US Army Corps of Engineers®
Northwestern Division

Fish Passage Plan
Corps of Engineers Projects

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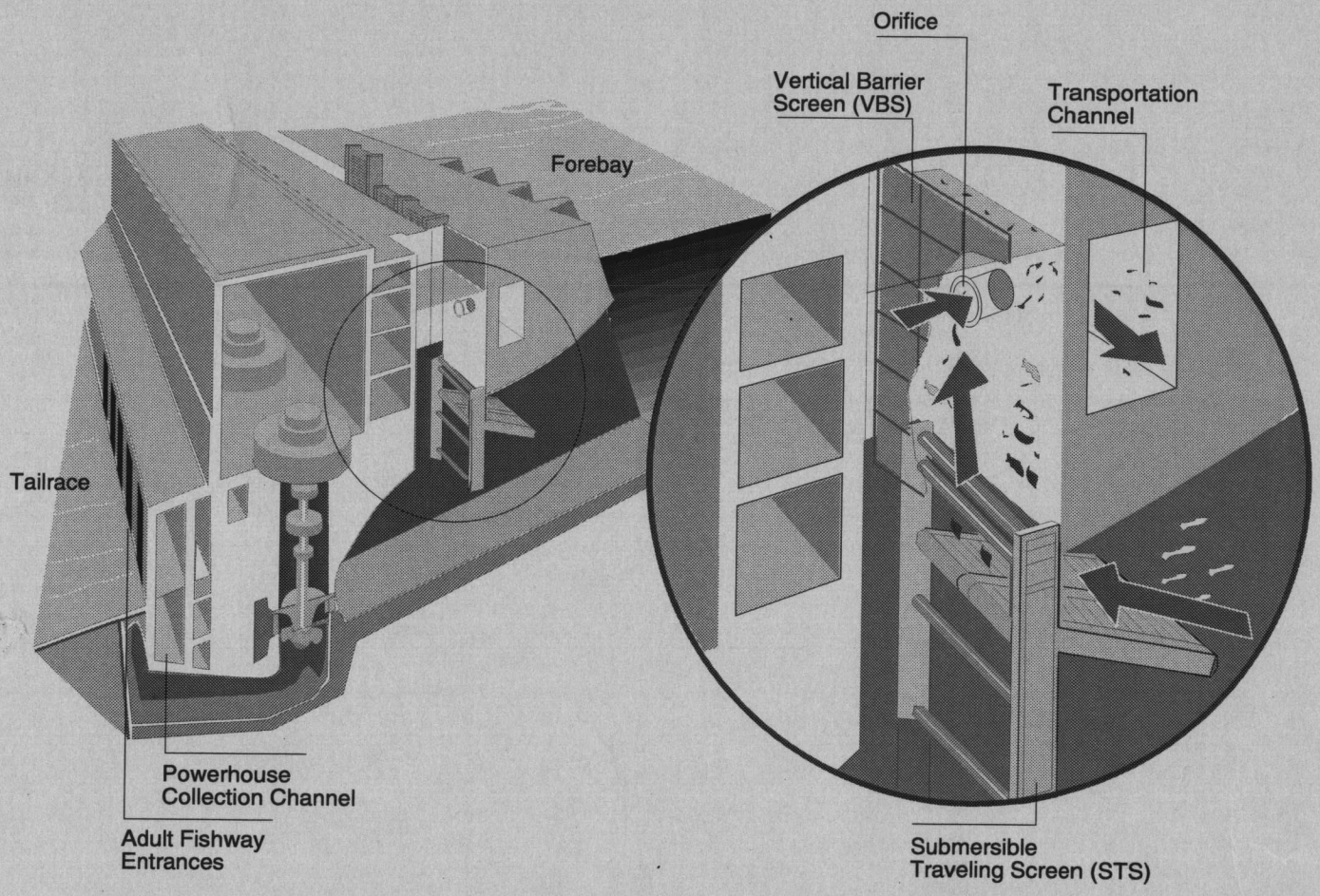

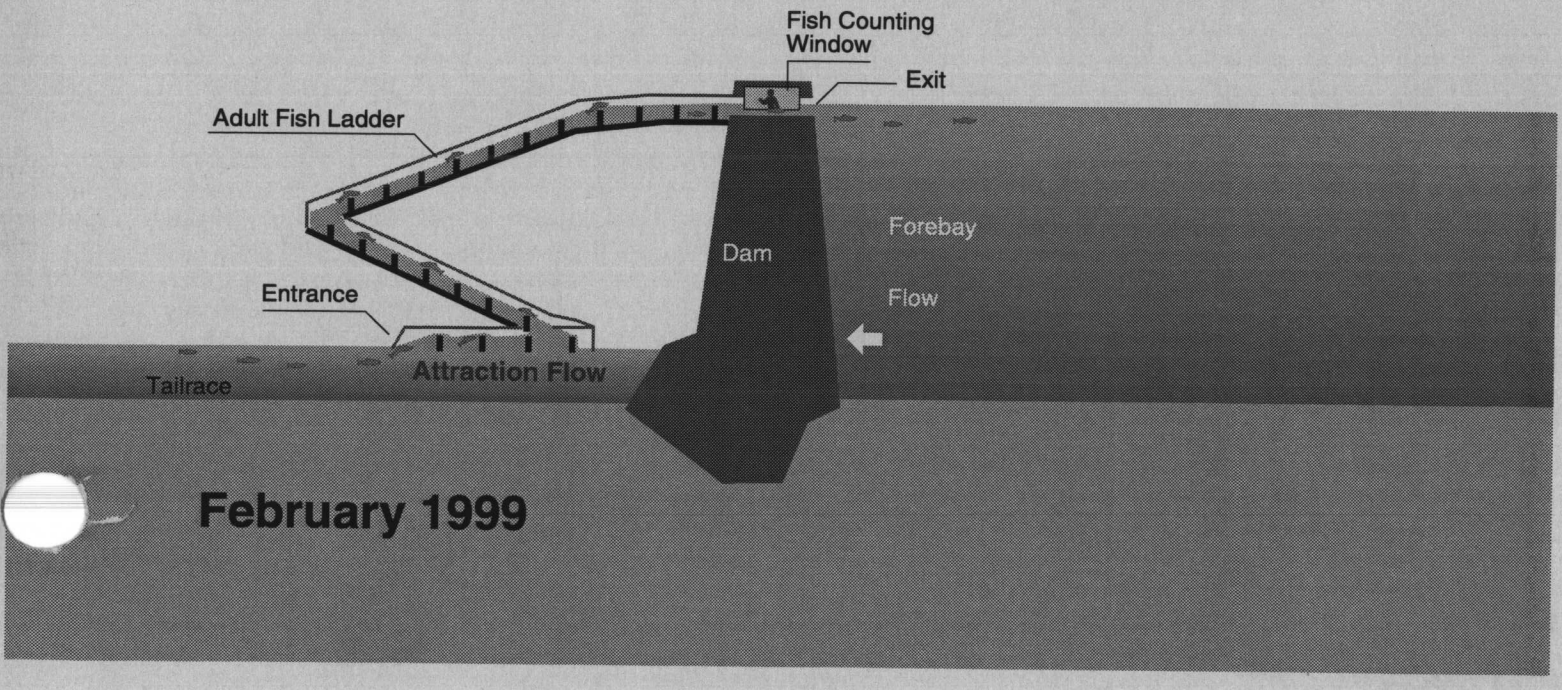

February 1999

FISH PASSAGE PLAN

FOR

CORPS OF ENGINEERS PROJECTS

U.S. ARMY CORPS OF ENGINEERS

NORTH PACIFIC DIVISION

PORTLAND, OREGON

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OVERVIEW

1. Fish Passage Plan

1.1. Overview

The Fish Passage Plan (FPP) is developed by the US Army Corps of Engineers (COE) in coordination with the region's fish agencies, Indian tribes, Bonneville Power Administration (BPA), and other participants through the Corps' Fish Passage O&M Coordination Team. The FPP describes year-round project operations necessary to protect and enhance ESA-listed salmon species as well as other anadromous fish species. The FPP guides Corps actions in regard to providing fish protection and passage at the eight Corps mainstem Columbia and Snake river projects. Other Corps documents and agreements related to fish passage at these projects are consistent with the FPP.

The FPP is revised as necessary to incorporate changes to project operations and maintenance as a result of new facilities or changes in operational procedures. Revisions will incorporate changes adopted through coordination with the National Marine Fisheries Service (NMFS) as part of the Endangered Species Act (ESA) Section 7 consultation, Recovery Plan, or Section 10 permit processes, and through consideration of other regional input and plans. The current revisions reflect provisions contained in the NMFS Biological Opinion issued March 2, 1995 (Reinitiation of Consultation on 1994 - 1998 Operation of the Federal Columbia River Power System and Juvenile Transportation Program in 1995 and Future Years), in the Corps Record of Decision signed March 10, 1995 (U.S. Army Corps of Engineers North Pacific Division Record of Decision, Reservoir Regulation and Project Operations, 1995 and Future Years), in the 1998 Supplemental Biological Opinion, and in the Corps' Record of Consultation and Summary of Decision, signed June 24, 1998. When revising the FPP, the Corps considers the amended Northwest Power Planning Council (NPPC) Columbia River Basin Fish and Wildlife Program to the fullest extent practicable.

Comments on the FPP are welcome. They may be directed either to the Fish Passage O&M Coordination Team or the Northwest Division, Reservoir Control Center (RCC) office in Portland, Oregon. Unresolved differences between FPP criteria and prior recommendations of the fish agencies and

tribes are highlighted within Sections 2 through 9.

1.2 Emergency Deviations From FPP. River operations emergencies may occur which require projects to deviate temporarily from the FPP. To the extent possible, these operations will be conducted to minimize fish impacts and coordinated with fish agencies and tribes. Normally, coordination occurs prior to an action. However, if an emergency situation requires immediate attention, coordination will be done as soon as possible after the fact.

1.3 Technical Management Team. Decisions on river operations to achieve fish passage efficiency (FPE) or survival goals for spring and summer outmigrants will be made in coordination with the Technical Management Team (TMT). Coordination of special operations identified in the FPP will occur through the TMT and they will be identified in the Water Management Plan. These may include maintenance or research activities requiring unit outages that affect other river operations, operation of turbines outside of the 1% efficiency range, zero nighttime flow, and implementation of the Juvenile Fish Transportation Program.

1.4 Spill at Corps Mainstem Projects. Corps mainstem projects will provide spill for juvenile fish passage according to the NMFS Biological Opinions (specifications in Appendix E) to protect ESA-listed salmon species. Target spill levels were developed through consultation with NMFS and may be adjusted during the fish migration season as recommended by the TMT. Continuous spill is provided at Bonneville, The Dalles, and Ice Harbor Dams for spring and summer outmigrants to meet Biological Opinion requirements. Nightly spill is also provided at John Day, McNary, Lower Monumental, Little Goose, and Lower Granite Dams. Spill may also be provided under special circumstances for non-listed fish species if recommended by the fish agencies and tribes and if the recommendations are consistent with regional operational agreements (i.e., Spring Creek National Fish Hatchery release in March).

1.5 Total Dissolved Gas Monitoring. Total dissolved gas (TDG) saturation levels are monitored at the forebay and tailrace of each mainstem project during the fish passage season. The water quality standard and criterion developed

by the states and EPA is 110% of saturation at ambient temperature and pressure. The Corps policy (Appendix F) is to operate each mainstem project to meet state standards insofar as physically possible unless other overriding reasons cause temporary deviations. The NMFS Biological Opinions call for fish spill to be provided at levels that create higher TDG levels (Appendix E). Also, implementation of fish spill requests from fish agencies and tribes have in the past resulted in TDG levels of 120% or greater. Therefore, fish spill implementation will be subject to further coordination with appropriate entities if excessive TDG levels occur or if evidence of gas bubble disease is observed in fish. Any spill requests that will cause exceedance of the state TDG standard must include prior coordination with state water quality agencies, including waivers of state water quality standards obtained in advance by the requester.

1.6 System Load Shaping. Guidelines coordinated by BPA on system load shaping to consider fish impacts are included in Appendix C. The guidelines describe procedures BPA follows to make hydropower load requests that enable the Corps to operate units within the 1% turbine operating range.

1.7. Juvenile Fish Transportation Plan (JFTP). Juvenile fish will be transported in accordance with the NMFS Biological Opinions and Section 10 permit. Transport criteria are contained in the JFTP, Appendix B. The JFTP covers collection, holding, and transport of juvenile fish. Other project criteria on operation of the juvenile fish bypass facilities are contained in Sections 2 through 9. Additional criteria may be developed as part of the ESA Section 10 permit process and/or in coordination with the TMT. Implementation of juvenile fish transportation, including deviation from the plan described in Appendix B, will be coordinated through the TMT and with NMFS (ESA).

1.8. Project Fish Passage Facilities Inspection and Reporting Criteria.

1.8.1 General. Sections 2 through 9 contain the detailed criteria for inspection and reporting for fish passage facilities at the Corps projects on the lower Snake and lower Columbia rivers. The Corps provides weekly written inspection reports to the NMFS Hydropower Program office

describing out-of-criteria situations, adjustments made to resolve problems, and a detailed account of how out-of-criteria situations affected project fish passage and survival. The weekly inspection reports also include summaries of equipment calibrations, adult fish collection channel velocity monitoring, and water temperature monitoring. Equipment which does not require calibrating will not routinely be included in the weekly report. The Corps also provides an annual report to NMFS which summarizes project operations and maintenance and fish passage facility inspections and monitoring.

1.8.2 Criteria for Reporting Excursions Outside the 1% Turbine Operating Efficiency Range. Excursions outside the 1% turbine operating range will be reported by BPA annually. These reports will describe instances where lower Columbia and lower Snake river turbines were operated outside the 1% efficiency ranges for significant periods, as defined under the guidelines in Appendix C. BPA will prepare the reports by consolidating data provided by Corps project operators and the reports will be sent to NMFS by BPA. The intent of excursion reporting is to provide a means for quality assurance for project operations.

1.9. Implementation of the Fish Passage Plan.

Implementation of the FPP requires information from and coordination with NMFS, BPA, other federal and state fish agencies, and tribes. RCC coordinates operation of Corps projects that affect system water management, spill, unit availability, or other project uses through the TMT. District biologists may coordinate directly with the fish agencies and tribes on other project-specific operations that do not have system impacts.

Daily RCC briefings are held at 1300 hours, Monday through Friday, during the flood control and fish passage seasons, in the U.S. Custom House, Portland, Oregon. RCC also participates in weekly meetings of the TMT during the fish passage season which recommends river operations to implement the Biological Opinion and other recommendations from fish interests. Corps representatives are available at these meetings to discuss the latest weather and runoff forecasts, as well as fish, hydrologic, water quality, and power information to assist in the planning of operations

for fish passage for the following days. Fish operation recommendations are evaluated by the Corps to determine impact on overall system operations. The Corps also coordinates with NMFS and U.S. Fish and Wildlife Service (FWS) to meet ESA requirements for endangered species.

1.9.1 Agency Responsibilities.

1.9.1.1. U.S. Army Corps of Engineers.

a. Coordinate with NMFS and FWS on operational actions that might impact threatened, endangered, or candidate species.

b. Prepare a Water Management Plan for in-season management, in coordination with TMT members, which implements the Corps Record of Decision.

c. In cooperation with the fish agencies and tribes, provide fish passage monitoring, surveillance, and reporting at Corps projects throughout the migration period.

d. Provide timely information on all proposed and/or scheduled studies or special operations which may negatively impact or otherwise constrain fish passage or energy production. Discuss unforeseen changes in fish passage operation with fish agencies and tribes.

e. Carry out routine and emergency fish passage operations and maintenance procedures in accordance with criteria in Sections 2 through 9 and Appendix A.

f. Conduct the Dissolved Gas Monitoring Program as described in Appendix D.

1.9.1.2. Fish Agencies and Indian Tribes.

a. Request spill for fish through TMT to protect endangered species or other species in accordance with the TMT Guidelines.

b. Through TMT, provide RCC with a spill priority list and recommendations for modifications.

c. Provide biological monitoring and surveillance

reports throughout the migration period from predetermined locations, such as Smolt Monitoring Program sample sites.

d. Provide status reports on the timing of the downstream migration, including pertinent marked fish release and recovery data, with weekly written reports estimating percentage of run past key projects.

e. Where biologically and logistically feasible, coordinate hatchery releases to ensure they are protected by regulated fish flows and spills while minimizing impacts on endangered species. Provide and update hatchery release schedules weekly.

f. Provide recommendations to the operating agencies for maintaining acceptable fish passage conditions. This information can be used to maximize other project uses, including power generation.

g. Provide information on all proposed and scheduled studies or special operations designed to improve fish passage operations which may affect energy production or project operation. Discuss unforeseen changes with the Corps.

h. Recommend viable methods and procedures to reduce mortality to resident and migratory fish. This may include such operations as collection and transport of migrants, use of alternate bypass strategies, or other methods to reduce fish mortality.

1.9.1.3. Bonneville Power Administration.

a. Report to RCC on updated load-resource studies during the April-to-September period to supplement the National Weather Service River Forecast Center's runoff volume forecast for fish passage planning assistance.

b. Provide to RCC, NMFS, other fish agencies, and tribes, the BPA estimate of power market impacts of requested spill operations.

c. Utilize available flexibility of the Federal Columbia River Power System to shape flow requirements, spill priorities, and plant generation consistent with BPA

policies and statutory requirements related to fish protection.

d. Adjust system generation to provide adequate water to meet fish operations requirements in accordance with the NMFS Biological Opinion on hydrosystem operations.

e. Provide project load requests on a real-time, hourly basis that enable the Corps to implement spill priorities.

f. Provide information on unit operation within the 1% operating range, as indicated in Appendix C.

1.9.1.4. Mid-Columbia Public Utility Districts.

Operate projects for spill transfer in accordance with provisions of the FPP with at least one and one-half hours notification to start or stop spill.

1.9.2. Coordination Procedures.

1.9.2.1. Coordination of the FPP.

The FPP is effective year-round and revisions are coordinated with the Fish Passage O&M Coordination Team, which includes NMFS, other Federal and state fish agencies, tribes, and other interested parties. Different parts of the FPP may be revised at different times. Suggested revisions should be submitted to the Committee for consideration by the Corps. Draft FPP revisions will be provided for a two-week regional review. FPP revisions will be published two weeks after the close of the regional review period. FPP revisions are provided to TMT for use as part of the overall river operation plan. Sections dealing with special operational requirements will be included in the Water Management Plan.

1.9.2.2. Day-to-day Coordination of River System.

a. Flow Augmentation and Reservoir Operations Recommendations. Procedures described in the Water Management Plan will be used for fish operations. Coordination for system and project operations will occur through TMT. This will include requests for operation of

turbine units outside of the 1% best efficiency range, zero nighttime flow in the Snake River, reservoir operation at minimum operating pool (MOP) or some other specific level, and special operations for implementation of approved research projects as identified in Appendix A. During the time when reservoirs are not being operated to provide special protection for fish passage, projects may be operated within the full reservoir operating range.

b. Fish Spill Management. The Corps will implement fish spill provisions described in Appendix E, consistent with state water quality standards including applicable TDG waivers in effect at the time. The TDG and gas bubble trauma signs in fish will be monitored and evaluated during the spill season by the Corps, NMFS, other fish agencies, tribes, BPA, and water quality agencies. Recommendations on adjusting spill levels based on physical and biological monitoring results will be forwarded to the TMT for discussion at their weekly meetings.

c. Special Operation Recommendations (Fish-related and for Project O&M Activities). Recommendations for special fish operations outside the Water Management Plan may be made to RCC. Coordination of these recommendations will be made through the TMT. Recommendations related to project O&M activities requiring special operations will be evaluated for impacts on fish migration. Sufficient lead time will be given on a planned operation, whenever practical, to allow coordination with the TMT and NMFS (ESA). As much lead time as possible will be provided for activities requiring immediate action. After-action coordination will occur when advance notice is not possible, such as in emergency actions.

d. Other Operational Requests. As with Corps O&M requests, all other operational recommendations will be evaluated for impacts on fish migration and effects on other project O&M requirements. Coordination of special operations with NMFS, other fish agencies, and tribes will occur through the TMT. Except as necessary for emergency actions, adequate time will be allowed for evaluation of all project and fish impacts prior to implementation. Coordination of emergencies, as identified in the Emergency Operations Protocol adopted by the TMT, will be followed.

1.9.2.3. Activities by Non-Corps Personnel. All non-Corps personnel intending to conduct any activity, such as fish handling or minor facility modifications, at a Corps facility must have prior written approval. This approval must be requested in writing to the Chief, Operations Division, at the district office responsible for a particular project. If the activity could affect fish listed for ESA protection, proof of consultation with NMFS or FWS (Section 10 permit) must also be provided.

Bonneville Dam

1. Fish Passage Information. The locations of fish passage facilities are shown on the following general site plans for Bonneville Lock and Dam (Figures BON-1 through BON-3). Dates for project operations for fish purposes and special operations are listed in Table BON-1.

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description, First Powerhouse. Juvenile fish passage facilities at the Bonneville first powerhouse consist of STSs, VBSs, 12" gatewell orifices, fish bypass channel, excess water elimination facility, fish sampler, and a 24" fish transport pipe to the tailrace. All 10 main turbine units have STSs. A small unit (unit O) is located at the south end of the powerhouse and is not equipped with screens.

There are also small channels associated with the auxiliary water intakes for adult fishways at the south end of the powerhouse and at both ends of the spillway. These older juvenile fish passage channels discharge into the adult fishways at the ends of the spillway and into the ice and trash sluiceway at the south end of the powerhouse. These facilities are no longer operated on a regular basis.

1.1.2. Facilities Description, Second Powerhouse. Juvenile fish passage facilities at the Bonneville second powerhouse comprise turbine intake extensions (TIEs), streamlined trash racks, STSs, VBSs, two 12" orifices per gatewell (with only one operating per gatewell) flowing into a fish bypass channel, an excess water elimination facility, and a 48" fish transport pipe which connects the bypass channel to the tailrace in the new outfall location. A juvenile fish sampling facility is included in the bypass. All eight main turbine units have STSs, TIEs, and streamlined trashracks. Two smaller turbines that supply adult fishway auxiliary water do not have STSs, TIEs, or streamlined trashracks.

1.1.3. Juvenile Migration Timing. The juvenile fish migration season occurs from March 1 through November 30. Table BON-2 shows the primary passage periods for each species. Maintenance of juvenile fish facilities is scheduled for the period December 16 through February to reduce the impact on downstream migrants. Maintenance activities will be coordinated to minimize potential impacts on juvenile migrants that may be present during this time period.

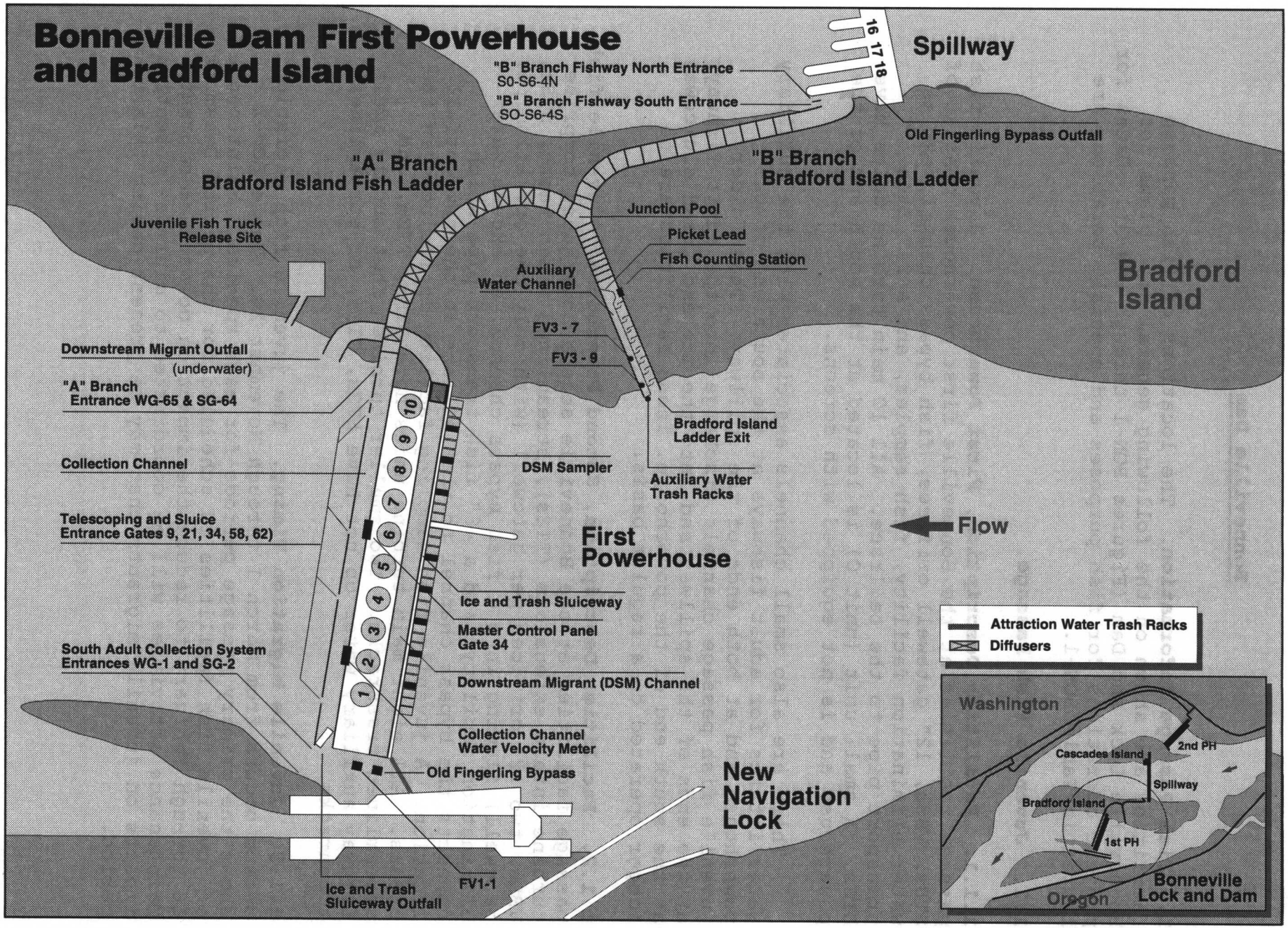

Figure BON-1 Bonneville Dam first powerhouse and Bradford Island fish ladder.

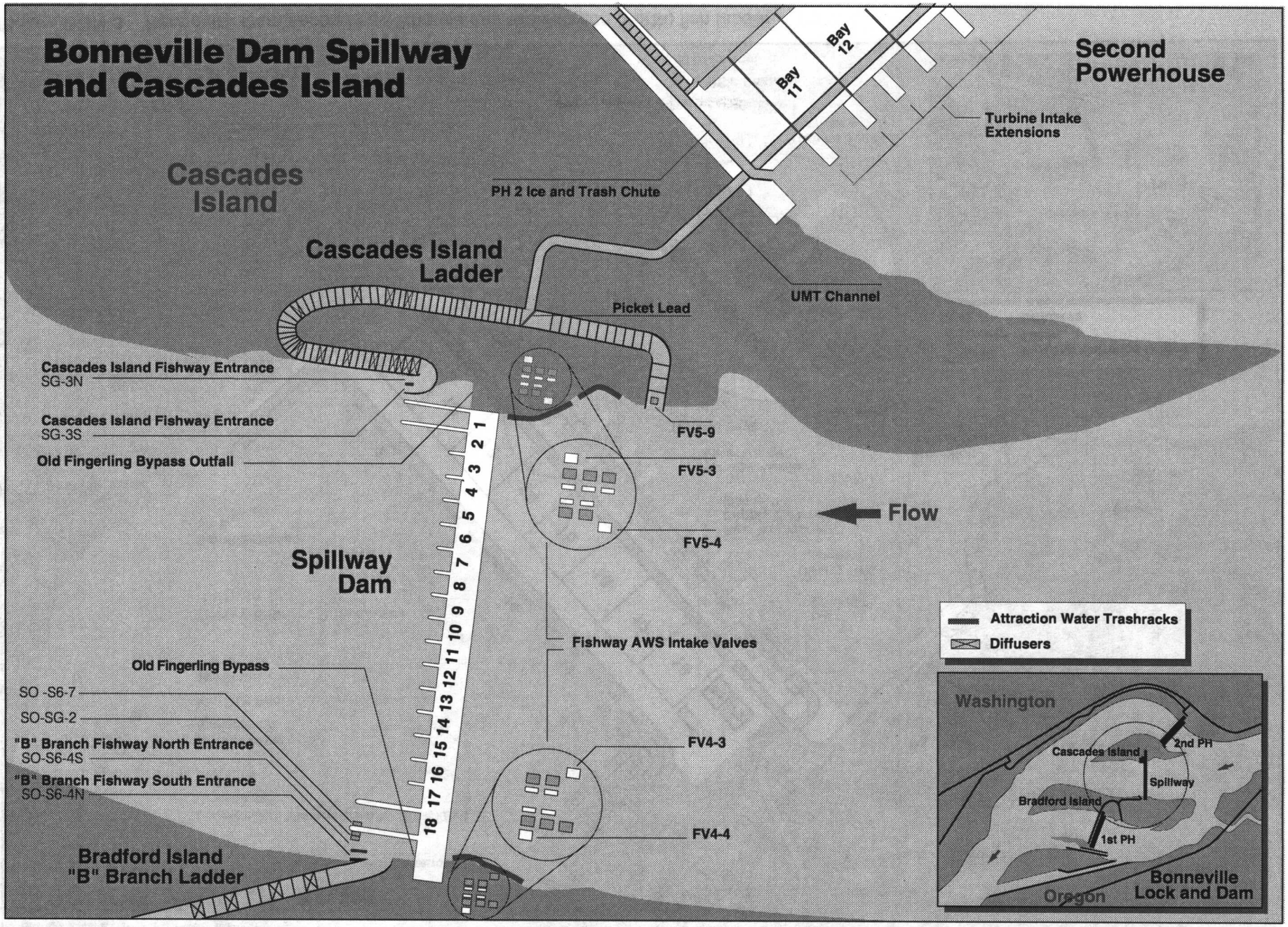

Figure BON-2 Bonneville Dam spillway, Cascades Island fish ladder and upstream migrant transportation channel (UMT).

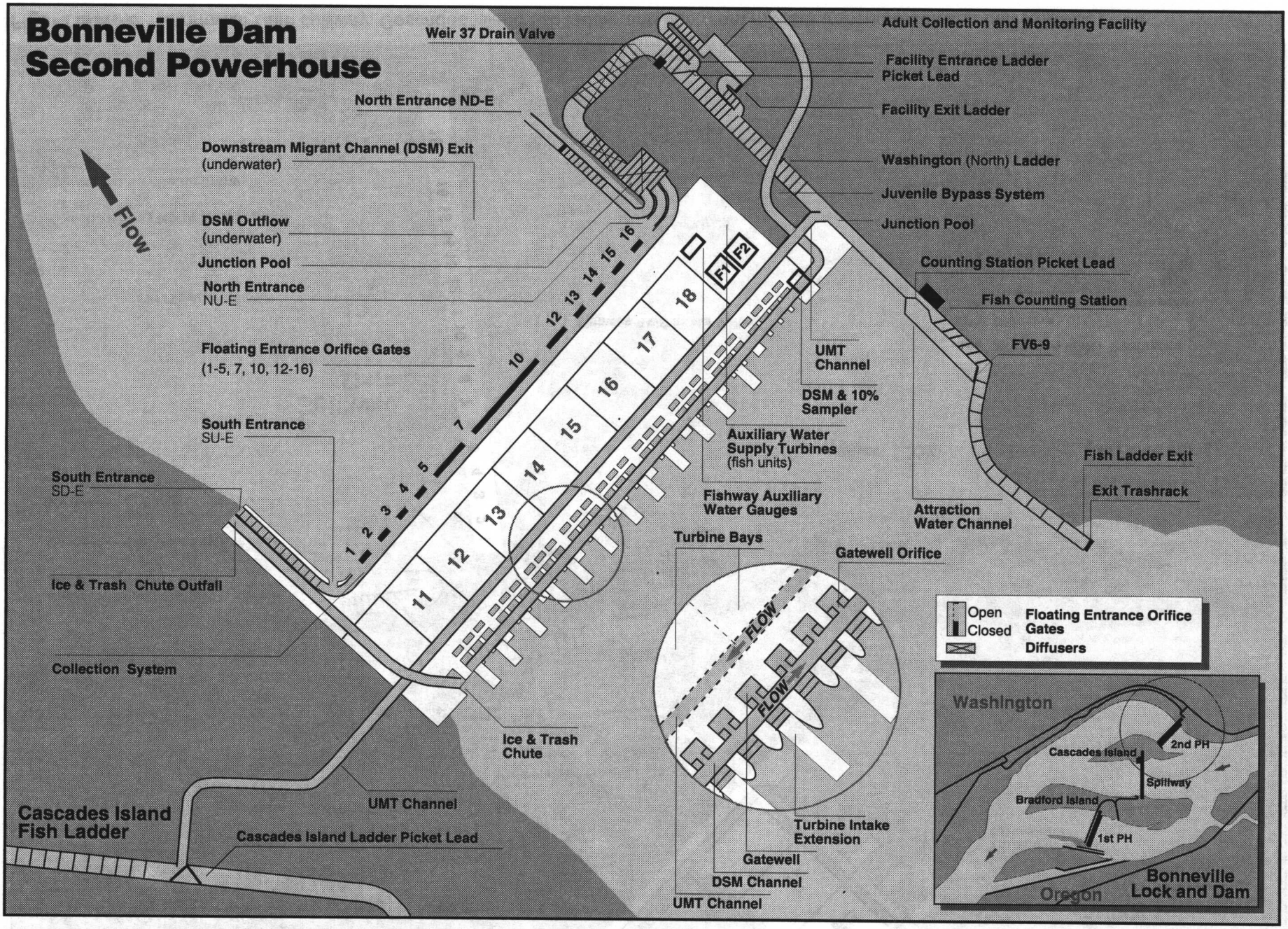

Figure BON-3 Bonneville Dam second powerhouse and Washington (north) fish ladder.

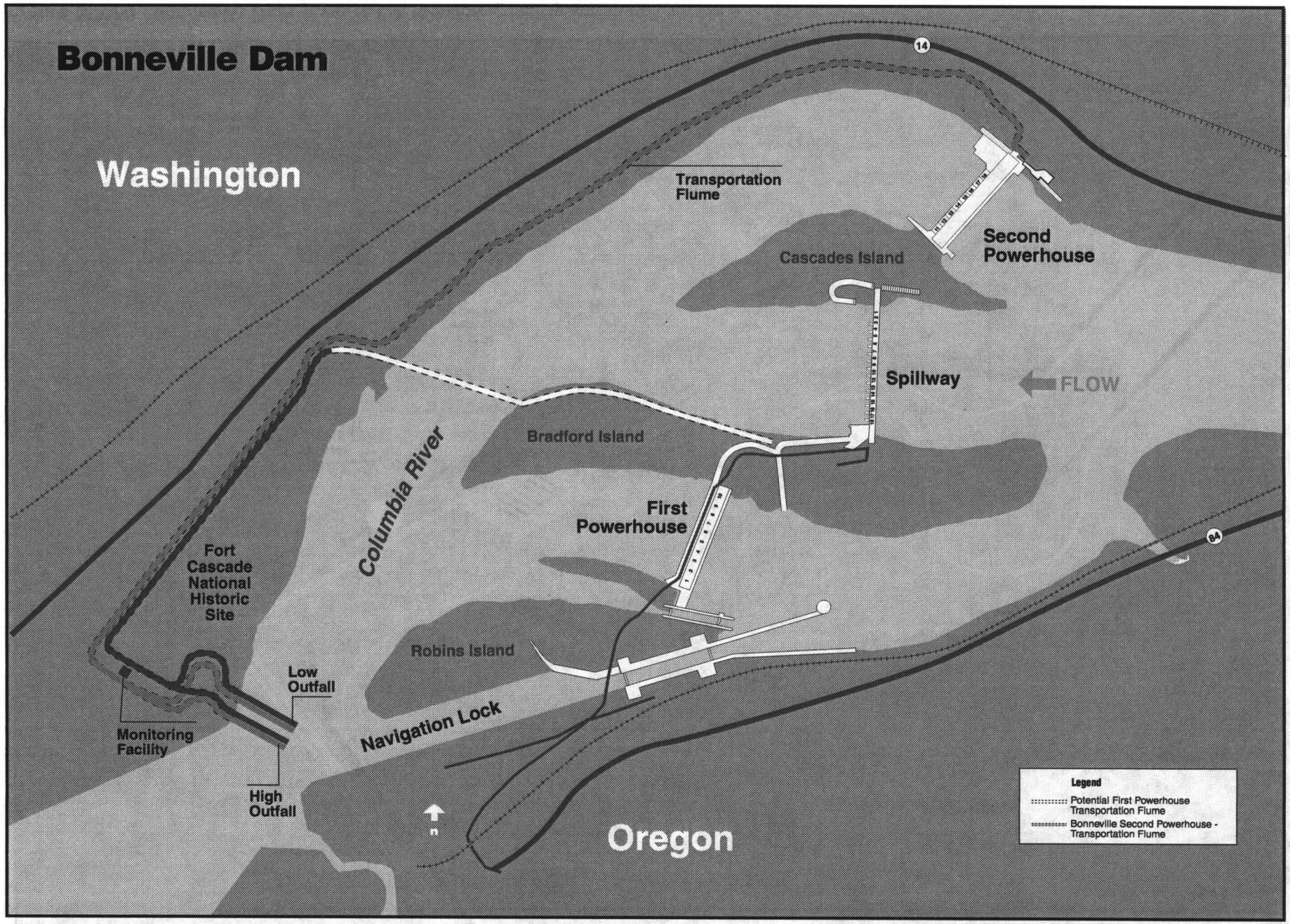

Figure BON-4 Bonnevillle juvenile fish passage system.

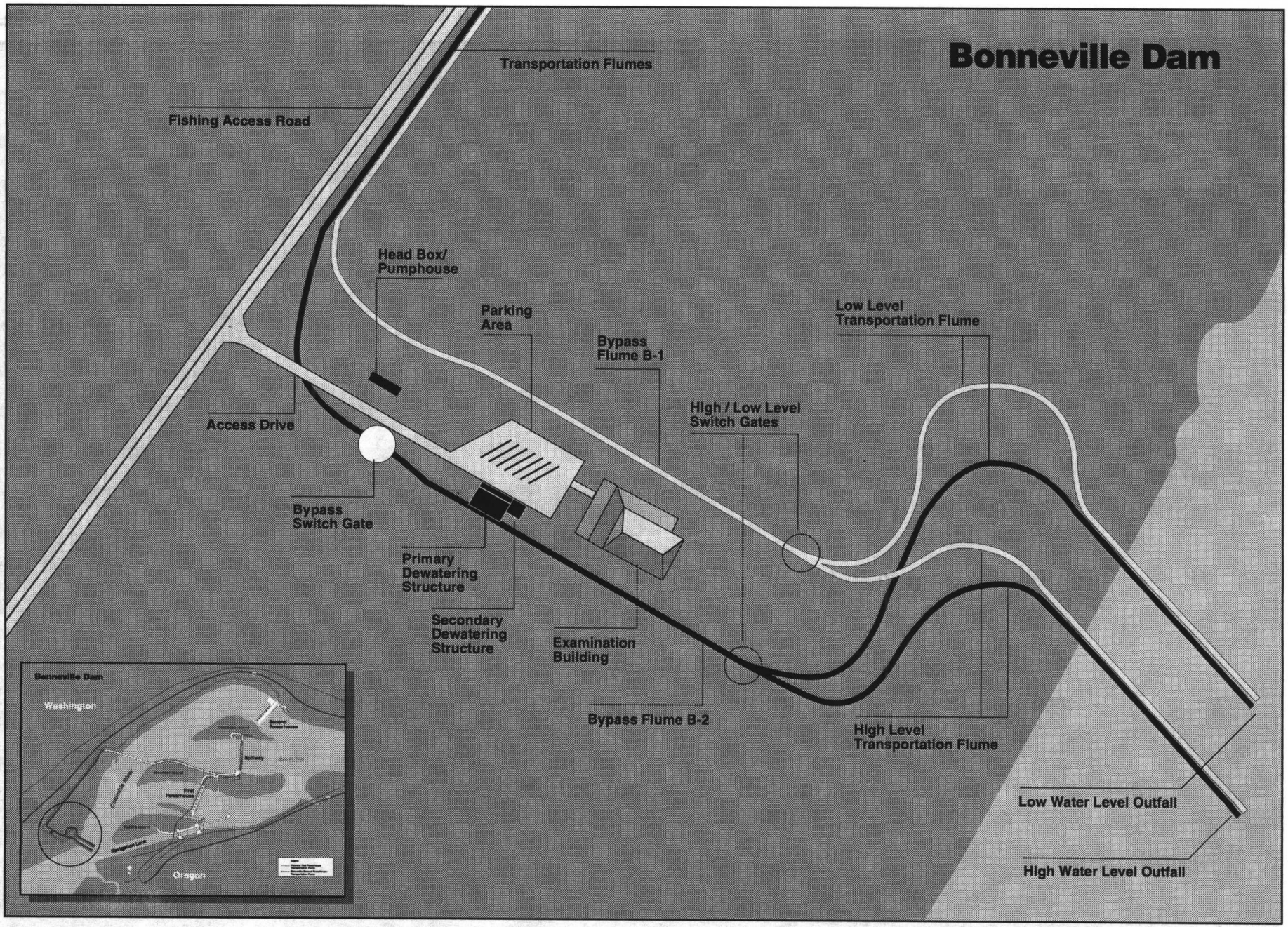

Figure BON-5 Bonnevillle Dam juvenile fish monitoring facility and outfall flumes.

Table BON-1. Dates of project operations for fish purposes at Bonneville Dam, 1999.

Task Name	Start	Finish	Reference
Juvenile Migration Timing	3/1/1999	11/30/1999	FPP Bon 1.1.3
Adult Fish Counting	**3/1/1999**	**2/29/2000**	**FPP Bon 1.2.2**
Video Only	3/1/1999	3/31/1999	FPP Bon 1.2.2
Visual Count 0400 - 2000	4/1/1999	10/31/1999	FPP Bon 1.2.2
Video Count 2000 - 0400	4/1/1999	10/31/1999	FPP Bon 1.2.2
Video Only	11/1/1999	2/29/2000	FPP Bon 1.2.2
Special Power House Operations	**3/1/1999**	**11/30/1999**	**FPP Bon 2.1.1.1**
TDG Monitoring	**3/1/1999**	**2/29/2000**	**FPP Bon 2.3**
Avian Abatement in Place	3/1/1999	3/1/1999	FPP Bon 2.4.1.1 g
Screens in Place	3/1/1999	12/15/1999	FPP Bon 2.4.1.2
Install TIES	3/1/1999	3/1/1999	FPP Bon 2.4.2.2 n
Adult Fish Passage Season	3/1/1999	11/30/1999	FPP Bon 2.5.1.2
Spill Gates 1 and 18 Open 4"	3/1/1999	11/30/1999	FPP Bon 2.5.1.2 b 1
1% limitations	**3/1/1999**	**2/29/2000**	**FPP Bon 4.4**
ESBS Testing and Installation	3/1/1999	12/15/1999	FPP App A Bon 2.1
Lower Columbia River Adult Study	3/1/1999	9/30/1999	FPP App A Bon 2.3
Spring Creek Hatchery Release	3/18/1999	3/27/1999	FPP App A Bon 1.1
Prototype Surface Collector Testing	4/19/1999	7/16/1999	FPP App A Bon 2.4.1
Spill for Juvenile Fish	4/20/1999	9/30/1999	FPP App A Bon 1.2
Special Spill Time for Sockeye	6/1/1999	8/15/1999	FPP Bon 2.2.3
Rehab Biological Testing	6/1/1999	10/31/1999	FPP App A Bon 2.2
Remove TIES	7/1/1999	7/1/1999	FPP Bon 2.4.2.2 n
Possible closure of Ice and Trash Chute	10/1/1999	11/30/1999	FPP Bon 2.4.1.2 m
Maintenance of Adult Fish Facilities	12/1/1999	2/29/2000	FPP Bon 1.2.2
Maintenance of Juvenile Fish Facilities	12/16/1999	2/29/2000	FPP Bon 1.1.3
Annual Report	1/31/2000	1/31/2000	FPP Bon 2.6

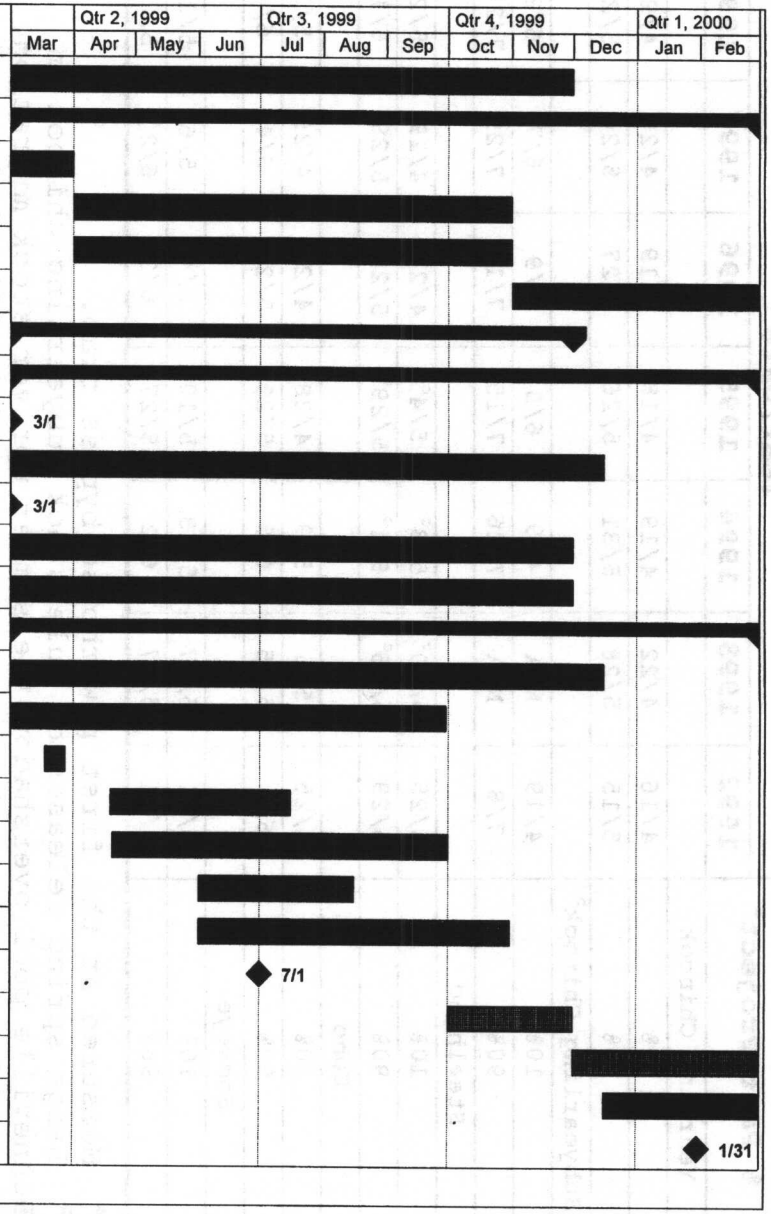

Table BON-2. Juvenile fish migration timing at Bonneville Dam, 1992-1998.

% Past Project[a]	Year/Date						
	1992	1993	1994	1995	1996	1997	1998
Yearling Chinook							
10%	4/16	4/22	4/19	4/18	4/19	4/20	4/23
90%	5/15	5/28	5/31	5/26	5/27	5/26	5/23
Subyearling Chinook[b]							
10%	4/19	N/A	6/9	6/5	6/9	6/7	6/3[d]
90%	7/8	N/A	7/26	7/15	7/18	7/29	7/20[d]
Steelhead							
10%	4/25	5/10[c]	5/3[c]	5/4[c]	4/27[c]	4/29[c]	5/2[c]
90%	5/29	5/26[c]	6/4[c]	5/29[c]	5/29[c]	5/28[c]	6/1[c]
Coho							
10%	4/25	5/5	5/9	4/28	4/23	4/29	5/3
90%	6/3	5/25	6/5	5/29	5/28	6/4	6/4
Sockeye							
10%	5/11	5/17	5/13	5/10	5/4	5/6	5/10
90%	5/31	5/27	6/2	5/27	6/2	6/22	5/29

[a] Measured at the first powerhouse bypass trap.
[b] Large spring releases of tule stock subyearling chinook in Bonneville pool overshadow the summer upriver stock migration. To avoid this, these dates are for the middle 80% of the subyearling chinook run which occurs after June 1.
[c] Dates are for hatchery steelhead. Wild steelhead averaged a few days earlier for the 10% and 90% passage.
[d] "Brights" only.

1.2. Adult Fish Passage.

1.2.1. Facilities Description. Adult fish passage facilities at Bonneville Dam consist of two main fishway segments. The first powerhouse collection system with A-branch ladder and the south spillway collection system with B-branch ladder join together at the Bradford Island ladder to form the Bradford Island fishway segment. The Cascades Island ladder at the north side of the spillway is connected to the Washington shore ladder by the upstream migrant transportation (UMT) channel. The second powerhouse collection system/ladder join together at the Washington shore to form the Washington shore fishway segment. Both the Bradford Island and the Washington shore fishways have counting stations. The second powerhouse ladder has an adult fish sampling facility. All four collection systems have auxiliary water supplies for fish attraction.

1.2.2. Adult Migration Timing. Upstream migrants are present at the project throughout the year and adult passage facilities are operated year round. Because passage through the winter months is relatively light, fish counting is by video-taping (no visual counting), primarily to monitor winter steelhead passage. The adult fish counting schedule is shown in Table BON-3. Annual winter maintenance of adult fish facilities is scheduled from December 1 through February (in-water work period) to minimize the impact on upstream migrants and to minimize adult fall chinook and steelhead fallback.

Table BON-3. Adult fish counting schedule.

Period	Counting Method
January 1 - March 31	Video count 24 hours/day
April 1 - October 31	Visual count 16 hours/day (0400-2000 PST)
April 1 - October 31	Video Count 8 hours/day (2000-0400 PST)
November 1 December 31	Video count 24 hours/day

Adult migration count data for Bonneville Dam have been collected since 1938. Table BON-4 summarizes adult fish passage timing through 1998. The primary passage period and the earliest and latest peaks of migration recorded are listed for each species (from fish counts compiled by the Corps).

Table BON-4. Adult migration timing from fish counts, 1938-1998.

Species	Count Period	Earliest Peak	Latest Peak
Spring chinook	3/14 - 5/31	4/15	5/27
Summer Chinook	6/1 - 7/31	6/5	7/31
Fall Chinook	8/1 - 11/15	8/31	9/17
Steelhead	3/15 - 11/15	7/16	9/22
Coho	7/15 - 11/15	8/29	9/22
Sockeye	6/1 - 8/15	6/22	7/13

2. Project Operation.

2.1. General. Yearling chinook and most other juvenile salmonids migrate downstream in the spring, whereas during the summer, after mid-June, sub-yearling chinook dominate. Studies specific to Bonneville Project indicate that fish survival rates for passage through various routes differ between spring and summer. For this reason, distribution of flow between powerhouses and spill volume will change as described in sections

2.1.1. and 2.2.

2.1.1. Powerhouse Flow Distribution. The first powerhouse will operate as a priority, throughout the juvenile and adult fish passage season (March 1 through November), over the second powerhouse. Maintain first powerhouse flows of at least 60 kcfs to provide favorable tailwater conditions for juvenile outmigration. If the second powerhouse is operated, also maintain flows of at least 60 kcfs. Both powerhouses can be reduced below 60 kcfs to minimum unit loading if needed to achieve the desired spill (sections 2.2.2. and 2.2.3.) and if necessary due to low river flows. The minimum loading in the first powerhouse is units 1, 2, 9, and 10. Units 9 and 10 are required to provide suitable flow to disperse juvenile fish from the JBS release site. Units 1 and 2 are necessary to provide energy to meet critical project loads including station service for the first powerhouse, navigation lock, fish hatchery, sewage treatment plant, project office buildings, well pumps, and an emergency first and second powerhouse interconnection. Normally, unit 1 is tied to the feeder bus and unit 2 remains on line, as a redundancy in the event unit 1 fails. Minimum loading in the second powerhouse is units 11, 17 and 18. These units provide suitable flow conditions for migrating fish.

2.1.2. Other Activities. Research, non-routine maintenance, other fish-related activities, and construction activities will not be conducted within 100' of any fishway entrance or exit or within 50' of the rest of the fishway, unless concurred with by regional fish managers through ESA and other fish passage forums. Currently approved special operations are described in Appendix A. Alternate actions will be considered by district and project biologists in coordination with the fish managers on a case by case basis. Emergency situations should be dealt with immediately by the project in consultation with the project or district biologist. If unavailable, the biologists will be informed of steps taken to correct the situation immediately following the incident. All activities within boat restricted zones (BRZ) will be coordinated in advance with the project.

2.2. Spill Management.

2.2.1. General. Regardless of time of day, only one spill schedule will be used at Bonneville Dam (Table BON-11, page BON-44). Nighttime spill is limited as necessary to control total dissolved gas (TDG) supersaturation. Adjustments of the nighttime spill level may be granted on a case-by-case basis by the Reservoir Control Center (RCC), dependent upon TDG monitoring at stations downstream of the dam, biological monitoring, and fish movement. The hours of nighttime spill are the daily complements of the periods of daytime spill (Table BON-5). The

transition from daytime spill cap to nighttime spill cap and vice versa will normally take 15 to 20 minutes due to the time required to start, synchronize, and load multiple generators. Frequently, a total river discharge change will occur concurrently with these spill transitions. The transition to the daytime cap should begin early enough in the day to minimize chances of violating the defined daytime spill maximum. The transition to the nighttime spill period should not start until after the daytime cap period is over.

2.2.2. Juvenile Fish. Spill for juvenile fish passage will begin April 20 and end August 31 (1998 Supplemental Biological Opinion). The daytime spill amount is 75 kcfs in order to reduce adult fallback (see section 2.2.3). At night, the spill amount will be up to the 120% gas cap. The second powerhouse ice and trash chute will be operated for ice and trash removal and for emergency auxiliary adult transportation channel water supply only as outlined in section 3.3.2.1.c. (second paragraph).

2.2.3. Adult Fish. During the adult fish passage period, March 1 through November, daytime spill will be limited to 75 kcfs whenever possible. Normally, this restriction will be from one hour before sunrise to one half hour before sunset (see Table BON-5. However, during the sockeye passage season, which begins when at least 10 fish pass the project per day (in combined ladder counts), but no later than June 1 through August 15, the cap will apply until one hour after sunset.

Table BON-5. Daytime spill schedule for Bonneville Project.

Date	Daytime Spill	
	Begin	End
Mar 1 - 17	0530	1745
Mar 18 - Apr 3	0500	1800
Apr 4 - 21	0530	1930
Apr 22 - May 10	0500	1945
May 11 - 31	0430	2015
Jun 1 - Jul 22[a]	0430	2200
Jul 23 - 31	0500	2200
Aug 1 - 15	0500	2130
Aug 16 - 31	0500	1930

[a] Start date for sockeye passage varies.

2.3. Total Dissolved Gas (TDG) Management and Control. Implementation of spill requests will take into account TDG

monitoring data and the observed condition of migrant juveniles and adults, along with juvenile migration monitoring data. The Corps will monitor TDG from a station in the Bonneville forebay and from several stations located below Bonneville Dam. The TDG data will be reported every four hours starting prior to an early Spring Creek National Fish Hatchery (NFH) fish release, but not later than March 10 for all stations at Bonneville. Spill volume and total project flow will be reported at the same time. The TDG data collection will continue year round at Bonneville forebay and Warrendale stations. The TDG monitoring plan is described in detail in Appendix D.

Excessive TDG levels, which may harm fish, will be controlled to the extent possible, subject to river flow conditions. Control measures will include system spill allocations through the spill priority list issued by RCC, nighttime or daytime spill limits, and shaping of spill discharge.

2.4. Juvenile Fish Passage Facilities.

2.4.1. Operating Criteria, First Powerhouse.

2.4.1.1. Prior to the Juvenile Fish Passage Season (December 1 through February).

a. Remove debris from forebay, trash racks, and gatewell slots such that these areas are free of debris.

b. Inspect VBSs for damage, holes, debris accumulations, and protrusions (video inspection acceptable). Clean and repair, as necessary, such that all VBSs in operable units are functional.

c. Inspect each STS and operate on a trial run (dogged off at deck level). Install STSs in each intake of operational turbine units by the end of February. However, see section 2.4.1.2. Juvenile Fish Passage Season about accommodations for an early fish release from Spring Creek NFH.

d. Inspect and, where necessary, clean and/or repair all gatewell orifices and orifice lighting systems such that the orifices and associated systems are fully functional.

e. Inspect and, where necessary, clean and/or repair dewatering screens and associated equipment.

f. Inspect and correct any deficiencies of DSM channel and outfall conduit walls and floor.

g. Avian Predation Lines. Reinstall or repair avian predator control lines in present locations as soon as possible following damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators. Implement other avian abatement measures as necessary in areas where avian lines are not practical. Avian abatement measures shall be in place by March 1 unless this work is delayed because of inclement weather. If this occurs, the work will be completed as soon as the weather permits after that date.

h. Inspections. The results of all inspections and the readiness of the facilities for operation will be reported to the Fish Passage Operations and Maintenance (FPOM) Coordination Team at the meeting immediately prior to the juvenile fish passage season.

2.4.1.2. Juvenile Fish Passage Season (March 1 through November). Juvenile fish protection devices (STSs, etc.) will be in place for an early fish release from Spring Creek NFH, if scheduled to occur before March 1. The 1999 release is scheduled for March 18. Screens will remain in operation through December 15 to protect adult fallbacks.

a. Main unit gatewell drawdown will be measured a minimum of once per week. Remove debris from forebay and trashracks as required to maintain less than 1.5' of total drawdown in gatewells, or as indicated by fish condition (e.g., higher than expected descaling), or as determined by the project biologist and smolt monitoring personnel who sample the fish. The STSs in units being raked will be run in continuous mode during raking operations. Gatewell orifices of the unit being raked must be closed during the procedure.

b. Operate STSs at an angle of 55 degrees from vertical.

c. Inspect STSs and VBSs within a time frame to minimize damage to screens following the arrival of heavy debris at the dam. Frequency of monthly inspections may be based on individual turbine unit run time. Inspect each STS once per month (or 720 hours run time) and each VBS a minimum of once every two months (or 1440 hours run time). Video is acceptable. Summaries of STS and VBS inspections will be included in weekly operation monitoring reports. All VBS inspections will occur immediately prior to peaks in juvenile fish migrations, which begin about May 1, mid-July, and September 1. Inspections will be concentrated on the priority units and others with the longer operating time. More frequent inspections may be required by the project biologist or under the following conditions: deterioration of fish condition, increased debris load in the

bypass system, and other indications of STS or VBS malfunctions or failure.

CBFWA recommends that VBS inspections be conducted once per month through the fish passage season.

If STS or VBS damage or plugging is detected, follow procedures in Section 3. Fish Facilities Maintenance. Records of inspections or summary of such records will be made available to the Fish Passage Center (FPC) by January 31.

d. Operate all gatewell orifice systems. Inspect each orifice twice daily to assure that the orifice valves and lights are operating correctly. Back-flush at least once every day or more often if indicated by debris accumulations. More frequent back-flushing is recommended during the high debris period of April through June. Replace all burned out orifice lights within 24 hours.

NMFS has recommended back-flushing at least three times per day during April through June.

e. DSM downwell area operation (during smolt sampling):

1. Maintain between 0.3' and 1' of depth over the end of the DSM inclined dewatering screen.

2. Maintain the differential between forebay and DSM channel water surface between 5' and 6'.

3. Maintain the drop from dewatering screen to water surface in the downwell between 4.5' and 6'.

4. Operate the dewatering screen trash sweep one revolution at 60-minute intervals. The interval between operations may be reduced or increased depending on the amount of debris passing.

5. Electrical modifications were made in 1995 to allow central, automatic lighting control in the first powerhouse DSM. The DSM is now darkened on a schedule as determined through coordination with the FPOM in 1994. Investigation has shown that darkening the channel results in faster fish evacuation.

f. DSM downwell area operation (non-sampling standards).

1. Maintain a depth between 0.9' and 1.3' over the end of the DSM inclined dewatering screen.

2. Maintain the differential between forebay and DSM channel water surface between 5' and 6'.

3. Maintain the drop from dewatering screen to water surface in the downwell between 3' and 4.5'.

NMFS has recommended that, any time the DSM is unmanned, the trash sweep interval be returned to 20 minutes to reduce the possibility of screen plugging.

g. Observe each STS watt and/or amp gauge reading at least once each day and record readings once per day. If an STS failure occurs, then follow procedures in Section 3. Fish Facilities Maintenance.

h. Inspect all STS gatewells daily. The project will clean gatewells before the water surface becomes one-half covered with debris. If, due to the volume of debris, it is not possible to keep the gatewell surfaces half clear, they will be cleaned at least once daily. Turbines with a gatewell fully covered with debris will not be operated except to be in compliance with other coordinated fish measures, and then only on a last on/first off basis. The first powerhouse gatewell orifices will be closed during cleaning operations. After cleaning a gatewell, back-flush the orifice in that gatewell then check gatewell drawdown.

i. A slight oily sheen is commonly found in many gatewells. This may come from sources such as lubricated lifting beams, etc. But, when unusual accumulations of oil (e.g., oil slick) occur in gate slots, they will be removed within 24 hours. When this is not possible, the JBS orifice will be closed and the turbine unit will be shut down until cleaning is accomplished. Appropriate procedures to remove fish during this situation will be determined in coordination with FPC and NMFS. Regardless of unit operating status, oil accumulations will be dealt with promptly.

j. Coordinate gatewell cleaning with personnel operating downstream migrant sampling facilities.

k. Reinstall or repair avian predator control lines in present locations as soon as possible following significant damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators.

l. Turbine units without a full complement of STSs will not operate except to be in compliance with other coordinated fish measures.

m. Open ice and trash sluiceway chain gate 7A to elevation

72' msl, and set gate 10C to full open. However, if the forebay is expected to stay below 72.5' for more than 48 hours (as during a specially-coordinated low forebay period), then gate 7A should be set at 70' above msl with gate 10C still full open. (Calculated from hydraulic equations to achieve approximately 475 cfs (3.7' of head) (Evaluation of Ice and Trash Sluiceway at Bonneville Dam as a Bypass System for Juvenile Salmonids, 1981). The ice and trash sluiceway may be closed October 1 through November if it is determined, through regional coordination, that migrating juvenile salmonid numbers are low enough that closure will not adversely affect fish migration or fish condition. This closure may be terminated at any time if problems arise that negatively impact fish migration or condition.

n. Inspect juvenile fish passage facilities twice per day. At least three inspections per week will be performed by project fish biologists.

2.4.1.3. Winter Maintenance Season (December 16 through February). The end of the season may be shortened for an early fish release from Spring Creek NFH. This will not be the case in 1999 since the Spring Creek NFH release is scheduled for March 18.

a. Remove all STSs.

b. When STSs are removed at the end of the fish passage season, they are normally stored in a position extending up through the forebay deck. An alternate storage position is below the deck, but this places the screens close in front of the gatewell orifice. When it is necessary to make room on the forebay deck for priority activities at this time of year by storing the screens beneath the deck, the orifices should be closed and the DSM channel drained.

2.4.2. Operating Criteria, Second Powerhouse.

2.4.2.1. Prior to the Juvenile Fish Passage Season (December 1 through February).

a. Remove debris from forebay, trash racks, and gatewell slots such that these areas are free of debris.

b. Inspect VBSs for damage, holes, debris accumulations, and protrusions (video inspection acceptable). Clean and repair, as necessary, such that all VBSs in operable units are functional.

c. Inspect each STS and operate on trial run (dogged off at deck level). Install STS in each intake of operational

units by the end of February. However, see section 2.4.2.2. about accommodations when there is an early fish release from Spring Creek NFH.

d. Inspect and, where necessary, clean and/or repair all gatewell orifices and orifice lighting systems such that the orifices and associated systems are fully functional.

e. Inspect and, where necessary, clean and/or repair dewatering screens and associated equipment.

f. Inspect and correct any deficiencies of DSM channel and conduit outfall walls and floor.

g. Flume Pipe (from exit of DSM to outfall). Visually inspect outfall flume pipe and associated switch gates from the transition section leaving the powerhouse to the outfall return to the river for obstructions, protrusions, or structural deficiencies that may affect fish passage. A video inspection may be acceptable if this technique is shown to work.

h. Juvenile Monitoring Facility (all equipment). Preseason inspections in 1999 will focus on post-construction assessment of facility performance relative to contract requirements and potential for successful operation for fish passage. Operational criteria will be developed throughout the early part of the fish migration season.

i. Avian Predation Lines. Reinstall or repair avian predator control lines in present locations as soon as possible following significant damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators. Implement other avian abatement measures as necessary in areas where avian lines are not practical. Avian abatement measures shall be in place by March 1 unless this work is delayed because of inclement weather. If this occurs, the work will be completed as soon as possible after that date.

j. Inspections. The results of all inspections and the readiness of the facilities for operation will be reported to the FPOM at the meeting immediately prior to the juvenile fish passage season.

2.4.2.2. Juvenile Fish Passage Season (March 1 through November). Juvenile fish protection devices (STSs, TIEs, etc.) will be in place for an early fish release from Spring Creek NFH, if scheduled to occur before March 1. Screens will remain in operation through December 15 to protect adult fallbacks.

a. Main unit gatewell drawdown will be measured a minimum of once per week. Remove debris from the forebay and trash racks as required to maintain less than 1.5' of drawdown in gatewells, or as indicated by fish condition (e.g., higher than expected descaling), or as determined by the project biologist. The STSs in units being raked will be run continuously during raking operations. Gatewell orifices of the unit being raked must be closed during the procedure.

b. Measure fish unit gatewell drawdown at least once per week. When the head across trash racks exceeds 1.5', the trash racks will be cleaned that day. This may be done by raking late in the work day or by turning the unit off at night and letting the debris float off the racks. However, if the head exceeds 3' or if the adult fishway head is reduced, the unit's racks will be raked immediately, even if it is early in the day. When debris accumulation is persistent, unit 18 may be operated while the fish unit is off at night to help draw loosened debris away. An FPOM task group will develop operational guidelines on an as-needed basis.

c. Operate STSs at angle of 60° from vertical.

d. Inspect each STS once per month (or 720 hours run time) and each VBS a minimum of once every two months (or 1440 hours run time) (video is acceptable). Frequency of monthly inspections may be based on individual turbine unit run time. No STS inspections will be scheduled when they will cause excessive TDG due to increased forced spill. Summaries of STS and VBS inspections will be included in weekly operation monitoring reports. VBS inspections will occur immediately prior to peaks in juvenile fish migrations, which begin about May 1, mid-July, and September 1. Inspections will be concentrated on the priority units and others with the longer operating time. More frequent inspections may be required by the project biologist or under the following conditions: deterioration of fish conditions, increased debris load in bypass system, and other indications of STS or VBS malfunctions or failure. Prior to pulling VBSs for inspections, shut off units and dip gatewells.

CBFWA recommends that VBS inspections be conducted once per month through the fish passage season.

If STS or VBS damage or plugging is detected, follow procedures in section 3. Fish Facilities Maintenance. Records of inspections or a summary of such records will be made available to the FPC by January 31, upon request.

e. Operate all gatewell orifice systems. Inspect each orifice twice daily to assure that the orifice valves and lights

are operating correctly. Orifices with less than a clear flow jet will be cleaned. Replace all burned out orifice lights within 24 hours. Electrical modifications were made in 1996 which allow central, automatic lighting control in the second powerhouse DSM. The DSM is now darkened on a schedule as determined through coordination with the FPOM in 1994. The DSM lights should be left off, per this guidance, except when people are in the gallery. Investigation has shown that darkening the channel results in faster fish evacuation.

f. Observe each STS watt and/or amp gauge at least once each day and record reading once per day. If an STS failure occurs, then follow procedures in Section 3. Fish Facilities Maintenance.

g. Inspect all STS gatewells daily. The project will clean gatewells before the water surface becomes one-half covered with debris. If, due to the volume of debris, it is not possible to keep the gatewell surfaces half clear, they will be cleaned at least once daily. Turbines with a gatewell fully covered with debris will not be operated except to be in compliance with other coordinated fish measures, and then only on a last on/first off basis. The second powerhouse gatewell orifices will be closed during the cleaning operations. After cleaning a gatewell, inspect and, if necessary, clean the orifice in that gatewell and then check gatewell drawdown.

h. A slight oily sheen is commonly found in many gatewells. This may come from sources such as lubricated lifting beams, etc. But, when unusual accumulations of oil (e.g., oil slick) occur in gate slots, they will be removed within 24 hours. When this is not possible, the JBS orifice will be closed and the turbine unit will be shut down until cleaning is accomplished. Appropriate procedures to remove fish during this situation will be determined in coordination with FPC and NMFS. Regardless of unit operating status, oil accumulations will be dealt with promptly.

i. Coordinate gatewell cleaning with personnel operating downstream migrant sampling facilities.

j. Reinstall or repair avian predator control lines in present locations as soon as possible following significant damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators.

k. Turbine units without a full compliment of STSs will not operate except to be in compliance with other coordinated fish measures.

l. When the new bypass and monitoring facility are in service, operational criteria will be developed throughout the early part of the fish migration season. These criteria will be refined during the season. The FPOM will be kept informed of progress and changes throughout the season.

m. Inspect facilities twice per day. At least three inspections per week will be performed by project fish biologists.

n. All TIEs will be removed following the spring juvenile yearling chinook outmigration period, usually in early July. The TIEs will be re-installed just prior to the start of the juvenile fish passage season, including, when practicable, prior to early fish releases from Spring Creek NFH.

2.4.2.3. Winter Maintenance Season (December 16 through February). The end of the season may be shortened for an early fish release from Spring Creek NFH. To reduce adult fallback mortality, the juvenile bypass system, or DSM channel will operate from November 30 through December 15. STSs in priority units will be left in place during this period. Screens from non-priority units may be removed between December 1 and 15, but only if scheduled for maintenance. In all units, screens that are not being serviced shall be left in place during this period. Unscreened units will be operated on a last-on, first-off basis. Beginning December 16, all remaining STSs may be removed. DSM may be dewatered (see section 5. Dewatering Plans) only when required for maintenance. The maintenance period will be minimized to the extent practicable. Facilities, when operating, are to be inspected at least once per day to assure criteria are being met. These inspections are to be performed at least three times per week by project fish biologists.

2.4.3. Operating Criteria, Spillway.

2.4.3.1. Prior to Juvenile Fish Passage Season (December 1 through February).

a. Inspect and, where necessary, repair spill gates and control systems. The spillway, except for coordinated exceptions, must be able to achieve spill patterns on the first day of the juvenile fish passage season.

b. The results of all inspections and the readiness of the facilities for operation will be reported to the FPOM at the meeting immediately prior to the juvenile fish passage season.

2.4.3.2. Juvenile Fish Passage Season (March 1 through November). Bonneville Dam uses a single spill schedule for both

day and night (See section 2.2. for guidance).

2.4.3.3. Winter Maintenance Season (December 16 through February). Refer to Appendix E for spill guidance during non-passage periods at Bonneville Project.

2.5. Adult Fish Passage Facilities.

2.5.1. Operating Criteria.

2.5.1.1. Prior to Adult Passage Period (December 1 through February).

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

b. Unless specially coordinated, dewater all ladders and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or slow their progress up the ladder. Repair deficiencies.

c. Inspect for and, when necessary, clear debris in the ladder exits.

d. Reinstall picket leads at counting stations prior to watering up the ladders during maintenance.

e. The results of all inspections and the readiness of the facilities for operation will be reported at the FPOM meeting immediately prior to the passage season.

2.5.1.2. Adult Fish Passage Period (March 1 through November).

a. All Adult Facilities.

1. Maintain the water depth over fish ladder weirs at 1' +/- 0.1' during the non-shad passage season (August 16 through May 14) and 1.3' +/- 0.1' during the shad passage season (May 15 through August 15). These water depths will be measured at the A and B-branch staff gages in the Bradford Island fishway, at weirs 37 and 38 in the Washington shore fishway, and in the Cascades Island just downstream of the entrance to the UMT. For FV3-9 calibration purposes to achieve the target depth in the A and B branches, the depth in the main ladder below the count station is 1.1' during shad passage and 0.9' during the non-shad season.

2. Water temperature will be measured in an adult fishway at each powerhouse. When water temperature reaches 70° F, all fish handling activities will coordinated through FPOM

prior to any action to verify protocols that will be followed.

3. Head on all entrances: 1' to 2' (1.5' preferred). A head of approximately 1' to 2' at the NUE entrance is indicated by a 1.2' to 2.2' (1.7' preferred) entrance head calculated using the fishway and tailwater staff gauges closest to NUE. Refer to section 3.3. Adult Fish Passage Facilities when unable to achieve head criterion.

4. A water velocity of 1.5 to 4 fps (2 fps preferred) shall be maintained for the full length of the powerhouse collection channel, and the lower ends of the fish ladders which are below the tailwater. Water velocities will be measured directly, and monitored during fishway inspections to verify channels are operating between 1.5 and 4 fps. Water velocities in the UMT shall be maintained within criteria, but the channel will not contain a permanent velocity meter.

5. A maximum of 0.5' head will be allowed on the first powerhouse attraction water intakes and trash racks at all the ladder exits, with 4" maximum head on all picket leads. Debris shall be removed when significant amounts accumulate.

6. Staff gauges and water level indicators will be readable at all water levels encountered during the fish passage period. Stillwells used in lieu of staff gauges will be checked for calibration once per week and summaries of these stillwell calibrations will be included in weekly operation monitoring reports.

7. The current fish counting program is conducted 24 hours per day year around. Count station crowders shall remain in the operating position while visual counting and/or video taping is being conducted. The crowder shall be closed to allow the count slot width to be no less than 18". This will usually occur during high turbidity conditions to allow count accuracy criteria to be achieved. If passage is impaired by this condition, the count slot may be widened until proper passage conditions are achieved, even though count accuracy may be compromised to some degree. Project biologists, FFU, and the WDFW fish count supervisor shall coordinate to achieve optimum count slot passage and/or count accuracy conditions. If counting is temporarily discontinued due to unscheduled events, the crowder shall be fully opened. The crowder may remain in operating position during the counters' hourly ten-minute break period. Leave the fish passage slot lighted overnight.

8. Inspect facilities twice per day. At least three inspections per week will be performed by project fish biologists.

9. Upstream light banks in both count stations shall remain off to facilitate fish passage through the count slot and help reduce the number of fish impacting the count window framework, unless other passage problems result, or count accuracy is compromised.

10. Inspect and ensure that optimum passage conditions are maintained at fishway entrances, exits, and in the count slots.

b. Spillway Ladders.

1. Spillway gates 1 and 18 shall be open 4" for adult attraction.

2. Side entrances SW-SG-5 and SO-SG-7 and downstream entrances SW-SG-1 and SO-SG-2 shall operate as continuously open free-flowing vertical slots. Downstream entrances SW-SG-3 and SO-SG-4 (adjacent to shore) consist of pairs of sluice gates. When the tailwater is below 9', sluice gates SW-SG-3N, SW-SG-3S, SO-SG-4N, and SO-SG-4S shall be open. When the tailwater is between 9' and 17', sluice gates SO-SG-4S and SW-SG-3N shall close. When the tailwater exceeds 17', sluice gates SW-SG-3N, SW-SG-3S, SO-SG-4N, and SO-SG-4S shall be closed.

c. First Powerhouse.

1. General. The Program Logic Controller (PLC) receives analog signals representing the 4 weir gate positions, the 5 orifice gate positions, the north, central, and south tailwater and collection channel water elevations, and the water pressure at the south end of the auxiliary water conduit. It also receives inputs from the bulkhead upper/lower limit switches. From this information, the PLC control program determines when to activate outputs which serve to raise or lower the weir gates, bulkheads, orifice gates, sluice gates, A branch diffusion gates, and fish valves FV1-1 and FV3-7.

2. Weir Gates. The first powerhouse weir gates have the requirements shown in Table BON-6.

3. Gate Pairing. The four weir gates will be operated in two pairs. Only one gate pair will be allowed to operate at any given time. Gates 1 and 65 will operate together as the active pair (enabled) for tailwater elevations greater than 23' msl., while gates 2 and 64 will operate together as the active pair (enabled) for tailwater elevations less than 26' msl. For tailwater elevations between 23' and 26', the designated active pair will depend on whether the tailwater elevation has been rising or falling with a "dead band" of 1.5'.

Table BON-6. Bonneville Dam first powerhouse weir gate requirements.

Weir Gate	Submergence Requirement	Differential Requirement	Sill Elevation
1	>6'	1'-2'	8.5'
2	>6'	1'-2'	2'
64	8'-8.4'	1'-2'	2'
65	8'-8.4'	1'-2'	8.5'

4. Gate Pair Enabling/Disabling. If the tailwater elevation is 26' or greater, gates 2 and 64 will be closed off (raised to their maximum position and their bulkheads lowered) and their control disabled. Gates 1 and 65 will be enabled and will therefore operate as described above. Gates 1 and 65 will then continue to be enabled (and gates 2 and 64 closed off and their control disabled) until the tailwater elevation drops below 23'. Once this occurs, the bulkheads for gates 2 and 64 will be raised, the control for gates 2 and 64 will be enabled and these gates will be moved to their appropriate post-transition positions, and gates 1 and 65 will be raised to their maximum closed positions. The control for gates 1 and 65 will then be disabled. Gates 2 and 64 will then be the active pair.

If the tailwater elevation is less than 23', gates 1 and 65 will be closed off (raised to their maximum positions) and their control disabled. Gates 2 and 64 will be enabled and will then operate as described above. Gates 2 and 64 will then continue to be enabled (and gates 1 and 65 closed off and their control disabled) until the tailwater elevation rises to 26'. Once this occurs, the control for gates 1 and 65 will be enabled and these gates will be moved to their appropriate post-transition positions, gates 2 and 64 will be raised to their maximum positions, and the bulkheads for gates 2 and 64 will be lowered. The control for gates 2 and 64 will then be disabled. Gates 1 and 65 will then be the active pair.

5. Transition Positioning. During a transition, the former active pair is closed and the new active pair is positioned according to tailwater. If gates 1 and 65 are the active pair and the tailwater falls below 23', there is a transition in which gates 2 and 64 will be enabled and moved to their appropriate post-transition positions. Gates 1 and 65 will then be raised to their maximum closed position (26'). If gates 2 and 64 are the active pair and the tailwater rises to more than 26', there is a transition in which gates 1 and 65 then become the active pair. Gates 1 and 65 will be enabled and moved to their appropriate post-transition positions. Gates 2 and 64 will

be raised to their maximum closed position (gate 2: 11', gate 64: 18'). In either case, there is a 1.5' "dead band" as described above.

6. Control of Orifice Gates 9, 21, 34, 58 and 62. Orifice gates open from tailwater elevation 16.2' to 36' on a rising tailwater and elevation 36' to 15.8' on a falling tailwater.

7. Control of Sluice Gates 9, 21, 34, 58 and 62. Sluice gates open from tailwater elevation 15.8' and less on a falling tailwater and close from tailwater elevation 16.2' and more on a rising tailwater.

8. Control of Fish Valve FV1-1.

(a) Emergency Closure. If the collection channel/tailwater differential is greater than 2.5' or if the pressure differential between the auxiliary water supply conduit and the collection channel exceeds 10 psi.

(b) Differential. Low: if the collection channel/tailwater differential is less than 1'. High: if the collection channel/tailwater differential is more than 1.6'.

(c) Control of Fish Valve FV3-7. Maintain the opening concurrent with the charts for valve opening, as set by the forebay and tailwater elevations.

(d) Control of A-Branch Diffusion Gates FG3-3, 4, 5, 6, 7, 8, and 9. First powerhouse A-branch diffusers are open according to the pattern in Table BON-7.

Table BON-7. Bonneville Dam A-branch diffuser operating ranges.

Diffusers	Operating Range (Tailwater Elevation)	Dead Bands
FG3-3	8.2' - 13.3'	7.8' - 8.2'
FG3-4	13.7' - 16.3'	13.3' - 13.7'
FG3-5	16.7' - 19.3'	16.3' - 16.7'
FG3-6	19.7' - 24.8'	19.3' - 19.7'
FG3-7	25.2' - 27.8'	24.8' - 25.2'
FG3-8	28.2' - 30.8'	27.8' - 28.2'
FG3-9	> 31.2'	30,8' - 31.2'

11. First Powerhouse Collection Channel Diffusers. Diffuser valves are operated according to the pattern in Table BON-8.

Table BON-8. Bonneville Dam first powerhouse adult fish collection channel diffuser valve settings.

Valve	Setting	Valve	Setting
FG2-1	Closed	FG2-13	Closed
FG2-2	Closed	FG2-14	Closed
FG2-3	Closed	FG2-15	Closed
FG2-4	Open	FG2-16	Closed
FG2-5	Closed	FG2-17	Closed
FG2-6	Closed	FG2-18	Closed
FG2-7	Closed	FG2-19	Open
FG2-8	Open	FG2-20	Open
FG2-9	Closed	FG2-21	Open
FG2-10	Closed	FG2-22A	Open
FG2-11	Closed	FG2-22B	Open
FG2-12	Open		

d. Second Powerhouse.

1. Operate all north (NUE and NDE) and south (SUE and SDE) entrances. Operate weir crests at elevation 1' (fully lowered) for tailwater elevations up to 14'. For tailwater elevations greater than 14', operate weir crest 13' or greater below tailwater.

2. Operate all 12 powerhouse floating gate fishway entrances.

e. Spillway Operations. Bonneville Dam uses a single spill schedule (Table BON-11) for both day and night. See section 2.2. Spill Management for guidance.

2.5.2. Winter Operating Period, or In-water Work Period (December 1 through February).

2.5.2.1. Adult Fish Facilities. Operate the adult fish passage facilities according to the fish passage period standards above, except systems may be dewatered or operated out of criteria for repair and maintenance.

a. Only one of the ladders servicing the two powerhouses and the associated powerhouse collection system (including the

auxiliary water supply system) may be out of service or operating out of standard operating criteria at any one time unless specifically coordinated. The units in the powerhouse with the fully operating fish facility will be first on/last off to meet power demand except, when the first powerhouse collection facility is out of service, units 1, 2 and 10 will continue to operate. One of the two ladders servicing the spill channel will be in full operation at all times unless specially coordinated. Outage periods will be minimized to the extent practicable.

b. Adult facilities will be inspected once per day to assure operation as per criteria above. These inspections are to be performed at least three times per week by project fish staff.

c. Spill bays 1 and 18 may be on seal throughout the winter operating period.

d. Adjust crowders at fish counting stations to full open if video taping is temporarily discontinued due to unscheduled events or during the winter maintenance (dewatering) period only.

2.6. Facility Monitoring and Reporting.

2.6.1. Inspections. Fish passage facilities will be inspected at least once a day to assure operation according to established criteria. More frequent inspections of some facility components that may be required will occur as noted throughout the text. At a minimum, project biologists shall perform adult and juvenile fish facility inspections at least 3 days weekly. Additional fishway inspections may be performed by FFU, project operations, and/or fish agencies.

2.6.2. Zebra Mussel Monitoring. A zebra mussel monitoring program will continue. These organisms have become a serious problem elsewhere in the country and may become introduced into the Columbia River basin. Inspections should also be made when dewatering all project facilities.

2.6.3. Reporting. Project biologists shall prepare weekly reports throughout the year summarizing project operations. The weekly reports will 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 reports shall include: any out-of-criteria situations observed and subsequent corrective actions taken; any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities; adult fishway control calibrations; STS and VBS inspections; AWS closures (i.e. cleaning times); times picket leads were lowered and raised in the Washington shore ladder when adult trapping is occurring in the adult fish collection and

monitoring facility (AFCMF); and any unusual activities which occurred at the project which may affect fish passage. The weekly reports shall cover a Sunday through Saturday time period and the Project Manager shall send them to CENWP-OP and other interested parties as soon as possible the following week, with a copy to RCC, Attention: Jim Athearn. The reports may be delivered electronically. The project biologist shall prepare an annual report by January 31, summarizing the operation of the project fish passage facilities for the previous year. The report will cover from the beginning of one adult fish facility winter maintenance period to the beginning of the next. The annual report will be provided to CENWP-OP in time for distribution to FPOM members at the February meeting.

3. Fish Facilities Maintenance.

3.1. General.

3.1.1. Scheduled Maintenance.

3.1.1.1. Staff gauges will be installed, cleaned, and/or repaired as required.

3.1.1.2. Scheduled fishway maintenance, to the extent practicable, will be conducted during periods when passage has been documented to be at its lowest during the regular scheduled workday, to minimize impacts to migrating salmonids. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports (section 2.6.3.).

3.2. Juvenile Fish Passage Facilities.

3.2.1. Scheduled Maintenance.

3.2.1.1. Submersible Traveling Screens. The STS system will receive preventive maintenance or repair at all times of the year, including the winter maintenance period. Whenever a generator malfunctions or is scheduled for maintenance, the three STSs in that turbine may be maintained, repaired, or exchanged for other STSs needing maintenance or repair. One third of the STSs at Bonneville are scheduled for complete overhaul each year resulting in a three-year maintenance cycle unless future developments indicate that longer life expectancy is possible.

3.2.1.2. Juvenile Bypass System. The juvenile bypass facilities will receive preventive maintenance throughout the year. During the juvenile fish passage season this will normally be above-water work such as maintenance of automatic systems, air lines, electrical systems, and monitoring equipment. During the winter

maintenance period, the systems may be dewatered downstream of the gatewell orifices. The systems will then be visually inspected in all accessible areas for damaged equipment and in areas that may cause problems to the juvenile fish. Any problem areas identified are to be repaired if the project is able. In extreme cases the work will be contracted as soon as possible or repaired during the next winter maintenance period. Modifications and general maintenance to the channels are also to be completed at this time.

The trash racks are to be raked just prior to the juvenile fish passage season and whenever trash accumulations are suspected because of increased head across the trash racks (>1.5') or increased juvenile fish descaling. Additional trash rack raking may be necessary when a storm brings large quantities of debris down river to the project. Gatewell orifices in the unit being raked will be closed during the procedure.

3.2.1.3. Turbines and Spillways. Maintenance and routine repair of project turbines and spillways is a regular and recurring process which requires units to be shut down for extended periods of time (see section 5. Dewatering Plans). The maintenance schedules for these turbines and spillways will be coordinated with fish agencies through the FPOM. Certain turbine and spillway discharges at the projects are secondarily used to attract adult fish to fishway entrances, to keep predator fish from accumulating near juvenile release sites, and to move juveniles downstream away from the project. The maintenance schedules for these turbines and spillways will reflect equal weighting given to fish, power, and water management and will be coordinated with the appropriate resource agencies. Units which should not be scheduled for maintenance during the fish passage season are F1, F2, 1, 2, 9, 10, 11, 17, and 18.

Some types of turbine maintenance will require testing the turbine throughout its full operating range before returning it to normal service. These operations will be coordinated with the appropriate resource agencies.

3.2.2. Unscheduled Maintenance. Maintenance of facilities such as fish screens, which sometimes break down during the fish passage season, will be carried out as described below. Unscheduled maintenance that will have a significant impact on juvenile fish passage shall be coordinated with the CBFWA (through the FPC) and NMFS on a case-by-case basis by project and CENWP-CO biologists. The CENWP-CO biologists will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Project Manager has the authority to initiate work prior to notifying CENWP-CO when, in her opinion, delay of the work will result in an unsafe situation for people,

property, or fish. Information required by CENWP-CO 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.

3.2.2.1. Submersible Traveling Screens. If an STS or VBS is found to be damaged or inoperative in an operating unit, the unit will be regarded as an unscreened unit. The screen will be repaired or replaced before returning the unit to normal service.

3.2.2.2. Juvenile Bypass System. Juvenile bypass systems are controlled automatically (PLC). When an automatic system fails, it can usually be operated manually. This allows either facility to operate according to criteria while repair of the automatic system is completed. Orifices allow fish out of the gatewells into a bypass channel. If an orifice valve system becomes inoperative, it will be repaired expeditiously. When the orifices become plugged with debris they are pneumatically cleaned (first powerhouse is automatic; second powerhouse is manual). If the automatic systems fail and the system is operated manually, facility inspections should be increased to a frequency that assures these systems continue to operate within criteria.

All STS gatewells will be inspected daily and the project will clean them before they become half covered with debris. If, due to volume of debris, it is not possible to keep the gatewell surfaces at least half clear, they will be cleaned at least once daily. Turbines with a gatewell fully covered with debris will not be operated, except on a last on/first off basis, if required to be in compliance with other coordinated fish measures. This is to maintain clean orifices and minimize fish injury. The gatewell orifices will be closed during the cleaning operation. Check gatewell drawdown.

a. First Powerhouse. If any part of the dewatering screen, downwell, or juvenile release conduit fails, making this portion of the system unsafe for juvenile fish, the juveniles will be diverted to the ice and trash sluiceway. This operating mode will require the gate at the south end of the DSM channel to be removed and a stop-log installed at the north end so migrants will flow down into the ice and trash sluiceway channel. Assure that sluiceway gate 7A is opened to 72' msl, gate 10C is opened

fully, and the ice and trash sluiceway end gate is open to provide safe transportation flows for juveniles. Forebay elevation will be kept above 74' msl to the extent practicable. The bypass will then continue operating while repairs are completed. In either operating mode, the orifices will be cleaned with the air pressure system at least once per day, when plugged orifices are indicated, or after trash rack raking and gatewell debris removal.

b. Second Powerhouse. If the bypass system fails in the dewatering section or release pipe, fish may be released through the emergency relief conduit. This operation will continue until repairs are accomplished or until the end of the fish passage season. Any decision on whether or not to shut this system down for dewatering and repairs will be made in coordination with the FPOM. During this emergency operating mode, power generation will be minimized at the second powerhouse. Repairs will receive high priority.

c. During fishway inspections the VBSs may be found plugged or damaged. In these cases, the associated unit will be taken out of service as if unscreened and repairs will be made before returning the unit to normal service.

3.2.2.3. Turbines and Spillways. If a spill gate becomes inoperable, the operator will make the changes necessary to accommodate the spill and then immediately notify the operations supervisor and project biologist to determine the best pattern to follow until repairs are completed. This interim operation shall be coordinated with the FPOM through the district biologist who will provide additional guidance to the project.

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 the fish passage way and physically inspecting the diffuser gratings, or by using underwater video cameras and divers or other methods to inspect the gratings. 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 which may indicate problems with diffuser gratings. If a diffuser grating is known to or suspected of having 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. If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffusers 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.

3.3. Adult Fish Passage Facilities.

3.3.1. Scheduled Maintenance. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports (section 2.6.3).

3.3.1.1. Fishway Auxiliary Water Systems. Bonneville Project auxiliary water systems consist of gravity flow and hydroelectric generating systems. Preventive maintenance and normal repair are carried out as needed throughout the year. Trash racks for the AWS intakes will be raked when drawdown exceeds criteria. When practicable, rake trash racks during the time of day when fish passage is least affected.

3.3.1.2. Powerhouse and Spillway Adult Fish Collection Systems. Preventive maintenance and repair occurs throughout the year. During the adult fish passage season this maintenance will not involve any operations which will cause failure to comply with the adult fishway criteria except as specially coordinated or as needed for semi-annual maintenance. Inspection of those parts of the adult collection channel systems which require dewatering, such as diffusion gratings, leads, and entrance gates, will be scheduled once per year during the winter maintenance season while the system is dewatered, with one additional inspection during the fish passage season, unless a channel must be dewatered for fishway modifications or to correct observed problems (see section 5. Dewatering Plans.). A diver or underwater video system may be used for the underwater inspections. This scheduled inspection and any associated maintenance will occur during the winter maintenance period (in-water work period) unless specially coordinated. Any non-routine maintenance and fishway modifications will be handled on a case by case basis.

The project biologist or alternate Corps fish personnel will attend all dewatering activities potentially involving fish, as well as inspections, to provide fish-related input (see section 5. Dewatering Plans).

3.3.1.3. Adult Fish Ladders and Counting Stations. The adult fish ladders will be dewatered once each year during the winter maintenance period. During this time, the ladders will be inspected for blocked orifices, projections into the fishway that may injure fish, stability of the weirs, damaged picket leads,

exit gate problems, loose diffusion gratings, unreadable or damaged staff gauges, defective diffusion valves, and malfunctioning operating equipment at the counting stations, as well as other potential problems. Problems identified throughout the passage year that do not affect fish passage, as well as those identified during the dewatered period, may then be repaired. Trash racks at the ladder exits will be raked when criteria is approached or exceeded. When practicable, rake trash racks during the time of day when fish passage is least affected. Fish count station windows, light panels, and crowder panels will be cleaned as needed to achieve accurate counts and, when practicable, during the time of day when fish passage is least affected.

CBFWA recommends that trash rack raking be performed after dark.

3.3.2. Unscheduled Maintenance. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports (section 2.6.3.). Unscheduled maintenance that will significantly affect the operation of a facility, such as repair of displaced diffuser gratings, will be coordinated with the CBFWA (through the FPC) and NMFS. Coordination procedures for unscheduled maintenance of adult facilities are the same as for juvenile facilities (section 3.2.2).

3.3.2.1. Fishway Auxiliary Water Systems. Most fishway auxiliary water systems are operated automatically. If the automatic system fails, then the system will be manually operated by project personnel to maintain criteria while repair of the automatic system is carried out. When this operation becomes necessary, project personnel will increase the surveillance of the adult system to ensure that criteria are being met. In the event of AWS failure, FPOM will be used in an advisory capacity to assist the project as needed.

a. First Powerhouse. If any of the valves or any other part of the system fails, then the project is to attempt to maintain criteria by adjusting those valves which continue to function. Conduit pressure must be monitored and not allowed to exceed the established limits. If this maneuver fails to keep the facility operating according to the adult fishway criteria and repairs cannot be made within 24 hours, then close powerhouse entrances 9, 21, 34, 58, and 62, one at a time, starting with gate 9 and proceeding north.

If closing the orifice gate fails to achieve a minimum fishway head of 1' when tailwater is greater than 17' msl, then operation of newly modified gate 1 and gate 65 weirs becomes necessary. Operational guidelines of these gates appear in

section 2.5.1.2.c.

When tailwater elevation is less than 17' and the gate 65 weir crest is at least 6' below tailwater, then operation of gates 1, 2, 64, and 65 becomes necessary. Operational guidelines of these gates appear in section 2.5.1.2.c.

b. Spillway. Two separate fishway auxiliary water valves add water to each spillway ladder (Cascades Island and B-branch ladders). If one of these valves or any other part of the system malfunctions, the functioning parts of the system are to be adjusted to compensate. If repairs cannot be made in 24 hours, close the sluice gate entrance, if open. This will divert the reduced available water to the entrance slots. If a head of 1' is still not achieved, stoplogs are to be added to the entrance slots until the desired head or a weir depth of not less than 6' below the tailwater surface is reached. At this point maintain the gate positions until the auxiliary water system is repaired.

c. Second Powerhouse. If either or both of the fishway auxiliary water turbines are unable to provide water sufficient to meet full criteria between April 1 and August 31, raise the NUE in 1' increments until the weir crest is 6' below the tailwater or a fishway head of at least 1' is achieved. If this fails to achieve the above criteria then apply the same procedure, until the criteria are achieved, using in addition the NDE, then the SUE, and finally the SDE. The weir crests for these entrances will not be raised above 6' below tailwater. If the correct fishway head is still not achieved after this procedure, then fully close NUE and operate in this configuration until repairs can be made to the system.

If one of the fishway water supply turbine units fails between September 1 and March 31, during a time when tailwater is high enough that normal operation can't be maintained using the remaining fish unit, and repairs can't be made within 24 hours, then the ice and trash sluiceway will be used to supplement discharge to allow operation of the fishway according to the above standards. Between September 1 and 15, and March 1 and 31, the juvenile and adult runs will be evaluated to decide if the sluice chute should be operated when one fish unit is out of service. Care will be taken to keep the trash chute screen free of debris. When the ice and trash chute is operated as supplemental discharge, a barrier rack will be used at the entrance to the ice and trash chute to exclude adult salmonids. Under this operation, the ice and trash chute downstream end gate will be raised briefly at least once weekly to flush trapped juvenile salmonids, smaller resident fish, and debris out of the chute. If the rack is not used, the chute will be flushed twice weekly, on Monday and Thursday.

NMFS recommends that, if a barrier rack is not used, the chute should be flushed daily if it is used for auxiliary water during the peak adult passage season (September and early October).

If both of the fishway auxiliary water turbines fail between September 1 and March 31, and repairs can't be made within 8 hours, then the ice and trash chute will be started up. The adult facility will be operated as follows:

1. Close NDE, SUE, and NUE.

2. Operate the SDE weir crest at 8' below tailwater.

3. Operate the floating orifice gates. However, if the backup fishway auxiliary water system must be used for a period exceeding 30 days, then block off as many of the center floating orifice gates as possible and open NDE to a weir depth of 8' below the tailwater surface. While under this configuration, power generation at the second powerhouse will be minimized to reduce fish attraction into this area.

If all auxiliary water systems fail or malfunction, then close SUE, NDE, and NUE and raise SDE weir crest to 6' below tailwater elevation with the floating orifice gates open. Maintain this configuration until the system is repaired. While under this configuration, power generation at the second powerhouse will be minimized to the extent practicable to reduce fish attraction into this area unless the first powerhouse facilities are dewatered.

Second powerhouse adult fishway diffusion system valves A3 and A4 were found damaged and have been removed. These valves were designed to be closed when tailwater drops below 11' and 9', respectively. Even though the valves cannot be closed, velocity in the channel has remained in criteria.

3.3.2.2. Powerhouse and Spillway Adult Fish Collection Systems. Bonneville Project contains several types of fishway entrances. In most cases, if failures occur, the entrance can and will be operated manually by project personnel until repairs are made. If this operation becomes necessary, project personnel will increase the surveillance of the adult system to ensure that criteria are being met. In those cases in which the failure will not allow the entrance to be operated manually, the gate will be maintained, to the extent possible, in an operational position. If this is not possible, the entrance will be repaired expediently and returned to manual or automatic control at the earliest possible date.

3.3.2.3. Adult Fish Ladders and Counting Stations. The first powerhouse ladder was completed in 1937 and the second powerhouse ladder in 1981. Modification of the first powerhouse ladder was completed during the winter of 1981-82. The components of the ladders include picket leads, counting stations, fishway exits, and overflow weirs with orifices. Picket leads can cause problems. Pickets with excessive spacing (greater than 1"), concrete erosion around the leads, or missing pickets can allow fish into areas where escape is difficult. In some instances of picket lead failure, spare leads and spare installation slots are available. In these cases the spare leads are installed and the damaged leads are removed and repaired. In the remaining instances of picket lead failure or concrete erosion, the timing and method of repair will depend upon the severity of the problem. The decision of whether or not to dewater the fishway and repair any problems will be made in coordination with FPOM.

3.3.2.4. 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 the fish passage way and physically inspecting the diffuser gratings, or by using underwater video cameras and divers or other methods to inspect the gratings. 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 which may indicate problems with diffuser gratings. If a diffuser grating is known to or suspected of having 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. If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffusers 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. Unit operating priority during the fish passage seasons (March 1 through November) is shown in Table BON-9.

4.2. During the winter maintenance season, when powerhouse fish collection systems are operating, the operating priority sequence is unit 1, 10, 2, 18, and 11. Additional units will be selected in any sequence at the discretion of the powerhouse operators

(See Table BON-9). Generally, when a unit on this list is not available, then an adjacent unit will be operated. When a fish collection channel is out of service, the unit operating sequence will change accordingly, within the limitations of the project power distribution requirements.

Table BON-9. Bonneville Dam unit operating priority. Units 4 and 6 are not included due to their rehab and subsequent testing status.

Season	First Powerhouse[a]	Second Powerhouse[a]
Fish Passage March 1 - November	1[b], 10[c], 9, 2, 3, and 5-8 in any order	18, 11, 17, 12, 16[d], 13, 15
Winter Maintenance December 1 - February	1, 10, 2, 18, 11, add remaining units in any order	

[a] Flow distribution between powerhouses will be determined by CENWD-NP-ET-WR.
[b] If unit 1 is out of service, replace it with unit 2 to maintain station service
[c] Unit 10 being run continuously because of stator problems. If it is shut off for any reason, it will remain out of service until repaired or rehabilitated.
[d] Unit 16 will follow unit 17 in priority if unit 18 is out of service.

4.3. Guidelines for operating turbine units within 1% of best efficiency and within cavitation limits at various head ranges are provided Table BON-10 for both powerhouses.

4.4. To the extent technically feasible, turbines will be operated within +/-1% of best turbine efficiency, unless operation outside of that range is necessary to meet load requests from the BPA administrator, consistent with BPA's System Load Shaping Guidelines (Appendix C), avoid excess daytime spill (during the time of year when the 75 kcfs spill cap applies), or to comply with other coordinated fish measures. The guidelines apply between March 15 and October 31. However, during the rest of the year, the project will continue to operate units within the 1% turbine efficiency range, except as specifically requested by BPA to do otherwise as provided in Appendix C.

CBFWA recommends operation of all units within 1% of best turbine efficiency unless otherwise agreed.

4.5. If it is necessary to operate outside the +/- 1% efficiency range, then units which pass the least fish should be selected

Table BON-10. Turbine operating ranges within the 1% turbine efficiency range for Bonneville first and second powerhouses [a].

Head (feet)	First Powerhouse (units 1-10)				Second Powerhouse (units 11-18)			
	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)
34	14	6,116	26	11,258	29	12,047	39	16,478
35	14	6,114	27	11,278	29	12,055	40	16,578
36	15	6,112	28	11,297	30	12,063	41	16,578
37	16	6,158	29	11,328	31	12,070	43	16,627
38	16	6,205	30	11,360	32	12,078	44	16,677
39	17	6,251	31	11,391	33	12,086	45	16,727
40	17	6,318	32	11,422	34	12,044	47	16,777
41	18	6,371	33	11,464	35	12,022	49	16,826
42	19	6,424	34	11,506	36	11,960	51	16,876
43	19	6,476	35	11,547	37	11,918	53	16,926
44	20	6,529	36	11,589	38	11,881	55	17,008
45	21	6,582	37	11,631	39	11,844	56	17,090
46	22	6,646	38	11,646	39	11,807	58	17,173
47	22	6,711	39	11,661	40	11,770	59	17,255
48	23	6,775	40	11,677	41	11,733	61	17,337
49	24	6,839	41	11,692	42	11,747	63	17,338
50	25	6,904	41	11,707	43	11,760	65	17,338
51	25	6,968	42	11,722	44	11,774	66	17,339
52	26	7,030	43	11,738	45	11,787	68	17,339
53	27	7,091	44	11,752	46	11,801	70	17,340
54	28	7,153	45	11,768	47	11,842	72	17,340
55	29	7,214	46	11,783	48	11,884	73	17,341
56	29	7,276	46	11,798	49	11,925	75	17,342
57	30	7,337	47	11,813	51	11,967	76	17,342
58	31	7,399	48	11,828	52	12,008	77	17,343
59	32	7,427	49	11,844	53	12,050	77	17,343
60	32	7,455	50	11,859	54	12,091	77	17,344
61	33	7,482	51	11,874	55	12,103	77	16,967
62	33	7,510	52	11,889	56	12,115	77	16,590
63	34	7,538	53	11,904	57	12,128	77	16,214
64	34	7,566	54	11,919	58	12,140	77	15,837
65	35	7,593	55	11,935	59	12,152	77	15,460
66	36	7,621	56	11,950	60	12,164	77	15,083
67	36	7,649	58	11,965	61	12,176	77	14,706
68	37	7,677	58	11,951	62	12,189	77	14,330
69	38	7,704	59	11,937	63	12,201	77	13,953
70	39	7,732	59	11,923	64	12,213	77	13,576

[a] **NOTE:** The turbine efficiency tables are being revised to reflect new information. This table contains the best information currently available.

first. Assuming a preference to pass fish through the juvenile bypass system, units which pass the least fish will be selected first. Therefore, when units must be selected to operate outside the 1% efficiency range, they will be chosen according to the following prioritized list, when not constrained by specific project limitations: (5-8), 3, 9, 10, 2, 1, 15, 14, 13, 16, 12, 17, 11, 18.

4.6. The project turbine unit maintenance schedules will be reviewed 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. See section 3.2.1.3.

4.6.1. Unit 10 provides important attraction flow for adult fish and helps move juvenile fish out of an area of high predation in the tailrace. Therefore, long-term outages will be avoided after the beginning of the juvenile fish passage season, particularly the first Spring Creek NFH fish release, until after the adult fall chinook and coho runs at the end of October.

4.6.2. Unit 1 provides important attraction flow for adult fish, and, when the juvenile bypass system flow is reversed, it also helps move juvenile fish downstream. Therefore, long-term outages will be avoided after the beginning of the juvenile fish passage season, particularly the first Spring Creek NFH fish release, until after the adult fall chinook and coho runs at the end of October.

4.6.3. In the event of long-term outages at Bonneville powerhouses, affected units will be exercised periodically. Each unit will be operated 4-8 hours every two weeks to exercise governor components and clean wetted surfaces of corrosion, so that if needed, fish injury will be minimized and the units will be in good operating condition. This may be performed at night, daytime, or whenever unit cycling will have the least effect on fish passage.

4.7. Until problems with the second powerhouse hydraulic head gate operating system are corrected, the gates at units 11 through 18 will be set onto the latches. Oil leaks develop frequently when the system operates with normal pressure. Further related instructions are described in a memorandum from the project operations superintendent. (Memorandum for All Operations, from BON Chief of Operations, dated September 23,

1993. Subject: Powerhouse 2 Hydraulic Head Gate Operation).

5. Dewatering Plans.

5.1. Guidelines for Dewatering and Fish Handling Plans (Appendix G) have been developed and are followed for most project facilities dewaterings. These plans include consideration for fish safety and are consistent with the following general guidance. The appropriate plans are reviewed by participants before each salvage operation. Although it isn't a complete dewatering, the procedure for reversing flow in the first powerhouse DSM is also included in Appendix G.

5.2. The project fish biologist and/or alternate Corps fish personnel will attend all project activities involving fish handling.

5.3. The fish agencies and tribes will be invited to assist in any dewatering and, at a minimum, are invited to participate in all ladder dewaterings.

5.4. Juvenile bypass systems. Key elements of the Guidelines for Dewatering and Fish Handling Plans (Appendix G) for JBS flow reversal are shown in sections 5.4.1. through 5.4.5., below.

5.4.1. A project biologist or biological technician will attend all activities which involve dropping the JBS water surface below the end of the dewatering screen. Refer to the project Fish Salvage Plan for descriptions of JBS dewaterings. (The plan is available from the project biologist).

5.4.2. Personnel involved in use of the sampling facilities will be advised before facilities are drained.

5.4.3. Automatic controls for the trash sweeps will be turned off.

5.4.4. Flow through the dewatering screen will be reduced before the water level drops below the upper end of the screen. Refer to the Fish Salvage Plan.

5.4.5. The area beneath the dewatering screen will be filled before allowing water in the channel to rise to the elevation of the dewatering screen.

5.5. Adult Fish Ladder.

5.5.1. Scheduled Maintenance.

5.5.1.1. When possible, operate the ladder to be dewatered at a reduced flow for at least 24 hours, and up to 96 hours, prior to dewatering. Reduced flow is defined as less than criterion operation, but more than orifice flow.

5.5.1.2. Discontinue all fishway auxiliary water supply at least 24 hours, but no more than 96 hours, prior to dewatering.

5.5.1.3. The project biologist will assure that fish rescue equipment is available and will coordinate to assure adequate numbers of personnel will be available to move fish out of the dewatered ladder.

5.5.1.4. Project personnel will install head gates to shut down ladder flow. Where possible, a minimum flow depth of 1"-2" will be maintained in the ladder until fish are rescued.

5.5.1.5. The project biologist or alternate Corps fish personnel will oversee fish rescue when the ladders are dewatered. The project biologist will invite fish agency and/or tribal biologists to participate in the dewatering. Rescue personnel will walk the inside of the ladder from the head gates down to tailwater, salvaging all fish either by moving fish to tailwater within the ladder flow, or capturing and placing the fish in a large water-filled tank, which is then transported to the forebay or tailrace for release. Adult fish will be released into the forebay and juvenile fish will be released into the tailrace. If a ladder is dewatered in the spring or summer, steelhead kelts will be released into the tailrace.

5.5.1.6. Orifice blocking devices which are placed in the lower-most weirs to prevent fish from re-ascending the dewatered portion of the adult fishway shall have ropes placed on them to be tied to fishway railings. The orifice blocks shall be removed just before the fishway is returned to service. The ropes will help identify and prevent the orifice blocks from being accidentally left in place after fishway water-up. The orifice blocking devices will appear on the pre-water-up checklist maintained by the project biologist.

5.5.2. Unscheduled Maintenance.

5.5.2.1. When possible, discontinue fishway auxiliary water and operate the ladder at orifice flow as long as possible (prefer 3-24 hours) prior to dewatering.

5.5.2.2. Follow guidance in sections 5.5.1.3. through 5.5.1.5. above.

5.6. Powerhouse Fish Collection System.

5.6.1. Scheduled Maintenance.

5.6.1.1. During the pumping or draining operation to dewater a portion or all of the collection channel, the water level will not be allowed to drop to a level which strands fish. Adequate inspections will be conducted to ensure that stranding does not occur.

5.6.1.2. The project biologist will assure that rescue equipment and adequate personnel are available if needed.

5.6.1.3. The project biologist will provide technical guidance to assure fish safety and will assist directly as needed in rescue operations.

5.7. Turbines.

5.7.1. Immediately before setting the head gates, remove juvenile fish from the gatewell(s) which will be drained. This is done by use of a special dipping basket. Typically, one of the three gatewells is drained to allow ventilation into the draft tube.

5.7.2. When possible, place head gates and tail logs immediately after a turbine unit is shut down if the draft tube is to be dewatered. This is necessary for both scheduled and unscheduled outages.

5.7.3. If a turbine unit draft tube is to be dewatered and the turbine unit has been idle, it will be operated when possible at speed/no load and stop logs will then be placed immediately.

5.7.4. Water levels in the draft tube will not be allowed to drop to a level which strands fish. Adequate inspections will be conducted to ensure that stranding does not occur.

5.7.5. Fish rescue personnel will inspect dewatered turbine draft tubes, scroll cases, and intakes as soon as the water levels reach a depth permitting visual inspection and the hatch cover is opened. The project biologist and/or alternate Corps fish personnel will provide technical guidance for fish safety and will directly participate in fish salvage.

5.7.6. The project biologist will invite FPOM members to participate in the dewatering, and will assure that rescue

equipment is available if needed.

5.7.7. If the unit is planned to be out of service and partially drained for less than 4 days and low numbers of fish are trapped, then it will not be necessary to remove fish from draft tubes as long as an adequate safety pool is maintained. Adequate inspections will be conducted to ensure the safety pool is maintained and fish are in good condition.

6. Forebay Debris Removal. Debris can impact fish passage conditions in several ways. It can plug or block trash racks, VBSs, gatewell orifices, dewatering screens, and facility piping, resulting in impingement, injuries, and descaling of fish. Debris is removed by operating the ice and trash sluiceway at the first powerhouse, the ice and trash chute at the second powerhouse, or passing it through the spillway with special spill gate operation.

Special spill operations that don't follow the normal spill schedule or volume limits will be coordinated prior to their execution. Normally, the project shall contact CENWP-CO at least two work days prior to the day the special operation is required. Using information provided by the project, CENWP-CO will coordinate with RCC, NMFS, and other FPOM members as necessary. Once the coordination is complete, RCC will issue a teletype detailing the specifics of the special operations.

Table BON-8. Spill patterns for Bonneville Dam.

Bay Number																		Total Dogs	kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
4"	1																4"	1	3.1
4"	1															1	4"	2	6.2
4"	1	1														1	4"	3	9.3
4"	1	1													1	1	4"	4	12.4
4"	1	1	1												1	1	4"	5	15.5
4"	1	1	1											1	1	1	4"	6	18.6
4"	1	1	1	1										1	1	1	4"	7	21.7
4"	1	1	1	1									1	1	1	1	4"	8	24.8
4"	1	2	1	1									1	1	1	1	4"	9	28.5
4"	3	2									2				1	2	4"	10	33.6
4"	3	2									2				2	2	4"	11	37.2
4"	3	2			1						2				2	2	4"	12	40.3
4"	3	2			2						2				2	2	4"	13	43.9
4"	3	2	1		2						2				2	2	4"	14	47.0
4"	3	2	1		2						2			1	2	2	4"	15	50.1
4"	3	2	1		2				1		2			1	2	2	4"	16	53.2
4"	3	2	1		2				2		2			1	2	2	4"	17	56.9
4"	3	2	2		2				2		2			1	2	2	4"	18	60.5
4"	3	2	2		2		1		2		2			1	2	2	4"	19	63.6
4"	3	2	2		2		2		2		2			1	2	2	4"	20	67.2
4"	3	2	2		2		2		2		2		1	1	2	2	4"	21	70.3
4"	3	2	2		2		2		2		2		2	1	2	2	4"	22	74.0
4"	3	2	2		2		2		2		2		2	1	2	3	4"	23	77.5
4"	3	2	2		2		2		2		2		2	2	2	3	4"	24	81.1
4"	3	3	2		2		2		2		2		2	2	2	3	4"	25	84.6
4"	3	3	2		2		2	1	2		2		2	2	2	3	4"	26	87.7
4"	3	3	2		2		2	2	2		2		2	2	2	3	4"	27	91.4
4"	4	3	2		2		2	2	2		2		2	2	2	3	4"	28	94.9
4"	4	3	2		2		2	2	2		2		2	2	3	3	4"	29	98.4
4"	4	3	2		2		2	2	2		2		2	2	3	4	4"	30	102
4"	4	3	3		2		2	2	2		2		2	2	3	4	4"	31	105
4"	4	3	3	1	2		2	2	2		2		2	2	3	4	4"	32	109
4"	4	3	3	2	2		2	2	2		2		2	2	3	4	4"	33	112
4"	4	3	3	2	2		2	2	2		2	1	2	2	3	4	4"	34	115
4"	4	3	3	2	2		2	2	2		2	2	2	2	3	4	4"	35	119
4"	4	3	3	2	2	1	2	2	2		2	2	2	2	3	4	4"	36	122
4"	4	3	3	2	2	2	2	2	2		2	2	2	2	3	4	4"	37	126
4"	4	3	3	2	2	2	2	2	2	1	2	2	2	2	3	4	4"	38	129
4"	4	3	3	2	2	2	2	2	2	2	2	2	2	2	3	4	4"	39	132
4"	4	4	3	2	2	2	2	2	2	2	2	2	2	2	3	4	4"	40	136
4"	4	4	3	2	2	2	2	2	2	2	2	2	2	3	3	4	4"	41	139
4"	4	4	3	2	2	2	2	2	2	2	2	2	2	3	4	4	4"	42	143
4"	4	4	3	3	2	2	2	2	2	2	2	2	2	3	4	4	4"	43	146
4"	4	4	3	3	2	2	2	2	2	2	3	2	2	3	4	4	4"	44	150
4"	4	4	3	3	2	2	2	2	2	2	3	2	3	3	4	4	4"	45	153

Table BON-8 (cont). Spill patterns for Bonneville Dam.

Bay Number																		Total Dogs	kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
4"	4	4	3	3	2	3	2	2	2	2	3	2	3	3	4	4	4"	46	157
4"	4	4	3	3	2	3	2	2	3	2	3	2	3	3	4	4	4"	47	160
4"	4	4	3	3	2	3	2	3	3	2	3	2	3	3	4	4	4"	48	164
4"	5	4	3	3	2	3	2	3	3	2	3	2	3	3	4	4	4"	49	167
4"	5	4	3	3	2	3	2	3	3	2	3	2	3	3	4	5	4"	50	171
4"	5	4	4	3	2	3	2	3	3	2	3	2	3	3	4	5	4"	51	174
4"	5	5	4	3	2	3	2	3	3	2	3	2	3	3	4	5	4"	52	178
4"	5	5	4	3	2	3	2	3	3	2	3	2	3	3	5	5	4"	53	181
4"	5	5	4	3	2	3	2	3	3	3	3	2	3	3	5	5	4"	54	185
4"	5	5	4	3	2	3	3	3	3	3	3	2	3	3	5	5	4"	55	188
4"	5	5	4	3	2	3	3	3	3	3	3	2	3	4	5	5	4"	56	192
4"	5	5	4	4	2	3	3	3	3	3	3	2	3	4	5	5	4"	57	195
4"	5	5	4	4	2	3	3	3	3	3	3	2	3	4	5	5	4"	57	195
4"	5	5	5	4	3	3	3	3	3	3	3	2	3	4	5	5	4"	59	202
4"	5	5	5	4	3	3	3	3	3	3	3	3	3	4	5	5	4"	60	206
4"	5	5	5	4	3	4	3	3	3	3	3	3	3	4	5	5	4"	61	209
4"	5	5	5	4	3	4	3	3	3	3	4	3	3	4	5	5	4"	62	213
4"	5	5	5	4	4	4	3	3	3	3	4	3	3	4	5	5	4"	63	216
4"	5	5	5	4	4	4	3	4	3	3	4	3	3	4	5	5	4"	64	220
4"	5	5	5	4	4	4	3	4	3	3	4	3	4	4	5	5	4"	65	223
4"	5	5	5	4	4	4	3	4	4	3	4	3	4	4	5	5	4"	66	227
4"	5	5	5	4	4	4	3	4	4	3	4	3	4	5	5	5	4"	67	230
4"	5	5	5	4	4	4	3	4	4	4	4	3	4	5	5	5	4"	68	234
4"	5	5	5	4	4	4	3	4	4	4	4	4	4	5	5	5	4"	69	237
4"	5	5	5	5	4	4	3	4	4	4	4	4	4	5	5	5	4"	70	241
4"	5	5	6	5	4	4	3	4	4	4	4	4	4	5	5	5	4"	71	244
4"	5	5	6	5	4	4	4	4	4	4	4	4	4	5	5	5	4"	72	248
4"	5	5	6	5	4	4	4	4	4	4	4	4	4	6	5	5	4"	73	251
4"	5	5	6	5	4	5	4	4	4	4	4	4	4	6	5	5	4"	74	255
4"	5	5	6	5	4	5	4	4	4	4	4	4	5	6	5	5	4"	75	258
4"	5	5	6	5	4	5	4	4	4	4	5	4	5	6	5	5	4"	76	262
4"	5	5	6	5	5	5	4	4	4	4	5	4	5	6	5	5	4"	77	265
4"	5	5	6	6	5	5	4	4	4	4	5	4	5	6	5	5	4"	78	268
4"	5	5	6	6	5	5	4	5	4	4	5	4	5	6	5	5	4"	79	272
4"	5	5	6	6	5	5	4	5	4	5	5	4	5	6	5	5	4"	80	275
4"	5	5	6	6	5	5	4	5	5	5	5	4	5	6	5	5	4"	81	279
4"	5	5	6	6	5	5	4	5	5	5	5	5	5	6	5	5	4"	82	282
4"	5	5	6	6	5	5	5	5	5	5	5	5	5	6	5	5	4"	83	286
4"	5	5	6	6	5	6	5	5	5	5	5	5	5	6	5	5	4"	84	289
4"	5	5	6	6	5	6	5	5	5	5	5	5	6	6	5	5	4"	85	292
4"	5	5	6	6	5	6	5	5	5	5	6	5	6	6	5	5	4"	86	296
4"	5	5	6	6	6	6	5	5	5	5	6	5	6	6	5	5	4"	87	299
4"	5	5	6	6	6	6	5	6	5	5	6	5	6	6	5	5	4"	88	302
4"	5	5	6	6	6	6	5	6	6	5	6	5	6	6	5	5	4"	89	306
4"	5	5	6	6	6	6	5	6	6	6	6	5	6	6	5	5	4"	90	309

Table BON-8 (cont). Spill patterns for Bonneville Dam.

Bay Number																		Total Dogs	kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
4"	5	5	6	6	6	6	5	6	6	6	6	6	6	6	5	5	4"	91	312
4"	5	5	6	6	6	6	6	6	6	6	6	6	6	6	5	5	4"	92	316
4"	5	5	6	6	6	7	6	6	6	6	6	6	6	6	5	5	4"	93	319
4"	5	5	6	6	6	7	6	6	6	6	6	6	7	6	5	5	4"	94	323
4"	5	5	6	6	6	7	6	6	6	6	7	6	7	6	5	5	4"	95	326
4"	5	5	6	6	7	7	6	6	6	6	7	6	7	6	5	5	4"	96	330
4"	5	5	6	6	7	7	6	7	6	6	7	6	7	6	5	5	4"	97	333