2014 Fish Passage Plan

Section 5 – McNary Dam

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McNary Dam

Project Acronym	MCN
River Mile (RM)	Columbia River – RM 292
Reservoir	Lake Wallula
Minimum Instantaneous Flow (kcfs)	Dec–Feb: 12.5 kcfs \ Mar–Nov: 50 kcfs
Forebay Normal Operating Range (ft)	337’ – 340’
Tailrace Rate of Change Limit (ft)	1.5’/hr
Powerhouse Length (ft)	1,422’
Powerhouse Hydraulic Capacity (kcfs)	232 kcfs
Turbine Units (#)	14 Main Units (S. Morgan Smith Kaplan)
Turbine Unit Generating Capacity (MW)	Rated: 980 MW (70 MW/unit) \ Maximum: 1,127 MW (80.5 MW/unit)
Gatewell Orifice Diameter (in)	Two 12” orifices per gatewell (6 per unit)
Spillway Length (ft)	1,310’
Spillway Hydraulic Capacity (kcfs)	2,200 kcfs
Spillbays (#)	22
Spillway Weirs (#)	2 (Bays 19-20)
Navigation Lock Length x Width (ft)	650’ x 84’ (Usable Space)
Navigation Lock Maximum Lift (ft)	75’
FISH STRUCTURE/OPERATION START DATE	
Fish Lock	1953 (1st Generation)
Adult Fish Counts – WA Shore & OR Shore	1954
Juvenile Bypass System (JBS)	1980 (1st Generation); 1994 (current)
Submersible Traveling Screens (STS)	1980 (Prototype Mesh)
Extended-Length Submersible Bar Screens (ESBS)	1997
Juvenile Fish Transportation Program - Corps	1981-2012
Temporary Spillway Weir (TSW)	2007
Bypass Outfall Flume Relocation	2012

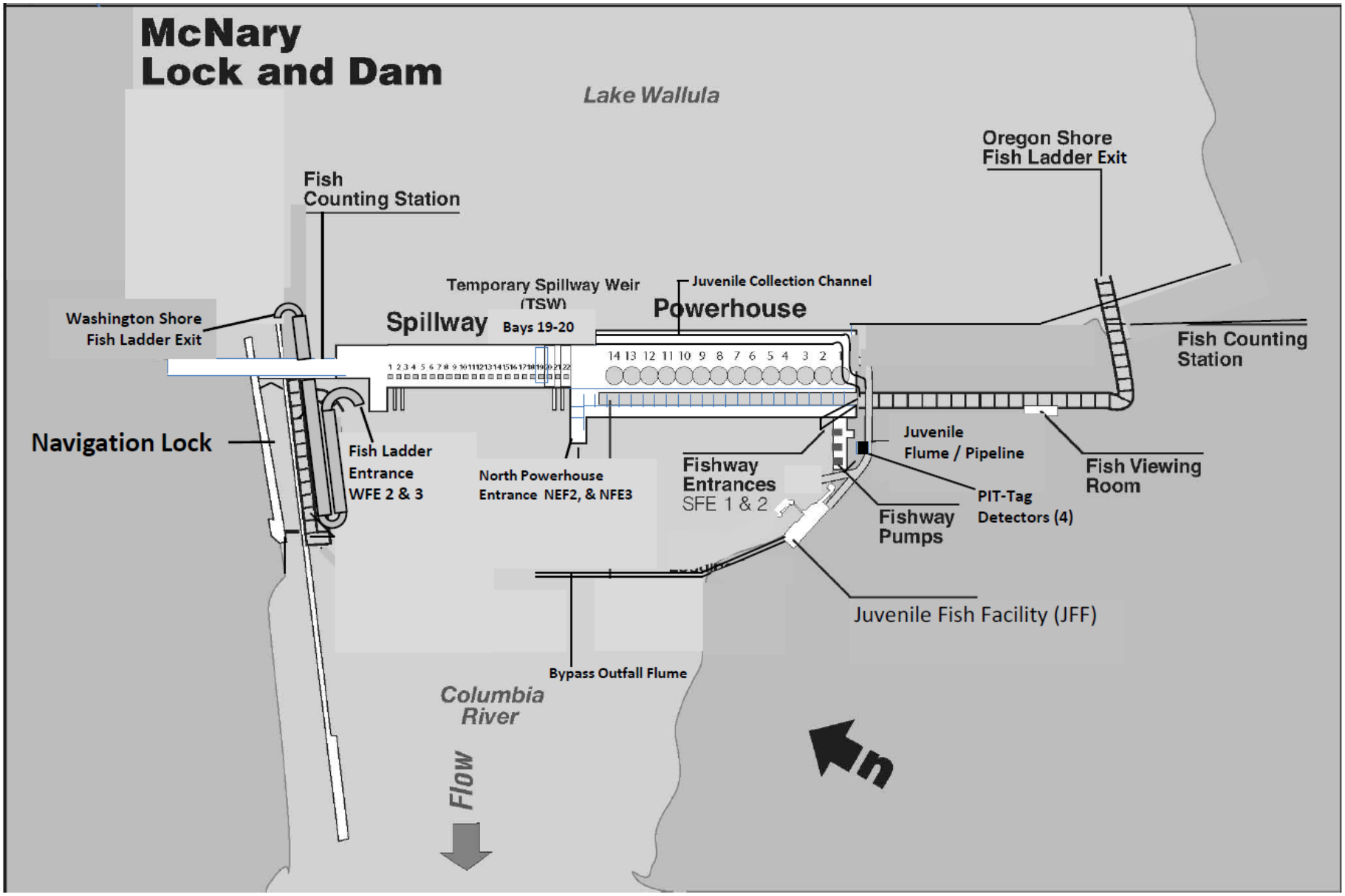
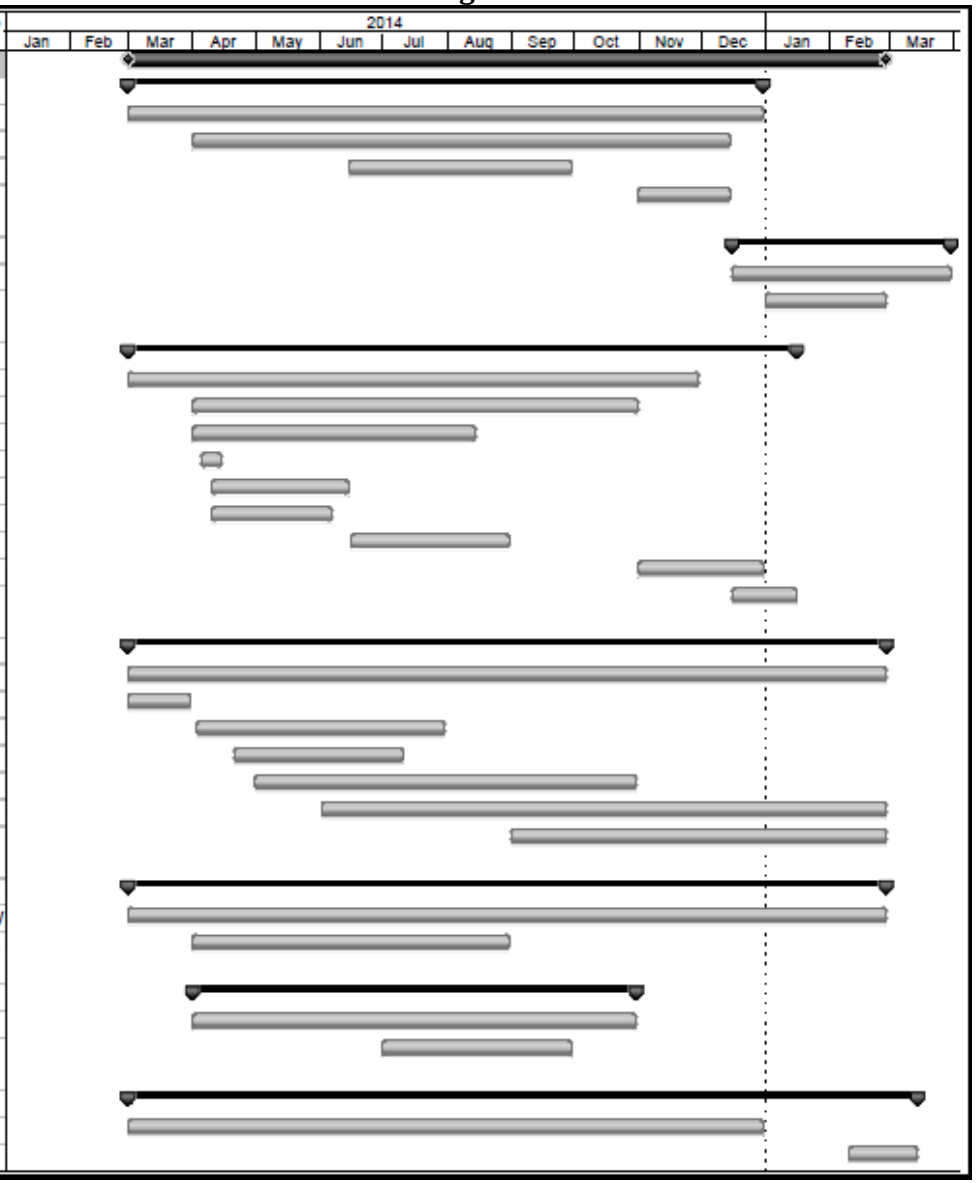


Figure MCN-1. McNary Lock & Dam General Site Plan.

Table MCN-1. McNary Dam Schedule of Operations and Actions Defined in the 2014 Fish Passage Plan.

Task Name	Start Date	End Date	FPP Reference
2014 FPP Operations & Actions - McNary Dam	**3/1/14**	**2/28/15**	**MCN**
Fish Passage Facilities Operation	**3/1/14**	**12/31/14**	**2.3.**
Adult Fish Facilities	3/1/14	12/31/14	2.3.2.2.
Juvenile Fish Facilities	4/1/14	12/15/14	2.3.1.2.
Adult Facilities Operations for Lamprey	6/15/14	9/30/14	2.3.2.2.j.
Juvenile Facilities Operations for Cold Weather	11/1/14	12/15/14	2.3.1.2.l.
Fish Passage Facilities Maintenance	**12/16/14**	**3/31/15**	**2.3.**
Juvenile Fish Facilities Winter Maintenance	12/16/14	3/31/15	2.3.1.1.
Adult Fish Facilities Winter Maintenance	1/1/15	2/28/15	2.3.2.1.
Project Operations for Fish Passage	**3/1/14**	**1/16/15**	
Turbine operating priority order	3/1/14	11/30/14	Table MCN-5
Turbine 1% operating range - hard constraint	4/1/14	10/31/14	4.1.2.
Inspect and cyle orifices ≥ twice per day	4/1/14	8/15/14	2.3.1.2.c.6.
Install ESBSs	4/5/14	4/15/14	2.3.1.2.b.1.
Spring Spill Operations	4/10/14	6/15/14	FOP
Spillway Weir in service	4/10/14	6/7/14	2.3.1.2.h.
Summer Spill Operations	6/16/14	8/31/14	FOP
Priority turbine unit maintenance	11/1/14	12/31/14	4.2.
Inspect/Rake ≤ 4 trashracks	12/16/14	1/16/15	2.3.1.1.
Special Operations & Studies (dates approximate)	**3/1/14**	**2/28/15**	**Appendix A**
Adult Salmon Studies	3/1/14	2/28/15	5.2.2
Adult Steelhead Direct Injury & Survival	3/1/14	3/31/14	5.2.1.
BiOp Performance Standard Tests	4/3/14	7/31/14	5.2.3.
Forebay Range for Waterfowl Nesting	4/21/14	7/11/14	5.1.4.
Adult Lamprey Studies	5/1/14	10/31/14	5.2.4-.6.
Units 9 and 12 Rewind	6/2/14	2/28/15	5.1.6.
Adult Steelhead TSW Passage Efficiency	9/1/14	2/28/15	5.2.7.
TDG Monitoring	**3/1/14**	**2/28/15**	**2.3.1.**
TDG Monitoring - Tailrace	3/1/14	2/28/15	station MCPW
TDG Monitoring - Forebay	4/1/14	8/31/14	station MCNA
Adult Fish Counting	**4/1/14**	**10/31/14**	**Table MCN-3**
Daytime Visual 0400-2000 PST	4/1/14	10/31/14	
Night Video 2100-0500 DST	7/1/14	9/30/14	
Reports	**3/1/14**	**3/15/15**	**2.3.**
Weekly Reports	3/1/14	12/31/14	
Annual Report	2/10/15	3/15/15	



1. FISH PASSAGE INFORMATION

The locations of fish passage facilities at McNary Lock & Dam are shown on the general site plan in **Figure MCN-1**. The schedule for project operations described in the Fish Passage Plan (FPP) is included in **Table MCN-1**.

1.1. Juvenile Fish Passage.

1.1.1. Juvenile Fish Passage Facilities. The juvenile sampling facilities at McNary Dam consist of extended-length submersible bar screens (ESBSs) with flow vanes, vertical barrier screens (VBSs), gatewell orifices, a concrete collection channel with emergency bypass outlets, primary and secondary dewatering structures, a pipeline/corrugated metal flume for routing juvenile fish to the sampling facilities or bypassing them back to the river, and a full-flow PIT tag detection system. Juvenile sampling facilities at McNary include: a separator to separate adult from juvenile fish and juvenile fish by size; a flume system routing juvenile fish either through the secondary bypass system or to the sample system; covered raceways and tanks for holding sampled fish; sampling facilities; an office and sampling building with fish marking facilities; and PIT tag detection and deflection systems.

1.1.2. Juvenile Migration Timing. Juvenile passage timing at McNary Dam (**Table MCN-2**) is calculated based on juvenile fish collection data over the most recent 10-year period and do not reflect bypass (FGE) or spillway passage. Salmon, steelhead, bull trout, lamprey, and other species are routinely counted. Maintenance of juvenile fish passage facilities that may impact juvenile fish or facility operations should be conducted during the winter maintenance season.

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

Year	10%	50%	90%	# Days	10%	50%	90%	# Days
	Yearling Chinook				Subyearling Chinook			
2004	27-Apr	11-May	31-May	34	22-Jun	30-Jun	18-Jul	26
2005	3-May	15-May	29-May	26	16-Jun	25-Jun	3-Jul	17
2006	21-Apr	9-May	19-May	28	14-Jun	6-Jul	19-Jul	35
2007	1-May	11-May	25-May	24	22-Jun	6-Jul	28-Jul	36
2008	9-Apr	15-May	27-May	48	22-Jun	8-Jul	9-Aug	48
2009	2-May	15-May	25-May	23	18-Jun	4-Jul	22-Jul	34
2010	3-May	17-May	27-May	24	18-Jun	4-Jul	4-Aug	47
2011	29-Apr	8-May	23-May	24	24-Jun	24-Jul	19-Aug	56
2012	29-Apr	11-May	25-May	26	22-Jun	18-Jul	22-Aug	61
2013	1-May	9-May	29-May	28	16-Jun	4-Jul	22-Jul	36
MEDIAN	**30-Apr**	**11-May**	**26-May**	**26**	**20-Jun**	**5-Jul**	**25-Jul**	**36**
MIN	**9-Apr**	**8-May**	**19-May**	**23**	**14-Jun**	**25-Jun**	**3-Jul**	**17**
MAX	**3-May**	**17-May**	**31-May**	**48**	**24-Jun**	**24-Jul**	**22-Aug**	**61**
	Unclipped Steelhead				Clipped Steelhead			
2004	23-Apr	13-May	4-Jun	42	23-Apr	10-May	31-May	38
2005	1-May	17-May	27-May	26	19-Apr	15-May	29-May	40
2006	19-Apr	7-May	27-May	38	23-Apr	1-May	23-May	30
2007	27-Apr	11-May	25-May	28	29-Apr	9-May	23-May	24
2008	1-May	15-May	29-May	28	3-May	11-May	23-May	20
2009	25-Apr	7-May	23-May	28	27-Apr	7-May	23-May	26
2010	1-May	13-May	2-Jun	32	1-May	9-May	29-May	28
2011	19-Apr	7-May	27-May	38	19-Apr	1-May	17-May	28
2012	24-Apr	5-May	25-May	31	23-Apr	1-May	17-May	24
2013	23-Apr	11-May	2-Jun	40	25-Apr	3-May	19-May	24
MEDIAN	**24-Apr**	**11-May**	**27-May**	**31.5**	**24-Apr**	**8-May**	**23-May**	**27**
MIN	**19-Apr**	**5-May**	**23-May**	**26**	**19-Apr**	**1-May**	**17-May**	**20**
MAX	**1-May**	**17-May**	**4-Jun**	**42**	**3-May**	**15-May**	**31-May**	**40**
	Coho				Sockeye (Wild & Hatchery)			
2004	15-May	31-May	18-Jun	34	15-May	31-May	14-Jun	30
2005	5-May	21-May	6-Jun	32	11-May	19-May	31-May	20
2006	9-May	27-May	2-Jun	24	3-May	17-May	29-May	26
2007	3-May	21-May	8-Jun	36	11-May	21-May	31-May	20
2008	13-May	25-May	6-Jun	24	15-May	25-May	6-Jun	22
2009	13-May	23-May	12-Jun	30	5-May	21-May	2-Jun	28
2010	9-May	31-May	12-Jun	34	11-May	29-May	2-Jun	22
2011	24-Apr	19-May	8-Jun	45	4-May	13-May	31-May	27
2012	7-May	23-May	4-Jun	28	1-May	11-May	21-May	20
2013	3-May	21-May	8-Jun	36	29-Apr	15-May	27-May	28
MEDIAN	**8-May**	**23-May**	**8-Jun**	**33**	**8-May**	**20-May**	**31-May**	**24**
MIN	**24-Apr**	**19-May**	**2-Jun**	**24**	**29-Apr**	**11-May**	**21-May**	**20**
MAX	**15-May**	**31-May**	**18-Jun**	**45**	**15-May**	**31-May**	**14-Jun**	**30**

1.2. Adult Fish Passage.

1.2.1. Adult Fish Passage Facilities. McNary Dam adult fish passage facilities consist of separate north and south shore facilities.

1.2.1.1. North Shore Adult Fish Passage Facility. The north shore facilities are made up of a fish ladder with counting station, submerged orifice PIT-tag antennas in the ladder, a small collection system, and a gravity-flow auxiliary water supply system. The gravity-flow auxiliary water supply system has a turbine unit installed on it, operated by North Wasco County PUD. The gravity-flow auxiliary water supply system takes water from the forebay through two conduits, passes the water through a turbine unit or through a bypass/energy dissipater when the turbine unit is not in operation, and distributes the water through a diffuser system at the bottom of the ladder and in the transportation channel. The north shore collection system has three downstream entrances and a side entrance into the spillway basin. Two of the downstream entrances are used during normal operation.

1.2.1.2. South Shore Adult Fish Passage Facility. The south shore facilities are comprised of a fish ladder with counting station, submerged orifice PIT-tag antennas in the ladder and antennas at the counting station, two south shore entrances, a powerhouse collection system, and gravity and pumped auxiliary water supply systems.

1.2.1.3. Powerhouse Collection System. The powerhouse collection system contains three downstream entrances and one side entrance into the spillway basin at the north end of the powerhouse, twelve operating floating orifices, and a common transportation channel. At the north end of the powerhouse, two of the downstream entrances are used during normal operation with the other downstream and side entrances closed. The gravity-flow auxiliary water is provided by one conduit from the forebay and supplies the diffusers at the bottom of the ladder at tailwater level. The pumped auxiliary water is supplied by three electric pumps with variable-pitched blades. Two pumps are capable of providing the required flow when the third pump is bulkheaded to prevent water from flowing back through the pump to the river. The electric pumps supply the auxiliary water for the diffusers at the entrances and in the transportation channel. Excess water from the primary dewatering structure in the juvenile fish collection channel is routed to the adult collection system at the north end of the powerhouse.

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

Table MCN-3. Adult Fish Counting Schedule at McNary Dam (3/1/14 - 2/28/15).

Count Period	Counting Method and Hours *
April 1 – October 31	Visual 0400–2000 hours (PST)
July 1 – September 30	Night Video 2000–0400 hours (PST)

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

Table MCN-4. Adult Fish Count Period and Peak Passage Timing at McNary Dam (based on yearly counts since 1954).

Species	Count Period	Earliest Peak	Latest Peak
Spring Chinook	Apr 1 – Jun 8	Apr 20	May 26
Summer Chinook	Jun 9 – Aug 8	Jun 13	Jul 26
Fall Chinook	Aug 9 – Oct 31	Sep 10	Sep 28
Steelhead	Apr 1 – Oct 31	Jul 9	Oct 13
Sockeye	Apr 1 – Oct 31	Sep 5	Oct 11
Coho	Apr 1 – Oct 31	Jul 23	Oct 5
Lamprey	Apr 1 – Oct 31	Jul 21	Aug 12

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

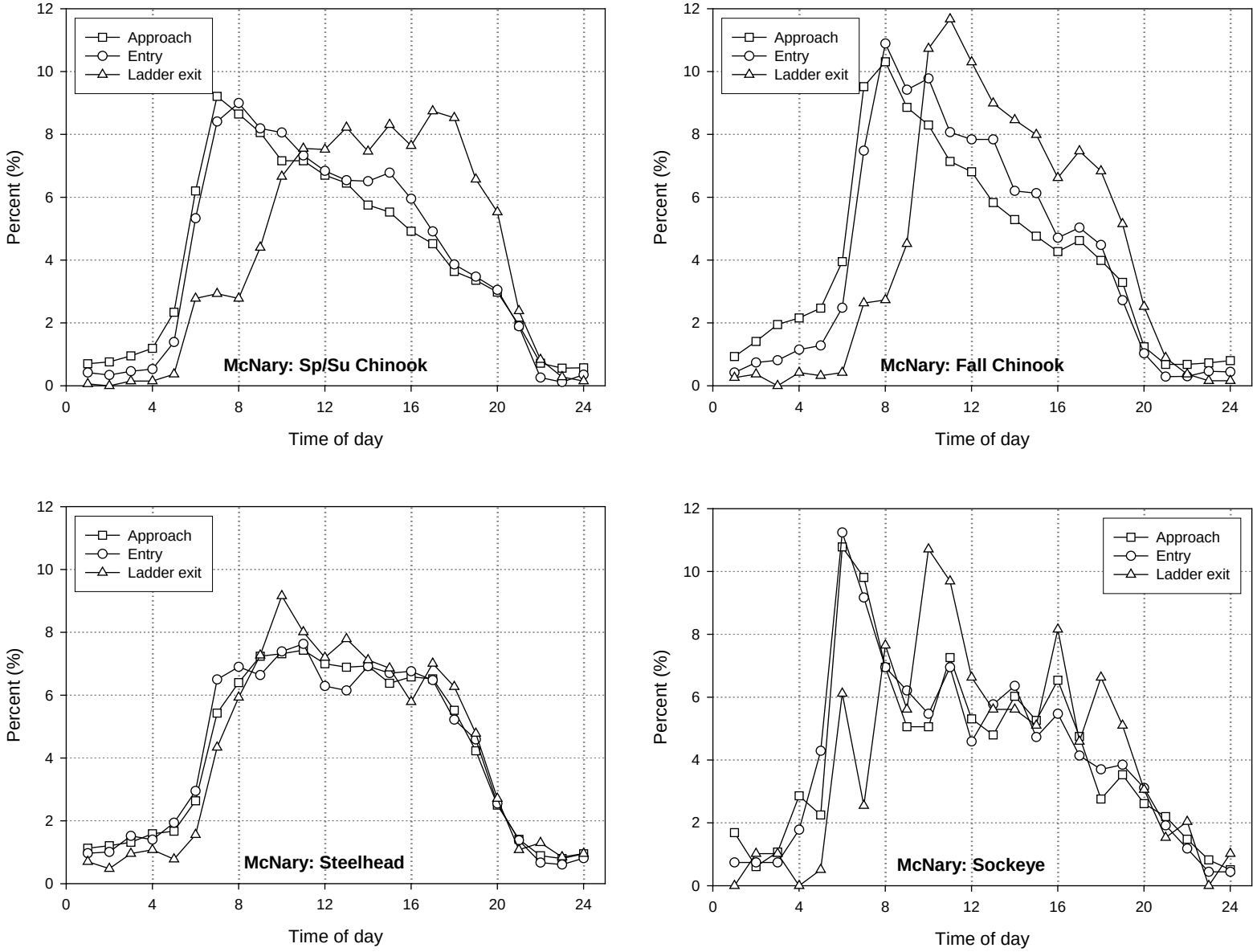


Figure MCN-2. Diel Distribution of Adult Salmonids at McNary Dam Fishway Entrances and Exits (*Keefer & Caudill 2008*).

2. PROJECT OPERATIONS

2.1. Spill Management.

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

2.1.1. Involuntary Spill. Involuntary spill occurs when river flow exceeds powerhouse capacity, there is insufficient load (lack of load), forced or scheduled turbine outages, or a failure of a key component of the juvenile fish facility requires spill to provide juvenile fish passage. Spill at McNary Dam shall be distributed in accordance with the spill patterns for fish passage (**Table MCN-7**) or the appropriate pattern during and after TSW removal (**Tables MCN-10** and **MCN-9**, respectively).

2.2. Total Dissolved Gas (TDG) Management.

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

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. Operate from April 6 through December 15 for juvenile fish bypass sampling and for bypassing adult fallbacks. Operate according to the criteria listed below and in Appendix J (Smolt Facility Protocols, McNary Section), for the bypassing and collection (for research purposes) of juvenile salmonids.

2.3.1.1. Winter Maintenance Period (December 16 – March 31). Check and perform maintenance as required on the items listed below. Prior to January 16, inspect or rake up to four trashracks to determine if debris is present. Prioritize raking trashracks at units with known debris issues and longer run times, and ensure to the extent practicable that racked units are distributed evenly across the powerhouse.

2.3.1.1.a. Forebay Area and Intakes.

a.1. Remove debris from forebay and trashracks.

a.2. Rake trashracks.

a.3. Remove debris from gatewell slots.

a.4. Measure and log drawdown in gatewell slots.

a.5. Inspect and repair gatewell dip net as needed.

2.3.1.1.b. ESBSs, Flow Vanes and VBSs.

b.1. After ESBSs are removed at the end of the season, inspect them for the presence of juvenile salmonid mortalities and all other incidental fish mortalities. Inspect

ESBSs within a week after removal, or as soon as practical. All mortalities are to be counted, or otherwise estimated, for each ESBS and reported to CENWW-OD-T.

b.2. Maintenance completed on all ESBSs.

b.3. Inspect ESBSs for good running order and operate debris cleaner one trial run (dogged off at deck level).

b.4. Inspect flow vanes to make sure they are in good condition and all surfaces are smooth. Repair as needed.

b.5. Inspect all VBSs at least once per year by either raising the VBS and visually inspecting or inspecting with an underwater video camera.

2.3.1.1.c. Collection Channel.

c.1. Orifice lights are operational.

c.2. Orifices clean and valves operating correctly.

c.3. Orifice air backflush system works correctly.

c.4. Netting over handrails and orifice chutes maintained and in good condition.

c.5. Plastic covers over orifice chutes maintained and in good condition and clean so orifice flow is visible.

2.3.1.1.d. Dewatering Structure and Flume.

d.1. Inclined and side dewatering screens are clean and in good condition with no gaps between screen panels, no damaged panels, and no missing silicone.

d.2. Cleaning brush systems are maintained and operating correctly.

d.3. All valves in good condition and operating correctly.

d.4. Stilling well water level sensing device inspected and operable.

d.5. Flume and pipe interiors smooth with no rough edges.

d.6. Maintain full-flow PIT-tag system as required. Coordinate with PSMFC.

2.3.1.1.e. Sampling Facilities.

e.1. Flume switch gate is maintained and operational.

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

e.3. Perforated plate and bar screen edges are smooth with no rough edges.

e.4. Wet separator and fish distribution system maintained and operating as designed.

e.5. Brushes on all crowders in good condition or new.

e.6. Crowders maintained and operating properly.

e.7. All valves, slide gates, and switch gates maintained and operating correctly.

e.8. Raceway and tank retainer screens set in place with no holes or sharp wires protruding.

e.9. All sampling equipment should be maintained and operating correctly.

e.10. 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.

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

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

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

2.3.1.2.a. Forebay Area and Intakes.

a.1. Remove debris from forebay.

a.2. Inspect gatewell slots daily for debris, fish buildup, and contaminating substances (particularly oil). Clean gatewells before they become 50% covered with debris. If due to the volume of the debris, it is not possible to keep the gatewell at least 50% clear, clean gatewells at least once daily. If flow through an orifice or fish sampling results indicate that an orifice may be partially obstructed with debris, close the orifice(s) and backflush to remove the obstruction. If the obstruction cannot be removed, the orifice shall be closed and the alternate orifice for that gatewell slot shall be operated. If both orifices become obstructed or plugged with debris, the turbine unit will not be operated until the gatewell and orifices are cleared of debris.

a.3. If a visible accumulation of contaminating substances (such as oil) is detected in a gatewell and it cannot be removed within 24 hours, the gatewell orifices shall be closed immediately and the turbine unit shut down within one hour until the material has been removed and any problems corrected. A preferred method for removing oil from the water surface is to install absorbent socks, booms, or pads capable of encapsulating the material, tied off with a rope for later disposal. Action should be taken as soon as possible to remove the oil from the gatewell so the orifice can be

reopened to allow the fish to exit the gatewell. Orifices shall not be closed for longer than 48 hours.

a.4. Remove debris from forebay and trashracks as required to minimize fish impacts. Generally this will result in removing debris from trashracks at least four times per year - just prior to the fish passage season and, monthly for the first three months Raking may be required when heavy debris loads are present in the river. Fish quality and trash rack differential may also be an indicator of debris buildup on the trashracks. Project biologist shall determine when trash raking is required.

a.5. Coordinate cleaning efforts with personnel operating juvenile collection facilities.

a.6. Dip bulkhead gatewell slots to remove fish prior to installing bulkhead for dewatering bulkhead slot.

2.3.1.2.b. ESBSs and VBSs.

b.1. Operate ESBSs with flow vanes attached to the screen. Installation of the ESBSs will not start before April 5 and will be completed no later than April 15.

b.2. Operate ESBSs with debris cleaners in automatic mode. Set cleaning frequency to 60 minutes. Increase or decrease cleaning frequency if needed to maintain clean screens.

b.3. Inspect ESBSs in at least 3 operating turbine units per week by means of underwater video. Spot-check VBSs at the same time.

b.4. Conduct additional ESBS inspections if fish condition warrants it.

b.5. If an ESBS is damaged or fails during the juvenile fish passage season, follow procedures detailed under unscheduled maintenance of ESBSs (section **3.1.2.1**). In no case should a turbine unit be operated with a missing or known non-operating or damaged ESBS or VBS. Turbine units shall not operate for more than 10 hours, *and preferably less than 3 hours*, with ESBSs in place and orifices closed. Orifice closure should be minimized by efficient planning and completion of the work to be done (e.g., having equipment, materials and personnel ready before orifices are closed).

b.6. Make formal determination at end of season as to adequacy of bar screen panels and debris cleaner brushes and replace components as necessary.

b.7. Measure head differentials across VBSs daily during times of debris. Clean and inspect VBS when head differentials reach 1.5'. When a head differential of 1.5' is reached, the respective turbine unit should be operated at a reduced generation loading if the VBSs cannot be cleaned within 8 hours, to minimize loading on the VBS and potential fish impingement.

b.8. Between the spring and summer periods, inspect at least four VBSs in two different turbine units that were operated frequently during the spring. If debris accumulation is noted, inspect other VBSs and clean debris as necessary.

b.9. Inspect all VBSs at least once per year and when pulled for cleaning. Repair as needed.

2.3.1.2.c. Collection Channel.

c.1. Orifices clean and operating. Operate at least one orifice per gatewell slot (preferably the south orifice). If orifices must be closed to repair any part of the facility, do not close orifices in operating turbine units with ESBSs in place for longer than 10 hours, and preferably less than 3 hours. During periods of high fish numbers or high debris, this time period may be less. Reduce turbine unit loading to the lower end of the 1% efficiency range if deemed necessary by the project biologist. Monitor fish conditions in gatewells hourly or more frequently during orifice closure periods.

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

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

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

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

c.6. Cycle orifices at least once per day and more frequently if required. During periods of high fish and debris passage, April 1 through August 15, orifices should be inspected and cycled twice daily or more frequently as determined by the project biologist, to keep orifices clean. If debris is causing continual orifice plugging problems in a particular turbine unit gatewell, the respective turbine unit generation may be restricted to the lower end of the 1% turbine efficiency range to minimize orifice plugging problems.

c.7. Netting along handrails maintained in good condition (no holes or gaps).

c.8. Plastic covers over orifice chutes in good condition.

2.3.1.2.d. Dewatering Structure.

d.1. No gaps between panels or missing silicone in side and inclined screens.

d.2. Trash sweeps operating correctly.

d.3. The project biologist shall determine the frequency of operation of the trash sweeps. The sweeps should operate at a frequency to maintain a clean screen given present debris loads. Frequency of operation may vary from as low as once every 15 minutes to once every 2 or more hours. This frequency should coincide with the ESBS cycle time.

d.4. If automated cleaning system problems occur, project personnel shall operate cleaners at least once per shift unless determined differently by the project biologist.

d.5. The dewatering structure may be dewatered twice during the season, during low fish passage periods in June and September, for inspection and cleaning of the dewatering screens. Before dewatering occurs, the project biologist must notify CENWW-OD-T who in turn will coordinate the proposed action with NOAA Fisheries and other FPOM participants.

d.6. Lights at the dewatering structure should be turned off at night, unless needed for personnel access, to encourage fish to move downstream volitionally.

2.3.1.2.e. Sampling Facilities. Note: Normal operations when not sampling fish is to operate the juvenile bypass facilities in full flow bypass to the river. During this operation, fish may be periodically routed through the sampling facilities to sample fish for the Smolt Monitoring Program or for routine sampling to monitor facility descaling and fish condition. Sampling during full flow bypass operations will be coordinated on an as needed basis. Sampling during the juvenile fish bypass season is normally done every other day per **Appendix J**.

e.1. There should be no holes or gaps between screen panels. All silicone sealer should be in good condition.

e.2. Crowder screen brushes should be in good operating condition.

e.3. Assure that retainer screens in raceways and tanks are clean with no holes or protruding wires.

e.4. Operate wet separator and fish distribution system as designed.

e.5. Project personnel shall release ice blocks through each 10" bypass line, 1-3 times per day as warranted by woody debris loads, during the spring as a preventative measure for debris plugging. Additional ice blocks shall be passed down the pipelines during high debris periods as needed to keep the pipes debris free. Releasing ice blocks through the pipes should continue during the summer when transporting fish, as determined by the project biologist to keep the pipelines debris free.

e.6. 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 dewatering).

2.3.1.2.f. Avian Predation Areas (Forebay, Tailrace, and Collection Channel).

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

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

f.3. Project biologists shall routinely monitor project areas to determine areas of active avian predation and, if possible, adjust harassment program to cover these areas or install bird wires or other deterrent devices to discourage avian predation activities. Grebes should be routinely captured in the juvenile fish channel and released below the dam, in coordination with USDA/Wildlife Services.

2.3.1.2.g. Inspection and Record Keeping. Inspect all facilities according to fish facilities monitoring plan. Record all inspections.

2.3.1.2.h. TSW Operation.[1] Spring spill for fish passage will begin with temporary spillway weirs (TSWs) operating in bays 19 and 20 and spill will be distributed in the "Spill Pattern for Fish Passage" (**Table MCN-7**). Both TSWs will be in service through June 7 and removed on June 8 or the next available work day. During removal of the TSWs, spill will be distributed in the "Spill Pattern During TSW Removal" (**Table MCN-10**) to ensure worker safety. Upon completion of the TSW removal when both TSWs are not in service, spill will be distributed in the "Spill Pattern After Both TSWs Removed" (**Table MCN-9**) for the remainder of the fish passage spill season.

2.3.1.2.i. Emergency Bypass during Freezing Conditions.

i.1. When cold weather is forecasted for Umatilla, Oregon, between November 1 and December 15, the McNary Fisheries staff may place the McNary Juvenile Fish Facility (JFF) channel in emergency bypass mode until the beginning of the winter maintenance season when the juvenile channel is fully dewatered.

i. "*Cold weather*" is defined as: forecasted daily high temperature <32°F or daily low temperature < 20°F. Staff shall use the forecast for Umatilla, Oregon, provided by NOAA's National Weather Service at www.weather.gov.

ii. If the projects installs a proposed "X" or "Y" valve in the south trash sluiceway that eliminates the need for emergency bypass, then the fisheries staff may shut down the water supply to the JFF after November 1 until the JFF is re-watered the following March, unless earlier re-watering is required for testing or maintenance.

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

2.3.1.2.j. Emergency Bypass During Late Season Mechanical Failure. After November 30, if a mechanical failure forces the McNary JFF juvenile channel into emergency bypass mode, the McNary Fisheries staff may leave the juvenile channel in emergency bypass mode until the beginning of the winter maintenance season when the juvenile channel is fully dewatered.

2.3.2. Adult Fish Passage Facilities. Operate the adult fish passage facilities according to the following criteria:

2.3.2.1. Winter Maintenance Period (January 1 – end of February).

2.3.2.1.a. Inspect all staff gages and water level indicators. Repair and/or clean where necessary.

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

2.3.2.1.c. Inspect for and clean debris from the fish ladder exits. All trashracks and picketed leads must be clean and installed correctly.

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

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

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

2.3.2.1.g. Maintain adult PIT-tag system as required. Coordinate with PSMFC.

2.3.2.1.h. Outage periods will be minimized to the extent practicable. Only one ladder may be out of service or operating out of standard operating criteria at any one time, unless specifically coordinated with CENWW-OD-T and FPOM.

2.3.2.2. Adult Fish Passage Period (March 1 – December 31). See special operations during lamprey passage June 15 – September 30 (paragraph **j** below).

2.3.2.2.a. Fishway Ladders. Water depth over weirs: 1.0’–1.3'.

2.3.2.2.b. Counting Windows. The crowder shall be opened to full count slot width when not counting. The crowder shall be open as far as possible to allow accurate counting and shall not be closed to less than 18 inches while counting, to the extent possible. This will usually occur during high turbidity conditions to allow count accuracy criteria to be achieved. All equipment should be maintained and in good condition. The

counting window and backboard should be cleaned as needed to maintain good visibility. Crowder ranges at MCN are as follows:

i. Washington Shore = 19 $^{3}/_{16}$" (not adjustable)

ii. Oregon Shore downstream = 13 $^{1}/_{8}$" – 17 $^{5}/_{8}$"

iii. Oregon Shore upstream = 13 $^{1}/_{2}$" – 17 $^{1}/_{8}$"

2.3.2.2.c. Head on all Fishway Entrances. Head range: 1'–2'.

2.3.2.2.d. Channel Velocity. Adult collection channel water velocities must flow between 1.5' - 4' per second. This velocity is optimum criteria for returning adult salmon and steelhead to migrate upstream though the fishway. Velocity readings are completed three times a week and are included in required fishway inspections and reported in the weekly and annual reports.

d.1. Surface water velocities will be measured in the open access area near the south shore fish entrance. The surface velocity will be measured using a large piece of woody debris (stick, bark) timed over a marked fixed distance. A Doppler meter location near the same location measures the subsurface flow. The measurement of the water velocity at this location typifies the slowest velocity conditions throughout the length of the channel.

2.3.2.2.e. North Shore Entrances (WFE 2 & 3).

e.1. Operate 2 downstream gates.

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

2.3.2.2.f. North Powerhouse Entrances (NFE 2 & 3).

f.1. Operate 2 downstream gates.

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

2.3.2.2.g. Floating Orifice Gates (FOGs). Operate twelve FOGs (1, 3, 4, 8, 14, 21, 26, 32, 37, 41, 43, and 44).

2.3.2.2.h. South Shore Entrances (SFE 1 & 2).

h.1. Operate 2 downstream gates.

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

2.3.2.2.i. Head on Trashracks.

i.1. Maximum head of 0.5' on ladder exits.

i.2. Maximum head on picketed leads shall be 0.5'. Normal head differential on clean leads is 0.3'.

i.3. Trashracks and picketed leads installed correctly.

2.3.2.2.j. Lamprey Passage Season June 15–September 30 (modifications with removal of segmental gate stationary section).

j.1. Implement nighttime (2100–0400 hours) segmental gate operations:

i. Lower the SFE 1 entrance weir to the lowest elevation (244 fmsl).

ii. Lower the NFE 2 & 3 entrance weir to the lowest elevation (252 fmsl).

j.2. Daytime operations from 0400–2100 hours:

i. Extend telescoping segmental gates SFE 1 and NFE 2 & 3 depth: 8’ or greater below tailwater.

ii. Maintain tail water and channel differential of 1.0–2.0’.

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

2.3.2.2.l. 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., emergency dewatering).

2.3.2.2.m. Facility Inspections.

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

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

m.3. Picketed leads shall be inspected during all inspections to ensure they are clean and in the correct position (all the way down).

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

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

m.6. Record all inspections.

2.3.3. Facility Monitoring & Reporting. Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections.

2.3.3.1. Weekly Reports. From March 1 – December 31, Project biologists shall prepare weekly reports summarizing project operations. The weekly reports should provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The weekly reports shall cover Friday–Thursday and shall be emailed to CENWW-OD-T by noon the following Monday. The reports shall include:

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

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

iii. Adult fishway control calibrations;

iv. ESBS and VBS inspections;

v. Any unusual activities that occurred at the project that may affect fish passage.

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

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

3. PROJECT MAINTENANCE

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

3.1. Juvenile Fish Passage Facilities.

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

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

survival. Maintenance of facilities such as ESBSs, which sometimes break down during the fish passage season, will be carried out as described below. In these cases, repairs will be made as prescribed and CENWW-OD-T notified for further coordination. Unscheduled maintenance that will have a significant impact on juvenile fish passage shall be coordinated with NOAA Fisheries and other FPOM participants on a case-by-case basis by CENWW-OD-T. CENWW-OD-T will be notified as soon as possible after it becomes apparent that maintenance is required. The Operations Manager may determine that work must be initiated prior to notifying CENWW-OD-T if a delay will result in an unsafe situation for people, property, or fish. Information required by CENWW-OD-T includes (see also **FPP Overview Section 1** for coordination form):

i. Description of outage;

ii. Type of outage required;

iii. Impact on facility operation;

iv. Length of time for repairs; and

v. Potential fish impacts and proposed mitigation measures.

3.1.2.2. Extended-Length Submersible Bar Screens (ESBSs). The ESBSs deflect fish and water up the gatewell slots as part of the fish bypass system and are inspected periodically throughout the juvenile passage season with a video monitoring system. If an ESBS is found to be damaged, it will be removed and either replaced with a spare, or repaired and returned to service. A turbine unit shall not be operated with a known damaged or nonfunctioning screen or without a full complement of ESBSs, flow vanes and VBSs. If a screen 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 a fully screened unit. If all screened turbine units are in service, water may be spilled until the affected screen can be removed and repaired or replaced.

3.1.2.3. Vertical Barrier Screens (VBSs). Each gatewell has a VBS located vertically between the bulkhead slot and the operating gate slot to guide fish away from the turbine intake. The VBSs are designed to distribute flow evenly through the screens to minimize fish impingement and/or descaling. The gatewell water surface elevations are routinely measured to determine head differential across the VBSs caused by debris. VBSs are to be pulled and cleaned when head differentials reach 1.5'. Prior to pulling a VBS for cleaning, the turbine unit loading will be lowered to the lower end of the 1% efficiency range and the gatewell dipped with a gatewell basket to remove all fish present in the gatewell unless doing so results in increased mortality (e.g., high numbers of adult or juvenile shad in gatewells). Immediately after dipping, the VBS shall be raised and debris hosed off. The turbine unit shall remain operating at the lower end of 1% while the VBS is being cleaned so gatewell flow will carry the debris into the operating gatewell where it will pass through the turbine unit. Immediately after cleaning the VBS, the VBS shall be lowered to the normal operating position to prevent fish passing from the bulkhead slot into the operating gate slot. The VBSs shall not be raised longer than 30 minutes with the turbine unit running. If VBSs cannot be cleaned within 1 workday of the head differential reaching 1.5', the turbine unit loading will be lowered to the lower end of the 1% range until the VBS can be cleaned. If the cleaning frequency of VBSs exceeds project personnel's cleaning capability of approximately 10 VBSs per day, 7 days per week, project personnel will notify CENWW-

OD-T. Then CENWW-OD-T will coordinate with NOAA Fisheries and other FPOM participants regarding an exemption to dipping gatewells prior to cleaning VBSs. An exemption to dipping gatewells prior to cleaning VBSs will be based on fish numbers and TDG levels. If a VBS is found to be damaged during an inspection or cleaning, the VBS panel will be repaired or replaced with a spare panel. The turbine unit will not be operated with a known damaged VBS.

3.1.2.4. Gatewell Orifices. Each gatewell has two orifices with valves to allow fish to exit the gatewell. Under normal operation, one orifice per gatewell (normally the south orifice) is operated. If an orifice becomes blocked with debris or is damaged, it will be closed and the alternate orifice for that gatewell operated until repairs can be made. If both orifices are blocked with debris, damaged, or must be kept closed, the turbine unit will be taken out of service until repairs can be made. If there is a major failure with the bypass system that prevents the gatewell orifices from operating, traveling screens and bar screens will remain in operation. Turbine units shall not be operated with blocked or closed orifices for longer than 10 hours. During any orifice closure, project personnel shall monitor gatewells for signs of fish problems or mortality. If repairs are expected to take longer than two days, a salvage program will be initiated to dip the juveniles from the gatewells with a gatewell basket until repairs are made and the system watered up again or orifices opened. Juvenile fish shall not remain in gatewells longer than 48 hours. During periods of high fish passage, it may be necessary to cease operation of turbine units with ESBSs in place and with closed orifices in less than 10 hours, depending on fish numbers and condition. Spill may occur to provide an alternate avenue for fish passage during facility outages.

3.1.2.5. Dewatering Structure. The dewatering structure acts as a transition from the collection channel to the bypass pipe/flume. An inclined screen and a side dewatering screen allow excess water to be bled off, with all fish and remaining water transitioning into the bypass pipe. Some of the excess water is discharged into the adult fish facility auxiliary water supply system and some is used as the water supply for the sampling facilities. The dewatering structure contains trash sweeps and an air-burst system for cleaning the dewatering screens of impinged debris. If a trash sweep breaks and interferes with juvenile fish passage through the structure or if a screen is damaged, an emergency bypass system in the collection channel may be used 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 dewatering structure. The emergency bypass is then opened and the bypass system operated with one orifice per gatewell open. Spill may also be required to bypass juvenile fish while in emergency bypass operations. Prior to any emergency dewatering of the collection channel, the project will notify CENWW-OD-T. Then CENWW-OD-T will be responsible for notifying NOAA Fisheries and other FPOM participants of the action and coordinating changes in spill or other project operations. The emergency bypass system is not equipped with PIT-tag detectors.

3.1.2.6. Bypass Outfall Pipe/Flume. The corrugated metal bypass pipeflume routes juveniles to either the sampling facilities or to the river below the project through the primary bypass pipe. If a problem interferes with the flume's operation, the project can open the emergency bypass system in the collection system and all of the fish in the bypass system

will be diverted into the ice and trash sluiceway and passed to the river through the north powerhouse ice and trash sluiceway exit.

3.1.2.7. Sampling Facilities. The sampling facilities can be operated to collect and hold juveniles for research and sampling purposes, enumerate fish through the sampling system, or bypass part or all of the fish back to the river (secondary bypass). If part of the facility malfunctions or is damaged, the switch gate in the bypass flume will be used to bypass fish directly to the river (primary bypass) until repairs can be made. .

3.2. Adult Fish Passage Facilities.

3.2.1. Scheduled Maintenance. Scheduled maintenance of a facility that must be dewatered to work on or whose maintenance will have a significant effect on fish passage will be done during the January and February winter maintenance period. Maintenance of facilities that will have no effect on fish passage may be conducted at any time. Maintenance is normally conducted on one fish ladder at a time during the winter to provide some fish passage at the project at all times. When facilities are not being maintained during the winter maintenance period, they will be operated according to normal criteria unless otherwise coordinated with NOAA Fisheries and other FPOM participants.

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

3.2.2.1. Fish Ladders & Counting Stations. The fish ladders contain tilting weirs, fixed weirs, counting stations with picket leads, and fish exits with trashracks. If any part of the fish 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, tilting weir mechanisms, and counting stations can sometimes be repaired or maintained without dewatering the ladder. The decision to dewater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after coordination with the fish agencies and tribes.

3.2.2.2. North Shore Auxiliary Water Supply System. The auxiliary water for the north shore fish ladder is provided by gravity-flow from the forebay. The water passes either through a turbine unit or through a bypass system. The turbine/bypass system is operated by North Wasco County PUD. During normal operations, when the turbine unit is operating, water passes through conduits 3 and 4 to the turbine unit. From the turbine unit, the water discharges into an open pool where it feeds into ladder diffusers. If there are problems with the turbine unit, automatic valves close and the auxiliary water is diverted through conduits 1 and 3A to the baffled bypass system within the old fish lock, where the hydraulic head is dissipated and the water discharged into the diffuser pool.

3.2.2.3. South Shore Auxiliary Water Supply System. The south shore auxiliary water is made up of a combination of gravity flow from the forebay and pumped water from the tailrace. The gravity flow supplies the diffusers above weir 253 (diffusers 7 through 14) and the pumps supply diffusers below weir 253 (diffusers 1 through 7 and main unit diffusers). Diffuser 7 is where both systems meet and is supplied by either gravity flow or pumped flow. Gravity flow diffusers are regulated by rotovalves and pumped flow diffusers by sluice gates.

3.2.2.3.a. If a rotovalve fails, the nearest closed rotovalve will be opened to supply flow. If more rotovalves fail than there are closed valves, the sluice gates in diffusers 3 through 7 will be opened more to provide required flows.

3.2.2.3.b. If any sluice gates fail, the nearest sluice gates will be opened further to make up the flow.

3.2.2.3.c. If one pump fails, the other two pumps will be operated to maintain facilities within criteria.

3.2.2.3.d. If two pumps fail and are expected to be out of service short-term, then NFE3 will be closed and SFE1, SFE2, and NFE2 will be operated as deep as possible to maintain the 1–2' head differential.

3.2.2.3.e. If two pumps fail and are expected to be out of service long-term, then the middle eight of twelve open floating orifices (4,8,14,21,26,32,37,41) should be closed and monitored before closing main entrances. If extra water is still needed, NFE3 will be closed and SFE1, SFE2, and NFE2 will be operated as deep as possible to maintain the 1–2' head differential.

3.2.2.3.f. If all three pumps fail and the outage is expected to last five days or less, CENWW-OD-T will be notified and in turn will coordinate with NOAA Fisheries and other FPOM participants.

3.2.2.3.g. If all three pumps fail and the outage is expected to last six days or longer, the powerhouse transportation channel will be bulkheaded off at the junction pool and SFE1 and SFE2 operated a deep as possible and to maintain the 1–2' head differential. If a depth of 6' on both gates cannot be maintained, SFE2 will be closed.

3.2.2.3.h. If both the gravity flow and pumped auxiliary water supply systems fail, the powerhouse transportation channel will be bulkheaded off at the junction pool, SFE2 closed, and SFE1 operated at 6' below tailwater until repairs can be made.

3.2.2.4. Fishway Entrances. Fishway entrances consist of main entrance weirs with hoists and automatic controls, and floating orifices that self-regulate with tailwater fluctuations. If any automatic controls malfunction, the weirs can be operated manually by project personnel and kept within criteria. If there is a further failure that prevents the entrance from being operated manually, the entrance may be lowered down and left in an operating position or an alternate entrance opened until repairs can be made. If a floating orifice fails, it will be pulled out of the water and replaced with a spare floating orifice.

3.2.2.5. Diffuser Gratings. Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally checked during winter maintenance to ensure they are in place. These inspections are done by both 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 **3.1.2**). If possible, a video inspection should be made as soon as possible to determine 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 UNITS OPERATION & MAINTENANCE

4.1. Turbine Unit Operation.

From March 1 – November 30, turbine units will be operated in priority order to enhance adult and juvenile fish passage and juvenile bypass (**Table MCN-5**). During this time period, turbine units available for operation will be operated as needed to meet generation requirements in the following priority order: 1, then 14 through 2 in descending order. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. Unit operation during warm water events are described below in paragraph **4.1.1.**

Table MCN-5. Turbine Unit Operation Priority for McNary Dam.

Operation	Unit Priority
March 1–November 30 Fish Passage Season, Fish Bypass	1, then 14 through 2 in descending order [a]
Warm Water Operations [b]	"Warm Water Operations" STOP Units in the following order: Unit 1 available: every other unit starting w/ 2 and move north. 2, 4, 6, 8, 10, 12, 14, 3, 5, 7, 9, 11, 13, then 1 Unit 1 OOS: every other unit starting w/ 3 and move north. 3, 5, 7, 9, 11, 13, 2, 4, 6, 8, 10, 12, 14

a. Provides positive downstream flows at the outfall and based on unit availability.

b. See section **4.1.1**. below for criteria and protocols during Warm Water Operations. Shut down units in a staggered manner (every other unit) starting with Unit 2 moving northward. If Unit 1 is OOS, start with Unit 3 and move northward. This order may be adjusted if necessary as coordinated by the Project Biologist.

4.1.1. Warm Water Operations. At the request of McNary Fisheries, the project will implement the following protocols during "*Warm Water Operations*" when water temperatures at the McNary Juvenile Fish Facility (JFF) exceed 68°F in order to minimize thermal stress on

salmonid species. The project and CENWW will coordinate these protocols with fish agencies and tribes through FPOM and other entities as necessary. The purpose of these protocols is to provide precautionary measures to avoid or minimize any direct or delayed mortality resulting from additional thermal stress when handling juvenile salmonid fishes.

4.1.1.1. Operation in Secondary Bypass or Sample Mode. When any of the criteria listed below occur, the project will begin to shut down turbine units in a staggered priority, stopping every other unit starting with unit 2, and ascending as necessary to avoid temperature shocks within the juvenile channel (i.e., shutting down units 2, 4, 6, 8, 10, 12 and 14 as necessary). If possible, unit 1 shall be left in operation to provide attraction flow to the two entrances of the Oregon shore fish ladder. The Project Biologist will coordinate with CENWW to modify this sequence if necessary to provide equal or better levels of protection to salmonid fishes. Starting and stopping of two or more units at a time should be avoided if possible during periods of warm water, especially during the hours of 1000–2400. Turbine operations during periods of warm water will begin when *any* of the following criteria occur:

i. Water temperatures in the McNary JFF >68°F; or

ii. Water temperatures elsewhere at the project (e.g., gatewells) that are likely to induce thermal stress in juvenile salmonids; or

iii. Temperature gradients >5°F; or

iv. Sample mortality >3%; or

v. System mortality >6%.

4.1.1.2. Continued Mortality. If juvenile salmonid populations continue to experience high mortality after implementing the above procedures, collection for fish condition sampling by smolt monitoring staff should continue for up to 8 hours a day. The project shall switch to primary bypass, routing fish past the JFF and through the outfall bypass line, except for daily monitoring, for the duration of the event.

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

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

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

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

iv. Comply with other coordinated fish measures.

Table MCN-6. McNary Dam Turbine Unit Output (MW) and Discharge (cfs) Per Unit at Upper and Lower Limits of the 1% Peak Efficiency Operating Range. *

Project Head (feet)	With ESBSs				Without ESBSs			
	1% Lower Limit		1% Upper Limit		1% Lower Limit		1% Upper Limit	
	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)	(MW)	(cfs)
67	37.5	7,934	56.7	11,997	37.7	7,739	57.9	11,887
68	38.0	7,911	58.2	12,121	38.2	7,716	59.4	12,009
69	38.5	7,887	59.7	12,240	38.7	7,694	60.9	12,128
70	**39.0**	**7,864**	**61.2**	**12,355**	**39.2**	**7,671**	**62.5**	**12,243**
71	39.6	7,874	62.1	12,355	39.8	7,681	63.4	12,243
72	40.2	7,883	63.1	12,354	40.4	7,691	64.4	12,242
73	40.9	7,892	64.0	12,353	41.1	7,699	65.3	12,241
74	41.5	7,901	64.9	12,351	41.7	7,708	66.3	12,240
75	**42.2**	**7,909**	**65.8**	**12,350**	**42.4**	**7,716**	**67.2**	**12,239**
76	42.8	7,907	66.4	12,282	43.0	7,714	67.9	12,172
77	43.4	7,905	67.1	12,216	43.6	7,713	68.5	12,107
78	44.0	7,903	67.7	12,151	44.2	7,711	69.1	12,043
79	44.6	7,900	68.3	12,088	44.8	7,709	69.7	11,980
80	**45.2**	**7,897**	**68.9**	**12,026**	**45.5**	**7,706**	**70.3**	**11,920**
81	45.9	7,893	70.0	12,039	46.1	7,720	71.5	11,961
82	46.5	7,889	71.1	12,050	46.8	7,734	72.6	12,000
83	47.2	7,884	72.2	12,061	47.4	7,747	73.7	12,038

* Table revised to reflect new information using the 1998 index test and 1955 Prototype Hill Curve.

4.2. Turbine Unit Maintenance.

The project turbine unit maintenance schedule will be reviewed annually by project and Operations Division biologists for fish impacts. If possible, maintenance of priority units will be scheduled for non-fish passage periods, or when there are low numbers of fish passing the project. Each turbine unit requires annual maintenance that may take from several days to two weeks. Annual maintenance of all turbine units is normally scheduled during the mid-July to late December time frame. The maintenance of priority units for adult passage is normally conducted in November or December but can be completed in mid-August. Impacts to migrating adults should be minimized. When possible, units used for temperature operations should remain available. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the one percent best efficiency range. This work will be scheduled in compliance with BPA Load Shaping Guidelines (**Appendix C**) to minimize impacts on juvenile fish.

4.3. Head Gates. [2]

Head gates will normally remain in the standard operating position, except as required for maintenance activities.

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

4.3.2. Operational Testing. Units may be operationally tested for up to 30 minutes before going into maintenance status by running the unit at speed no load and various loads within the 1% criteria to allow pre-maintenance measurements and testing and to allow all fish to move through the unit. Units may be operationally tested after maintenance or repair while remaining in maintenance or forced outage status. Operational testing may consist of running the unit for up to a cumulative time of 30 minutes (within 1% criteria) before it is returned to operational status. Operational testing of unit under maintenance is in addition to a unit in run status (e.g., minimum generation) required for power plant reliability. Operational testing may deviate from fish priority units and may require water that would otherwise be used for spill if the running unit for reliability is at its 1% minimum load. Water will be used from the powerhouse allocation if possible, and water diverted from spill for operational testing will be minimized to that necessary to maintain and assure generation system reliability.

5. FOREBAY DEBRIS REMOVAL

Debris at projects can adversely impact fish passage conditions. Debris can plug or block trashracks, VBSs, gatewell orifices, dewatering screens, separators, and facility piping resulting in impingement, injuries, and descaling of fish. Removing debris at its source in the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation, and other project activities. Debris can be removed from the forebay by:

i. Using a boat to physically encircle debris with a log boom to pull it to the spillway where operators can spill it or to the shore to be removed by crane;

ii. removing the debris from the top of the dam using a crane and scoop;

iii. passing debris through the spillway with special powerhouse and/or spill operations; or

iv. Using a boom, spreader bar or other device, suspended from a crane, to move the debris to the spillway, in coordination with special powerhouse and spill operations (if needed).

[2] Head gates may also be referred to as "operating" gates. The terms are interchangeable.

The preferred option is to remove debris at each project when possible to avoid passing debris on to the next project downstream. This is not always possible at each project as some projects do not have forebay debris removal capability. In this case, the only viable alternative is to spill to pass the debris. Except in an emergency, the project shall contact CENWW-OD-T and the John Day Dam Control Room and Fishery Biologist at least one workday in advance of debris passage operations that will be commencing. Using information provided by the project, CENWW-OD-T will notify FPOM. The special operation will be detailed in a teletype issued by RCC. In an emergency operation, notification may be provided as indicated in section **5.1.1.**

5.1. Special Spills.

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. Then CENWW-OD-T shall coordinate the special operations with RCC, NOAA Fisheries, and other FPOM participants. Project personnel shall provide CENWW-OD-T the reason for the debris spill request including an explanation of project facilities being impacted by the debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

5.1.1. Emergency Spills. Implement as necessary to pass woody debris that is accumulating in the forebay, 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 MCN-7. [*pg 1 of 4*] McNary Dam Spill Patterns with TSWs for Fish Passage. [a]

Total Spill [a]	MCN Spill Patterns with TSWs for Fish Passage – # Gate Stops per Spillbay [b]																						Total Stops
(kcfs)	1 [c]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 TSW	20 TSW	21	22 [c]	(#)
21.2																			5.5	5.5	1		12
23.2																		1	5.5	5.5	1		13
25.2																		1	5.5	5.5	1	1	14
27.1																		1	5.5	5.5	2	1	15
29.0																		2	5.5	5.5	2	1	16
31.0																	1	2	5.5	5.5	2	1	17
32.9																	2	2	5.5	5.5	2	1	18
34.9															1		2	2	5.5	5.5	2	1	19
36.8															1		2	2	5.5	5.5	2	2	20
38.7															2		2	2	5.5	5.5	2	2	21
40.7															2	1	2	2	5.5	5.5	2	2	22
42.6															2	2	2	2	5.5	5.5	2	2	23
44.6														1	2	2	2	2	5.5	5.5	2	2	24
46.5														2	2	2	2	2	5.5	5.5	2	2	25
48.5											1		2		2	2	2	2	5.5	5.5	2	2	26
50.4											2		2		2	2	2	2	5.5	5.5	2	2	27
52.4									1		2		2		2	2	2	2	5.5	5.5	2	2	28
54.3									2		2		2		2	2	2	2	5.5	5.5	2	2	29
56.3									2	1	2		2		2	2	2	2	5.5	5.5	2	2	30
58.2									2	2	2		2		2	2	2	2	5.5	5.5	2	2	31
60.2									2	2	2		2	1	2	2	2	2	5.5	5.5	2	2	32
62.1									2	2	2		2	2	2	2	2	2	5.5	5.5	2	2	33
64.1									2	2	2	1	2	2	2	2	2	2	5.5	5.5	2	2	34
66.0									2	2	2	2	2	2	2	2	2	2	5.5	5.5	2	2	35
68.0							1		2	2	2	2	2	2	2	2	2	2	5.5	5.5	2	2	36
69.9							2		2	2	2	2	2	2	2	2	2	2	5.5	5.5	2	2	37
71.9					1		2		2	2	2	2	2	2	2	2	2	2	5.5	5.5	2	2	38
73.8					2		2		2	2	2	2	2	2	2	2	2	2	5.5	5.5	2	2	39
75.3	2.5	2	3.5		2		2		2		2		2	1	2		2	2	5.5	5.5	2	2	40
77.3	2.5	2	3.5		2		2		2		2		2	1	2	1	2	2	5.5	5.5	2	2	41
79.3	2.5	2	3.5		2	1	2		2		2		2	1	2	1	2	2	5.5	5.5	2	2	42
81.3	2.5	2	3.5		2	1	2		2	1	2		2	1	2	1	2	2	5.5	5.5	2	2	43
83.3	2.5	2	3.5		2	1	2		2	1	2	1	2	1	2	1	2	2	5.5	5.5	2	2	44
85.3	2.5	2	3.5		2	1	2	1	2	1	2	1	2	1	2	1	2	2	5.5	5.5	2	2	45
87.3	2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	1	2	1	2	2	5.5	5.5	2	2	46

Total Spill [a] (kcfs)	MCN Spill Patterns with TSWs for Fish Passage – # Gate Stops per Spillbay [b]																						Total Stops (#)
	1 [c]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 TSW	20 TSW	21	22 [c]	
89.0	2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	1	2	1	2	2	5.5	5.5	2.5	2.5	**47**
90.9	2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	2	2	1	2	2	5.5	5.5	2.5	2.5	**48**
90.9	2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	2	2	1	2	2	5.5	5.5	2.5	2.5	**48**
92.8	2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	2	2	2	2	2	5.5	5.5	2.5	2.5	**49**
94.7	2.5	2	3.5	1	2	2	2	1	2	1	2	1	2	2	2	2	2	2	5.5	5.5	2.5	2.5	**50**
96.6	2.5	2	3.5	1	2	2	2	1	2	2	2	1	2	2	2	2	2	2	5.5	5.5	2.5	2.5	**51**
98.5	2.5	2	3.5	1	2	2	2	1	2	2	2	2	2	2	2	2	2	2	5.5	5.5	2.5	2.5	**52**
100.4	2.5	2	3.5	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	5.5	5.5	2.5	2.5	**53**
102.3	2.5	2	3.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	5.5	5.5	2.5	2.5	**54**
103.9	2.5	2.5	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	5.5	5.5	2.5	2.5	**55**
105.6	2.5	2.5	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	5.5	5.5	3.5	2.5	**56**
107.3	2.5	2.5	4	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	3	5.5	5.5	2.5	2.5	**57**
109.0	2.5	2.5	4	2	2	2	2.5	2	2	2	2.5	2	2	2	2	2.5	2.5	3	5.5	5.5	2.5	2.5	**58**
110.7	2.5	2.5	4	2	2.5	2	2.5	2	2	2	2.5	2	2	2	2.5	2.5	2.5	3	5.5	5.5	2.5	2.5	**59**
112.4	2.5	2.5	4	2	2.5	2	2.5	2	2.5	2	2.5	2	2.5	2	2.5	2.5	2.5	3	5.5	5.5	2.5	2.5	**60**
114.1	2.5	2.5	4	2	2.5	2.5	2.5	2	2.5	2.5	2.5	2	2.5	2	2.5	2.5	2.5	3	5.5	5.5	2.5	2.5	**61**
115.8	2.5	2.5	4	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2.5	2.5	3	5.5	5.5	2.5	2.5	**62**
117.5	2.5	2.5	4	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2.5	2.5	3	5.5	5.5	2.5	2.5	**63**
119.2	2.5	2.5	4	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	5.5	5.5	3	2.5	**64**
120.9	2.5	2.5	4	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3	3	5.5	5.5	3	2.5	**65**
122.6	2.5	2.5	4.5	3	2.5	2.5	2.5	2.5	2.5	2.5	3	2.5	2.5	2.5	2.5	3	3	3	5.5	5.5	3	2.5	**66**
124.3	2.5	2.5	4.5	3	2.5	2.5	3	2.5	2.5	2.5	3	2.5	3	2.5	2.5	3	3	3	5.5	5.5	3	2.5	**67**
126.0	2.5	2.5	4.5	3	3	2.5	3	2.5	3	2.5	3	2.5	3	2.5	2.5	3	3	3	5.5	5.5	3	2.5	**68**
127.7	2.5	2.5	4.5	3	3	3	3	2.5	3	2.5	3	2.5	3	2.5	3	3	3	3	5.5	5.5	3	2.5	**69**
129.3	2.5	2.5	5	3	3	3	3	2.5	3	3	3	2.5	3	2.5	3	3	3	3	5.5	5.5	3	2.5	**70**
131.0	2.5	2.5	5	3	3	3	3	3	3	3	3	3	3	2.5	3	3	3	3	5.5	5.5	3	2.5	**71**
132.7	3	3	5	3	3	3	3	3	3	3	3	3	3	2.5	3	3	3	3	5.5	5.5	3	2.5	**72**
134.4	3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	5.5	5.5	3	3	**73**
136.0	3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	5.5	5.5	3	3	**74**
137.6	3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	5.5	5.5	3	3	**75**
139.2	3	4	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	5.5	5.5	3	3	**76**
140.8	4	4	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	5.5	5.5	3	3	**77**
142.4	4	4	5	3	3	3	4	3	3	3	3	3	3	3	3	3	4	4	5.5	5.5	3	3	**78**
144.0	4	4	5	3	3	3	4	3	3	3	4	3	3	3	3	3	4	4	5.5	5.5	3	3	**79**
145.6	4	4	5	3	4	3	4	3	3	3	4	3	3	3	3	3	4	4	5.5	5.5	3	3	**80**
147.2	4	4	5	3	4	3	4	3	3	3	4	3	3	3	4	3	4	4	5.5	5.5	3	3	**81**

Total Spill [a] (kcfs)	MCN Spill Patterns with TSWs for Fish Passage – # Gate Stops per Spillbay [b]																						Total Stops (#)
	1 [c]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 TSW	20 TSW	21	22 [c]	
148.8	4	4	5	3	4	3	4	3	4	3	4	3	3	3	4	3	4	4	5.5	5.5	3	3	**82**
150.4	4	4	5	3	4	3	4	3	4	3	4	3	4	3	4	3	4	4	5.5	5.5	3	3	**83**
152.0	4	4	5	3	4	4	4	3	4	3	4	3	4	3	4	3	4	4	5.5	5.5	3	3	**84**
153.6	4	4	5	3	4	4	4	3	4	4	4	3	4	3	4	3	4	4	5.5	5.5	3	3	**85**
155.2	4	4	5	3	4	4	4	3	4	4	4	4	4	3	4	3	4	4	5.5	5.5	3	3	**86**
156.8	4	4	5	3	4	4	4	4	4	4	4	4	4	3	4	3	4	4	5.5	5.5	3	3	**87**
158.4	4	4	5	3	4	4	4	4	4	4	4	4	4	3	4	4	4	4	5.5	5.5	3	3	**88**
160.0	4	4	5	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	5.5	5.5	3	3	**89**
161.6	4	4	5	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	5.5	5.5	4	3	**90**
163.2	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5.5	5.5	4	3	**91**
164.8	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5.5	5.5	4	3	**92**
166.4	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5.5	5.5	4	3	**93**
168.0	4	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5.5	5.5	4	3	**94**
169.6	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5.5	5.5	4	3	**95**
171.2	5	5	5	4	4	4	5	4	4	4	4	4	4	4	4	4	5	5	5.5	5.5	4	3	**96**
172.8	5	5	5	4	4	4	5	4	4	4	5	4	4	4	4	4	5	5	5.5	5.5	4	3	**97**
174.4	5	5	5	4	5	4	5	4	4	4	5	4	4	4	4	4	5	5	5.5	5.5	4	3	**98**
176.0	5	5	5	4	5	4	5	4	4	4	5	4	4	4	5	4	5	5	5.5	5.5	4	3	**99**
177.6	5	5	5	4	5	4	5	4	5	4	5	4	4	4	5	4	5	5	5.5	5.5	4	3	**100**
179.2	5	5	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	5	5.5	5.5	4	3	**101**
180.8	5	5	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	5	5.5	5.5	5	3	**102**
182.4	5	5	5	4	5	5	5	4	5	4	5	4	5	4	5	4	5	5	5.5	5.5	5	3	**103**
184.0	5	5	5	4	5	5	5	4	5	5	5	4	5	4	5	4	5	5	5.5	5.5	5	3	**104**
185.6	5	5	5	4	5	5	5	4	5	5	5	5	5	4	5	4	5	5	5.5	5.5	5	3	**105**
187.2	5	5	5	4	5	5	5	5	5	5	5	5	5	4	5	4	5	5	5.5	5.5	5	3	**106**
188.8	5	5	5	4	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5.5	5.5	5	3	**107**
190.4	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5.5	5.5	5	3	**108**
192.0	5	5	6	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5.5	5.5	5	3	**109**
193.6	5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5.5	5.5	5	3	**110**
195.2	5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	6	5.5	5.5	5	3	**111**
196.8	5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	6	6	5.5	5.5	5	3	**112**
198.4	5	5	6	5	5	5	5	5	5	5	5	5	5	5	6	5	6	6	5.5	5.5	5	3	**113**
200.0	5	5	6	5	5	5	5	5	5	5	5	5	6	5	6	5	6	6	5.5	5.5	5	3	**114**
201.6	5	5	6	5	5	5	5	5	5	5	5	5	6	5	6	6	6	6	5.5	5.5	5	3	**115**
203.2	5	5	6	6	5	5	5	5	5	5	5	5	6	5	6	6	6	6	5.5	5.5	5	3	**116**
204.8	5	5	6	6	5	5	5	5	5	5	5	5	6	5	6	6	6	6	5.5	5.5	6	3	**117**

Total Spill [a] (kcfs)	MCN Spill Patterns with TSWs for Fish Passage – # Gate Stops per Spillbay [b]																						Total Stops (#)
	1 [c]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 TSW	20 TSW	21	22 [c]	
206.4	5	5	6	6	5	5	5	5	5	5	5	6	6	5	6	6	6	6	5.5	5.5	6	3	**118**
208.0	5	5	6	6	5	5	5	5	5	5	5	5	6	6	6	6	6	6	5.5	5.5	6	4	**119**
211.2	5	5	6	6	6	5	5	5	5	5	5	6	6	6	6	6	6	6	5.5	5.5	6	4	**121**
214.4	5	5	6	6	6	5	6	5	5	5	6	6	6	6	6	6	6	6	5.5	5.5	6	4	**123**
217.6	5	5	6	6	6	6	6	5	6	5	6	6	6	6	6	6	6	6	5.5	5.5	6	4	**125**
220.8	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5.5	5.5	6	4	**127**
224.0	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5.5	5.5	6	4	**129**
230.4	6	6	6	6	6	6	6	6	6	6	7	6	7	6	7	6	7	6	5.5	5.5	6	4	**133**
233.6	6	6	6	6	6	6	7	6	7	6	7	6	7	6	7	6	7	6	5.5	5.5	6	4	**135**
236.8	6	6	7	6	7	6	7	6	7	6	7	6	7	6	7	6	7	6	5.5	5.5	6	4	**137**
240.0	7	6	7	6	7	6	7	6	7	6	7	6	7	6	7	6	7	7	5.5	5.5	6	4	**139**
243.2	7	6	7	6	7	6	7	6	7	6	7	6	7	7	7	7	7	7	5.5	5.5	6	4	**141**
246.4	7	6	7	6	7	6	7	6	7	7	7	7	7	7	7	7	7	7	5.5	5.5	6	4	**143**
249.6	7	6	7	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5.5	5.5	6	4	**145**
252.8	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5.5	5.5	6	4	**147**
256.0	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5.5	5.5	6	6	**149**
259.2	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5.5	5.5	7	7	**151**

a. Total Spill calculated based on forebay elevation 339 ft = ~1.8 kcfs spill per 1 gate stop.

b. Bays 19-20 with TSWs = ~5.5 stops (at fb el 339). Raise tainter gates ~3-5 ft above water surface to ensure free flow through TSW.

c. Bays 1 & 22 *MAY* require special open/close sequence (pending field test verification). Open: Bays 2–21, then 1 & 22 after 2-21 have operated ≥10 minutes. Close: Bays 1 & 22, then 2–21.

Table MCN-8. McNary Dam Spill Patterns with TSWs for Navigation. [a]

Total Spill [a]	MCN Spill Patterns with TSWs for Navigation – # Gate Stops per Spillbay [b]																						Total Stops
(kcfs)	1 [c]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 TSW	20 TSW	21	22 [c]	(#)
21.2																			5.5	5.5	1		12
23.2																		1	5.5	5.5	1		13
25.2		1																1	5.5	5.5	1		14
27.1		2																1	5.5	5.5	1		15
28.8		3																1	5.5	5.5	1		16
30.8		3																1	5.5	5.5	1	1	17
32.4		4																1	5.5	5.5	1	1	18
34.7		3	2															1	5.5	5.5	1	1	19
36.3		4	2															1	5.5	5.5	1	1	20
38.0		4	3															1	5.5	5.5	1	1	21
40.0		4	3													1		1	5.5	5.5	1	1	22
41.6		4	4													1		1	5.5	5.5	1	1	23
43.6		4	4												1	1		1	5.5	5.5	1	1	24
45.6		4	4										1		1	1		1	5.5	5.5	1	1	25
47.5		4	4										2		1	1		1	5.5	5.5	1	1	26
49.5		4	4								1		2		1	1		1	5.5	5.5	1	1	27
51.5		4	4						1		1		2		1	1		1	5.5	5.5	1	1	28
53.4		4	4						1		2		2		1	1		1	5.5	5.5	1	1	29
55.3		4	4						1		2		2		1	1		1	5.5	5.5	2	1	30
57.2		4	4						1		2		2		1	1		2	5.5	5.5	2	1	31
59.1		4	4						2		2		2		1	1		2	5.5	5.5	2	1	32
61.0		4	4						2		2		2		1	2		2	5.5	5.5	2	1	33
62.9		4	4						2		2		2		2	2		2	5.5	5.5	2	1	34
64.5		5	4						2		2		2		2	2		2	5.5	5.5	2	1	35
66.4		5	4						2		2		2		2	2		2	5.5	5.5	2	2	36

a. Total Spill calculated based on forebay elevation 339 ft = ~1.8 kcfs spill per 1 gate stop.
b. Bays 19-20 with TSWs =~5.5 stops (at fb el 339). Raise tainter gates ~3-5 ft above water surface to ensure free flow through TSW.
c. Bays 1 & 22 *MAY* require special open/close sequence (pending field test verification). Open: Bays 2–21, then 1 & 22 after 2-21 have operated ≥10 minutes.
Close: Bays 1 & 22, then 2–21.

Table MCN-9. [*pg 1 of 5*]. McNary Dam Spill Patterns with No TSWs. [a]

Total Spill [a]	MCN Spill Patterns with *No* TSWs – # Gate Stops per Spillbay																						Total Stops
(kcfs)	1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)
3.9																			2				**2**
7.8																			2	2			**4**
9.5																			2.5	2.5			**5**
11.7																		2	2	2			**6**
13.4																		2	2.5	2.5			**7**
15.6																	2	2	2	2			**8**
17.3																	2	2.5	2.5	2			**9**
19.5															2		2	2	2	2			**10**
21.2															2		2	2.5	2.5	2			**11**
23.4													2		2		2	2	2	2			**12**
25.1													2		2		2	2.5	2.5	2			**13**
27.3											2		2		2		2	2	2	2			**14**
29.0											2		2		2		2	2.5	2.5	2			**15**
31.2									2		2		2		2		2	2	2	2			**16**
32.9									2		2		2		2		2	2.5	2.5	2			**17**
35.1									2		2		2		2	2	2	2	2	2			**18**
36.8									2		2		2		2	2	2.5	2	2.5	2			**19**
39.0							2		2		2		2		2	2	2	2	2	2			**20**
40.7							2		2		2		2		2	2	2.5	2	2.5	2			**21**
42.9					2		2		2		2		2		2	2	2	2	2	2			**22**
44.6					2		2		2		2		2		2	2	2.5	2	2.5	2			**23**
46.8					2		2		2		2		2	2	2	2	2	2	2	2			**24**
48.5					2		2		2		2		2	2	2	2.5	2	2.5	2	2			**25**
50.7					2		2		2		2		2	2	2	2	2	2	2	2	2		**26**
52.4					2		2		2		2		2	2	2	2.5	2	2.5	2	2	2		**27**
54.6					2		2		2		2		2	2	2	2	2	2	2	2	2	2	**28**
56.3					2		2		2		2		2	2	2	2.5	2	2.5	2	2	2	2	**29**
58.5					2		2		2		2	2	2	2	2	2	2	2	2	2	2	2	**30**
60.2					2		2		2		2	2	2	2	2	2.5	2	2.5	2	2	2	2	**31**
61.9					2		2		2		2	2	2	2.5	2	2.5	2	2.5	2	2.5	2	2	**32**
63.6					2		2		2		2	2	2	2.5	2	2.5	2.5	2.5	2	2.5	2.5	2	**33**
65.3					2		2		2		2	2	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	**34**

Total Spill [a]	MCN Spill Patterns with *No* TSWs – # Gate Stops per Spillbay																						Total Stops
(kcfs)	1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)
67.0					2		2		2		2	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	**35**
68.7					2		2		2		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	**36**
70.4					2		2		2		2.5	2.5	2.5	2.5	2.5	3	2.5	3	2.5	2.5	2.5	2.5	**37**
71.3	2	3.5	3.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2						**37**
73.0	2	3.5	3.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2	2						**38**
74.7	2.5	3.5	3.5	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2						**39**
76.3	2.5	4	4	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2	2						**40**
78.0	2.5	4	4	2.5	2.5	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2						**41**
79.6	2.5	4.5	4.5	2.5	2.5	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2						**42**
81.3	2.5	4.5	4.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2	2	2	2	2	2						**43**
82.9	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2	2	2	2	2	2						**44**
85.1	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2	2	2	2	2	2	2	2	2	2					**45**
86.8	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2	2	2	2	2	2	2					**46**
88.5	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2	2	2	2	2					**47**
90.2	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2	2	2					**48**
92.4	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2	2	2	2	2	2				**49**
94.1	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2	2	2	2				**50**
95.8	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2	2				**51**
98.0	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2	2	2	2	2			**52**
99.7	2.5	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2	2.5	2	2.5	2			**53**
101.4	3	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2	2.5	2			**54**
103.1	3	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2			**55**
105.3	3	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2	2.5	2	2		**56**
107.0	3	5	5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2		**57**
108.7	3	5	5	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2		**58**
110.4	3	5	5	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2		**59**
112.1	3	5	5	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5		**60**
114.3	3	5	5	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2	2	**61**
116.0	3.5	5	5	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2	**62**
117.7	3.5	5	5	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	**63**
119.4	3.5	5	5	3	3	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	**64**
121.1	3.5	5	5	3	3	3	3	3	3	3	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	**65**

Total Spill [a]	MCN Spill Patterns with *No* TSWs – # Gate Stops per Spillbay																					Total Stops
(kcfs)	1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)
122.8	3.5	5	5	3	3	3	3	3	3	3	3	2.5	3	2.5	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	**66**
124.5	3.5	5	5	3	3	3	3	3	3	3	3	2.5	3	2.5	3	2.5	3	2.5	3	2.5	2.5	2.5	**67**
126.0	3.5	6	6	3	3	3	3	3	3	3	3	2.5	3	2.5	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	**68**
127.6	4	6	6	3	3	3	3	3	3	3	3	2.5	3	2.5	3	2.5	3	2.5	2.5	2.5	2.5	2.5	**69**
129.3	4	6	6	3	3	3	3	3	3	3	3	3	3	2.5	3	2.5	3	2.5	3	2.5	2.5	2.5	**70**
131.0	4	6	6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2.5	3	2.5	2.5	2.5	**71**
132.7	4	6	6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2.5	2.5	**72**
134.4	4	6	6	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	**73**
136.0	4	6	6	3.5	3	3.5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	**74**
137.6	4	6	6	3.5	3	3.5	3	3.5	3	3.5	3	3	3	3	3	3	3	3	3	3	3	3	**75**
139.2	4	6	6	3.5	3	3.5	3	3.5	3	3.5	3	3.5	3	3.5	3	3	3	3	3	3	3	3	**76**
140.8	4.5	7	7	3.5	3	3.5	3	3.5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	**77**
142.4	4.5	7	7	3.5	3	3.5	3	3.5	3	3.5	3	3.5	3	3	3	3	3	3	3	3	3	3	**78**
144.0	4.5	7	7	3.5	3.5	3.5	3	3.5	3	3.5	3	3.5	3	3.5	3	3	3	3	3	3	3	3	**79**
145.6	4.5	7	7	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3	3.5	3	3.5	3	3	3	3	3	3	3	3	**80**
147.2	4.5	7	7	4	3.5	4	3.5	3.5	3.5	3.5	3	3.5	3	3.5	3	3	3	3	3	3	3	3	**81**
148.8	4.5	7	7	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3	3	3	3	3	3	3	3	**82**
150.4	4.5	7	7	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3	3.5	3	3.5	3	3	3	3	**83**
152.0	4.5	7	7	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3	3.5	3	3.5	3	3	**84**
153.6	4.5	7	7	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3	3	**85**
155.2	4.5	7	7	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	**86**
157.0	4.5	8	8	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3	3	**87**
158.6	4.5	8	8	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	**88**
160.2	4.5	8	8	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	3.5	4	3.5	3.5	3.5	3.5	**89**
161.8	4.5	8	8	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	3.5	4	3.5	4	3.5	4	3.5	3.5	**90**
163.4	4.5	8	8	4	3.5	4	3.5	3.5	3.5	4	3.5	4	3.5	4	3.5	4	3.5	4	3.5	4	3.5	3.5	**91**
165.0	4.5	8	8	4	3.5	4	3.5	4	3.5	4	3.5	4	3.5	4	3.5	4	3.5	4	3.5	4	3.5	4	**92**
166.6	4.5	8	8	4	3.5	4	3.5	4	3.5	4	3.5	4	3.5	4	3.5	4	4	4	4	4	3.5	4	**93**
168.2	4.5	8	8	4	3.5	4	3.5	4	3.5	4	3.5	4	4	4	4	4	4	4	4	4	3.5	4	**94**
169.8	4.5	8	8	4	3.5	4	3.5	4	3.5	4	4	4	4	4	4	4	4	4	4	4	4	4	**95**
171.4	4.5	8	8	4	3.5	4	3.5	4	3.5	4	4	4	4	4	4	4.5	4	4.5	4	4	4	4	**96**
173.0	4.5	8	8	4	3.5	4	3.5	4	3.5	4	4	4	4	4	4	4.5	4.5	4.5	4.5	4	4	4	**97**

Total Spill [a]	MCN Spill Patterns with *No* TSWs – # Gate Stops per Spillbay																					Total Stops
(kcfs)	1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)
174.6	4.5	8	8	4	3.5	4	3.5	4	3.5	4	4	4	4	4.5	4	4.5	4.5	4.5	4.5	4.5	4	4	**98**
176.2	5	8	8	4	3.5	4	3.5	4	4	4	4	4	4	4.5	4	4.5	4.5	4.5	4.5	4.5	4	4	**99**
177.8	5	8	8	4	3.5	4	3.5	4	4	4.5	4	4.5	4	4.5	4	4.5	4.5	4.5	4.5	4.5	4	4	**100**
179.4	5	8	8	4	3.5	4	3.5	4	4	4.5	4	4.5	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4	**101**
181.0	5	8	8	4	3.5	4	3.5	4	4	4.5	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	**102**
182.6	5	8	8	4	3.5	4	3.5	4	4	4.5	4	4.5	4.5	4.5	4.5	5	4.5	5	4.5	4.5	4.5	4.5	**103**
184.2	5	8	8	4	3.5	4	3.5	4	4	4.5	4	4.5	4.5	5	4.5	5	4.5	5	4.5	5	4.5	4.5	**104**
185.8	5	8	8	4	4	4	4	4	4	4.5	4	4.5	4.5	5	4.5	5	4.5	5	4.5	5	4.5	4.5	**105**
187.4	5	8	8	4	4	4	4	4.5	4	4.5	4	4.5	4.5	5	4.5	5	5	5	4.5	5	4.5	4.5	**106**
189.0	6	8	8	4	4	4	4	4.5	4	4.5	4	4.5	4.5	5	4.5	5	5	5	4.5	5	4.5	4.5	**107**
190.6	6	8	8	4	4	4	4	4.5	4	4.5	4	4.5	4.5	5	5	5	5	5	5	5	4.5	4.5	**108**
192.2	6	8	8	4	4	4	4	4.5	4	4.5	4.5	4.5	4.5	5	5	5	5	5	5	5	5	4.5	**109**
193.8	6	8	8	4.5	4	4.5	4	4.5	4	4.5	4.5	4.5	4.5	5	5	5	5	5	5	5	5	4.5	**110**
195.4	6	8	8	4.5	4	4.5	4	4.5	4.5	4.5	4.5	5	4.5	5	5	5	5	5	5	5	5	4.5	**111**
197.0	6	8	8	4.5	4	4.5	4.5	4.5	4.5	5	4.5	5	4.5	5	5	5	5	5	5	5	5	4.5	**112**
198.6	6	8	8	4.5	4.5	4.5	4.5	5	4.5	5	4.5	5	4.5	5	5	5	5	5	5	5	5	4.5	**113**
200.2	6	8	8	5	4.5	5	4.5	5	4.5	5	4.5	5	4.5	5	5	5	5	5	5	5	5	4.5	**114**
201.8	6	8	8	5	4.5	5	4.5	5	4.5	5	4.5	5	5	5	5	5	5	5	5	5	5	5	**115**
203.4	6	8	8	5	4.5	5	4.5	5	4.5	5	4.5	5	5	5	5	5	6	5	5	5	5	5	**116**
206.6	6	8	8	5	4.5	5	4.5	5	4.5	5	4.5	5	5	5	6	5	6	5	6	5	5	5	**118**
209.8	6	8	8	5	4.5	5	4.5	5	4.5	5	4.5	5	6	5	6	5	6	5	6	5	6	5	**120**
213.0	6	8	8	5	4.5	5	4.5	5	4.5	5	4.5	5	6	5	6	6	6	6	6	5	6	5	**122**
216.2	6	8	8	5	5	5	5	5	5	5	5	5	6	5	6	6	6	6	6	5	6	5	**124**
219.4	7	9	8	5	5	5	5	5	5	5	5	5	6	5	6	6	6	6	6	5	6	5	**126**
222.6	7	9	8	5	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	5	**128**
225.8	7	9	8	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	6	6	**130**
229.0	7	9	8	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	**132**
232.2	7	9	8	5	5	5	5	5	5	6	6	6	6	6	7	6	6	7	6	6	6	6	**134**
235.4	7	9	8	5	5	5	5	5	5	6	6	6	6	6	7	7	6	7	7	6	6	6	**136**
238.6	7	9	8	5	5	5	5	5	5	6	6	6	6	7	7	7	7	7	7	6	6	6	**138**
241.8	7	9	8	5	5	5	5	6	6	6	6	6	6	7	7	7	7	7	7	6	6	6	**140**
245.1	7	9	8	5	5	5	5	6	6	6	6	6	6	7	7	7	8	7	7	7	6	6	**142**

Total Spill [a]	MCN Spill Patterns with *No* TSWs – # Gate Stops per Spillbay																						Total Stops
(kcfs)	1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22 [b]	(#)
248.5	7	9	8	5	5	5	5	6	6	6	6	6	6	7	8	7	8	7	8	7	6	6	**144**
251.7	7	9	8	5	5	5	5	6	6	7	6	7	6	7	8	7	8	7	8	7	6	6	**146**
254.9	7	9	8	6	5	6	5	6	6	7	6	7	6	7	8	7	8	7	8	7	6	6	**148**
258.1	7	9	8	6	5	6	5	6	6	7	6	7	7	7	8	7	8	7	8	7	7	6	**150**
261.4	7	9	8	6	5	6	5	6	6	7	6	7	8	7	8	7	8	7	8	7	7	7	**152**
264.6	7	9	8	6	6	6	6	6	6	7	6	7	8	7	8	7	8	7	8	7	7	7	**154**
267.9	7	9	8	6	6	6	6	6	6	7	7	7	8	7	8	8	8	7	8	7	7	7	**156**
271.3	7	9	8	6	6	6	6	6	6	7	7	7	8	8	8	8	8	8	8	7	7	7	**158**
274.7	7	9	8	6	6	6	6	6	6	7	7	8	8	8	8	8	8	8	8	8	7	7	**160**
277.9	7	9	8	6	6	7	6	6	7	7	7	8	8	8	8	8	8	8	8	8	7	7	**162**
281.3	7	9	8	6	6	7	6	6	7	7	8	8	8	8	8	8	8	8	8	8	8	7	**164**
284.5	7	9	8	7	6	7	6	7	7	7	8	8	8	8	8	8	8	8	8	8	8	7	**166**
287.9	7	9	8	7	6	7	6	7	7	8	8	8	8	8	8	8	8	8	8	8	8	8	**168**
291.1	7	9	8	7	7	7	7	7	7	8	8	8	8	8	8	8	8	8	8	8	8	8	**170**
294.5	8	9	8	7	7	7	7	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	**172**
297.9	8	9	8	7	8	7	8	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	**174**
301.3	8	9	8	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	**176**

a. Total Spill calculated based on forebay elevation 339 ft = ~1.8 kcfs spill per 1 gate stop.
b. Bays 1 & 22 *MAY* require special open/close sequence (pending field test verification). Open: Bays 2–21, then 1 & 22 after 2-21 have operated ≥10 minutes.
Close: Bays 1 & 22, then 2–21.

Table MCN-10. [*pg 1 of 4*]. McNary Dam Spill Pattern During TSW Removal. [a]

Total Spill [a]	MCN Spill Patterns During Removal of TSWs – # Gate Stops per Spillbay																						Total Stops
(kcfs)	1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 TSW	20 TSW	21	22 [b]	(#)
23.4									2		2		2		2	2	2						**12**
25.4									2	1	2		2		2	2	2						**13**
27.3									2	2	2		2		2	2	2						**14**
29.3									2	2	2		2	1	2	2	2						**15**
31.2									2	2	2		2	2	2	2	2						**16**
33.2									2	2	2	1	2	2	2	2	2						**17**
35.1									2	2	2	2	2	2	2	2	2						**18**
37.1							1		2	2	2	2	2	2	2	2	2						**19**
39.0							2		2	2	2	2	2	2	2	2	2						**20**
41.0					1		2		2	2	2	2	2	2	2	2	2						**21**
42.9					2		2		2	2	2	2	2	2	2	2	2						**22**
44.4	2.5	2	3.5		2		2		2		2		2	1	2		2						**23**
46.4	2.5	2	3.5		2		2		2		2		2	1	2	1	2						**24**
48.4	2.5	2	3.5		2	1	2		2		2		2	1	2	1	2						**25**
50.4	2.5	2	3.5		2	1	2		2	1	2		2	1	2	1	2						**26**
52.4	2.5	2	3.5		2	1	2		2	1	2	1	2	1	2	1	2						**27**
54.4	2.5	2	3.5		2	1	2	1	2	1	2	1	2	1	2	1	2						**28**
56.4	2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	1	2	1	2						**29**
58.3	2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	2	2	1	2						**30**
60.2	2.5	2	3.5	1	2	1	2	1	2	1	2	1	2	2	2	2	2						**31**
62.1	2.5	2	3.5	1	2	2	2	1	2	1	2	1	2	2	2	2	2						**32**
64.0	2.5	2	3.5	1	2	2	2	1	2	2	2	1	2	2	2	2	2						**33**
65.9	2.5	2	3.5	1	2	2	2	1	2	2	2	2	2	2	2	2	2						**34**
67.8	2.5	2	3.5	1	2	2	2	2	2	2	2	2	2	2	2	2	2						**35**
69.7	2.5	2	3.5	2	2	2	2	2	2	2	2	2	2	2	2	2	2						**36**
71.3	2.5	2.5	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2						**37**
73.0	2.5	2.5	4	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5						**38**
74.7	2.5	2.5	4	2	2	2	2.5	2	2	2	2.5	2	2	2	2	2.5	2.5						**39**
76.4	2.5	2.5	4	2	2.5	2	2.5	2	2	2	2.5	2	2	2	2.5	2.5	2.5						**40**
78.1	2.5	2.5	4	2	2.5	2	2.5	2	2.5	2	2.5	2	2.5	2	2.5	2.5	2.5						**41**
79.8	2.5	2.5	4	2	2.5	2.5	2.5	2	2.5	2.5	2.5	2	2.5	2	2.5	2.5	2.5						**42**
81.5	2.5	2.5	4	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2.5	2.5						**43**
83.2	2.5	2.5	4	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2.5	2.5	2.5						**44**
84.1	2.5	2.5	4	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5						**44.5**
85.8	2.5	2.5	4	3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3						**45.5**

Total Spill [a]	MCN Spill Patterns During Removal of TSWs – # Gate Stops per Spillbay																						Total Stops
(kcfs)	1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 TSW	20 TSW	21	22 [b]	(#)
87.4	2.5	2.5	4.5	3	2.5	2.5	2.5	2.5	2.5	2.5	3	2.5	2.5	2.5	2.5	3	3						**46.5**
89.1	2.5	2.5	4.5	3	2.5	2.5	3	2.5	2.5	2.5	3	2.5	3	2.5	2.5	3	3						**47.5**
90.8	2.5	2.5	4.5	3	3	2.5	3	2.5	3	2.5	3	2.5	3	2.5	2.5	3	3						**48.5**
92.5	2.5	2.5	4.5	3	3	3	3	2.5	3	2.5	3	2.5	3	2.5	3	3	3						**49.5**
94.2	2.5	2.5	5	3	3	3	3	2.5	3	3	3	2.5	3	2.5	3	3	3						**50.5**
95.9	2.5	2.5	5	3	3	3	3	3	3	3	3	3	3	2.5	3	3	3						**51.5**
97.6	3	3	5	3	3	3	3	3	3	3	3	3	3	2.5	3	3	3						**52.5**
98.4	3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	3						**53**
100.0	3	3	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4						**54**
101.6	3	4	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4						**55**
103.2	4	4	5	3	3	3	3	3	3	3	3	3	3	3	3	3	4						**56**
104.8	4	4	5	3	3	3	4	3	3	3	3	3	3	3	3	3	4						**57**
106.4	4	4	5	3	3	3	4	3	3	3	4	3	3	3	3	3	4						**58**
108.0	4	4	5	3	4	3	4	3	3	3	4	3	3	3	3	3	4						**59**
109.6	4	4	5	3	4	3	4	3	3	3	4	3	3	3	4	3	4						**60**
111.2	4	4	5	3	4	3	4	3	4	3	4	3	3	3	4	3	4						**61**
112.8	4	4	5	3	4	3	4	3	4	3	4	3	4	3	4	3	4						**62**
114.4	4	4	5	3	4	4	4	3	4	3	4	3	4	3	4	3	4						**63**
116.0	4	4	5	3	4	4	4	3	4	4	4	3	4	3	4	3	4						**64**
117.6	4	4	5	3	4	4	4	3	4	4	4	4	4	3	4	3	4						**65**
119.2	4	4	5	3	4	4	4	4	4	4	4	4	4	3	4	3	4						**66**
120.8	4	4	5	3	4	4	4	4	4	4	4	4	4	3	4	4	4						**67**
122.4	4	4	5	4	4	4	4	4	4	4	4	4	4	3	4	4	4						**68**
124.0	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4						**69**
125.6	4	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5						**70**
127.2	4	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5						**71**
128.8	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	5						**72**
130.4	5	5	5	4	4	4	5	4	4	4	4	4	4	4	4	4	5						**73**
132.0	5	5	5	4	4	4	5	4	4	4	5	4	4	4	4	4	5						**74**
133.6	5	5	5	4	5	4	5	4	4	4	5	4	4	4	4	4	5						**75**
135.2	5	5	5	4	5	4	5	4	4	4	5	4	4	4	5	4	5						**76**
136.8	5	5	5	4	5	4	5	4	5	4	5	4	4	4	5	4	5						**77**
138.4	5	5	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5						**78**
140.0	5	5	5	4	5	5	5	4	5	4	5	4	5	4	5	4	5						**79**
141.6	5	5	5	4	5	5	5	4	5	5	5	4	5	4	5	4	5						**80**
143.2	5	5	5	4	5	5	5	4	5	5	5	5	5	4	5	4	5						**81**

Total Spill [a]	MCN Spill Patterns During Removal of TSWs – # Gate Stops per Spillbay																						Total Stops
(kcfs)	1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 TSW	20 TSW	21	22 [b]	(#)
144.8	5	5	5	4	5	5	5	5	5	5	5	5	5	4	5	4	5						82
146.4	5	5	5	4	5	5	5	5	5	5	5	5	5	4	5	5	5						83
148.0	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5						84
149.6	5	5	6	5	5	5	5	5	5	5	5	5	5	4	5	5	5						85
151.2	5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5						86
152.8	5	5	6	5	5	5	5	5	5	5	5	5	5	5	5	5	6						87
154.4	5	6	6	5	5	5	5	5	5	5	5	5	5	5	5	5	6						88
156.0	6	6	6	5	5	5	5	5	5	5	5	5	5	5	5	5	6						89
157.6	6	6	6	5	5	5	6	5	5	5	5	5	5	5	5	5	6						90
159.2	6	6	6	5	5	5	6	5	5	5	6	5	5	5	5	5	6						91
160.8	6	6	6	5	6	5	6	5	5	5	6	5	5	5	5	5	6						92
162.4	6	6	6	5	6	5	6	5	5	5	6	5	5	5	6	5	6						93
164.0	6	6	6	5	6	5	6	5	6	5	6	5	5	5	6	5	6						94
165.6	6	6	6	5	6	5	6	5	6	5	6	5	6	5	6	5	6						95
167.2	6	6	6	5	6	6	6	5	6	5	6	5	6	5	6	5	6						96
168.8	6	6	6	5	6	6	6	5	6	6	6	5	6	5	6	5	6						97
170.4	6	6	6	5	6	6	6	5	6	6	6	6	6	5	6	5	6						98
172.0	6	6	6	5	6	6	6	6	6	6	6	6	6	5	6	5	6						99
173.6	6	6	6	5	6	6	6	6	6	6	6	6	6	5	6	6	6						100
175.2	6	6	6	6	6	6	6	6	6	6	6	6	6	5	6	6	6						101
176.8	6	6	7	6	6	6	6	6	6	6	6	6	6	5	6	6	6						102
178.4	6	6	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6						103
180.0	6	6	7	6	6	6	6	6	6	6	6	6	6	6	6	6	7						104
181.6	6	7	7	6	6	6	6	6	6	6	6	6	6	6	6	6	7						105
183.2	7	7	7	6	6	6	6	6	6	6	6	6	6	6	6	6	7						106
184.8	7	7	7	6	6	6	7	6	6	6	6	6	6	6	6	6	7						107
186.4	7	7	7	6	6	6	7	6	6	6	7	6	6	6	6	6	7						108
188.0	7	7	7	6	7	6	7	6	6	6	7	6	6	6	6	6	7						109
189.6	7	7	7	6	7	6	7	6	6	6	7	6	6	6	7	6	7						110
191.2	7	7	7	6	7	6	7	6	7	6	7	6	6	6	7	6	7						111
192.8	7	7	7	6	7	6	7	6	7	6	7	6	7	6	7	6	7						112
194.4	7	7	7	6	7	7	7	6	7	6	7	6	7	6	7	6	7						113
196.0	7	7	7	6	7	7	7	6	7	7	7	6	7	6	7	6	7						114
197.6	7	7	7	6	7	7	7	6	7	7	7	7	7	6	7	6	7						115
199.2	7	7	7	6	7	7	7	7	7	7	7	7	7	6	7	6	7						116
200.8	7	7	7	6	7	7	7	7	7	7	7	7	7	6	7	7	7						117

Total Spill [a]	MCN Spill Patterns During Removal of TSWs – # Gate Stops per Spillbay																						Total Stops
(kcfs)	1 [b]	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 TSW	20 TSW	21	22 [b]	(#)
202.4	7	7	7	7	7	7	7	7	7	7	7	7	7	6	7	7	7						**118**
204.1	7	7	8	7	7	7	7	7	7	7	7	7	7	6	7	7	7						**119**
205.7	7	7	8	7	7	7	7	7	7	7	7	7	7	7	7	7	7						**120**
207.4	7	7	8	7	7	7	7	7	7	7	7	7	7	7	7	7	8						**121**
209.1	7	8	8	7	7	7	7	7	7	7	7	7	7	7	7	7	8						**122**
210.8	8	8	8	7	7	7	7	7	7	7	7	7	7	7	7	7	8						**123**
212.5	8	8	8	7	7	7	8	7	7	7	7	7	7	7	7	7	8						**124**
214.2	8	8	8	7	7	7	8	7	7	7	8	7	7	7	7	7	8						**125**
215.9	8	8	8	7	8	7	8	7	7	7	8	7	7	7	7	7	8						**126**
217.6	8	8	8	7	8	7	8	7	7	7	8	7	7	7	8	7	8						**127**
219.3	8	8	8	7	8	7	8	7	8	7	8	7	7	7	8	7	8						**128**
221.0	8	8	8	7	8	7	8	7	8	7	8	7	8	7	8	7	8						**129**
222.7	8	8	8	7	8	8	8	7	8	7	8	7	8	7	8	7	8						**130**
224.4	8	8	8	7	8	8	8	7	8	8	8	7	8	7	8	7	8						**131**
226.1	8	8	8	7	8	8	8	7	8	8	8	8	8	7	8	7	8						**132**
227.8	8	8	8	7	8	8	8	8	8	8	8	8	8	7	8	7	8						**133**
229.5	8	8	8	7	8	8	8	8	8	8	8	8	8	7	8	8	8						**134**
231.2	8	8	8	8	8	8	8	8	8	8	8	8	8	7	8	8	8						**135**
232.8	8	8	9	8	8	8	8	8	8	8	8	8	8	7	8	8	8						**136**
234.5	8	8	9	8	8	8	8	8	8	8	8	8	8	8	8	8	8						**137**
236.1	8	8	9	8	8	8	8	8	8	8	8	8	8	8	8	8	9						**138**
237.7	8	9	9	8	8	8	8	8	8	8	8	8	8	8	8	8	9						**139**
239.3	9	9	9	8	8	8	8	8	8	8	8	8	8	8	8	8	9						**140**

a. Total Spill calculated based on forebay elevation 339 ft = ~1.8 kcfs spill per 1 gate stop.

b. Bays 1 & 22 *MAY* require special open/close sequence (pending field test verification). Open: Bays 2–21, then 1 & 22 after 2-21 have operated ≥10 minutes. Close: Bays 1 & 22, then 2–21.