required to maintain in clean condition.

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

iv. Ensure there are no gaps between screen panels or damaged panels in the inclined screen and that the screen panels are in place and tightly secured.

v. Turn off lights at the dewatering structure at night, unless needed for personnel access, to encourage fish to move downstream volitionally.

2.3.2.7. Adjustable Spillway Weir (ASW).

2.3.2.7.a. Little Goose has one adjustable spillway weir (ASW) in spillbay 1 that provides a surface route for fish passage. The ASW can be operated from the control room and the crest elevation can be adjusted lower or higher to pass more water or less water, respectively, according to the flow and forebay criteria defined below.

2.3.2.7.b. The ASW spill rate is a function of the crest elevation versus forebay elevation – as the pool elevation over the crest increases, more water is spilled over the ASW. Therefore, to maintain the intended spill rate over the ASW (approximately 7-8 kcfs at high crest and 11-12 kcfs at low crest), the ASW crest elevation will be set relative to the current forebay operating range, as defined below in **Table LGS-5**:

Table LGS-5. ASW Crest Elevation Relative to Forebay Range to Maintain High Crest Spill at ~7-8 kcfs and Low Crest Spill at ~11-12 kcfs.

LGS Forebay Operating Range (ft)	ASW High Crest Elevation (ft) = ~7-8 kcfs spill	ASW Low Crest Elevation (ft) = ~11-12 kcfs spill
MOP (633.0 - 634.5)	622’	618’
0.5’ Raised MOP (633.5 - 635.0)	622.5’	618.5’
1’ Raised MOP (634.0 - 635.5)	623’	619’
1.5’ Raised MOP (634.5 - 636.0)	623.5’	619.5’
2’ Raised MOP (635.0 - 636.5)	624’	620’
2.5’ Raised MOP (635.5 - 637.0)	624.5’	620.5’
3’ Raised MOP (636.0 - 637.5)	625’	621’
3.5’ Raised MOP (636.5 - 638.0)	625.5’	621.5’

2.3.2.7.c. High Crest (ASW-Hi):

i. The ASW high crest spills approximately 7–8 kcfs when operated relative to the forebay operating range (**Table LGS-5**). High crest spill patterns are in **Table LGS-8** and **Table LGS-9** (30% Spill).

ii. *Unless flow conditions defined below are met, ASW spill for fish passage will occur with the ASW at high crest (approximately 7-8 kcfs spill).*

2.3.2.7.d. Low Crest (ASW-Lo):

i. The ASW low crest spills approximately 11–12 kcfs when operated relative to the forebay operating range (**Table LGS-5**). Low crest spill patterns are in **Table LGS-8** and **Table LGS-10** (30%).

ii. Change the ASW to low crest elevation relative to forebay (**Table LGS-5**) to pass more water during high flow (i.e., spring freshet) when the following flow criteria are met: 1) day average total project outflow above 85 kcfs, and 2) NWRFC inflow forecast above 85 kcfs for at least the next 3 days.

iii. When the previous day's average outflow drops below 85 kcfs and is forecasted to stay below 85 kcfs for at least the next three days, change back to high crest elevation relative to the forebay range.

2.3.2.7.e. No ASW (Bay 1 Closed):

i. On or after August 1, when day average project outflow drops below 35 kcfs and is forecasted to stay below 35 kcfs for at least 3 days, close the ASW and spill per patterns in **Table LGS-11** (No ASW).

ii. The ASW will not be closed before August 1 even if the low flow criteria are achieved to avoid impacting subyearling migration unless an adult passage delay is observed or due to unit operational constraints at low flow. Closing the ASW prior to August 1 will be coordinated through FPOM by CENWW-OD-T.

iii. Re-open the ASW in high crest if day average project outflow subsequently increases above 35 kcfs and is forecasted to stay above 35 kcfs for 3 or more days. Continue to open and close the ASW according to these criteria for the remainder of the summer spill season.

2.3.2.8. Avian Predation Management. Operate in accordance with *Predation Monitoring and Deterrence Action Plans* for Little Goose in **Appendix L** (Table 2 and section 9). Monitor bird wires and other avian deterrent devices to ensure good condition and replace any broken wires or devices as soon as possible. Implement harassment program to deter avian predation in areas actively used by birds and not covered by bird wires or other devices. Routinely monitor project areas to determine areas of active avian predation and, if possible, adjust the harassment program to cover these areas or install bird wires or other deterrents to discourage avian predation.

2.4. <u>Operating Criteria - Adult Fish Facilities.</u>

2.4.1. <u>Adult Facilities - Winter Maintenance Period (January 1 – end of February).</u>

2.4.1.1. Inspect all staff gauges and water level indicators. Repair and/or clean as necessary. Calibrate all water level measuring devices as necessary for proper facility operations.

2.4.1.2. Dewater the ladder and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices that could injure fish or impede fish passage. The 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. Annually inspect all diffuser gratings and chambers and the fallout fence by dewatering or by using divers or video inspection techniques. Dewater and physically inspect all diffuser gratings and chambers at least every 3 years. Repair deficiencies.

2.4.1.3. Inspect for and clean debris from the fish ladder exit. Ensure the trashrack and picketed leads are clean and installed correctly.

2.4.1.4. Inspect all spill gates and ensure they are operable.

2.4.1.5. Maintain fish pumps ready for operation.

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

2.4.2. <u>Adult Facilities – Adult Fish Passage Season (March 1 – December 31).</u>

***Note*:** The Lower Monumental forebay may be operated within the Minimum Operating Pool (MOP) 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. Maintain all staff gauges in readable condition at all water levels encountered during the fish passage period. Repair or clean as necessary.

2.4.2.2. Maintain water depth over fishway ladder weirs in the range of 1.0’–1.3’.

2.4.2.3. Maintain head on all fishway entrances in the range of 1’ to 2’.

2.4.2.4. Ensure trashracks and picketed leads are installed correctly. Maximum head on ladder exit is 0.5’. Maximum head on picketed leads is 0.3’.

2.4.2.5. North Shore Entrances (NSE-1&2).

i. Operate both downstream gates.

ii. Top of gate elevation on sill = 529’.

iii. Weir depth ≥ 6’ below tailwater.

2.4.2.6. North Powerhouse Entrances (NPE-1&2).

i. Operate both downstream gates.

ii. Top of gate elevation on sill = 532’.

iii. Weir depth ≥ 7’ below tailwater (tailwater permitting). At tailwater below elevation 539’, entrance weirs should be on sill.

2.4.2.7. South Shore Entrances (SSE-1&2).

i. Operate both gates.

ii. Top of gate elevation on sill = 529'.

iii. Weir depth ≥ 8' below tailwater.

2.4.2.8. No FOGs will be operated.

2.4.2.9. Channel Velocity.

i. Maintain water velocities in the adult collection channel in the range of 1.5–4.0 feet per second (fps). This is the optimum velocity for returning adult salmon and steelhead to migrate upstream through the fishway.

ii. Measure surface water velocities in the open access area near the north powerhouse weir/fish entrance using a piece of woody debris (stick, bark) or water bubble timed over a marked fixed distance. Water velocity measurements at this location typifies the velocity conditions throughout the length of the channel.

iii. Measure subsurface water velocity and report once per month using an underwater flowmeter. Calculate the average velocity using several measurements taken at various depths across the width of the channel that best represents the average subsurface flow. Take measurements at a location in the channel that represents the overall flow characteristic.

iv. Include velocity readings in required fishway inspections and weekly and annual reports.

2.4.2.10. Ensure lights are functioning in the tunnel section under the spillway during fish passage season.

2.4.2.11. The Little Goose counting window slot is fixed at a width of no less than 18". Clean the counting window and backboard as needed to maintain good visibility. Maintain all equipment in good condition.

2.4.2.12. Facility Inspections.

i. Inspect fish fallout fence for debris buildup, holes, etc.

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

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

iv. Check picketed leads during all inspections to ensure they are clean and in the correct position (all the way down and vanes in line with flow).

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

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

vii. Record all inspections.

2.4.2.13. Fishway Temperature Monitoring. From June 1 through September 30, measure water temperature at adult fishway entrances and exits and submit data to the Fish Passage Center (FPC) weekly for posting online.[6] Ensure the location of the monitors meets the following criteria:

i. Within 10 meters of all shore-oriented entrances and exits.

ii. Entrance monitor within 1 meter above the ladder floor and at least 10 meters downstream of ladder diffusers, if possible, to allow for sufficient mixing with surface water.

iii. Exit monitor within 1 meter above the ladder floor and above all diffusers to allow for sufficient mixing with surface water.

iv. If an existing temperature monitoring location is proposed to be used for either the exit or entrance, verify that the site accurately reflects water temperature within 10 meters of the entrance or exit.

2.4.2.14. Adult Ladder Exit Pool Cooling Pump. Operate the forebay exit pool cooling pump that sprays upstream of the fish ladder exit to enhance conditions for adult fish exiting the ladder and to supplement cooler water throughout the ladder. The water supply for the manifold at the exit pool originates from an added forebay pump with intake at elevation 543' in the forebay, which is 90' below minimum operating pool elevation 633'.

i. Begin operation of exit pool cooling pump after June 1 and no later than the day after the Little Goose forebay temperature string[7] at 0.5 meters exceeds 64°F (18°C) at any time.

ii. Continue this operation until September 1 and until the Little Goose forebay temperature string at 0.5 m is below 68°F (20°C) for 3 consecutive days. Restart pumps if the temperature at 0.5 m reaches 68°F (20°C) at any time and follow above criteria on when to discontinue pump operation.

iii. The pump may be turned on or off at the Project Biologist's discretion if adult passage delays are observed either in the forebay or within the ladder, and operation of the pump is believed to influence the adult passage issue.

[6] FPC ladder temperature data: www.fpc.org/smolt/smolt_queries/Q_ladderwatertempgraphv2.php
[7] Corps temperature string data: pweb.crohms.org/ftppub/water_quality/tempstrings/

2.5. Fish Facility Monitoring & Reporting.

2.5.1. Monitoring.

2.5.1.1. Project biologists shall inspect fish passage facilities at the frequencies described above in the juvenile and adult fish facilities operating criteria, **sections 2.3 and 2.4**.

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

2.5.2. Reporting.

2.5.2.1. Weekly Reports. Project Biologists shall prepare weekly reports March 1–December 31 summarizing project and fish facility operations for each week (Friday through Thursday), along with an evaluation of resulting fish passage conditions. The reports will be e-mailed CENWW-OD-T by noon the following Monday. The weekly reports will include:

i. Out-of-criteria situations and corrective actions taken.

i. Equipment malfunctions, breakdowns, or damage along with a summary of resulting repairs.

ii. Adult fishway control calibrations.

iii. ESBS and VBS inspections.

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

2.5.2.2. In-Season. Any adverse or negative impact to fish or fishways shall be reported in a *Memorandum for the Record* (MFR) prepared by Project biologists and sent to FPOM by the next working day, pursuant to the coordination process and template in **FPP Chapter 1 – Overview**.

2.5.2.3. 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 actions.

3. FISH FACILITIES MAINTENANCE

3.1. Dewatering & Fish Handling

3.1.1. Dewatering (also referred to as "unwatering") shall be accomplished pursuant to approved *Dewatering Guidelines and Fish Salvage Plans* in **Appendix F**. Project *Dewatering Plans*[8] were reviewed and revised in 2011 to ensure they comply with **Appendix F**.

[8] Project Dewatering Plans: pweb.crohms.org/tmt/documents/FPOM/2010/

3.1.2. Project biologists should be present to provide guidance at all project activities that may involve fish handling. When river temperatures are ≥ 70°F, all adult fish handling will be coordinated through CENWW-OD-T.

3.2. Maintenance - Juvenile Fish Facilities

3.2.1. Scheduled Maintenance.

3.2.1.1. Scheduled maintenance of juvenile facilities is conducted throughout the year.

3.2.1.2. Long-term maintenance or modifications that require facilities out of service for extended periods are conducted during winter maintenance period, beginning on Monday of the third week of December through March 24.

3.2.1.3. 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.

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

3.2.2.2. Maintenance of facilities such as ESBSs that 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.

3.2.2.3. ESBS.

3.2.2.3.a. 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.

3.2.2.3.b. 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 or unsafe operation of the power plant such as, but not limited to, unstable station service power, 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. FPOM will be notified via MFR, per **FPP Chapter 1 – Overview**.

3.2.2.4. 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 that operates the orifice fails, the orifice should be closed and the alternate orifice and air valve for that gatewell operated until repairs can be made. If both air-valves that operate the orifices in a gatewell fail and the orifice cannot be fully operated, or must be kept closed, the turbine unit will normally be taken out of service until repairs can be made. At the discretion of the Project Biologist, both orifices in a gatewell may be closed for up to 5 hours in an operating turbine unit with ESBSs in place, but orifice closure times may need to be less depending on fish numbers and condition. Turbine unit loading will be reduced to the lower end of the 1% range if deemed necessary by the Project Biologist. If both orifices remain closed after 5 hours, the turbine unit will be taken out of service. During any orifice closure, gatewells shall be monitored hourly (unit is operating) or at least every 2 hours (unit is not operating) by Project personnel for signs of fish problems or mortality. If repairs are anticipated to take longer than 48 hours and both orifices in a gatewell need to remain closed, juvenile fish will be dipped from the gatewell with a gatewell dip basket in accordance with the project dewatering and fish-handling plan. During times of high fish passage or if there is evidence of any difficulty in holding fish in gatewells, fish are to be dipped from the gatewells prior to the 48 hours.

3.2.2.5. 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 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.

3.2.2.6. 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 fish in the bypass system diverted to the river below the project through a 30” pipe while repairs are made.

3.2.2.7. 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. <u>Maintenance - Adult Fish Facilities.</u>

3.3.1. Scheduled Maintenance.

3.3.1.1. Maintenance that will have <u>no effect</u> on fish passage may be conducted at any time.

3.3.1.2. Scheduled maintenance of a facility that must be dewatered, or maintenance that may have a <u>significant effect</u> on fish passage, will be done during the winter maintenance period (January–February).

3.3.1.3. When facilities are not being worked on 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. 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. Hazardous Materials Spill. In the event of a hazardous materials spill, the Project Biologist has the authority to make fishway adjustments outside of operating criteria as necessary to prevent contamination of the ladder until unified command is formed and consultation is established with FPOM. NOAA Fisheries will be notified within 24 hours of a ladder closure.

3.3.2.4. 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:

> **i.** First, increase the speed of the operable pump(s). Then, as necessary, close NSE-2 and NPE-2 and operate NPE-1 to provide the required 1' to 2' head differential.
>
> **ii.** If the desired head differential cannot be maintained at a depth of 5' or greater, raise NSE-1 until a depth of 5' below tailwater is reached.
>
> **iii.** If the head differential cannot be maintained at this point, raise SSE-1 and -2 at 1' increments until 6' below tailwater is reached.
>
> **iv.** If the head differential still cannot be maintained, bulkhead off the transportation channel to the north shore at the end of the powerhouse collection channel. Next, close NPE-1 and bulkhead off the powerhouse collection channel at the junction pool. Then, operate SSE-1 and -2 as deep as possible to maintain the head, but not shallower than 6' regardless of the head.

3.3.2.5. 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 water redistributed to other entrances while repairs are made.

3.3.2.6. 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-6** 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. Unit priority order may be coordinated differently for fish research, construction, or project maintenance activities.

4.1.2. If more than one unit is operating, discharge will be maximized through the southernmost unit (i.e., operated in the upper 1% range) starting with Unit 1 to the extent possible. See **section 4.2.2.2** for more information.

Table LGS-6. Little Goose Dam Turbine Unit Priority Order.

Dates	Unit Priority Order
March 1 – November 30 Fish Passage Season	1[a], 2, 3, 4, 5, 6 *During ASW spill and outflow >38 kcfs, maximize discharge through highest priority unit*
December 1 – end of February Winter Maintenance Period	Any Order

a. **Unit 1 special operation (section 4.2.2.2) – does not apply during hours of spring gas cap spill:** When the ASW is open and total outflow is > 38 kcfs, Unit 1 will be manually operated in the upper 1% range (~16.0–17.5 kcfs) to smooth out the eddy that forms during ASW spill. Assume other units operate approximately uniformly within their full 1% ranges. When other units are discharging < 16.0 kcfs, assume Unit 1 is at the lower end of the upper 1% (~16.0 kcfs). When average unit discharge is > 16.0 kcfs, assume all units are operating uniformly.

4.2. Turbine Unit Operating Range.

4.2.1. Turbine unit flow and power output at the lower and upper limits of the ±1% peak efficiency range, and at the operating limit, are defined in **Table LGS-7**. Turbine units will be operated within these ranges according to *BPA's Load Shaping Guidelines* (**Appendix C**), as summarized below.

4.2.2. In-Season: April 3–August 31 (Spring/Summer Spill for Juvenile Fish Passage).

4.2.2.1. Turbine units will be operated within ±1% of peak turbine efficiency (1% range), except under limited conditions and durations when turbines may be operated above the 1% range for the use of reserves or for TDG management during high flows (see **Appendix C** for more information). All required fish passage spill operations will be met prior to operating turbines above the 1% range. If in-season operation outside the 1% range is necessary, Project personnel shall record the information to provide to BPA on a weekly basis according to the *Guidelines*. Operation outside the 1% range may be necessary to:

i. Meet BPA load requests made pursuant to BPA's policy, statutory requirements, and *Load Shaping Guidelines* (**Appendix C**).

ii. If the draft tube is to be dewatered (**section 4.3.8**), the unit will be operated at full load > 1% (or at speed no load < 1% if not possible to load) for a minimum of 15 minutes prior to installing tail logs to flush fish from the unit.

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

iv. Comply with other coordinated fish measures.

4.2.2.2. Unit 1 Special Operation. *The operation described in this section does **not** apply during spring spill to the gas cap (April 3–June 20). During these hours, if flow is too low to achieve the spill cap target, Unit 1 will be operated in the lower 1% (minimum generation) and the remaining outflow spilled, in accordance with **section 4.2.2.3** below.*

When the ASW is open and total project outflow is greater than 38 kcfs, Unit 1 will be manually operated in the upper 25% of the 1% range to smooth out the eddy that forms during ASW spill (*except during hours of spring gas cap spill, as noted above*). Historically, the GDACS program tended to balance flow out of all units in operation. However, this special operation will at times result in unbalanced discharge where more flow is passing through Unit 1 than other operating units. Physical modeling indicated that a higher flow out of Unit 1 is critical to disrupting the eddy that forms along the south shore downstream of the powerhouse when the ASW is operating to optimize tailrace conditions for both adult passage and juvenile egress. When the ASW is closed, the tailrace eddy is mostly non-existent and all 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 avoid turbine dead-bands and to maintain MOP and spill operations.

4.2.2.3. Minimum Generation. During low flows, all lower Snake River projects may be required to keep one generating unit online to maintain power system reliability. The minimum generation flow range for each unit is defined in FOP Table 1 (**Appendix E**), as derived from the lower limit of the 1% range and actual unit operations. During spring and summer spill for juvenile fish passage, if there is not enough river flow to meet this generation requirement and the FOP spill target, the project will operate the first available priority unit at minimum generation and spill the remainder of outflow. Actual attainable minimum generation values may vary depending on real-time conditions.

4.2.3. Off-Season: September 1–April 2. While not required to do so in the off-season, turbines will normally run within the 1% range since it is the optimum point for maximizing energy output of a given unit of water over time. Operation outside the 1% range is allowed if needed for power generation or other needs.

4.3. Turbine Unit Maintenance.

4.3.1. Turbine unit maintenance schedules will be reviewed annually by Project and Operations Division biologists for fish impacts. If the maintenance requires operating outside of FPP criteria, the work will be coordinated with regional salmon managers via FPOM, per the coordination process in **FPP Chapter 1 – Overview** (section 2.3).

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

4.3.3. 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.

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

4.3.5. 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.

4.3.6. Operational Testing. 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 lower 1% 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.

> **i.** Pre-Maintenance: Units may be operationally tested for up to 30 minutes by running at speed-no-load and various loads within the 1% range for measurements and testing and to allow all fish to move through the unit, per section **4.3.8**.
>
> **ii.** Post-Maintenance: 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.

4.3.7. Operating Gates.[9] Operate turbine units with operating gates in the stored position, as originally designed, to ensure the safety of project personnel and facilities.

4.3.8. Dewatering Units. Dewater units (also referred to as "unwatering") in accordance with project *Dewatering Plans*.[8] 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 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 without tailrace stoplogs in place, make best efforts to not open the wicket gates if the scrollcase must be dewatered at a later date without the unit being spun beforehand.

4.3.9. Turbine Unit Outages during High Flows. During high spring flows, 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 exceeding TDG standards. It is important that this work be conducted when scheduled to ensure that facilities are operating correctly and not injuring 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.

4.3.9.1. 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.

4.3.9.2. 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.

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

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.

vii. 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.

4.3.10. Doble Testing. The yearly outage schedule is defined in **Appendix A**. 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 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.

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 spilling 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-7. Little Goose Dam Turbine Unit Power (MW) and Flow (cfs) at ±1% of Peak Turbine Efficiency (Lower and Upper Limits of 1% Range) and Operating Limits. [a]

Project Head (feet)	LGS Units 1, 2, 3 – with ESBS						LGS Units 1, 2, 3 – No ESBS					
	1% Lower Limit		1% Upper Limit		Operating Limit		1% Lower Limit		1% Upper Limit		Operating Limit	
	MW	cfs	MW	cfs	MW	cfs	MW	cfs	MW	cfs	MW	cfs
85	72.2	11,780	107.1	17,475	127.8	21,500	71.4	11,517	115.9	18,699	135.2	22,515
86	73.3	11,809	109.1	17,569	129.7	21,526	72.1	11,492	118.3	18,846	137.0	22,483
87	74.4	11,832	111.0	17,663	131.0	21,416	72.9	11,467	120.6	18,973	138.2	22,334
88	75.5	11,861	112.6	17,692	132.3	21,316	73.6	11,443	122.8	19,077	139.5	22,224
89	76.6	11,885	114.3	17,749	133.7	21,225	74.4	11,420	124.8	19,152	140.8	22,111
90	77.7	11,913	116.0	17,789	134.8	21,103	75.2	11,400	126.5	19,185	141.8	21,969
91	78.8	11,939	117.8	17,854	135.9	20,970	75.9	11,377	128.2	19,206	142.8	21,830
92	79.8	11,959	119.9	17,960	137.0	20,865	76.7	11,355	129.4	19,169	143.9	21,705
93	80.9	11,983	121.8	18,041	138.2	20,776	77.4	11,333	130.6	19,109	144.8	21,575
94	82.0	12,007	124.0	18,146	139.1	20,658	78.2	11,312	131.6	19,033	145.5	21,415
95	83.2	12,035	126.2	18,267	140.0	20,529	79.0	11,296	132.3	18,924	146.2	21,246
96	84.4	12,073	128.4	18,365	140.8	20,396	79.9	11,288	132.8	18,771	146.8	21,084
97	85.7	12,118	130.6	18,469	141.5	20,259	80.8	11,285	133.3	18,618	147.5	20,922
98	87.0	12,162	133.0	18,592	142.2	20,109	81.7	11,283	133.9	18,496	148.0	20,756
99	87.7	12,126	132.7	18,344	142.8	19,998	82.7	11,295	133.5	18,226	148.5	20,586
100	88.4	12,090	132.3	18,093	143.5	19,885	83.7	11,306	133.4	18,010	149.0	20,416
101	89.1	12,051	131.9	17,846	144.1	19,775	84.7	11,315	133.5	17,822	149.5	20,253
102	89.8	12,016	131.4	17,588	144.7	19,664	85.8	11,329	133.4	17,623	149.9	20,094
103	90.5	11,983	130.9	17,328	145.3	19,549	86.8	11,342	133.5	17,437	150.4	19,936
104	91.1	11,941	130.5	17,105	145.8	19,428	87.8	11,351	133.8	17,299	150.8	19,776
105	91.6	11,891	130.5	16,933	146.3	19,304	88.6	11,344	134.5	17,221	151.2	19,615
	LGS Units 4, 5, 6 – with ESBS						LGS Units 4, 5, 6 – No ESBS					
85	88.1	14,446	113.1	18,533	129.4	21,904	89.5	14,348	121.0	19,385	130.8	21,320
86	89.1	14,428	113.0	18,299	130.8	21,904	90.3	14,288	121.3	19,204	132.4	21,333
87	90.1	14,409	113.0	18,077	132.2	21,905	91.0	14,232	121.7	19,032	134.0	21,343
88	91.0	14,389	113.2	17,903	133.7	21,905	91.7	14,175	122.6	18,939	135.6	21,341
89	92.0	14,375	113.7	17,773	135.2	21,905	92.5	14,126	124.0	18,944	137.3	21,331
90	92.9	14,360	114.5	17,696	136.8	21,904	93.3	14,082	126.0	19,016	139.0	21,323
91	93.9	14,346	115.5	17,639	138.3	21,904	94.1	14,042	127.9	19,085	140.8	21,319
92	94.9	14,338	116.2	17,558	139.7	21,904	95.0	14,004	129.5	19,105	142.4	21,319
93	95.9	14,331	116.9	17,459	141.1	21,904	95.8	13,969	130.8	19,077	144.1	21,324
94	96.9	14,329	117.4	17,355	142.5	21,904	96.6	13,939	131.8	19,015	145.7	21,329
95	98.0	14,334	117.9	17,250	143.8	21,905	97.6	13,920	132.6	18,919	147.2	21,335
96	99.1	14,345	118.3	17,129	145.1	21,906	98.5	13,907	133.1	18,787	148.7	21,340
97	100.2	14,354	118.5	16,974	146.4	21,903	99.5	13,887	133.4	18,630	150.1	21,347
98	101.2	14,349	118.5	16,789	147.8	21,909	100.3	13,848	133.7	18,467	151.7	21,352
99	102.3	14,344	120.1	16,837	149.6	21,896	101.5	13,867	135.4	18,506	153.3	21,295
100	103.3	14,333	121.6	16,872	151.4	21,900	102.6	13,876	137.3	18,563	155.0	21,269
101	104.2	14,318	123.2	16,927	152.5	21,744	103.8	13,884	139.3	18,640	156.7	21,246
102	105.2	14,311	125.0	16,993	153.9	21,686	104.9	13,900	141.2	18,707	158.3	21,225
103	106.3	14,308	126.8	17,079	155.4	21,642	106.2	13,924	143.0	18,754	160.0	21,219
104	107.3	14,311	128.8	17,175	156.8	21,610	107.5	13,957	144.5	18,768	161.6	21,225
105	108.4	14,319	130.8	17,274	158.3	21,586	108.8	13,993	146.0	18,775	163.2	21,240

a. Values from HDC (May 2022). Flow (cfs) calculated based on turbine efficiency, project head, and power output (MW). "Operating Limit" is the maximum safe operating point based on cavitation or generator limit (added Feb 2018).

Table LGS-8. Little Goose Dam Spill Patterns with ASW in High Crest (ASW-Hi), Low Crest (ASW-Lo), and No ASW (Bay 1 Closed).

# GATE STOPS PER SPILLBAY								TOTAL	TOTAL SPILL (kcfs) [a]		
Bay 1 [a]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	STOPS	w/ ASW-Hi	w/ ASW-Lo	w/ No ASW
ASW								0	**7.2**	**11.2**	**0.0**
ASW							1	1	**8.9**	**13.0**	**1.8**
ASW	1						1	2	**10.7**	**14.7**	**3.5**
ASW	1						2	3	**12.6**	**16.6**	**5.4**
ASW	1		1				2	4	**14.3**	**18.4**	**7.2**
ASW	1		1		1		2	5	**16.1**	**20.1**	**8.9**
ASW	1		1		1	1	2	6	**17.9**	**21.9**	**10.7**
ASW	1	1	1		1	1	2	7	**19.6**	**23.7**	**12.5**
ASW	1	1	1	1	1	1	2	8	**21.4**	**25.4**	**14.2**
ASW	2	1	1	1	1	1	2	9	**23.3**	**27.3**	**16.1**
ASW	2	1	1	1	1	2	2	10	**25.2**	**29.2**	**18.0**
ASW	2	2	1	1	1	2	2	11	**27.1**	**31.1**	**19.9**
ASW	2	2	1	2	1	2	2	12	**29.0**	**33.0**	**21.8**
ASW	2	2	1	2	2	2	2	13	**30.9**	**34.9**	**23.7**
ASW	2	2	2	2	2	2	2	14	**32.8**	**36.8**	**25.6**
ASW	2	2	2	2	2	2	3	15	**34.8**	**38.8**	**27.6**
ASW	3	2	2	2	2	2	3	16	**36.8**	**40.8**	**29.6**
ASW	3	2	2	2	2	3	3	17	**38.8**	**42.8**	**31.6**
ASW	3	3	2	2	2	3	3	18	**40.8**	**44.8**	**33.6**
ASW	3	3	2	3	2	3	3	19	**42.7**	**46.8**	**35.6**
ASW	3	3	2	3	3	3	3	20	**44.7**	**48.8**	**37.6**
ASW	3	3	3	3	3	3	3	21	**46.7**	**50.8**	**39.6**
ASW	4	3	3	3	3	3	3	22	**48.7**	**52.8**	**41.6**
ASW	4	4	3	3	3	3	3	23	**50.7**	**54.7**	**43.5**
ASW	4	4	4	3	3	3	3	24	**52.6**	**56.7**	**45.5**
ASW	4	4	4	4	3	3	3	25	**54.6**	**58.7**	**47.5**
ASW	4	4	4	4	4	3	3	26	**56.6**	**60.6**	**49.4**
ASW	4	4	4	4	4	4	3	27	**58.6**	**62.6**	**51.4**
ASW	4	4	4	4	4	4	4	28	**60.5**	**64.6**	**53.4**
ASW	5	4	4	4	4	4	4	29	**62.5**	**66.5**	**55.3**
ASW	5	5	4	4	4	4	4	30	**64.5**	**68.5**	**57.3**
ASW	5	5	5	4	4	4	4	31	**66.4**	**70.5**	**59.3**
ASW	5	5	5	5	4	4	4	32	**68.4**	**72.4**	**61.2**
ASW	5	5	5	5	5	4	4	33	**70.4**	**74.4**	**63.2**
ASW	5	5	5	5	5	5	4	34	**72.3**	**76.4**	**65.2**
ASW	5	5	5	5	5	5	5	35	**74.3**	**78.3**	**67.1**
ASW	6	5	5	5	5	5	5	36	**76.2**	**80.3**	**69.1**
ASW	6	6	5	5	5	5	5	37	**78.2**	**82.3**	**71.1**
ASW	6	6	6	5	5	5	5	38	**80.2**	**84.2**	**73.0**
ASW	6	6	6	6	5	5	5	39	**82.1**	**86.2**	**75.0**

[a] Total Spill (kcfs) is calculated as a function of total # of gate stops in Bays 2–8 + ASW spill at forebay elevation 633.5' (in MOP). ASW spill is a function of crest and forebay elevation (see **section 2.3.2.7**).

# GATE STOPS PER SPILLBAY								TOTAL	TOTAL SPILL (kcfs) [a]		
Bay 1 [a]	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	STOPS	w/ ASW-Hi	w/ ASW-Lo	w/ No ASW
ASW	6	6	6	6	6	5	5	40	**84.1**	**88.1**	**76.9**
ASW	6	6	6	6	6	6	5	41	**86.0**	**90.1**	**78.9**
ASW	6	6	6	6	6	6	6	42	**88.0**	**92.1**	**80.9**
ASW	7	6	6	6	6	6	6	43	**89.9**	**94.0**	**82.8**
ASW	7	7	6	6	6	6	6	44	**91.9**	**95.9**	**84.7**
ASW	7	7	7	6	6	6	6	45	**93.8**	**97.9**	**86.7**
ASW	7	7	7	7	6	6	6	46	**95.8**	**99.8**	**88.6**
ASW	7	7	7	7	7	6	6	47	**97.7**	**101.8**	**90.6**
ASW	7	7	7	7	7	7	6	48	**99.7**	**103.7**	**92.5**
ASW	7	7	7	7	7	7	7	49	**101.6**	**105.7**	**94.5**
ASW	8	7	7	7	7	7	7	50	**103.6**	**107.6**	**96.4**
ASW	8	8	7	7	7	7	7	51	**105.5**	**109.6**	**98.4**
ASW	8	8	8	7	7	7	7	52	**107.5**	**111.6**	**100.4**
ASW	8	8	8	8	7	7	7	53	**109.5**	**113.5**	**102.3**
ASW	8	8	8	8	8	7	7	54	**111.4**	**115.5**	**104.3**
ASW	8	8	8	8	8	8	7	55	**113.4**	**117.5**	**106.3**
ASW	8	8	8	8	8	8	8	56	**115.4**	**119.4**	**108.2**
ASW	9	8	8	8	8	8	8	57	**117.3**	**121.4**	**110.2**
ASW	9	9	8	8	8	8	8	58	**119.2**	**123.3**	**112.1**
ASW	9	9	9	8	8	8	8	59	**121.2**	**125.2**	**114.0**
ASW	9	9	9	9	8	8	8	60	**123.1**	**127.1**	**115.9**
ASW	9	9	9	9	9	8	8	61	**125.0**	**129.1**	**117.9**
ASW	9	9	9	9	9	9	8	62	**127.0**	**131.0**	**119.8**
ASW	9	9	9	9	9	9	9	63	**128.9**	**132.9**	**121.7**
ASW	10	9	9	9	9	9	9	64	**130.9**	**134.9**	**123.7**
ASW	10	10	9	9	9	9	9	65	**132.9**	**137.0**	**125.8**
ASW	10	10	10	9	9	9	9	66	**134.9**	**139.0**	**127.8**
ASW	10	10	10	10	9	9	9	67	**136.9**	**141.0**	**129.8**
ASW	10	10	10	10	10	9	9	68	**138.9**	**143.0**	**131.8**
ASW	10	10	10	10	10	10	9	69	**140.9**	**145.0**	**133.8**
ASW	10	10	10	10	10	10	10	70	**143.0**	**147.0**	**135.8**

Table LGS-9. [*page 1 of 3*] Little Goose Dam Spill Patterns for 30% Spill with ASW in High Crest (ASW-Hi). [a, b, c]

ASW-Hi 30% Spill Patterns (# Gate Stops/Spillbay)								Total Stops	Total Spill	Example Turbine Outflow [b] (kcfs)						TOTAL PH	TOTAL Project	% Spill	Comments (see footnotes)
1 [a]	2	3	4	5	6	7	8	(#)	(kcfs)	1	2	3	4	5	6	(kcfs)	(kcfs)	(%)	
ASW-Hi								0	7.2	16.7						16.7	23.9	30.1%	Min. Q w/ SW-Hi
ASW-Hi							1	1	8.9	17.5						17.5	26.4	33.7%	1 unit + 1 stop = ~34% Spill
ASW-Hi							1	1	8.9	11.3	11.3					22.6	31.5	28.3%	2 units at min. 1% + 1 stop = ~28% Spill
ASW-Hi	1						1	2	10.7	13.0	11.3					24.3	35.0	30.6%	Min. Q w/ SW-Hi per FPP
ASW-Hi	1						1	2	10.7	13.6	11.3					24.9	35.6	30.1%	
ASW-Hi	1						1	2	10.7	16.0	11.3					27.3	38.0	28.2%	Min. Q w/ U1 in upper 1%
ASW-Hi	1						2	3	12.6	16.0	13.3					29.3	41.9	30.1%	
ASW-Hi	1		1				2	4	14.3	17.5	15.9					33.4	47.7	30.0%	
ASW-Hi	1		1		1		2	5	16.1	17.5	17.5					35.0	51.1	31.5%	2 units + 5 stops = ~31% Spill
ASW-Hi	1		1		1		2	5	16.1	16.0	11.3	11.3				38.6	54.7	29.4%	3 units + 5 stops = ~29% Spill
ASW-Hi	1	1	1		1		2	6	17.9	16.0	12.9	12.8				41.7	59.6	30.0%	
ASW-Hi	1	1	1		1	1	2	7	19.6	16.0	14.9	14.9				45.8	65.4	30.0%	
ASW-Hi	1	1	1	1	1	1	2	8	21.4	16.6	16.7	16.6				49.9	71.3	30.0%	
ASW-Hi	1	1	1	1	1	1	2	8	21.4	17.5	17.5	17.5				52.5	73.9	29.0%	Max. Q w/ 3 units = ~29% Spill
ASW-Hi	1	1	1	1	1	1	2	8	21.4	16.0	11.3	11.3	13.9			52.5	73.9	29.0%	Min. Q w/ 4 units = ~29% Spill
ASW-Hi	2	1	1	1	1	1	2	9	23.3	16.0	12.2	12.2	13.9			54.3	77.6	30.0%	
ASW-Hi	2	1	2	1	1	1	2	10	25.2	16.0	14.3	14.2	14.2			58.7	83.9	30.0%	
ASW-Hi	2	1	2	1	1	1	2	10	25.2	16.0	14.6	14.6	14.6			59.8	85.0	29.6%	Spring flow trigger for SW crest change
ASW-Hi	2	1	2	1	2	1	2	11	27.1	16.0	15.8	15.7	15.7			63.2	90.3	30.0%	
ASW-Hi	2	2	2	1	2	1	2	12	29.0	16.9	16.9	16.9	16.9			67.6	96.6	30.0%	
ASW-Hi	2	2	2	1	2	1	2	12	29.0	17.5	17.5	17.5	18.9			71.4	100.4	28.9%	Max. Q w/ 4 units+12 stops = ~29% Spill
ASW-Hi	2	2	2	1	2	1	2	12	29.0	16.0	13.9	13.8	13.8	13.9		71.4	100.4	28.9%	5 units + 12 stops = ~29% Spill
ASW-Hi	2	2	2	2	2	1	2	13	30.9	16.0	14.0	14.0	14.0	14.0		72.0	102.9	30.0%	
ASW-Hi	2	2	2	2	2	2	2	14	32.8	16.0	15.2	15.1	15.1	15.1		76.5	109.3	30.0%	
ASW-Hi	3	2	2	2	2	2	2	15	34.8	16.3	16.2	16.2	16.2	16.2		81.1	115.9	30.0%	
ASW-Hi	3	3	2	2	2	2	2	16	36.8	17.2	17.2	17.2	17.1	17.1		85.8	122.6	30.0%	
ASW-Hi	3	3	3	2	2	2	2	17	38.8	16.0	14.9	14.9	14.9	14.9	14.8	90.4	129.2	30.0%	
ASW-Hi	3	3	3	3	2	2	2	18	40.8	16.0	15.9	15.8	15.8	15.8	15.8	95.1	135.9	30.0%	
ASW-Hi	3	3	3	3	3	2	2	19	42.7	16.7	16.6	16.6	16.6	16.6	16.6	99.7	142.4	30.0%	
ASW-Hi	3	3	3	3	3	3	2	20	44.7	17.4	17.4	17.4	17.4	17.4	17.4	104.4	149.1	30.0%	

ASW-Hi 30% Spill Patterns (# Gate Stops/Spillbay)								Total Stops	Total Spill	Example Turbine Outflow [b] (kcfs)						TOTAL PH	TOTAL Project	% Spill	
1 [a]	2	3	4	5	6	7	8	(#)	(kcfs)	1	2	3	4	5	6	(kcfs)	(kcfs)	(%)	Comments (see footnotes)
ASW-Hi	3	3	3	3	3	3	3	21	46.7	17.5	17.5	17.5	18.9	18.9	18.9	109.2	155.9	30.0%	Max. PH capacity for 30% Spill.
ASW-Hi	4	3	3	3	3	3	3	22	48.7	17.5	17.5	17.5	18.9	18.9	18.9	109.2	157.9	30.8%	
ASW-Hi	4	4	3	3	3	3	3	23	50.7	17.5	17.5	17.5	18.9	18.9	18.9	109.2	159.9	31.7%	
ASW-Hi	4	4	4	3	3	3	3	24	52.6	17.5	17.5	17.5	18.9	18.9	18.9	109.2	161.8	32.5%	
ASW-Hi	4	4	4	4	3	3	3	25	54.6	17.5	17.5	17.5	18.9	18.9	18.9	109.2	163.8	33.3%	
ASW-Hi	4	4	4	4	4	3	3	26	56.6	17.5	17.5	17.5	18.9	18.9	18.9	109.2	165.8	34.1%	
ASW-Hi	4	4	4	4	4	4	3	27	58.6	17.5	17.5	17.5	18.9	18.9	18.9	109.2	167.8	34.9%	
ASW-Hi	4	4	4	4	4	4	4	28	60.5	17.5	17.5	17.5	18.9	18.9	18.9	109.2	169.7	35.7%	
ASW-Hi	5	4	4	4	4	4	4	29	62.5	17.5	17.5	17.5	18.9	18.9	18.9	109.2	171.7	36.4%	
ASW-Hi	5	5	4	4	4	4	4	30	64.5	17.5	17.5	17.5	18.9	18.9	18.9	109.2	173.7	37.1%	
ASW-Hi	5	5	5	4	4	4	4	31	66.4	17.5	17.5	17.5	18.9	18.9	18.9	109.2	175.6	37.8%	
ASW-Hi	5	5	5	5	4	4	4	32	68.4	17.5	17.5	17.5	18.9	18.9	18.9	109.2	177.6	38.5%	
ASW-Hi	5	5	5	5	5	4	4	33	70.4	17.5	17.5	17.5	18.9	18.9	18.9	109.2	179.6	39.2%	
ASW-Hi	5	5	5	5	5	5	4	34	72.3	17.5	17.5	17.5	18.9	18.9	18.9	109.2	181.5	39.8%	
ASW-Hi	5	5	5	5	5	5	5	35	74.3	17.5	17.5	17.5	18.9	18.9	18.9	109.2	183.5	40.5%	
ASW-Hi	6	5	5	5	5	5	5	36	76.2	17.5	17.5	17.5	18.9	18.9	18.9	109.2	185.4	41.1%	
ASW-Hi	6	6	5	5	5	5	5	37	78.2	17.5	17.5	17.5	18.9	18.9	18.9	109.2	187.4	41.7%	
ASW-Hi	6	6	6	5	5	5	5	38	80.2	17.5	17.5	17.5	18.9	18.9	18.9	109.2	189.4	42.3%	
ASW-Hi	6	6	6	6	5	5	5	39	82.1	17.5	17.5	17.5	18.9	18.9	18.9	109.2	191.3	42.9%	
ASW-Hi	6	6	6	6	6	5	5	40	84.1	17.5	17.5	17.5	18.9	18.9	18.9	109.2	193.3	43.5%	
ASW-Hi	6	6	6	6	6	6	5	41	86.0	17.5	17.5	17.5	18.9	18.9	18.9	109.2	195.2	44.1%	
ASW-Hi	6	6	6	6	6	6	6	42	88.0	17.5	17.5	17.5	18.9	18.9	18.9	109.2	197.2	44.6%	
ASW-Hi	7	6	6	6	6	6	6	43	89.9	17.5	17.5	17.5	18.9	18.9	18.9	109.2	199.1	45.2%	
ASW-Hi	7	7	6	6	6	6	6	44	91.9	17.5	17.5	17.5	18.9	18.9	18.9	109.2	201.1	45.7%	
ASW-Hi	7	7	7	6	6	6	6	45	93.8	17.5	17.5	17.5	18.9	18.9	18.9	109.2	203.0	46.2%	
ASW-Hi	7	7	7	7	6	6	6	46	95.8	17.5	17.5	17.5	18.9	18.9	18.9	109.2	205.0	46.7%	
ASW-Hi	7	7	7	7	7	6	6	47	97.7	17.5	17.5	17.5	18.9	18.9	18.9	109.2	206.9	47.2%	
ASW-Hi	7	7	7	7	7	7	6	48	99.7	17.5	17.5	17.5	18.9	18.9	18.9	109.2	208.9	47.7%	
ASW-Hi	7	7	7	7	7	7	7	49	101.6	17.5	17.5	17.5	18.9	18.9	18.9	109.2	210.8	48.2%	
ASW-Hi	8	7	7	7	7	7	7	50	103.6	17.5	17.5	17.5	18.9	18.9	18.9	109.2	212.8	48.7%	
ASW-Hi	8	8	7	7	7	7	7	51	105.5	17.5	17.5	17.5	18.9	18.9	18.9	109.2	214.7	49.1%	
ASW-Hi	8	8	8	7	7	7	7	52	107.5	17.5	17.5	17.5	18.9	18.9	18.9	109.2	216.7	49.6%	

ASW-Hi 30% Spill Patterns (# Gate Stops/Spillbay)								Total Stops	Total Spill	Example Turbine Outflow [b] (kcfs)						TOTAL PH	TOTAL Project	% Spill	
1 [a]	2	3	4	5	6	7	8	(#)	(kcfs)	1	2	3	4	5	6	(kcfs)	(kcfs)	(%)	Comments (see footnotes)
ASW-Hi	8	8	8	8	7	7	7	53	109.5	17.5	17.5	17.5	18.9	18.9	18.9	109.2	218.7	50.1%	
ASW-Hi	8	8	8	8	8	7	7	54	111.4	17.5	17.5	17.5	18.9	18.9	18.9	109.2	220.6	50.5%	
ASW-Hi	8	8	8	8	8	8	7	55	113.4	17.5	17.5	17.5	18.9	18.9	18.9	109.2	222.6	50.9%	
ASW-Hi	8	8	8	8	8	8	8	56	115.4	17.5	17.5	17.5	18.9	18.9	18.9	109.2	224.6	51.4%	
ASW-Hi	9	8	8	8	8	8	8	57	117.3	17.5	17.5	17.5	18.9	18.9	18.9	109.2	226.5	51.8%	
ASW-Hi	9	9	8	8	8	8	8	58	119.2	17.5	17.5	17.5	18.9	18.9	18.9	109.2	228.4	52.2%	
ASW-Hi	9	9	9	8	8	8	8	59	121.2	17.5	17.5	17.5	18.9	18.9	18.9	109.2	230.4	52.6%	
ASW-Hi	9	9	9	9	8	8	8	60	123.1	17.5	17.5	17.5	18.9	18.9	18.9	109.2	232.3	53.0%	
ASW-Hi	9	9	9	9	9	8	8	61	125.0	17.5	17.5	17.5	18.9	18.9	18.9	109.2	234.2	53.4%	
ASW-Hi	9	9	9	9	9	9	8	62	127.0	17.5	17.5	17.5	18.9	18.9	18.9	109.2	236.2	53.8%	
ASW-Hi	9	9	9	9	9	9	9	63	128.9	17.5	17.5	17.5	18.9	18.9	18.9	109.2	238.1	54.1%	
ASW-Hi	10	9	9	9	9	9	9	64	130.9	17.5	17.5	17.5	18.9	18.9	18.9	109.2	240.1	54.5%	
ASW-Hi	10	10	9	9	9	9	9	65	132.9	17.5	17.5	17.5	18.9	18.9	18.9	109.2	242.1	54.9%	
ASW-Hi	10	10	10	9	9	9	9	66	134.9	17.5	17.5	17.5	18.9	18.9	18.9	109.2	244.1	55.3%	
ASW-Hi	10	10	10	10	9	9	9	67	136.9	17.5	17.5	17.5	18.9	18.9	18.9	109.2	246.1	55.6%	
ASW-Hi	10	10	10	10	10	9	9	68	138.9	17.5	17.5	17.5	18.9	18.9	18.9	109.2	248.1	56.0%	
ASW-Hi	10	10	10	10	10	10	9	69	140.9	17.5	17.5	17.5	18.9	18.9	18.9	109.2	250.1	56.3%	
ASW-Hi	10	10	10	10	10	10	10	70	143.0	17.5	17.5	17.5	18.9	18.9	18.9	109.2	252.2	56.7%	

a. Total Spill (kcfs) is calculated as a function of total # of gate stops in Bays 2–8 + ASW spill at forebay elevation 633.5' (in MOP). ASW spill is a function of crest and forebay elevation (see **section 2.3.2.7**).

b. Turbine outflow is shown only to provide an example of how the special Unit 1 operation will look (see **section 4.2.2.2**) and is not a precise requirement. Actual turbine outflow will vary based on project head and turbine unit capabilities. See **Table LGS-7** for the current turbine operating range values.

c. Spill is > 30% when Total Outflow is > 156 kcfs (assuming all turbines available and max powerhouse capacity is approx. 109 kcfs).

Table LGS-10. [*page 1 of 3*] Little Goose Dam Spill Patterns for 30% Spill with ASW in Low Crest (ASW-Lo). [a, b, c]

ASW-Lo 30% Spill Patterns (# Gate Stops/Spillbay)								Total Stops	Total Spill	Example Turbine Outflow [b] (kcfs)						TOTAL PH	TOTAL Project	% Spill	
1 [a]	2	3	4	5	6	7	8	(#)	(kcfs)	1	2	3	4	5	6	(kcfs)	(kcfs)	(%)	Comments (see footnotes)
ASW-Lo								0	11.2	14.8	11.3					26.1	37.3	30.0%	Min. Q at SW-Lo
ASW-Lo								0	11.2	16.0	11.3					27.3	38.5	29.1%	Min. Q w/ U1 in upper 1%
ASW-Lo							1	1	13.0	16.0	14.2					30.2	43.2	30.1%	
ASW-Lo	1						1	2	14.7	17.2	17.1					34.3	49.0	30.0%	
ASW-Lo	1						1	2	14.7	17.5	17.5					35.0	49.7	29.6%	Max. Q w/ 2 units + 2 stops = ~30% Spill
ASW-Lo	1						1	2	14.7	16.0	11.3	11.3				38.6	53.3	27.6%	Min. Q w/ 3 units + 2 stops = ~28% Spill
ASW-Lo	1						2	3	16.6	16.0	11.4	11.4				38.8	55.4	30.0%	
ASW-Lo	1		1				2	4	18.4	16.0	13.5	13.4				42.9	61.3	30.0%	
ASW-Lo	1		1		1		2	5	20.1	16.0	15.5	15.5				47.0	67.1	30.0%	
ASW-Lo	1	1	1		1		2	6	21.9	17.1	17.0	17.0				51.1	73.0	30.0%	
ASW-Lo	1	1	1		1		2	6	21.9	17.5	17.5	17.5				52.5	74.4	29.4%	Max. Q w/ 3 units + 6 stops = ~29% Spill
ASW-Lo	1	1	1		1		2	6	21.9	16.0	11.3	11.3	13.9			52.5	74.4	29.4%	Min. Q w/ 4 units + 6 stops = ~29% Spill
ASW-Lo	1	1	1		1	1	2	7	23.7	16.0	12.7	12.6	13.9			55.2	78.9	30.0%	
ASW-Lo	1	1	1	1	1	1	2	8	25.4	16.0	14.5	14.4	14.4			59.3	84.7	30.0%	Spring flow trigger for SW crest change
ASW-Lo	2	1	1	1	1	1	2	9	27.3	16.0	15.9	15.9	15.9			63.7	91.0	30.0%	
ASW-Lo	2	1	2	1	1	1	2	10	29.2	17.1	17.1	17.0	17.0			68.2	97.4	30.0%	
ASW-Lo	2	1	2	1	1	1	2	10	29.2	17.5	17.5	17.5	18.9			71.4	100.6	29.0%	Max. Q w/ 4 units+10 stops = ~29% Spill
ASW-Lo	2	1	2	1	1	1	2	10	29.2	16.0	13.9	13.8	13.8	13.9		71.4	100.6	29.0%	5 units + 10 stops = ~29% Spill
ASW-Lo	2	1	2	1	2	1	2	11	31.1	16.0	14.2	14.2	14.1	14.1		72.6	103.7	30.0%	
ASW-Lo	2	2	2	1	2	1	2	12	33.0	16.0	15.3	15.3	15.2	15.2		77.0	110.0	30.0%	
ASW-Lo	2	2	2	2	2	1	2	13	34.9	16.3	16.3	16.3	16.3	16.3		81.5	116.4	30.0%	
ASW-Lo	2	2	2	2	2	2	2	14	36.8	17.2	17.2	17.2	17.2	17.1		85.9	122.7	30.0%	
ASW-Lo	3	2	2	2	2	2	2	15	38.8	16.0	15.0	14.9	14.9	14.9	14.9	90.6	129.4	30.0%	
ASW-Lo	3	3	2	2	2	2	2	16	40.8	16.0	15.9	15.9	15.8	15.8	15.8	95.2	136.0	30.0%	
ASW-Lo	3	3	3	2	2	2	2	17	42.8	16.7	16.7	16.7	16.6	16.6	16.6	99.9	142.7	30.0%	
ASW-Lo	3	3	3	3	2	2	2	18	44.8	17.5	17.4	17.4	17.4	17.4	17.4	104.5	149.3	30.0%	
ASW-Lo	3	3	3	3	3	2	2	19	46.8	17.5	17.5	17.5	18.9	18.9	18.9	109.2	156.0	30.0%	Max. PH capacity
ASW-Lo	3	3	3	3	3	3	2	20	48.8	17.5	17.5	17.5	18.9	18.9	18.9	109.2	158.0	30.9%	
ASW-Lo	3	3	3	3	3	3	3	21	50.8	17.5	17.5	17.5	18.9	18.9	18.9	109.2	160.0	31.8%	
ASW-Lo	4	3	3	3	3	3	3	22	52.8	17.5	17.5	17.5	18.9	18.9	18.9	109.2	162.0	32.6%	

ASW-Lo 30% Spill Patterns (# Gate Stops/Spillbay)							Total Stops	Total Spill	Example Turbine Outflow [b] (kcfs)						TOTAL PH	TOTAL Project	% Spill	
1 [a]	2	3	4	5	6	7	8	(#)	(kcfs)	1	2	3	4	5	6	(kcfs)	(kcfs)	(%)	Comments (see footnotes)
ASW-Lo	4	4	3	3	3	3	3	23	54.7	17.5	17.5	17.5	18.9	18.9	18.9	109.2	163.9	33.4%	
ASW-Lo	4	4	4	3	3	3	3	24	56.7	17.5	17.5	17.5	18.9	18.9	18.9	109.2	165.9	34.2%	
ASW-Lo	4	4	4	4	3	3	3	25	58.7	17.5	17.5	17.5	18.9	18.9	18.9	109.2	167.9	35.0%	
ASW-Lo	4	4	4	4	4	3	3	26	60.6	17.5	17.5	17.5	18.9	18.9	18.9	109.2	169.8	35.7%	
ASW-Lo	4	4	4	4	4	4	3	27	62.6	17.5	17.5	17.5	18.9	18.9	18.9	109.2	171.8	36.4%	
ASW-Lo	4	4	4	4	4	4	4	28	64.6	17.5	17.5	17.5	18.9	18.9	18.9	109.2	173.8	37.2%	
ASW-Lo	5	4	4	4	4	4	4	29	66.5	17.5	17.5	17.5	18.9	18.9	18.9	109.2	175.7	37.8%	
ASW-Lo	5	5	4	4	4	4	4	30	68.5	17.5	17.5	17.5	18.9	18.9	18.9	109.2	177.7	38.5%	
ASW-Lo	5	5	5	4	4	4	4	31	70.5	17.5	17.5	17.5	18.9	18.9	18.9	109.2	179.7	39.2%	
ASW-Lo	5	5	5	5	4	4	4	32	72.4	17.5	17.5	17.5	18.9	18.9	18.9	109.2	181.6	39.9%	
ASW-Lo	5	5	5	5	5	4	4	33	74.4	17.5	17.5	17.5	18.9	18.9	18.9	109.2	183.6	40.5%	
ASW-Lo	5	5	5	5	5	5	4	34	76.4	17.5	17.5	17.5	18.9	18.9	18.9	109.2	185.6	41.2%	
ASW-Lo	5	5	5	5	5	5	5	35	78.3	17.5	17.5	17.5	18.9	18.9	18.9	109.2	187.5	41.8%	
ASW-Lo	6	5	5	5	5	5	5	36	80.3	17.5	17.5	17.5	18.9	18.9	18.9	109.2	189.5	42.4%	
ASW-Lo	6	6	5	5	5	5	5	37	82.3	17.5	17.5	17.5	18.9	18.9	18.9	109.2	191.5	43.0%	
ASW-Lo	6	6	6	5	5	5	5	38	84.2	17.5	17.5	17.5	18.9	18.9	18.9	109.2	193.4	43.5%	
ASW-Lo	6	6	6	6	5	5	5	39	86.2	17.5	17.5	17.5	18.9	18.9	18.9	109.2	195.4	44.1%	
ASW-Lo	6	6	6	6	6	5	5	40	88.1	17.5	17.5	17.5	18.9	18.9	18.9	109.2	197.3	44.7%	
ASW-Lo	6	6	6	6	6	6	5	41	90.1	17.5	17.5	17.5	18.9	18.9	18.9	109.2	199.3	45.2%	
ASW-Lo	6	6	6	6	6	6	6	42	92.1	17.5	17.5	17.5	18.9	18.9	18.9	109.2	201.3	45.8%	
ASW-Lo	7	6	6	6	6	6	6	43	94.0	17.5	17.5	17.5	18.9	18.9	18.9	109.2	203.2	46.3%	
ASW-Lo	7	7	6	6	6	6	6	44	95.9	17.5	17.5	17.5	18.9	18.9	18.9	109.2	205.1	46.8%	
ASW-Lo	7	7	7	6	6	6	6	45	97.9	17.5	17.5	17.5	18.9	18.9	18.9	109.2	207.1	47.3%	
ASW-Lo	7	7	7	7	6	6	6	46	99.8	17.5	17.5	17.5	18.9	18.9	18.9	109.2	209.0	47.8%	
ASW-Lo	7	7	7	7	7	6	6	47	101.8	17.5	17.5	17.5	18.9	18.9	18.9	109.2	211.0	48.2%	
ASW-Lo	7	7	7	7	7	7	6	48	103.7	17.5	17.5	17.5	18.9	18.9	18.9	109.2	212.9	48.7%	
ASW-Lo	7	7	7	7	7	7	7	49	105.7	17.5	17.5	17.5	18.9	18.9	18.9	109.2	214.9	49.2%	
ASW-Lo	8	7	7	7	7	7	7	50	107.6	17.5	17.5	17.5	18.9	18.9	18.9	109.2	216.8	49.6%	
ASW-Lo	8	8	7	7	7	7	7	51	109.6	17.5	17.5	17.5	18.9	18.9	18.9	109.2	218.8	50.1%	
ASW-Lo	8	8	8	7	7	7	7	52	111.6	17.5	17.5	17.5	18.9	18.9	18.9	109.2	220.8	50.5%	
ASW-Lo	8	8	8	8	7	7	7	53	113.5	17.5	17.5	17.5	18.9	18.9	18.9	109.2	222.7	51.0%	
ASW-Lo	8	8	8	8	8	7	7	54	115.5	17.5	17.5	17.5	18.9	18.9	18.9	109.2	224.7	51.4%	

ASW-Lo 30% Spill Patterns (# Gate Stops/Spillbay)							Total Stops	Total Spill	Example Turbine Outflow [b] (kcfs)						TOTAL PH	TOTAL Project	% Spill	
1 [a]	2	3	4	5	6	7	8	(#)	(kcfs)	1	2	3	4	5	6	(kcfs)	(kcfs)	(%)	Comments (see footnotes)
ASW-Lo	8	8	8	8	8	8	7	55	117.5	17.5	17.5	17.5	18.9	18.9	18.9	109.2	226.7	51.8%	
ASW-Lo	8	8	8	8	8	8	8	56	119.4	17.5	17.5	17.5	18.9	18.9	18.9	109.2	228.6	52.2%	
ASW-Lo	9	8	8	8	8	8	8	57	121.4	17.5	17.5	17.5	18.9	18.9	18.9	109.2	230.6	52.6%	
ASW-Lo	9	9	8	8	8	8	8	58	123.3	17.5	17.5	17.5	18.9	18.9	18.9	109.2	232.5	53.0%	
ASW-Lo	9	9	9	8	8	8	8	59	125.2	17.5	17.5	17.5	18.9	18.9	18.9	109.2	234.4	53.4%	
ASW-Lo	9	9	9	9	8	8	8	60	127.1	17.5	17.5	17.5	18.9	18.9	18.9	109.2	236.3	53.8%	
ASW-Lo	9	9	9	9	9	8	8	61	129.1	17.5	17.5	17.5	18.9	18.9	18.9	109.2	238.3	54.2%	
ASW-Lo	9	9	9	9	9	9	8	62	131.0	17.5	17.5	17.5	18.9	18.9	18.9	109.2	240.2	54.5%	
ASW-Lo	9	9	9	9	9	9	9	63	132.9	17.5	17.5	17.5	18.9	18.9	18.9	109.2	242.1	54.9%	
ASW-Lo	10	9	9	9	9	9	9	64	134.9	17.5	17.5	17.5	18.9	18.9	18.9	109.2	244.1	55.3%	
ASW-Lo	10	10	9	9	9	9	9	65	137.0	17.5	17.5	17.5	18.9	18.9	18.9	109.2	246.2	55.6%	
ASW-Lo	10	10	10	9	9	9	9	66	139.0	17.5	17.5	17.5	18.9	18.9	18.9	109.2	248.2	56.0%	
ASW-Lo	10	10	10	10	9	9	9	67	141.0	17.5	17.5	17.5	18.9	18.9	18.9	109.2	250.2	56.4%	
ASW-Lo	10	10	10	10	10	9	9	68	143.0	17.5	17.5	17.5	18.9	18.9	18.9	109.2	252.2	56.7%	
ASW-Lo	10	10	10	10	10	10	9	69	145.0	17.5	17.5	17.5	18.9	18.9	18.9	109.2	254.2	57.0%	
ASW-Lo	10	10	10	10	10	10	10	70	147.0	17.5	17.5	17.5	18.9	18.9	18.9	109.2	256.2	57.4%	

a. Total Spill (kcfs) is calculated as a function of total # of gate stops in Bays 2–8 + ASW spill at forebay elevation 633.5’ (in MOP). ASW spill is a function of crest and forebay elevation (see **section 2.3.2.7**).

b. Turbine outflow is shown only to provide an example of how the special Unit 1 operation will look (see **section 4.2.2.2**) and is not a precise requirement. Actual turbine outflow will vary based on project head and turbine unit capabilities. See **Table LGS-7** for the current turbine operating range values.

c. Spill is > 30% when Total Outflow is > 156 kcfs (assuming all turbines available and max powerhouse capacity is approx. 109 kcfs).

Table LGS-11. [*page 1 of 3*] Little Goose Dam Uniform Spill Patterns for 30% Spill with No ASW (Bay 1 Closed).

No ASW 30% Spill Patterns (# Gate Stops/Spillbay)								Total Stops	Total Spill	Example Turbine Outflow [b] (kcfs)						TOTAL PH	TOTAL Project	% Spill	
1 [a]	2	3	4	5	6	7	8	(#)	(kcfs)	1	2	3	4	5	6	(kcfs)	(kcfs)	(%)	Comments (see footnotes)
Closed								0	0.0	11.3						11.3	11.3	0.0%	Min. Q w/ SW closed and no spill.
Closed							1	1	1.8	11.3						11.3	13.1	13.5%	
Closed	1						1	2	3.5	11.3						11.3	14.8	23.8%	
Closed	1						2	3	5.4	12.6						12.6	18.0	30.0%	Min. Q w/ no SW and 30% spill.
Closed	1		1				2	4	7.2	16.8						16.8	24.0	29.9%	
Closed	1		1		1		2	5	8.9	17.5						17.5	26.4	33.8%	1 unit + 5 stops = ~34% spill
Closed	1		1		1		2	5	8.9	11.3	11.3					22.6	31.5	28.3%	2 units + 5 stops = ~28% spill
Closed	1	1	1		1		2	6	10.7	13.7	11.3					25.0	35.7	30.0%	
Closed	1	1	1		1		2	6	10.7	16.0	11.3					27.3	38.0	28.2%	Min. Q w/ U1 in upper 1%
Closed	1	1	1		1	1	2	7	12.5	16.0	13.1					29.1	41.6	30.0%	
Closed	1	1	1	1	1	1	2	8	14.2	16.6	16.6					33.2	47.4	30.0%	
Closed	2	1	1	1	1	1	2	9	16.1	17.5	17.5					35.0	51.1	31.5%	2 units + 9 stops = ~31% spill
Closed	2	1	1	1	1	1	2	9	16.1	16.0	11.3	11.3				38.6	54.7	29.5%	3 units + 9 stops = ~29% spill
Closed	2	1	2	1	1	1	2	10	18.0	16.0	13.0	13.0				42.0	60.0	30.0%	
Closed	2	1	2	1	2	1	2	11	19.9	16.0	15.3	15.2				46.5	66.4	30.0%	
Closed	2	2	2	1	2	1	2	12	21.8	17.0	17.0	16.9				50.9	72.7	30.0%	
Closed	2	2	2	1	2	1	2	12	21.8	17.5	17.5	17.5				52.5	74.3	29.4%	Max. Q w/ 3 units = ~29% spill
Closed	2	2	2	2	2	1	2	13	23.7	16.0	11.3	11.3	13.9			52.5	76.2	31.1%	Min. Q w/ 4 units = ~31% spill
Closed	2	2	2	2	2	1	2	13	23.7	16.0	12.7	12.7	13.9			55.3	79.0	30.0%	
Closed	2	2	2	2	2	2	2	14	25.6	16.0	14.6	14.6	14.6			59.8	85.4	30.0%	
Closed	3	2	2	2	2	2	2	15	27.6	16.1	16.1	16.1	16.1			64.4	92.0	30.0%	
Closed	3	3	2	2	2	2	2	16	29.6	17.3	17.3	17.3	17.2			69.1	98.7	30.0%	
Closed	3	3	3	2	2	2	2	17	31.6	16.0	14.5	14.4	14.4	14.4		73.7	105.3	30.0%	
Closed	3	3	3	3	2	2	2	18	33.6	16.0	15.6	15.6	15.6	15.6		78.4	112.0	30.0%	
Closed	3	3	3	3	3	2	2	19	35.6	16.7	16.6	16.6	16.6	16.6		83.1	118.7	30.0%	
Closed	3	3	3	3	3	3	2	20	37.6	17.5	17.5	17.5	17.5	17.5		87.5	125.1	30.1%	
Closed	3	3	3	3	3	3	3	21	39.6	16.0	15.3	15.3	15.3	15.3	15.2	92.4	132.0	30.0%	
Closed	4	3	3	3	3	3	3	22	41.6	16.2	16.2	16.2	16.2	16.1	16.1	97.0	138.6	30.0%	
Closed	4	4	3	3	3	3	3	23	43.5	17.0	17.0	16.9	16.9	16.9	16.9	101.6	145.1	30.0%	
Closed	4	4	4	3	3	3	3	24	45.5	17.5	17.5	17.5	17.9	17.9	17.9	106.2	151.7	30.0%	

No ASW 30% Spill Patterns (# Gate Stops/Spillbay)								Total Stops	Total Spill	Example Turbine Outflow [b] (kcfs)						TOTAL PH	TOTAL Project	% Spill	
1 [a]	2	3	4	5	6	7	8	(#)	(kcfs)	1	2	3	4	5	6	(kcfs)	(kcfs)	(%)	Comments (see footnotes)
Closed	4	4	4	4	3	3	3	25	47.5	17.5	17.5	17.5	18.9	18.9	18.9	109.2	156.7	30.3%	Max. PH capacity for 30% Spill. c
Closed	4	4	4	4	4	3	3	26	49.4	17.5	17.5	17.5	18.9	18.9	18.9	109.2	158.6	31.2%	
Closed	4	4	4	4	4	4	3	27	51.4	17.5	17.5	17.5	18.9	18.9	18.9	109.2	160.6	32.0%	
Closed	4	4	4	4	4	4	4	28	53.4	17.5	17.5	17.5	18.9	18.9	18.9	109.2	162.6	32.8%	
Closed	5	4	4	4	4	4	4	29	55.3	17.5	17.5	17.5	18.9	18.9	18.9	109.2	164.5	33.6%	
Closed	5	5	4	4	4	4	4	30	57.3	17.5	17.5	17.5	18.9	18.9	18.9	109.2	166.5	34.4%	
Closed	5	5	5	4	4	4	4	31	59.3	17.5	17.5	17.5	18.9	18.9	18.9	109.2	168.5	35.2%	
Closed	5	5	5	5	4	4	4	32	61.2	17.5	17.5	17.5	18.9	18.9	18.9	109.2	170.4	35.9%	
Closed	5	5	5	5	5	4	4	33	63.2	17.5	17.5	17.5	18.9	18.9	18.9	109.2	172.4	36.7%	
Closed	5	5	5	5	5	5	4	34	65.2	17.5	17.5	17.5	18.9	18.9	18.9	109.2	174.4	37.4%	
Closed	5	5	5	5	5	5	5	35	67.1	17.5	17.5	17.5	18.9	18.9	18.9	109.2	176.3	38.1%	
Closed	6	5	5	5	5	5	5	36	69.1	17.5	17.5	17.5	18.9	18.9	18.9	109.2	178.3	38.8%	
Closed	6	6	5	5	5	5	5	37	71.1	17.5	17.5	17.5	18.9	18.9	18.9	109.2	180.3	39.4%	
Closed	6	6	6	5	5	5	5	38	73.0	17.5	17.5	17.5	18.9	18.9	18.9	109.2	182.2	40.1%	
Closed	6	6	6	6	5	5	5	39	75.0	17.5	17.5	17.5	18.9	18.9	18.9	109.2	184.2	40.7%	
Closed	6	6	6	6	6	5	5	40	76.9	17.5	17.5	17.5	18.9	18.9	18.9	109.2	186.1	41.3%	
Closed	6	6	6	6	6	6	5	41	78.9	17.5	17.5	17.5	18.9	18.9	18.9	109.2	188.1	41.9%	
Closed	6	6	6	6	6	6	6	42	80.9	17.5	17.5	17.5	18.9	18.9	18.9	109.2	190.1	42.5%	
Closed	7	6	6	6	6	6	6	43	82.8	17.5	17.5	17.5	18.9	18.9	18.9	109.2	192.0	43.1%	
Closed	7	7	6	6	6	6	6	44	84.7	17.5	17.5	17.5	18.9	18.9	18.9	109.2	193.9	43.7%	
Closed	7	7	7	6	6	6	6	45	86.7	17.5	17.5	17.5	18.9	18.9	18.9	109.2	195.9	44.3%	
Closed	7	7	7	7	6	6	6	46	88.6	17.5	17.5	17.5	18.9	18.9	18.9	109.2	197.8	44.8%	
Closed	7	7	7	7	7	6	6	47	90.6	17.5	17.5	17.5	18.9	18.9	18.9	109.2	199.8	45.3%	
Closed	7	7	7	7	7	7	6	48	92.5	17.5	17.5	17.5	18.9	18.9	18.9	109.2	201.7	45.9%	
Closed	7	7	7	7	7	7	7	49	94.5	17.5	17.5	17.5	18.9	18.9	18.9	109.2	203.7	46.4%	
Closed	8	7	7	7	7	7	7	50	96.4	17.5	17.5	17.5	18.9	18.9	18.9	109.2	205.6	46.9%	
Closed	8	8	7	7	7	7	7	51	98.4	17.5	17.5	17.5	18.9	18.9	18.9	109.2	207.6	47.4%	
Closed	8	8	8	7	7	7	7	52	100.4	17.5	17.5	17.5	18.9	18.9	18.9	109.2	209.6	47.9%	
Closed	8	8	8	8	7	7	7	53	102.3	17.5	17.5	17.5	18.9	18.9	18.9	109.2	211.5	48.4%	
Closed	8	8	8	8	8	7	7	54	104.3	17.5	17.5	17.5	18.9	18.9	18.9	109.2	213.5	48.9%	
Closed	8	8	8	8	8	8	7	55	106.3	17.5	17.5	17.5	18.9	18.9	18.9	109.2	215.5	49.3%	
Closed	8	8	8	8	8	8	8	56	108.2	17.5	17.5	17.5	18.9	18.9	18.9	109.2	217.4	49.8%	

No ASW 30% Spill Patterns (# Gate Stops/Spillbay) 1 [a]	2	3	4	5	6	7	8	Total Stops (#)	Total Spill (kcfs)	Example Turbine Outflow [b] (kcfs) 1	2	3	4	5	6	TOTAL PH (kcfs)	TOTAL Project (kcfs)	% Spill (%)	Comments (see footnotes)
Closed	9	8	8	8	8	8	8	57	110.2	17.5	17.5	17.5	18.9	18.9	18.9	109.2	219.4	50.2%	
Closed	9	9	8	8	8	8	8	58	112.1	17.5	17.5	17.5	18.9	18.9	18.9	109.2	221.3	50.7%	
Closed	9	9	9	8	8	8	8	59	114.0	17.5	17.5	17.5	18.9	18.9	18.9	109.2	223.2	51.1%	
Closed	9	9	9	9	8	8	8	60	115.9	17.5	17.5	17.5	18.9	18.9	18.9	109.2	225.1	51.5%	
Closed	9	9	9	9	9	8	8	61	117.9	17.5	17.5	17.5	18.9	18.9	18.9	109.2	227.1	51.9%	
Closed	9	9	9	9	9	9	8	62	119.8	17.5	17.5	17.5	18.9	18.9	18.9	109.2	229.0	52.3%	
Closed	9	9	9	9	9	9	9	63	121.7	17.5	17.5	17.5	18.9	18.9	18.9	109.2	230.9	52.7%	
Closed	10	9	9	9	9	9	9	64	123.7	17.5	17.5	17.5	18.9	18.9	18.9	109.2	232.9	53.1%	
Closed	10	10	9	9	9	9	9	65	125.8	17.5	17.5	17.5	18.9	18.9	18.9	109.2	235.0	53.5%	
Closed	10	10	10	9	9	9	9	66	127.8	17.5	17.5	17.5	18.9	18.9	18.9	109.2	237.0	53.9%	
Closed	10	10	10	10	9	9	9	67	129.8	17.5	17.5	17.5	18.9	18.9	18.9	109.2	239.0	54.3%	
Closed	10	10	10	10	10	9	9	68	131.8	17.5	17.5	17.5	18.9	18.9	18.9	109.2	241.0	54.7%	
Closed	10	10	10	10	10	10	9	69	133.8	17.5	17.5	17.5	18.9	18.9	18.9	109.2	243.0	55.1%	
Closed	10	10	10	10	10	10	10	70	135.8	17.5	17.5	17.5	18.9	18.9	18.9	109.2	245.0	55.4%	

a. Total Spill (kcfs) is calculated as a function of total # of gate stops in Bays 2–8 at forebay elevation 633.5’ (in MOP).

b. Turbine outflow is shown only to provide an example of how the special Unit 1 operation will look (see **section 4.2.2.2**) and is not a precise requirement. Actual turbine outflow will vary based on project head and turbine unit capabilities. See **Table LGS-7** for the current turbine operating range values.

c. Spill is > 30% when Total Outflow is > 156 kcfs (assuming all turbines available and max powerhouse capacity is approx. 109 kcfs).