Section 7 Lower Monumental Dam

Lower Monumental Dam

1. Fish Passage Information. The locations of fish passage facilities at Lower Monumental Lock and Dam are shown in **Figure LMN-1**. Dates of project operations for fish purposes and special operations are listed in **Table LMN-2**.

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description. The Lower Monumental juvenile facilities consist of standard length submersible traveling screens, vertical barrier screens, 12" orifices, collection gallery, dewatering structure, and bypass flume to the tailrace below the project. Transportation facilities consist of a separator to sort juvenile fish by size and to separate them from adult fish, sampling facilities, raceways, office and sampling building, truck and barge loading facilities, and PIT tag detection and deflector systems.

1.1.2. Juvenile Migration Timing. Juvenile migration timing at Lower Monumental Dam is indicated in **Table LMN-1**. The dates in the table are based on juvenile fish collection numbers and do not reflect FGE, RSW or spill passage. Salmon, steelhead, bull trout, lamprey, and other species are routinely counted. Maintenance of juvenile fish passage facilities that may impact juvenile fish passage or facility operations should be conducted during the winter maintenance season.

Table LMN-1. Juvenile Migration Timing at Lower Monumental Dam, 2001 – 2010.[1]

Yearling Chinook				
	10 %	50%	90 %	# of Days
2001	17-Apr	11-May	25-May	38
2002	2-May	13-May	25-May	23
2003	15-Apr	9-May	29-May	44
2004	16-Apr	22-Apr	18-May	32
2005	18-Apr	8-May	17-May	29
2006	1-May	10-May	20-May	19
2007	12-May	15-May	20-May	8
2008	18-May	21-May	28-May	10
2009	10-May	20-May	27-May	17
2010	18-May	21-May	8-Jun	21
MEDIAN	30-Apr	12-May	24-May	24
MIN	15-Apr	22-Apr	17-May	8
MAX	18-May	21-May	8-Jun	44

Subyearling Chinook				
	10 %	50%	90 %	# of Days
2001	5-Jun	15-Jul	11-Aug	67
2002	21-Jun	9-Jul	27-Jul	36
2003	5-Jun	21-Jun	20-Jul	45
2004	16-May	26-Jun	13-Jul	58
2005	2-Jun	12-Jun	30-Jun	28
2006	26-May	8-Jun	1-Jul	36
2007	30-May	11-Jun	8-Jul	39
2008	5-Jun	14-Jun	5-Jul	30
2009	2-Jun	9-Jun	3-Jul	31
2010	8-Jun	12-Jun	7-Jul	29
MEDIAN	2-Jun	19-Jun	12-Jul	40
MIN	16-May	8-Jun	30-Jun	28
MAX	21-Jun	15-Jul	11-Aug	67

Unclipped Steelhead				
	10 %	50%	90 %	# of Days
2001	4-May	19-May	26-Jun	53
2002	8-May	25-May	9-Jun	32
2003	1-May	26-May	31-May	30
2004	17-Apr	16-May	1-Jun	45
2005	6-May	14-May	24-May	18
2006	2-May	16-May	25-May	23
2007	12-May	15-May	23-May	11
2008	20-May	21-May	31-May	11
2009	10-May	22-May	6-Jun	27
2010	18-May	26-May	11-Jun	24
MEDIAN	6-May	20-May	3-Jun	27
MIN	17-Apr	14-May	23-May	11
MAX	20-May	26-May	26-Jun	53

Clipped Steelhead				
	10 %	50%	90 %	# of Days
2001	4-May	19-May	4-Jul	61
2002	5-May	25-May	7-Jun	33
2003	1-May	26-May	30-May	29
2004	23-Apr	15-May	4-Jun	42
2005	20-Apr	13-May	20-May	30
2006	29-Apr	9-May	22-May	23
2007	12-May	15-May	21-May	9
2008	18-May	21-May	28-May	10
2009	10-May	20-May	1-Jun	22
2010	8-May	23-May	9-Jun	32
MEDIAN	4-May	18-May	2-Jun	29
MIN	20-Apr	9-May	20-May	9
MAX	18-May	26-May	4-Jul	61

Coho				
	10 %	50%	90 %	# of Days
2001	25-May	15-Jul	18-Aug	85
2002	25-May	1-Jun	15-Jun	21
2003	19-May	28-May	7-Jun	19
2004	15-May	29-May	8-Jun	24
2005	11-May	16-May	23-May	12
2006	14-May	22-May	31-May	17
2007	14-May	16-May	23-May	9
2008	20-May	20-May	24-May	4
2009	18-May	26-May	30-Jun	43
2010	19-May	5-Jun	14-Jun	26
MEDIAN	18-May	30-May	13-Jun	26
MIN	11-May	16-May	23-May	4
MAX	25-May	15-Jul	18-Aug	85

Sockeye (Wild & Hatchery)				
	10 %	50%	90 %	# of Days
2001	5-May	21-May	6-Jul	62
2002	2-May	22-May	11-Jun	40
2003	26-May	2-Jun	11-Jun	16
2004	16-May	25-May	3-Jun	18
2005	30-Apr	24-May	5-Jun	36
2006	4-May	21-May	29-May	25
2007	14-May	19-May	26-May	12
2008	21-May	22-May	3-Jun	13
2009	20-May	23-May	2-Jun	13
2010	23-May	3-Jun	16-Jun	24
MEDIAN	13-May	24-May	8-Jun	26
MIN	30-Apr	19-May	26-May	12
MAX	26-May	3-Jun	6-Jul	62

1. Dates are derived from daily and yearly facility collection numbers.

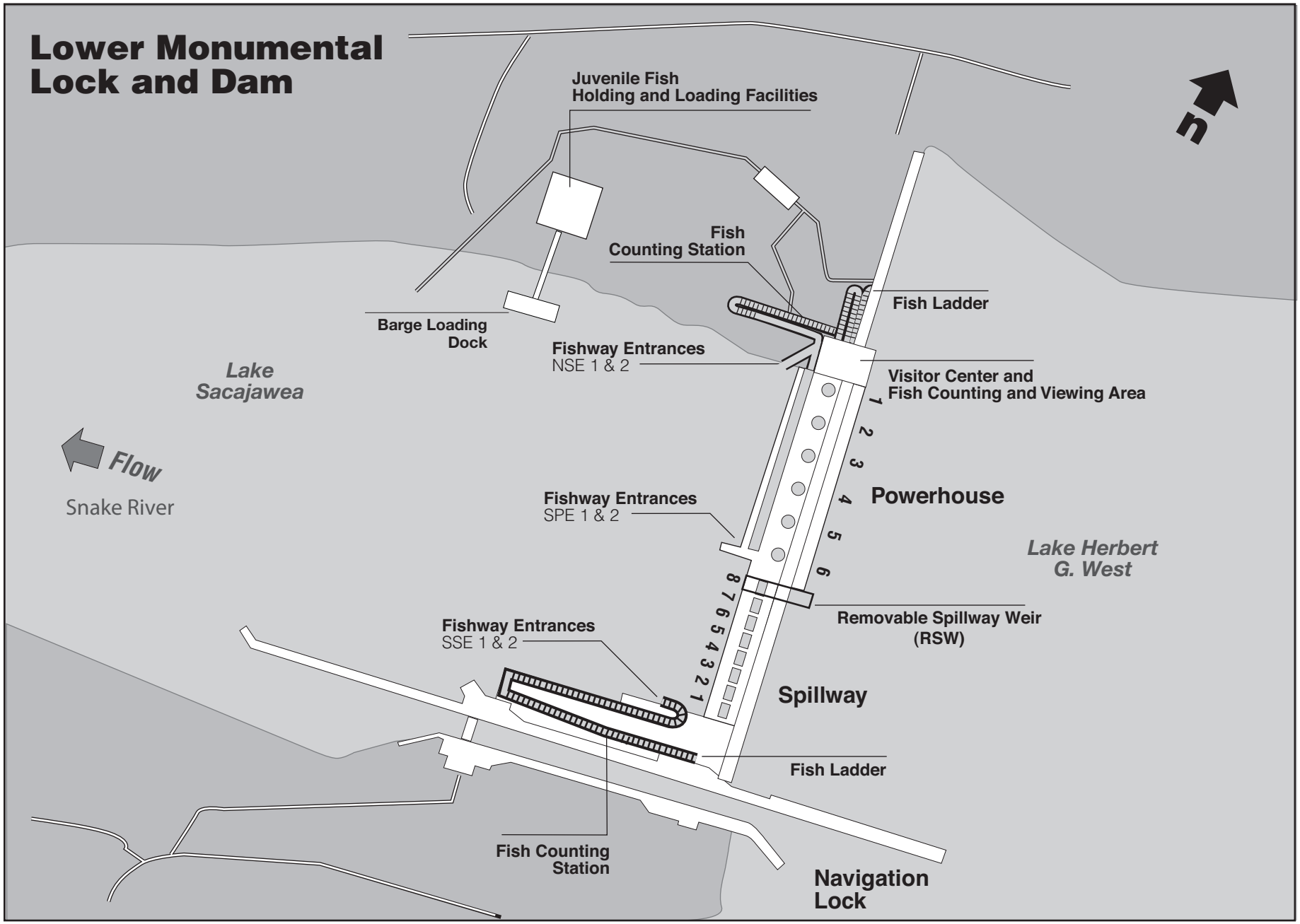
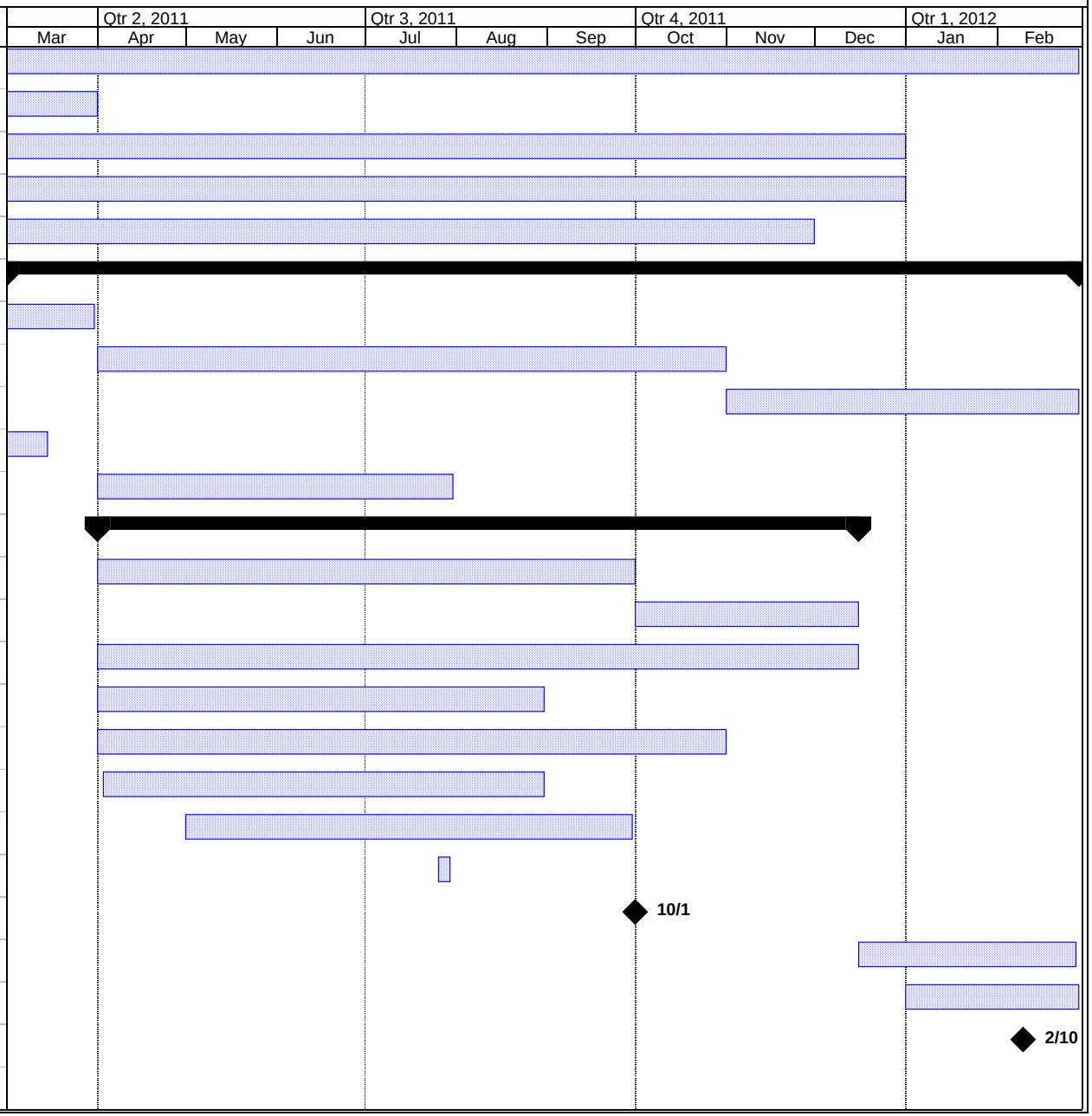


Figure LMN-1 Lower Monumental Lock and Dam General Site Plan

Table LMN-2. Dates of Project Operations for Fish Purposes at Lower Monumental Dam, 2011-12

Task Name	Start	Finish
TDG Monitoring	3/1/11	2/29/12
Winter Maintenance Period Juvenile	3/1/11	3/31/11
Adult Fish Passage Period	3/1/11	12/31/11
Weekly Reports	3/1/11	12/31/11
Operate Turbines for Fish Passage	3/1/11	11/30/11
1% limitations	**3/1/11**	**2/29/12**
1% Soft	3/1/11	3/31/11
1% Hard	4/1/11	10/31/11
1% Soft	11/1/11	2/29/12
Lower Monumental RSW Installation	3/1/11	3/15/11
Back flush orifices once per shift	4/1/11	7/31/11
Operate juvenile facilities	**4/1/11**	**12/15/11**
Operate for Juvenile Fish passage	4/1/11	9/30/11
Operate for Adult Fallback	10/1/11	12/15/11
Juvenile Passage Period	4/1/11	12/15/11
Lower Monumental RSW Operation	4/1/11	8/31/11
Adult Fish Counting (Visual 0400 - 2000)	4/1/11	10/31/11
Bull Trout Pit Tag Study	4/3/11	8/31/11
Juvenile Fish Transportation	5/1/11	9/30/11
Doble Tests	7/26/11	7/30/11
1/2 STS May Be Pulled	10/1/11	10/1/11
Winter Maintenance Period Juvenile	12/16/11	2/28/12
Maintenance of Adult Facilities	1/1/12	2/28/12
Draft Final Report	2/10/12	2/10/12
Final Report	3/15/12	3/15/12



1.2. Adult Fish Passage.

1.2.1. Facilities Description. The adult fish passage facilities at Lower Monumental are comprised of north and south shore fish ladders and collection systems with a common auxiliary water supply. The north shore fish ladder connects to two north shore entrances and the powerhouse collection system. The powerhouse collection system has two downstream entrances at the south end of the powerhouse (a former side entrance has been permanently closed), and a common transportation channel. Two north shore entrances, two downstream south powerhouse entrances, and none of the floating orifices will be used during the fish passage season. The south shore fish ladder has two downstream entrances (a former side entrance has been permanently closed). The auxiliary water is supplied by three turbine-driven pumps located in the powerhouse on the north side of the river. The water is pumped into a supply conduit that travels under the powerhouse collection channel, distributing water to the powerhouse diffusers, and then under the spillway to the diffusers in the south shore collection system. Excess water from the juvenile fish bypass system (approximately 200-240 cfs) is added to the auxiliary water supply system for the powerhouse collection system.

1.2.2 Adult Migration Timing. Upstream migrants are present at Lower Monumental Dam throughout the year and adult passage facilities are operated year round. Maintenance of adult fish facilities is scheduled for January and February to minimize impacts on upstream migrants. Facilities are usually shut down one shore at a time for maintenance. Adult fish (salmon, steelhead, shad, and lamprey) are counted as per **Table LMN-3**; these data appear daily on the Corps adult count website. Salmon migration timing data appear in **Table LMN-4**. Sturgeon and bull trout are also counted and recorded on the WDFW fish counters' daily summary sheet comments section; but do not appear on the Corps daily website total due to relative infrequency of passage. These data are posted in the Miscellaneous Fish Counts report during the passage season (updated periodically during the season) found on the Corps' web site, and summarized in the Annual Fish Passage Report.

Table LMN-3. Adult fish counting schedule at Lower Monumental Dam.

Period	Counting Method
April 1 – October 31	Visual count 0400 - 2000 PST

Table LMN-4. Adult Count Periods and Peak Migration Timing at Lower Monumental Dam based on 1969-2010 fish counts.

Species	Counting Period	Date of Peak Passage	
		Earliest	Latest
Spring Chinook	4/1 - 6/13	4/20	5/27
Summer Chinook	6/14 - 8/13	6/14	7/12
Fall Chinook	8/14 - 10/31	9/4	9/30
Steelhead	4/1 - 10/31	9/15	10/13
Sockeye	4/1 - 10/31	6/24	7/25
Lamprey	4/1 – 10/31	7/20	7/27

2. Project Operation.

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

2.1.2. Involuntary spill at Lower Monumental is the result of river flow exceeding powerhouse capacity, insufficient generation loads to pass the river flow, turbine unit outages (forced or scheduled), or the failure of a key component of the juvenile fish passage facility which forces the project to spill to provide juvenile fish passage. Spill at Lower Monumental shall be distributed in accordance with the spill patterns included at the end of this section, **Tables LMN-12 and LMN-13**.

2.1.3. To improve tailrace juvenile egress conditions and minimize eddying, it is recommended that the Lower Monumental project be operated as shown in **Table LMN-5** while voluntarily spilling for fish passage. If possible, involuntary spill under the flow levels shown should follow these project operations also.

2.2. Dissolved Gas Management and Control. Total dissolved gas (TDG) levels at Lower Monumental are monitored in accordance with the Dissolved Gas Monitoring Program, **Appendix D**.

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. Operate from April 1 through September 30 for juvenile fish bypass, collection and transportation, and from October 1 through December 15 for bypassing adult fallbacks. Operate the juvenile facilities according to the criteria listed below and in **Appendix B** for bypassing, collection, and transportation of juvenile salmonids. The transportation program may be revised in accordance with the ESA Section 10 permit and the NOAA Fisheries biological opinion.

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

a. Forebay Area and Intakes.

1. Remove debris from forebay and gatewell slots.

2. Rake trashracks just prior to the operating season.

3. Measure drawdown in gatewell slots after cleaning trashracks and with STSs in place.

4. Inspect and repair gatewell dip net as needed.

b. Submersible Traveling Screens and Vertical Barrier Screens.

1. Maintenance completed on all screens.

2. Inspect STSs prior to installation and operate one trial run (dogged off on deck) to ensure proper operation.

3. Log results of trial run.

4. Inspect all VBSs with an underwater video camera at least once per year. Repair as needed.

c. Collection Channel.

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

2. Orifice lights are operational.

3. Orifices clean and valves operating correctly.

4. Orifice air backflush system works correctly.

d. Dewatering Structure and Flume.

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

2. Screen cleaning system (brush and air flush) maintained and operating correctly.

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

4. All valves should be operating correctly.

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

e. Transportation Facilities.

1. Primary bypass flume switch gate maintained and in good operating condition.

2. Flume interior smooth with no rough edges.

3. Perforated plate edges smooth with no rough edges.

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

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

6. Crowders maintained, tested, and operating correctly.

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

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

9. Barge and truck loading pipes should be free of debris, cracks, or blockages. Truck and barge loading hose couplings should have no rough edges and barge loading boom should be maintained and tested.

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

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

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

f. Avian Predation Areas (Forebay and Tailrace). Inspect bird wires, avian deterrent devices, 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.

g. Maintenance Records. Record all maintenance and inspections.

2.3.1.2. Fish Passage Period (April 1 through December 15).

a. Forebay Area and Intakes.

1. Remove debris from forebay.

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

3. Remove debris from forebay and trashracks as required to maintain less than 1' of additional drawdown in gate slots. Additional raking may be required when heavy debris loads are present in the river. Coordinate turbine unit outages with other project work activities, if possible, to minimize turbine unit outages during the spring.

4. Inspect gatewell slots daily (preferably early in day shift) for debris, fish buildup, and contaminating substances (particularly oil). Clean gatewells before they become half covered with debris. If, due to the volume of the debris, it is not possible to keep the gatewell surfaces at least half clear, they should be cleaned at least once daily. If flows through an orifice or fish conditions give indications that an orifice may be partially obstructed with debris, the orifice will be closed and backflushed to remove the obstruction. If the obstruction cannot be removed, the orifice shall be closed and the alternate orifice for that gatewell slot shall be operated. If both orifices become obstructed or plugged with debris, the turbine unit will not be operated until the gatewell and orifices are cleared of debris.

5. If a visible accumulation of contaminating substances (such as oil) is detected in a gatewell and it cannot be removed within 24 hours, the gatewell orifices shall

be closed immediately and the turbine unit shut down within one hour until the material has been removed and any problems corrected. A preferred method for removing oil from the water surface is to install lipophilic 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 fish to exit the gatewell. Orifices shall not be closed for longer than 48 hours.

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

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

b. **Submersible Traveling Screens, Vertical Barrier Screens, and Operating Gates**.

1. Operate STSs in cycle mode when average fork length of sub-yearling Chinook or sockeye is greater than 120 mm.

2. Operate STSs in continuous run mode when average fork length of sub-yearling chinook or sockeye is less than 120 mm or if fish condition deteriorates. Return to cycle mode after one week has passed and re-evaluate.

3. Inspect each installed STS once per month by means of underwater video camera. Spot check VBSs at the same time.

4. Record STS amp readings daily.

5. If an STS is damaged or fails during the juvenile fish passage season, follow procedures detailed under unscheduled maintenance of STSs. In no case should a turbine unit be operated with a missing or a known non-operating or damaged STS.

6. Half of the STSs may be pulled after October 1 for maintenance as long as unscreened turbine units are not operated.

7. Make formal determination at end of season as to adequacy of STS mesh and any replacement needs.

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

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

10. When extreme cold weather is forecasted (as defined as: anticipated

temperatures below 20^{o} Fahrenheit for 24 hours) to occur for an extended period of time between Thanksgiving and December 15, ESBSs and STSs may be removed. The project will first request special permission from CENWW-OD-T. CENWW-OD-T will inform NOAA Fisheries and other FPOM participants of the action.

c. Collection Channel.

1. Assure that orifices are clean and operable. Operate at least one orifice per gatewell slot (preferably the north orifice). If the project is operating at MOP, additional orifices may be operated to maintain a full collection channel. If orifices must be closed to repair any part of the facility, monitor the gatewells hourly (unit is operating) or at least every two hours (unit is not operating) for fish condition and behavior. Also see section 3.1.2.2. to determine if the turbine unit must be shut down and if fish must be dipped from the gatewell(s).

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

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

4. Orifice jets must hit no closer than 3' from the back wall with the collection channel full.

5. Orifice valves must be either fully open or fully closed.

6. Backflush orifices at least once per day and more frequently if required. During periods of high debris volumes and fish numbers, April 1 through July 31, orifices should be inspected and backflushed once per 8-hour shift or more frequently as determined by the project biologist, to keep orifices clean.

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

d. Dewatering Structure.

1. Assure the trash sweep is operating correctly. The frequency of the sweep should be set as necessary to maintain a clean screen, with a minimum operation of at least once per hour. Operate the air flush as specified by the project biologist to maintain a clean screen.

2. Hand clean trapezoidal section once a day or as often as needed to maintain a clean condition.

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

4. There should be no gaps between screen panels or damaged panels in the inclined screen.

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

e. Transportation Facilities.

1. All screens should be inspected to make sure there are no holes or sharp edges.

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

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

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

5. Truck and barge loading facilities in good operating condition.

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

f. Avian Predation Areas (Forebay and Tailrace).

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.

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

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.

g. Removable Spillway Weir (RSW). The RSW will be in the raised position and operational on the first day of spill.

1. When the RSW is in operation, the spillgate shall be raised to where it does not touch flow passing down the RSW.

2. When the National Weather Service forecasts Lower Monumental inflows to exceed 200,000 cfs, initiate aggressive forebay debris removal so that RSW operation will not be impeded and coordinate with RCC and CENWW-OD-T.

3. Complete RSW stow (complete rotation to the landing pad) when inflows exceed 260,000 cfs, upstream river gage flows are increasing, and the NWS forecasts Lower Monumental inflow to exceed 300,000 cfs.

4. Operation of the RSW for short periods of time may be requested by the project biologist through CENWW during low flow years if it appears the juvenile fish transportation facility and barge holding capacities will be exceeded (refer to **Appendix B**, Juvenile Fish Transportation Plan, Section 4.d.(4)).

h. Inspection and Record Keeping.

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

2. Record all maintenance and inspections.

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 through February 28).

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

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. Spare trashracks should be on hand for use as necessary. 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.

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

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

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

f. Fish pumps maintained and ready for operation.

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

2.3.2.2. Fish Passage Period (March 1 through December 31). **Note:** Ice Harbor pool may be operated at minimum operating pool (MOP), between elevations 437' and 438' msl, as part of the Corps' efforts for improving migration conditions for juvenile salmonids. This may result in some of the adult fishway entrances at Lower Monumental

Dam bottoming out on their sills prior to reaching criteria depths. Continuous operation at MOP may also result in increased pumping head on the auxiliary water supply pumps, decreasing the amount of water supplied by the pumps.

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

b. Counting Windows. The minimum counting slot width should be 18". All equipment should be maintained and in good condition. The counting window and backboard should be cleaned as needed to maintain good visibility.

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

d. North Shore Entrances (NSE 1 & 2). Elevation of top of gate when on sill = 429'.

1. Operate both gates.

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

e. Floating Orifice Gates. No floating orifice gates will be operated.

f. South Powerhouse Entrances (SPE 1 & 2). Elevation at top of gate when on sill = 432'.

1. Operate both downstream gates.

2. Weir depth: 8' or greater below tailwater. At tailwaters below elevation 440', weirs should be on sill.

g. South Shore Entrances (SSE 1 & 2). Elevation of top of gate when on sill = 431'.

1. Operate both downstream gates.

2. Weir depth: SSE 1 operate 8' or greater below tailwater. SSE 2 raised 6' above sill. At tailwaters below elevation 439', SSE 1 weir should be on sill.

h. Channel Velocity. 1.5' to 4' per second.

1. A permanently installed “RED LION PLC with DETEC sensor” type 3020-1002, 4-20 milliamp unit was installed (by Leopold Stevens Inc., Gresham, OR) in the collection channel at the unit 1 / unit 2 transition. The unit is located in the channel’s length and width to avoid the non-characteristic high readings that would occur on the slope near an entrance or the non-characteristic low reading that would occur in the turbulent zone on the curve from the pump discharge supply conduit. The location of the sending unit typifies the velocity conditions throughout the length of the channel.

2. To read the meter, the toggle switch is positioned in the “ON” position. As the unit warms up the velocity reading output shows the numerical readout increasing. When it stabilizes and repeats a number the reading is recorded.

3. The velocity reading is a part of the ladder inspections that are done 3 times per week at Lower Monumental; additionally the reading will be added to the state biologists daily inspection form so that daily readings are documented.

i. Head on Trashracks.

1. Maximum head of 0.5' on ladder exits.

2. Maximum head on south shore picketed leads shall be 0.3'. Maximum head on north shore picketed leads shall be 0.4'.

3. Trashracks and picketed leads installed correctly.

j. 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.

k. Facility Inspections.

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

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

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

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.

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

6. Record all inspections.

2.3.3. Facility Monitoring and 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. Project biologists shall prepare weekly reports, from March 1 through December 31, 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.

2.3.3.2. The reports shall include:

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

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

c. Adult fishway control calibrations;

d. STS and VBS inspections;

e. Any unusual activities which occurred at the project which may affect fish passage.

2.3.3.3. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENWW-OD-T by noon the following Monday via electronic mail.

2.3.3.4. 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 actions taken to discourage avian predation at the project, and an overview of the effectiveness of those activities in discouraging predation.

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

2.4. Navigation Spill Operations. Short-term adjustments in spill are required for navigation safety. This may include changes in spill patterns, reduction in spill discharges rates, or short-term spill stoppages. These operations take approximately 1 hour but under some situations may take up to 3.5 hours. Listed below are two examples of the types of navigation situations that may occur that require short-term spill adjustments. Actual operations will vary due to conditions such as spill patterns, turbine unit operations, wind, experience of boat captains, etc. The Corps will make short-term adjustment in spill as appropriate in real-time to provide safe navigation conditions.

2.4.1. Fish Barge Transit Across the Tailrace Spill may create hydraulic conditions that are unsafe for fish barges crossing the tailrace and/or while moored at fish loading facilities. If a tug boat operator determines hydraulic conditions are unsafe they will contact the Lower Monumental Dam (LMN) control room and the project operator will reduce or stop spill temporarily when fish transport barges approach or leave the barge dock or are moored at loading facilities. Spill reductions will utilize the existing spill pattern.

If conditions warrant a spill adjustment, the MOP elevation range at Lower Monumental may be exceeded temporarily to enable the barge to exit the tailrace safely. The LGS operator will attempt to minimize MOP exceedances at LMN by contacting BPA real time when a fish barge leaves LGS. Contacting BPA real time when a fish barge leaves LGS will provide BPA will sufficient time to stage the LMN forebay elevation at an adequate elevation in the event a short term spill curtailment is needed at LMN.

2.4.2. All Navigation (fish barges, commercial, non-commercial, etc.) Entering and Exiting the Tailrace Navigation Lock. When flows are less than 32 kcfs spill at LMN can create hydraulic conditions (eddies) that cause navigation safety concerns. Eddies cause boat and/or barge collisions with the guide wall as boats enter and or exit the tailrace navigation lock. Non-

fish barge navigation does not involve traversing the tailrace, but eddies still cause collisions with the guide wall. If a boat captain has a navigation safety concern they will contact the LMN operator and request a short-term adjustment in spill. This will occur when boats are traveling upstream to, or departing from, the tailrace navigation lock. The operator will shut off spill at the RSW and redistribute all scheduled spill evenly through the remaining bays. The operator will implement this operation for the shortest period of time necessary to allow safe navigation. After boats have safely passed the project the project will reverts back to normal spill operation.

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 degrees Fahrenheit or greater, all adult fish handling will be coordinated through CENWW-OD-T. Dewatering and fish handling plans were reviewed and revised in 2011 to ensure that they comply with **Appendix F, Guidelines for Dewatering and Fish Handling Plans**.

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

a. Description of the problem.

b. Type of outage required.

c. Impact on facility operation.

d. Length of time for repairs.

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

3.1.2.1. Submersible Traveling Screens. The STSs are inspected periodically throughout the juvenile migration season with a video monitoring system. If a screen is

found to be damaged it will be removed and either replaced with the spare STS or repaired and returned to service. A turbine unit shall not be operated with a known damaged or nonfunctioning STS or without a full complement of STSs. If an STS fails on a weekend or at night when maintenance crews are not available, the respective turbine unit will be shut down and generation switched to another, fully screened unit. If all screened turbine units are in service, water may be spilled until the effected STS can be removed and repaired or replaced.

3.1.2.2 Gatewell Orifices. Each gatewell has two 12" orifices with air operated valves to allow fish to exit the gatewell. Under normal operation, one orifice per gatewell is operated. To minimize blockage from debris, orifices are cycled and backflushed at least once per day, and more frequently if required by heavy debris loads. If an air-valve fails, the valve should 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 repairs are to take longer than 48 hours, juvenile fish will be dipped from the gatewell with a gatewell dip basket. During any closure event of orifices in an operating turbine unit, gatewells will be checked hourly. During times of high fish passage or if there is evidence of any difficulty in holding fish in gatewells, fish are to be dipped from the gatewells at a more frequent interval.

3.1.2.3. Dewatering Structure. The dewatering structure acts as a transition from the collection channel to the corrugated metal flume. An inclined screen allows excess water to be bled off, with all fish and remaining water transitioning into the corrugated metal flume. The excess water is discharged into the adult fish facility auxiliary water supply system and is also used as the water supply for the transportation facilities. The dewatering structure contains a trash sweep and air burst system for cleaning the inclined screen of impinged debris. If the cleaning systems break and interfere with juvenile fish passage through the structure or if the inclined screen is damaged, an emergency bypass system at the upstream end of the dewatering structure will 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 inclined screen. The emergency bypass is then opened and the bypass system operated with 6 gatewell orifices open. Orifices will then need to be routinely rotated, every three hours, in order to let juveniles emigrate from all of the gatewells. While the facilities are in emergency bypass operation, project personnel shall monitor gatewells for signs of fish problems or mortality. Spill may be provided as an alternative avenue for fish passage during a collection channel outage.

3.1.2.4. Bypass Flume. The corrugated metal flume transports juveniles to either the transportation facilities or to the river below the project (primary bypass). If there is a problem with the flume that interferes with its operation, the emergency bypass system at the upper end of the flume can be opened and all of the fish in the bypass system diverted to the river below the project through the secondary emergency bypass system while repairs are made. Since the piping to the river for secondary emergency bypass is also part of the raw water supply for the load and hold facility, the load and hold must be evacuated of fish and dewatered before going into secondary emergency bypass.

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

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

3.2.2.2. Auxiliary Water Supply System. The auxiliary water for the fish ladders and the collection systems is supplied by three turbine-driven pumps on the north shore, with at least two pumps being required for normal operation. If one, two, or all three pumps fail, the fishway will be adjusted in the following manner until repairs can be made: SPE 2 and/or SSE 2 will be closed and SPE 1 raised to provide the required 1' to 2' head differential in the system. If the desired head differential cannot be reached by the time SPE 1 reaches 5' below tailwater, SPE 1 should be closed, the collection channel bulkheaded off at the junction pool, and NSE 1 and 2 and SSE 1 operated as deep as possible to maintain the head. If it cannot be maintained at a depth greater than 6', the weirs should be maintained at 6' regardless of the head differential.

3.2.2.3. Fishway Entrances. The fishway entrances consist of main entrance weirs with hoists and automatic controls. If any of the automatic controls malfunction, the weirs can be operated manually by project personnel and kept within criteria. If there is a further

failure which prevents an entrance from being operated manually, the weirs can usually be left in a lowered position while repairs are being conducted or the entrance may be closed and the water redistributed to other entrances while repairs are made.

3.2.2.4. 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 the winter maintenance period to make sure they are in place. These inspections are done by either 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 should begin immediately through the established unscheduled maintenance coordination procedures (see **section 3.1.2**). If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffuser gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

4. Turbine Unit Operation and Maintenance.

4.1. Turbine Unit Operation. When in operation, turbine units will be operated to enhance adult and juvenile fish passage from March 1 through November 30. During this time period turbine units will be operated as needed to meet generation requirements in the priority order shown in **Table LMN-5**. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. If a turbine unit is taken out of service for maintenance or repair, the next unit on the priority list shall be operated. Flows listed in Table LMN-5 are based upon hourly average flows. Also see **Section 2.1, Spill Management**.

Table LMN-5. Turbine Unit Operating Priority for Lower Monumental Dam.

Season	River Flow	Spill Level	Unit Priority
Mar 1 – Nov 30	Less than 70 kcfs	Bulk Spill Gas Cap	2, 3, 4, 5*, 6 then 1
	Over 70 kcfs	Bulk Spill Gas Cap	1**, 5*, 2, 3, 4, then 6
	Any River Flow	No Spill	2, 3, 4, 5, 6 then 1***
Dec 1 – Feb 28	Any River Flow	Any Spill Level, Including No spill	Any Order

*If U5 is OOS, run U4. **If U1 is OOS, run U2. ***If no spill is occurring, U1 may be operated at any priority level at the discretion of project personnel. **NOTE**: U1 has fixed-pitch blades and can operate only at about 130 megawatts.

Turbine Unit 1 was the Fish Priority unit prior to the failure of blade linkages. Temporary repairs included blades being welded in fixed positions. Operating turbine unit 1 improves juvenile fish passage by eliminating the eddy at the fish loading dock. Turbine unit 1 operation is also preferred as operation attracts adult fish to the North fish ladder. Since this turbine unit

has fixed blades and a narrow operation window, starts and stops can cause excessive wear and tear. Turbine unit 1 should be turned on and left on for extended periods to minimize starting and stopping the unit. The operation of turbine unit 1 in first priority position should be initiated when flows are in an increasing trend, and flows are over 70kcfs. Turbine unit 1 may be turned off at the power plant operator's discretion, when the flows are between 55kcfs-70kcfs.

4.1.1. Turbine units will be operated within 1% of best efficiency from April 1 through October 31 (as specified in BPA's load shaping guidelines, **Appendix C**) unless operation outside of that range is necessary to:

1) meet the load requirements of the BPA Administrator whose load requests will be made in accordance with BPA's policy, statutory requirements, and load shaping guidelines (**Appendix C**);

2) 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;

3) operating a turbine unit solely to provide station service; or

4) be in compliance with other coordinated fish measures. Project personnel shall record when turbine units are operated outside the 1% efficiency range and shall provide the information to BPA on a weekly basis according to the load shaping guidelines. Between November 1 and March 31, turbine units will continue to be operated within the 1% efficiency range except when BPA load requests require the units to be operated outside the 1% range. Guidelines for operation of the turbine units within the 1% efficiency range at various heads are shown in **Tables LMN-6 through LMN-11.**

4.1.2. All of the lower Snake River powerhouses may be required to keep one generating turbine unit on line at all times to maintain power system reliability. During low flows, there may not be enough river flow to meet this generation requirement and required minimum spill. Under these circumstances the power generation requirement will take precedence over the minimum spill requirement. At Lower Monumental Dam, minimum generation requirements are: 16.5 – 19.5 kcfs, for turbine unit 1 (blades are fixed); 11.3 – 13.1 kcfs, for turbine units 2-3, and; 13.5 – 14.5 kcfs, for turbine units 4-6. Actual attainable minimum generation levels may vary depending on project conditions.

Table LMN-6. The 1% Operating Efficiency Range for Turbine Unit 1 with STSs.

Head	Lower Generator Limits		Upper Generator Limits	
Feet	MW	CFS	MW	CFS
85	**106.9**	**18,185**	**113.8**	**19,346**
86	108.6	18,222	115.4	19,361
87	110.2	18,258	116.9	19,375
88	111.8	18,292	118.5	19,388
89	113.5	18,325	120.1	19,400
90	**115.0**	**18,338**	**121.6**	**19,394**
91	116.4	18,335	123.1	19,390
92	117.8	18,331	124.6	19,385
93	119.2	18,328	126.0	19,381
94	120.6	18,323	127.5	19,375
95	**121.9**	**18,304**	**128.9**	**19,354**
96	123.3	18,310	130.4	19,367
97	124.7	18,315	131.9	19,379
98	126.1	18,321	133.5	19,390
99	127.5	18,326	135.0	19,401
100	**128.8**	**18,316**	**136.4**	**19,396**
101	130.3	18,322	138.1	19,430
102	131.7	18,328	139.8	19,463
103	133.1	18,334	141.5	19,494
104	134.5	18,340	143.2	19,525
105	**135.9**	**18,331**	**144.8**	**19,539**

Table LMN-7. The 1% Operating Efficiency Range for Turbine Unit 1 Without STSs.

Head	Lower Generator Limits		Upper Generator Limits	
Feet	MW	CFS	MW	CFS
85	**108.5**	**18,234**	**115.3**	**19,383**
86	110.1	18,268	116.9	19,395
87	111.8	18,301	118.5	19,406
88	113.4	18,332	120.1	19,416
89	115.1	18,361	121.7	19,425
90	**116.7**	**18,390**	**123.3**	**19,433**
91	118.1	18,384	124.8	19,426
92	119.5	18,377	126.3	19,418
93	120.9	18,370	127.7	19,411
94	122.3	18,364	129.2	19,403
95	**123.7**	**18,356**	**130.7**	**19,394**
96	125.1	18,360	132.2	19,404
97	126.5	18,362	133.7	19,413
98	127.9	18,365	135.3	19,421
99	129.3	18,367	136.8	19,430
100	**130.7**	**18,369**	**138.3**	**19,437**
101	132.2	18,373	140.0	19,468
102	133.6	18,376	141.7	19,498
103	135.0	18,380	143.4	19,526
104	136.4	18,382	145.1	19,554
105	**137.9**	**18,385**	**146.8**	**19,581**

NOTE: Turbine unit 1 has fixed-pitch blades. Tables based on 1962 model test and 2005 U1 abbreviated index test.

Table LMN-8. Lower Monumental 1% Operating Efficiency Range for Turbine Units 2-3 With Standard Length Submersible Traveling Screens Installed.

Head	Lower Generator Limits		Upper Generator Limits	
Feet	MW	CFS	MW	CFS
80	**62.2**	**10,817**	**114.4**	**19,891**
81	63.5	10,892	117.2	20,106
82	64.8	10,964	120.0	20,314
83	66.1	11,035	122.8	20,517
84	67.3	11,103	125.6	20,714
85	**68.6**	**11,169**	**128.5**	**20,905**
86	69.4	11,154	131.0	21,056
87	70.2	11,140	133.5	21,204
88	70.9	11,125	136.1	21,348
89	71.7	11,111	138.6	21,488
90	**72.4**	**11,097**	**141.2**	**21,625**
91	73.3	11,088	141.6	21,418
92	74.1	11,079	142.0	21,216
93	75.0	11,071	142.4	21,018
94	75.8	11,061	142.8	20,824
95	**76.7**	**11,052**	**143.2**	**20,634**
96	77.7	11,071	143.3	20,416
97	78.8	11,088	143.5	20,203
98	79.8	11,105	143.6	19,994
99	80.8	11,121	143.8	19,789
100	**81.8**	**11,137**	**144.0**	**19,589**
101	82.7	11,138	145.9	19,641
102	83.6	11,140	147.8	19,692
103	84.5	11,141	149.7	19,741
104	85.4	11,142	151.6	19,789
105	**86.2**	**11,143**	**153.5**	**19,837**
106	86.9	11,122	154.9	19,822
107	87.6	11,101	155.2	19,632
108	88.4	11,081	155.2	19,420
109	89.1	11,061	155.2	19,221
110	**89.8**	**11,041**	**155.2**	**19,007**

NOTE: The turbine efficiency tables were revised to reflect new information using a 2002 index test and original 1975 turbine model test. Table is based on information provided by HDC in letter to NWW dated August 20, 2003 (Table LMN-8 revised 2005).

Table LMN-9. Lower Monumental 1% Operating Efficiency Range for Turbine Units 2-3 Without Standard Length Submersible Traveling Screens.

Head	Lower Generator Limits		Upper Generator Limits	
Feet	MW	CFS	MW	CFS
80	**62.8**	**10,772**	**112.1**	**19,234**
81	64.1	10,846	114.8	19,442
82	65.4	10,919	117.6	19,644
83	66.6	10,989	120.3	19,840
84	67.9	11,057	123.1	20,031
85	**69.2**	**11,123**	**125.8**	**20,216**
86	70.0	11,109	128.3	20,363
87	70.8	11,094	130.8	20,506
88	71.6	11,080	133.3	20,645
89	72.3	11,066	135.8	20,781
90	**73.1**	**11,052**	**138.3**	**20,913**
91	74.0	11,043	138.7	20,714
92	74.8	11,035	139.1	20,518
93	75.7	11,026	139.5	20,327
94	76.5	11,017	139.9	20,140
95	**77.4**	**11,009**	**140.3**	**19,956**
96	78.4	11,027	140.4	19,746
97	79.5	11,044	140.6	19,540
98	80.5	11,061	140.7	19,338
99	81.5	11,078	140.9	19,141
100	**82.6**	**11,093**	**141.0**	**18,947**
101	83.5	11,095	142.9	18,998
102	84.3	11,096	144.8	19,047
103	85.2	11,098	146.7	19,095
104	86.1	11,099	148.5	19,142
105	**87.0**	**11,100**	**150.4**	**19,188**
106	87.7	11,079	151.8	19,173
107	88.4	11,059	153.2	19,159
108	89.1	11,038	154.6	19,145
109	89.9	11,019	155.2	19,016
110	**90.6**	**10,999**	**155.2**	**18,818**

NOTE: The turbine efficiency tables were revised to reflect new information using a 2002 index test and original 1975 turbine model test. Table is based on information provided by HDC in letter to NWW dated August 20, 2003 (Table LMN-9 revised 2005).

Table LMN-10. Lower Monumental 1% Operating Efficiency range for Turbine Units 4-6 With Standard Length Submersible Traveling Screens Installed.

Head	Lower Generator Limits		Upper Generator Limits	
Feet	MW	CFS	MW	CFS
80	**84.3**	**14,189**	**115.1**	**19,364**
81	85.4	14,181	116.8	19,392
82	86.5	14,174	118.5	19,419
83	87.6	14,166	120.3	19,445
84	88.7	14,158	122.0	19,469
85	**89.8**	**14,150**	**123.8**	**19,493**
86	91.0	14,160	125.5	19,519
87	92.2	14,169	127.2	19,545
88	93.4	14,178	128.9	19,569
89	94.6	14,187	130.6	19,593
90	**95.7**	**14,195**	**132.3**	**19,616**
91	96.9	14,196	133.9	19,613
92	98.0	14,197	135.4	19,610
93	99.2	14,197	136.9	19,607
94	100.3	14,198	138.5	19,603
95	**101.4**	**14,198**	**140.0**	**19,600**
96	102.3	14,170	140.5	19,456
97	103.2	14,142	141.0	19,315
98	104.1	14,114	141.5	19,177
99	105.1	14,087	142.0	19,042
100	**106.0**	**14,061**	**142.5**	**18,909**
101	107.3	14,091	143.9	18,909
102	108.5	14,120	145.4	18,909
103	109.8	14,149	146.8	18,909
104	111.1	14,177	148.2	18,909
105	**112.4**	**14,204**	**149.6**	**18,909**
106	113.5	14,203	151.6	18,981
107	114.5	14,202	153.6	19,051
108	115.6	14,200	155.2	19,099
109	116.6	14,199	155.2	18,894
110	**117.7**	**14,198**	**155.2**	**18,694**

NOTE: The turbine efficiency tables were revised to reflect new information using a 2002 index test and original 1975 turbine model test. Table is based on information provided by HDC in letter to NWW dated August 20, 2003 (Table LMN-9 revised 2005).

Table LMN-11. Lower Monumental 1% Operating Efficiency Range for Turbine Units 4-6 Without Standard Length Submersible Traveling Screens.

Head	Lower Generator Limits		Upper Generator Limits	
Feet	MW	CFS	MW	CFS
80	**84.0**	**13,999**	**113.9**	**18,975**
81	85.1	13,992	115.6	19,002
82	86.2	13,985	117.3	19,029
83	87.3	13,977	119.1	19,054
84	88.4	13,969	120.8	19,079
85	**89.5**	**13,962**	**122.5**	**19,102**
86	90.7	13,971	124.2	19,128
87	91.9	13,981	125.9	19,153
88	93.1	13,990	127.6	19,177
89	94.2	13,998	129.3	19,201
90	**95.4**	**14,006**	**131.0**	**19,224**
91	96.5	14,007	132.5	19,221
92	97.7	14,008	134.0	19,218
93	98.8	14,009	135.5	19,215
94	99.9	14,010	137.1	19,211
95	**101.1**	**14,010**	**138.6**	**19,208**
96	102.0	13,982	139.1	19,067
97	102.9	13,954	139.6	18,929
98	103.8	13,928	140.1	18,794
99	104.7	13,901	140.5	18,662
100	**105.6**	**13,875**	**141.0**	**18,532**
101	106.9	13,904	142.5	18,532
102	108.2	13,933	143.9	18,532
103	109.4	13,962	145.3	18,532
104	110.7	13,989	146.7	18,532
105	**112.0**	**14,017**	**148.1**	**18,532**
106	113.1	14,015	150.1	18,602
107	114.1	14,014	152.0	18,670
108	115.2	14,013	154.0	18,738
109	116.2	14,011	155.2	18,725
110	**117.3**	**14,010**	**155.2**	**18,531**

NOTE: The turbine efficiency tables were revised to reflect new information using a 2002 index test and original 1975 turbine model test. Table is based on information provided by HDC in letter to NWW dated August 20, 2003 (Table LMN-11 revised 2005).

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

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

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

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

c. The RCC will coordinate the work activities through the TMT.

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

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

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

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

h. If work, such as screen inspections, is not finished, project personnel shall schedule another turbine unit outage for a date where it can be implemented again.

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

4.3. 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 November time frame. The maintenance of priority units for adult passage is normally completed in November and December but can be completed in mid-August. Impacts to migrating adults should be minimized. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the one percent best efficiency range. This work will be scheduled in compliance with BPA load shaping guidelines (Appendix C) to minimize impacts on juvenile fish. Transformers are Doble tested every 3 years. Testing may need to be more frequent if there is a known problem with a transformer. These tests normally take 2 to 3 workdays. To conduct the testing, the distribution lines have to be disconnected from the transformers and normal generation stopped. One turbine unit will operate in a speed-no-load condition to provide project power and operation of fish passage facilities. Spill may be provided to meet minimum required project discharges during the testing hours. The Doble tests are normally scheduled for the August or early September time period to minimize impacts on adult and juvenile fish passage. If doble testing impacts priority units for fish passage, adult passage timing should be considered. Impacts to migrating adults should be minimized.

4.3.1. Turbine units are to be operated with raised operating gates to improve fish passage conditions when STSs are installed, except as provided below. To facilitate annual maintenance, operating gates are used to dewater the turbine units. To minimize turbine outage periods to the actual time required for maintenance (during the July 1 through December 15 time period), operating gates in one turbine unit may be lowered to the standard operating position and connected to hydraulic cylinders on the afternoon of the last regular workday (normally Thursday) prior to the start of the maintenance. With the operating gates in the standard operating position, the turbine unit may be operated until 0700 hours of the next regular workday (normally Monday). On the completion of maintenance, the turbine unit can be operated with the operating gates in the standard operating position until 1200 hours of the first regular workday after the maintenance is completed. If turbine maintenance or the raising of the operating gates to the raised operating position is delayed after the time periods stated above, the turbine unit shall be immediately taken out of service until the work can be accomplished. Operation of turbine units with operating gates in the standard operating position shall be restricted to the July 1 through December 15 time period, and shall not occur unless at least 4 other turbine units are available for service. No more than 1 turbine unit at a time shall be operated with operating gates in the standard operating position and the turbine unit will be operated on last on, first off operating priority.

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

4.3.3. Units may be operationally tested for up to 30 minutes before going into maintenance status by running the unit at speed no load and various loads within the 1% criteria to allow pre-maintenance measurements and testing AND TO ALLOW ALL FISH TO MOVE THROUGH THE UNIT. Units may be operationally tested after maintenance or repair while remaining in

maintenance or forced outage status. Operational testing may consist of running the unit for up to a cumulative time of 30 minutes (within 1% criteria) before it is returned to operational status. Operational testing OF UNIT UNDER MAINTENANCE is in addition to a unit in run status (E.G. MINIMUM GENERATION) required for power plant reliability. Operational testing may deviate from fish priority units and may require water that would otherwise be used for spill if the running unit for reliability is at its 1% minimum load. Water will be used from the powerhouse allocation if possible, and water diverted from spill for operational testing will be minimized to that necessary to maintain and assure generation system reliability.

5. Forebay Debris Removal. Debris at projects can impact fish passage conditions. Debris can plug or block trashracks, VBSs, gatewell orifices, dewatering screens, separators, and facility piping resulting in 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: physically encircling the debris with log booms and pulling it to shore with boats where it can be removed with a crane, removing the debris from the top of the dam using a crane and scoop, or passing the debris through the spillway with special powerhouse operations and spill. 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 the debris. Normally, the project shall contact CENWW-OD-T at least two workdays prior to the day the special operation is required. Using information provided by the project, CENWW-OD-T will notify FPOM and RCC will issue a teletype detailing the special operations.

5.1. All special spills (other than normal spill patterns for ongoing spill operations and project operations for passing debris) will be coordinated prior to the operations taking place. Each project shall contact CENWW-OD-T at least two workdays prior to the day they want the special project operations for spilling to pass debris. The 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.

Table LMN-12. Bulk Spill Pattern

Spill Bay Stops								Total Stops	Total Spill (kcfs)	
1	2	3	4	5	6	7	8			
0	1	0	0	0	0	0	R	5.5	7.9	
0	2	0	0	0	0	0	R	6.5	9.6	
0	2	0	0	0	1	0	R	7.5	10.7	
0	2	0	0	0	2	0	R	8.5	12.4	
0	2	0	0	0	3	0	R	9.5	14.1	
0	2	0	0	0	4	0	R	10.5	15.8	
0	3	0	0	0	4	0	R	11.5	17.5	Summer
0	3	0	0	1	4	0	R	12.5	18.6	
0	3	0	0	1	5	0	R	13.5	20.3	
1	3	0	0	1	5	0	R	14.5	21.4	
1	1	1	1	1	6	0	R	15.5	21.9	
1	1	1	1	2	6	0	R	16.5	23.6	
1	1	1	2	2	6	0	R	17.5	25.3	
1	1	1	2	4	5	0	R	18.5	27.0	
1	1	1	2	5	5	0	R	19.5	28.7	
2	1	1	2	5	5	0	R	20.5	30.4	
2	1	2	2	5	5	0	R	21.5	32.1	
2	2	2	2	5	5	0	R	22.5	33.8	
3	2	2	2	5	5	0	R	23.5	35.5	
3	3	2	2	5	5	0	R	24.5	37.2	
3	3	2	2	5	5	1	R	25.5	38.3	
3	3	2	2	5	5	2	R	26.5	40.0	
3	3	2	3	5	5	2	R	27.5	41.7	
3	3	3	3	5	5	2	R	28.5	43.4	
3	3	3	3	5	6	2	R	29.5	45.1	
3	3	3	3	6	6	2	R	30.5	46.8	
3	3	3	3	6	6	3	R	31.5	48.5	
3	3	3	3	6	6	4	R	32.5	50.2	
3	3	3	3	6	6	5	R	33.5	51.9	
3	3	3	3	6	6	6	R	34.5	53.6	
3	3	3	4	6	6	6	R	35.5	55.3	
3	3	4	4	6	6	6	R	36.5	57.0	
3	4	4	4	6	6	6	R	37.5	58.7	
4	4	4	4	6	6	6	R	38.5	60.4	
4	4	4	5	6	6	6	R	39.5	62.1	
4	4	5	5	6	6	6	R	40.5	63.8	
4	5	5	5	6	6	6	R	41.5	65.5	
5	5	5	5	6	6	6	R	42.5	67.2	
5	5	5	6	6	6	6	R	43.5	68.9	
5	5	6	6	6	6	6	R	44.5	70.6	
5	6	6	6	6	6	6	R	45.5	72.3	
6	6	6	6	6	6	6	R	46.5	74.0	
6	6	6	6	6	7	6	R	47.5	75.6	
6	7	6	6	6	7	6	R	48.5	77.2	
6	7	6	6	7	7	6	R	49.5	78.8	

6	7	7	6	7	7	6	R	50.5	80.4
6	7	7	7	7	7	6	R	51.5	82.0
7	7	7	7	7	7	6	R	52.5	83.6
7	7	7	7	7	7	7	R	53.5	85.2
7	7	7	7	7	8	7	R	54.5	87.0
7	8	7	7	7	8	7	R	55.5	88.8
7	8	7	7	8	8	7	R	56.5	90.6
7	8	8	7	8	8	7	R	57.5	92.4
7	8	8	8	8	8	7	R	58.5	94.2
8	8	8	8	8	8	7	R	59.5	96.0
8	8	8	8	8	8	8	R	60.5	97.8
8	8	8	8	8	9	8	R	61.5	99.4
8	9	8	8	8	9	8	R	62.5	101.0
8	9	8	8	9	9	8	R	63.5	102.6
8	9	9	8	9	9	8	R	64.5	104.2
8	9	9	9	9	9	8	R	65.5	105.8
9	9	9	9	9	9	8	R	66.5	107.4
9	9	9	9	9	9	9	R	67.5	109.0
9	9	9	9	9	10	9	R	68.5	110.8
9	10	9	9	9	10	9	R	69.5	112.6
9	10	9	9	10	10	9	R	70.5	114.4
9	10	10	9	10	10	9	R	71.5	116.2
9	10	10	10	10	10	9	R	72.5	118.0
10	10	10	10	10	10	9	R	73.5	119.8
10	10	10	10	10	10	10	R	74.5	121.6
10	10	10	10	10	11	10	R	75.5	123.3
10	11	10	10	10	11	10	R	76.5	125.0
10	11	10	10	11	11	10	R	77.5	126.7
10	11	11	10	11	11	10	R	78.5	128.4
10	11	11	11	11	11	10	R	79.5	130.1
11	11	11	11	11	11	10	R	80.5	131.8
11	11	11	11	11	11	11	R	81.5	133.5
11	11	11	11	11	12	11	R	82.5	135.2
11	12	11	11	11	12	11	R	83.5	136.9
11	12	11	11	12	12	11	R	84.5	138.6
11	12	12	11	12	12	11	R	85.5	140.3
11	12	12	12	12	12	11	R	86.5	142.0
12	12	12	12	12	12	11	R	87.5	143.7
12	12	12	12	12	12	12	R	88.5	145.4
12	12	12	12	12	13	12	R	89.5	147.1
12	13	12	12	12	13	12	R	90.5	148.8
12	13	12	12	13	13	12	R	91.5	150.5
12	13	13	12	13	13	12	R	92.5	152.2
12	13	13	13	13	13	12	R	93.5	153.9
13	13	13	13	13	13	12	R	94.5	155.6
13	13	13	13	13	13	13	R	95.5	157.3
13	13	13	13	13	14	13	R	96.5	159.0
13	14	13	13	13	14	13	R	97.5	160.7

13	14	13	13	14	14	13	R	98.5	162.4
13	14	14	13	14	14	13	R	99.5	164.1
13	14	14	14	14	14	13	R	100.5	165.8
14	14	14	14	14	14	13	R	101.5	167.5
14	14	14	14	14	14	14	R	102.5	169.2
14	14	14	14	14	15	14	R	103.5	171.0
14	15	14	14	14	15	14	R	104.5	172.8
14	15	14	14	15	15	14	R	105.5	174.6
14	15	15	14	15	15	14	R	106.5	176.4
14	15	15	15	15	15	14	R	107.5	178.2
15	15	15	15	15	15	14	R	108.5	180.0
15	15	15	15	15	15	15	R	109.5	181.8

1) RSW in bay 8 has a flow equivent of 4.5 stops at forebay elevation 537.0

2) Raise gate for RSW 9 stops to ensure free surface and debris passage

Table LMN-13. Uniform Spill Pattern.

Spill Bay Stops								Total Stops	Total Spill (kcfs)
1	2	3	4	5	6	7	8		
0	0	0	0	0	1	0	R	5.5	7.9
0	1	0	0	0	1	0	R	6.5	9.0
0	1	0	0	1	1	0	R	7.5	10.1
0	1	1	0	1	1	0	R	8.5	11.2
0	1	1	1	1	1	0	R	9.5	12.3
1	1	1	1	1	1	0	R	10.5	13.4
1	1	1	1	1	1	1	R	11.5	14.5
1	1	1	1	1	2	1	R	12.5	16.2
1	2	1	1	1	2	1	R	13.5	17.9
1	2	1	1	2	2	1	R	14.5	19.6
1	2	2	1	2	2	1	R	15.5	21.3
1	2	2	2	2	2	1	R	16.5	23.0
2	2	2	2	2	2	1	R	17.5	24.7
2	2	2	2	2	2	2	R	18.5	26.4
2	2	2	2	2	3	2	R	19.5	28.1
2	3	2	2	2	3	2	R	20.5	29.8
2	3	2	2	3	3	2	R	21.5	31.5
2	3	3	2	3	3	2	R	22.5	33.2
2	3	3	3	3	3	2	R	23.5	34.9
3	3	3	3	3	3	2	R	24.5	36.6
3	3	3	3	3	3	3	R	25.5	38.3
3	3	3	3	3	4	3	R	26.5	40.0
3	4	3	3	3	4	3	R	27.5	41.7
3	4	3	3	4	4	3	R	28.5	43.4
3	4	4	3	4	4	3	R	29.5	45.1
3	4	4	4	4	4	3	R	30.5	46.8
4	4	4	4	4	4	3	R	31.5	48.5
4	4	4	4	4	4	4	R	32.5	50.2
4	4	4	4	4	5	4	R	33.5	51.9
4	5	4	4	4	5	4	R	34.5	53.6
4	5	4	4	5	5	4	R	35.5	55.3
4	5	5	4	5	5	4	R	36.5	57.0
4	5	5	5	5	5	4	R	37.5	58.7
5	5	5	5	5	5	4	R	38.5	60.4
5	5	5	5	5	5	5	R	39.5	62.1
5	5	5	5	5	6	5	R	40.5	63.8
5	6	5	5	5	6	5	R	41.5	65.5
5	6	5	5	6	6	5	R	42.5	67.2
5	6	6	5	6	6	5	R	43.5	68.9
5	6	6	6	6	6	5	R	44.5	70.6
6	6	6	6	6	6	5	R	45.5	72.3
6	6	6	6	6	6	6	R	46.5	74.0
6	6	6	6	6	7	6	R	47.5	75.6
6	7	6	6	6	7	6	R	48.5	77.2
6	7	6	6	7	7	6	R	49.5	78.8

6	7	7	6	7	7	6	R	50.5	80.4
6	7	7	7	7	7	6	R	51.5	82.0
7	7	7	7	7	7	6	R	52.5	83.6
7	7	7	7	7	7	7	R	53.5	85.2
7	7	7	7	7	8	7	R	54.5	87.0
7	8	7	7	7	8	7	R	55.5	88.8
7	8	7	7	8	8	7	R	56.5	90.6
7	8	8	7	8	8	7	R	57.5	92.4
7	8	8	8	8	8	7	R	58.5	94.2
8	8	8	8	8	8	7	R	59.5	96.0
8	8	8	8	8	8	8	R	60.5	97.8
8	8	8	8	8	9	8	R	61.5	99.4
8	9	8	8	8	9	8	R	62.5	101.0
8	9	8	8	9	9	8	R	63.5	102.6
8	9	9	8	9	9	8	R	64.5	104.2
8	9	9	9	9	9	8	R	65.5	105.8
9	9	9	9	9	9	8	R	66.5	107.4
9	9	9	9	9	9	9	R	67.5	109.0
9	9	9	9	9	10	9	R	68.5	110.8
9	10	9	9	9	10	9	R	69.5	112.6
9	10	9	9	10	10	9	R	70.5	114.4
9	10	10	9	10	10	9	R	71.5	116.2
9	10	10	10	10	10	9	R	72.5	118.0
10	10	10	10	10	10	9	R	73.5	119.8
10	10	10	10	10	10	10	R	74.5	121.6
10	10	10	10	10	11	10	R	75.5	123.3
10	11	10	10	10	11	10	R	76.5	125.0
10	11	10	10	11	11	10	R	77.5	126.7
10	11	11	10	11	11	10	R	78.5	128.4
10	11	11	11	11	11	10	R	79.5	130.1
11	11	11	11	11	11	10	R	80.5	131.8
11	11	11	11	11	11	11	R	81.5	133.5
11	11	11	11	11	12	11	R	82.5	135.2
11	12	11	11	11	12	11	R	83.5	136.9
11	12	11	11	12	12	11	R	84.5	138.6
11	12	12	11	12	12	11	R	85.5	140.3
11	12	12	12	12	12	11	R	86.5	142.0
12	12	12	12	12	12	11	R	87.5	143.7
12	12	12	12	12	12	12	R	88.5	145.4
12	12	12	12	12	13	12	R	89.5	147.1
12	13	12	12	12	13	12	R	90.5	148.8
12	13	12	12	13	13	12	R	91.5	150.5
12	13	13	12	13	13	12	R	92.5	152.2
12	13	13	13	13	13	12	R	93.5	153.9
13	13	13	13	13	13	12	R	94.5	155.6
13	13	13	13	13	13	13	R	95.5	157.3
13	13	13	13	13	14	13	R	96.5	159.0
13	14	13	13	13	14	13	R	97.5	160.7

13	14	13	13	14	14	13	R	98.5	162.4
13	14	14	13	14	14	13	R	99.5	164.1
13	14	14	14	14	14	13	R	100.5	165.8
14	14	14	14	14	14	13	R	101.5	167.5
14	14	14	14	14	14	14	R	102.5	169.2
14	14	14	14	14	15	14	R	103.5	171.0
14	15	14	14	14	15	14	R	104.5	172.8
14	15	14	14	15	15	14	R	105.5	174.6
14	15	15	14	15	15	14	R	106.5	176.4
14	15	15	15	15	15	14	R	107.5	178.2
15	15	15	15	15	15	14	R	108.5	180.0
15	15	15	15	15	15	15	R	109.5	181.8