

## SECTION 3

# JUVENILE SALMON MIGRATION

Salmon and steelhead begin and end life in many diverse streams and tributaries throughout the Columbia River Basin, but they all eventually share one route. They must make their way down and ultimately back up the mainstems of the Columbia and Snake rivers as they go to and from their spawning beds. Between passages, they spend most of their adult lives in the Pacific Ocean.

Given that their unusual life cycle depends on a long river journey that can stretch hundreds of miles, it is clear that safe passage is paramount to their survival. Downstream passage is especially dangerous. The juvenile fish face two major obstacles. First, dams are obvious physical barriers. Fish that pass through turbines have a significant mortality rate. Second, the fish are on a biological time clock. To reach the ocean safely, the spring migrants must complete their downstream journey quickly.

Development of the dams has greatly altered the natural flows and cross-sectional areas of rivers in the basin. The spring runoff is stored in reservoirs so it can be used during periods of naturally low flows. Regulating the river in this fashion increases its ability to produce electricity, as well as to provide for irrigation, transportation, recreation and flood control throughout the year. However, this practice and others also reduce river flows, particularly during the spring when juvenile salmon and steelhead are migrating downstream to the ocean.

The combination of reduced flows and the greater cross-sectional area of the river due to reservoir storage slows the juvenile fish as they migrate from their area of origin to the ocean. An increase in travel time in the river can affect the migratory behavior of juvenile fish and increase their exposure to predatory fish and birds. Reduced flows also endanger juvenile salmon by raising water temperatures, altering water chemistry and increasing susceptibility to disease.

The physical problems faced by salmon and steelhead have been compounded by the diversity of the parties involved in the river basin's management. Even with major efforts to increase the amount of water for salmon and steelhead, matching water supplies with the needs of spring and summer migrating fish poses a substantial problem of analysis and coordination.

From the start in 1982, the Council's program recognized and focused on the importance of improving mainstem survival for both smolts and returning adult salmon. However, in recent years, the problem has been exacerbated by a series of low water years, caused primarily by drought conditions in the southern and eastern parts of the basin. The Snake River Basin has been particularly dry. It is believed that this drought contributed significantly to a reversal in the progress to rebuild runs that had been made in the early 1980s.

To increase salmon survival in the mainstem, the approach must be multifaceted. Flows and reduced water temperatures alone are not sufficient. Control of predation, improved and/or new fish transportation methods, and completion of programs to install and upgrade screens at both the dams and all unscreened water diversions are all vital to successful mainstem passage.

## THE MEASURES

In 1991 and 1992, the Council adopted two kinds of measures to address these problems. First, a set of immediate measures—i.e., measures that could be implemented in time for the 1992 fish migration. These measures are contained in Sections 3.1–3.4, 3.7–3.8, 3.9.8 and 3.9.9. Second, recognizing that these immediate measures are not sufficient to rebuild some weak populations, the Council identified a set of intermediate-term measures that will be needed for rebuilding, but which must be evaluated further before implementation. These measures are contained in Sections 3.5–3.7.

## Immediate Measures

The Council has established a process to address potential trade-offs between the flow needs of Snake River spring, summer and fall chinook based on limited water storage capacity and availability of water at appropriate temperatures. Fishery managers and river operators should consider the benefits of proposed measures for weak stocks, and the cost to other stocks and river users. Lower water temperature may be important to the survival of fall chinook, and it will be affected by the source of mainstem flows (e.g., cold water reservoirs) as well as other factors such as local watershed conditions.

To augment flows for Snake River spring migrants, the program includes measures calling for lower Snake River reservoirs to be operated at near minimum operating pools, and for major storage contributions from Dworshak Reservoir, the Hells Canyon Complex and projects in the Snake River Basin. The same projects are called on to supply water to address water temperature problems for Snake River adult summer migrants (fall chinook). If there is a conflict between operations for spring and summer Snake River migrants, the Council calls for the conflict to be resolved by the Fish Operations Executive Committee in consultation with the National Marine Fisheries Service.

For Columbia and Snake river spring migrants, the program includes measures calling for the John Day Reservoir to be operated at a lower than normal level, and for substantially augmented flows, in addition to the existing water budget. For summer migrants, the Council calls for additional flows to be made available on an experimental basis, and for Bonneville to continue to seek energy exchanges and other power system operational changes to help increase flows. Because these measures are expensive and often controversial, the Council calls for careful monitoring of their biological effectiveness. The Council will consider modification if biological data so indicates.

The program also includes measures calling for aggressive efforts to control predation and improve salmon transportation in barges. The Council is not choosing inriver migration to the exclusion of options such as transportation. The Council has not found sufficient biological evidence on which to make such a choice. It is choosing to use either or both, as long as they are consistent with improved survival. The Council is proposing to improve conditions for survival in both modes of migration to the greatest extent practicable.

For the short term, the program measures call for a Fish Operations Executive Committee described in Section 3.2, to develop accounting procedures to improve the management of water for fish in the Snake and Columbia rivers. This committee should seek ways to make current operations more responsive to the needs of fish.

The Council welcomes recommendations from these groups, or others, for improvements in the flow program. The Council supports analyses of alternative ways to accommodate increased flows for fish.

The Council believes that these immediate measures, taken together, should improve survival for Snake and Columbia river sockeye, and spring, summer and fall chinook. However, the region needs expanded options for improving the survival of juvenile fish migrating in the river, both in the short term and the longer term.

## Intermediate-Term Measures

In Sections 3.5 and 3.6, the Council calls for demonstration, testing and evaluation of measures to achieve yet higher levels of mainstem protection in the longer term. Over the coming two years, the region must explore structural and non-structural improvements such as reservoir drawdowns, new storage, water use efficiency improvements, and new approaches to power system operations, such as seasonal exchanges. Unless they are structurally or economically infeasible, biologically unsound, or inconsistent with Sections 4(h)(5)–(7) of the Northwest Power Act, these measures should be implemented expeditiously. While the implementation schedule for these measures is ambitious, it is meant to convey the sense of urgency the Council believes these problems merit.

The Council believes that reservoir drafting holds great promise as a strategy for improving river velocities in the lower Snake River and increasing the survival of the Snake River salmon smolt migration. The reservoir drafting strategy, as well as additional measures, will be fully developed, demonstrated, tested and evaluated for quick implementation, unless it is shown to be structurally or economically infeasible, biologically imprudent or inconsistent with Sections 4(h)(5)–(7) of the Northwest Power Act.

Finally, measures designed for salmon must take into account the effects on resident fish and wildlife, especially endangered species, and on other uses of the river system, as well as impacts on the Northwest economy.

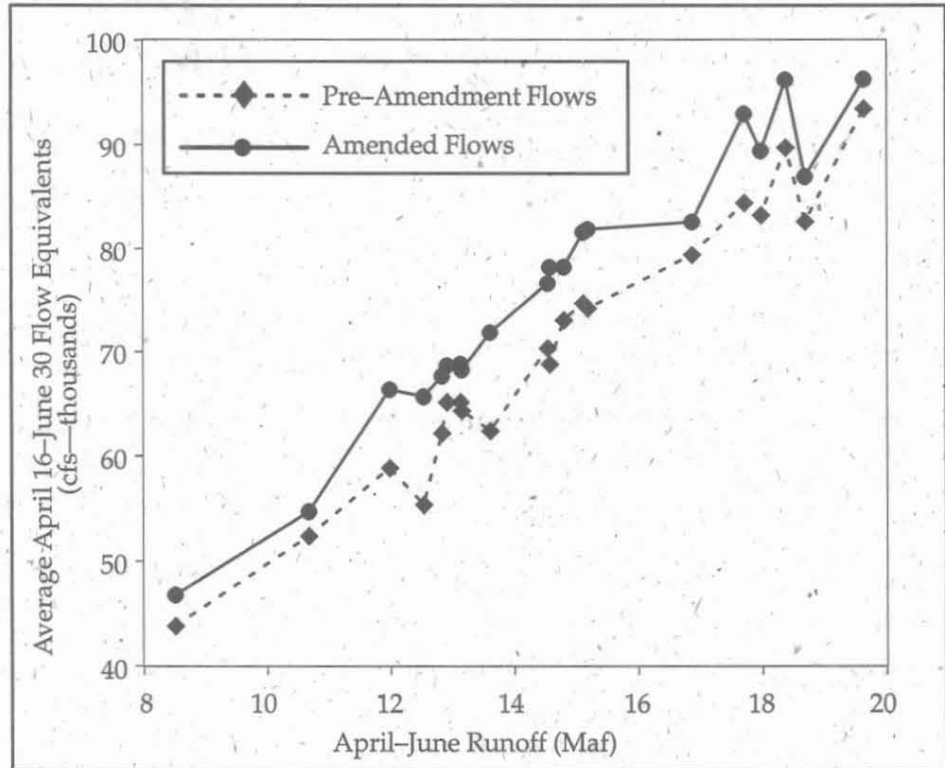
## 3.1 PERFORMANCE STANDARDS FOR IMMEDIATE MEASURES

### 3.1A Snake River Spring Migrants

Incorporate the measures described below into firm power planning. Figure 6 illustrates the approximate flows attained when these measures are applied to the historical water record.

# Lower Granite Flows

**Figure 6**  
Approximate Flows at Lower Granite for the 20 Years with Lowest Water Levels



## 3.1B Columbia River Spring Migrants

In addition to the existing water budget volume, provide up to 3 million acre-feet of water for spring migrants subject to conditions specified below.

## 3.2 RIVER OPERATIONS

Through an annual policy and technical process, the region will address flow and temperature regimes and reconcile measures described below to achieve protection for salmon and steelhead. The process will be initiated by the Council and managed by the Fish Operations Executive Committee, which will be appointed by the Council and made up of senior management representatives of the Council, as well as power and fishery interests.

This Executive Committee should produce a detailed, annual implementation plan for carrying out this program. Insofar as practical, the committee should incorporate matters such as spill, transportation, the Corps' annual Fish Passage Plan, the fishery agencies' and tribes' Detailed Fishery Operating Plan, annual operating plans for the Non-Treaty Storage Fish and Wildlife Agreement, planning for coordinated system

operations, Idaho Power Company's proposed operations under its weak stock plan, water identified by the Snake River Anadromous Fish Water Management Office, spring and fall trade-offs, research and monitoring results, and other mainstem passage matters.

In its meetings, the committee should identify all water available in a particular year and plan for its use. During low flow conditions, when the monthly average flow equivalent<sup>2</sup> of 85,000 cubic-feet per second in the Snake River cannot be provided for the full migration period, flows should be distributed to protect a portion of all known naturally reproducing stocks. The plan will have the flexibility to move flows between May and June, if such shaping is more likely to achieve the intent of this program. If there are conflicting water demands among anadromous species, conflicts should be resolved by the Fish Operations Executive Committee in consultation with the National Marine Fisheries Service.

2. "Flow equivalent" means the flow level required to achieve the same water particle travel time as 85,000 cubic-feet per second at average normal pool elevations at all projects. For example, 81,000 cubic-feet per second at minimum operating pool elevations is the flow equivalent of 85,000 cubic-feet per second at average normal pool levels.

All alterations in river operations undertaken pursuant to these amendments should consider impacts on resident fish and other species, especially threatened, endangered or native species, and should seek to avoid adverse effects on those species. The committee should produce an operating plan by March 31 of each year, and will need to begin in the preceding year to complete its work.

The Fish Passage Center should manage water supplies for fish in accordance with the annual implementation plan. To assist the full range of stocks migrating in the Snake and Columbia rivers, every effort must be made to shape water stored for fish flow augmentation to the fullest extent practicable. Any proposed deviations from the implementation plan must be approved by the Executive Committee. Therefore, the Executive Committee must develop a procedure to address fish flow operations throughout the fish migration season, if necessary.

Accounting procedures for the use of this water will be developed under the auspices of the Fish Operations Executive Committee. These procedures will be provided to the Council and other interested parties. The Fish Passage Center will be directed by one fish passage manager appointed under the joint authority of the fish and wildlife agencies and Indian tribes. All water supplies acquired under the measures below will be applied to the fish migration.

However, the Columbia River and its tributaries make up an extremely complex operating system. The Council recognizes that the flow, velocity and temperature improvement measures contained in this amendment will have a substantial impact on the operations of this system.

Given more time and experience, it is likely that additional refinement of these measures can be achieved, resulting in greater operational efficiency and better coordination between the needs of fish and other uses of the river.

The Council welcomes proposals from river operators, especially those proposals that emerge from the river operations process described above, for better ways of providing equivalent amounts of water for salmon and steelhead within time frames specified in this amendment. Any such proposals should be submitted to the Council and, on approval, implemented.

The Council expects that, beginning in 1992, river operation changes for fish will be in accordance with these measures as they are now written. The Council will carefully monitor these operations, and will welcome suggestions from all interested persons on how they can be improved. In the fall of 1992, and of each subsequent year until further notice, the Council will review the operations. At that time, it will determine whether these measures should be revised to provide the intended benefits to fish in the most practical and efficient manner.

## 3.3 SNAKE RIVER FLOW, VELOCITY AND TEMPERATURE CONTROL

### 3.3A Spring Migrants

Use the following measures to aim to provide a minimum monthly average flow equivalent of 85,000 cubic-feet per second at Lower Granite from April 16 through June 15 in all water years. Figure 6 illustrates the approximate flows attained when these measures are applied to the historical water record.

#### Corps of Engineers

1. Unless drawdown experiments require otherwise, reduce the level of Lower Granite, Little Goose, Ice Harbor and Lower Monumental pools to near minimum operating pool levels when juvenile fish begin migrating (typically about April 16). The Fish Operations Executive Committee will plan for reservoir refill between the end of the juvenile fall chinook migration and the beginning of the adult fall chinook migration. Ensure that refill does not reduce the effectiveness of temperature control measures. At present, near minimum operating level is assumed to be one foot above the minimum operating elevation. Identify and report to the Council by March 15, 1992, any measures which can be implemented promptly to remove limiting conditions and allow operations at a lower level without adversely affecting present users.

#### Bonneville, Corps of Engineers, Bureau of Reclamation and Other Parties

2. Operate the Dworshak Reservoir to improve salmon migration conditions consistent with the measures listed below:
  - a. From January to April 30, in years when Snake River runoff is forecast to be below average, shift system flood control storage space to other Columbia Basin projects.
  - b. Dworshak should be as close as possible to its upper rule curve by April 15 of each year.
  - c. When the official April forecast for the April-July runoff at Lower Granite is less than 16 million acre-feet, Dworshak will provide 900,000 acre-feet of water plus any water gained from the flood control shift for juvenile fish flow augmentation. This volume of water is in addition to any minimum flow release requirements at Dworshak. When the runoff forecast is greater than 16 million acre-feet and less than 29 million acre-feet, Dworshak will provide all available water, including any water gained from the

flood control shift, for juvenile fish flow augmentation, while providing a 70-percent confidence of refill by July 31. When the runoff forecast is 29 million acre-feet or more, augmentation from Dworshak is not required.

- d. Dworshak's outflow is limited to 25,000 cubic-feet per second during the migration period.
- e. In emergency situations, for capacity needs, Dworshak may be temporarily used to respond until arrangements can be made to continue filling toward the upper rule curve.

#### **Bureau of Reclamation and Idaho**

3. Use uncontracted storage space to supply at least 90,000 acre-feet of water for spring migrants.

#### **Bureau of Reclamation, Idaho, Oregon, Bonneville and Other Parties**

4. Unless the forecasted April through July runoff at Lower Granite exceeds 29 million acre-feet, use water efficiency improvements, water marketing transactions, dry-year option leasing, storage buy-backs, and other measures to secure at least 100,000 acre-feet of water from the Snake River Basin for spring migrants. Of this amount, half should be secured by the Bureau of Reclamation, and half should be secured with financial incentives provided by Bonneville (through the Idaho Water Rental Pilot Project, or such other processes as the Bureau of Reclamation, Idaho, Oregon and Bonneville choose).

#### **Bonneville**

5. Fund an independent, third-party evaluation of the effectiveness of these measures in providing water for salmon and steelhead.

#### **Idaho Power Company, Corps of Engineers, Bureau of Reclamation and Federal Energy Regulatory Commission**

6. Operate Brownlee Reservoir to ensure that water described in Section's 3.3A3 and 3.3A4, above, is passed to assist spring migrants. Report to the Council each year during the river operations planning process (Section 3.2) on the Idaho Power Company's effort to shape this water.
7. Unless the forecast April through July runoff at Lower Granite exceeds 29 million acre-feet, draft Brownlee Reservoir during May to a minimum elevation of 2,069 feet above sea level, which will provide a maximum of 110,000 acre-feet for spring migrants whenever sufficient inflows are forecast, so that resident fish, fall chinook and Brownlee refill by July 1 will not be significantly affected. In years when Snake River runoff is forecast to be below average, shift system flood control storage space from Brownlee to

other Columbia Basin projects whenever possible and needed.

#### **Bureau of Reclamation, Idaho and Oregon**

8. Establish, in cooperation with fish and wildlife agencies, Indian tribes and interested parties, a Snake River Anadromous Fish Water Management Office to facilitate the use of water from the Snake River Basin. Report to the Council by May 1992.

### **3.3B Fall Chinook**

#### **Corps of Engineers, Bonneville and Other Parties**

1. Continue to release cool water during August and September from both Dworshak and the Hells Canyon Complex dams to reduce lower Snake River water temperatures for adult fall chinook salmon and steelhead. Evaluate the effectiveness of this measure. The objective of this evaluation is to target reduced water temperatures at Ice Harbor Dam by September 1 of each year, and to determine the effectiveness of these operations on adult fish passage through the lower Snake River. Report results of this evaluation to the Council by December 1993. Policy and technical guidance for determining the magnitude and timing of Snake River temperature control releases from Dworshak and Brownlee should be provided in a July meeting of the Fish Operations Executive Committee.
2. If Dworshak Reservoir is full or nearly full by the end of July, draft Dworshak Reservoir as much as 20 feet in August as needed for the temperature control evaluation. In September, beginning immediately after Labor Day, release up to 200,000 acre-feet of additional cool water from Dworshak Reservoir, as needed for the temperature control evaluation. If Dworshak Reservoir is not full, use of Dworshak for temperature control will be addressed in the July meeting of the Fish Operations Executive Committee.

#### **All Parties**

3. Seek funding assistance for necessary modifications to recreational and commercial facilities to allow Dworshak Reservoir to operate at reduced levels to improve survival of fall chinook consistent with the mitigation provisions of these amendments (see Section 8).

#### **Idaho Power Company and Federal Energy Regulatory Commission**

4. Modify operation of the Hells Canyon Complex to provide coordinated fall and spring flows below Hells Canyon Dam to maintain fall chinook spawn-

ing, incubation and emergence. Evaluate options for providing more water for fish flows from Brownlee Reservoir, including substantially improved ability to shape water from the Snake River Basin for spring and summer migrants, and report to the Council by the end of 1993.

5. During July, draft Brownlee Reservoir to a minimum elevation of 2,067 feet above sea level, to provide up to 137,000 acre-feet for the juvenile fall chinook migrants. Refill this space in August with water from the Snake River Basin. The amount of July draft at Brownlee is subject to the availability of water in Section 3.3B7, below.
6. During September, draft 100,000 acre-feet from Brownlee Reservoir to help reduce Snake River water temperatures for adult fish passage. In addition, pass 100,000 acre-feet of water from the Snake River Basin through the Hells Canyon hydropower complex.

#### **Bureau of Reclamation, Idaho, Bonneville and Other Parties**

7. Use water efficiency improvements, water marketing transactions, dry-year option leasing, storage buy-backs, and other measures to provide up to 137,000 acre-feet of water to refill the Brownlee Reservoir in August, in light of the operation described in Section 3.3B5, above, and to provide 100,000 acre-feet of water to reduce water temperatures (see Section 3.3B6, above). Of this amount, half should be secured by the Bureau of Reclamation, and half should be secured on a matching basis using financial incentives provided by Bonneville (through the Idaho Water Rental Pilot Project or such other processes the parties choose).

#### **Bonneville**

8. Fund an independent, third-party evaluation of the effectiveness of these measures in Section 3.3B7, above, to provide water for salmon and steelhead.

## **3.4 COLUMBIA RIVER FLOW AND VELOCITY**

### **3.4A Spring Migrants**

#### **Bonneville, Corps of Engineers, Bureau of Reclamation and Other Parties**

1. Beginning immediately, operate John Day Reservoir at minimum irrigation pool from May 1 to August 31 of each year. Minimum irrigation pool is the lowest level at which the irrigation pumps drawing from the reservoir will operate effectively. Monitor and evaluate the biological benefits of John Day Reservoir operations so that the Fish Operations Executive

Committee can gain better information to determine in future years how the operations can complement flow velocities and other factors to achieve rebuilding targets. The Council recognizes that, as was the experience in 1991, under certain conditions, a slightly higher elevation may be required and some daily flexibility is necessary for operation of the reservoir. Other portions of this rule contain measures that will permit irrigators and other users of the John Day Pool to operate effectively at lower pool levels. The Council expects the level of the minimum irrigation pool to be lowered as these measures are implemented. The Council expects that this will be accomplished by 1994. The intent of this provision is for the John Day Reservoir to be operated at the lowest practical level during the spring and summer migrations of juvenile chinook and sockeye salmon.

2. When the adjusted April forecast for the January–July runoff at The Dalles Dam is less than 90 million acre-feet, have water in storage and available for juvenile fish flow augmentation by April 30. The appropriate volume is derived from the curve in Figure 7 based on the official April forecast, adjusted to the National Weather Service 95-percent confidence level. This volume is in addition to the existing water budget volume. When applied to the 20 lowest water years in the historical water record, this volume of water would provide approximately the flows shown in Figure 8.
3. Actions taken to store the required volume should not violate the following conditions:
  - a. flood control limitations;
  - b. daily reservoir drawdown or refill limits; and
  - c. Vernita Bar Agreement requirements, which protect fall chinook below Priest Rapids Dam.

#### **Bonneville**

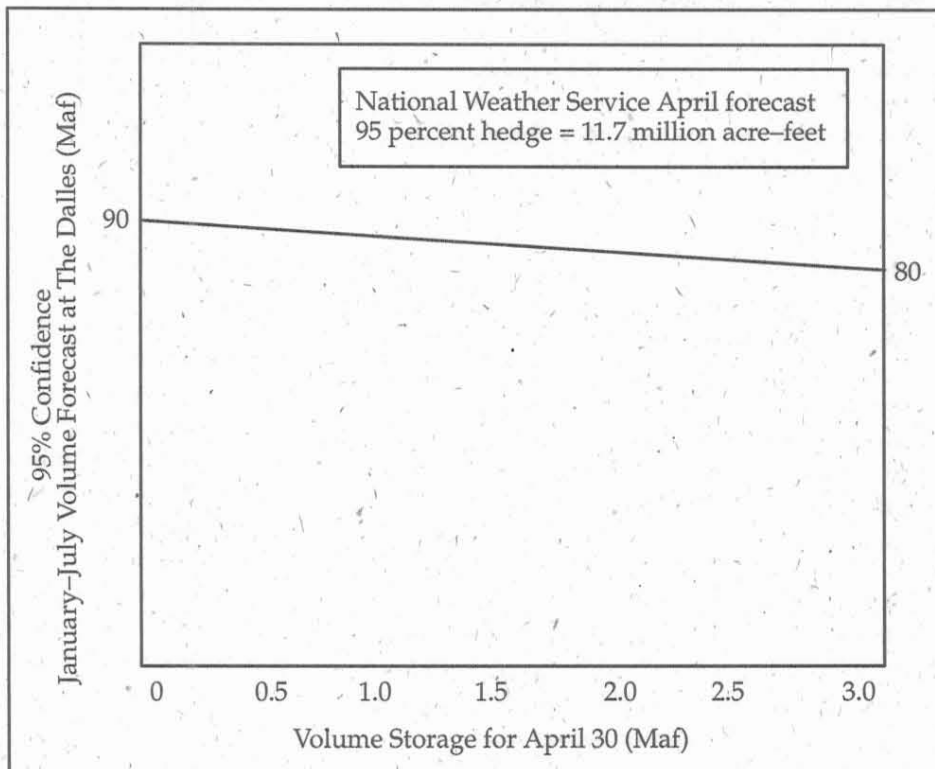
4. Beginning in January of each year, provide to the Council and other interested parties a written monthly report of the volume of water stored pursuant to Section 3.4A2, above. By April 30th of each year, identify the location and total volume of water stored for juvenile fish flow augmentation.

#### **Corps of Engineers**

5. Provide to the Council and other interested parties a written monthly report on where system flood control storage is being provided, including a summary of system flood control shifts.

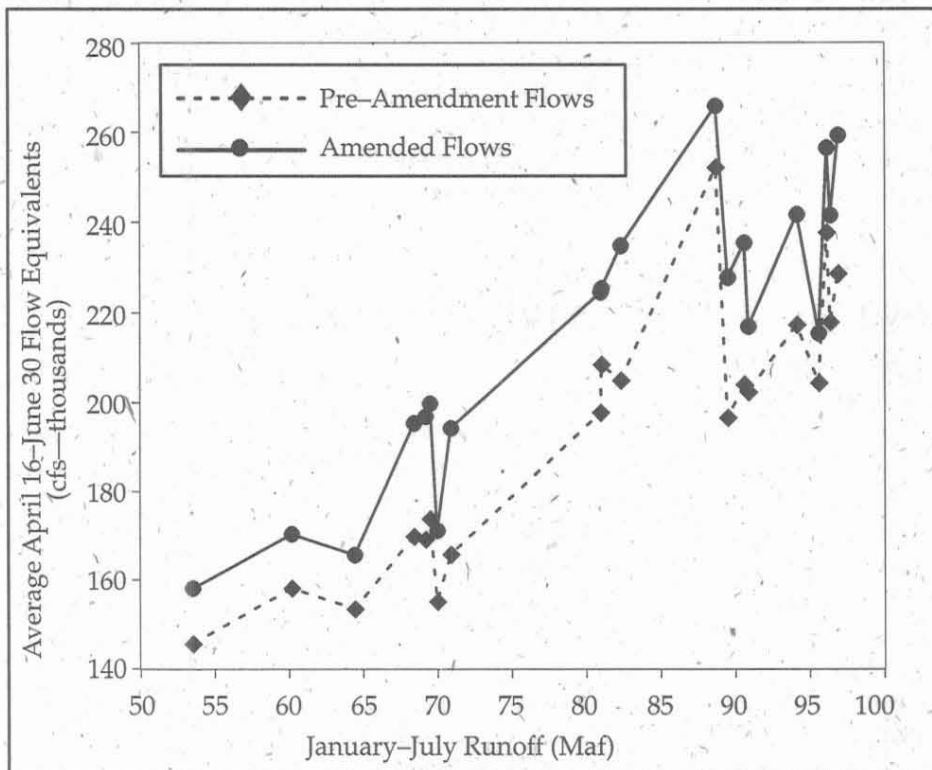
# Columbia River Fish Flows Storage

**Figure 7**  
Storage Volume Required for May/June Flow Augmentation on the Columbia River



# The Dalles Flows

**Figure 8**  
Approximate Flows at The Dalles for the 20 Years with Lowest Water Levels



### All Parties

6. Whenever flow augmentation measures are in effect, the weekend and holiday average flows should not be lower than 80 percent of the average of the five preceding weekdays.
7. The 140,000 cubic-foot per second flow cap in the mid-Columbia River is removed.

### Bonneville

8. Because of the uncertainty in the supply of out-of-region energy, immediately secure options for one or more resources to augment reduced hydroelectric energy during winter months. If the region is unable to store enough water for any reason other than those specified in Section 3.4A3, above, immediately begin to acquire the optioned resources called for under Objective 2 of the 1991 Northwest Conservation and Electric Power Plan, or otherwise acquire resources that are consistent with the plan, in an amount sufficient to ensure that the full volume of required water is available in succeeding years. The Council will consult with representatives from all interested parties to determine the proper amount and timing of the acquired resource(s).

## 3.4B Summer Migrants

### Bonneville

1. During July and August in below average water years, provide a volume of water from the U.S. Non-Treaty Storage water available in that year to facilitate evaluations described below.
2. Continue to seek energy exchanges and other energy alternatives with potential to increase Columbia River flows in July and August to facilitate evaluations and improve survival of summer migrants.

## 3.5 SNAKE RIVER RESERVOIR DRAWDOWN STRATEGY

The region must expand existing options for improving survival of juvenile fish migrating in the river. In this section, the Council identifies actions necessary to develop, demonstrate and implement a reservoir drawdown strategy for the lower Snake River. This strategy is intended to provide inriver juvenile migration conditions that will promote rebuilding of imperiled Snake River anadromous fish stocks.

Snake River flow augmentation and transportation measures, described in Sections 3.3 and 3.9, will be pursued pending implementation of the Snake River reservoir drawdowns. Such drawdowns will be implemented to achieve rebuilding targets unless they would be struc-

turally or economically infeasible, biologically imprudent, or inconsistent with Sections 4(h)(5)-(7) of the Northwest Power Act. The Council will review and re-evaluate transportation and flow measures upon receipt of final reservoir drawdown plans. It is the intent of the Council that these measures will be in addition to or complement measures already initiated to achieve rebuilding targets.

The region needs to evaluate these actions to identify biological benefits for weak stocks and strategies to mitigate adverse effects on other river users. Parties conducting tests and evaluations should report progress to the Council no less than semiannually, beginning May 30, 1992, and submit interim reports by November 1, 1992, and final reports by November 1, 1993. As soon as the results are available, they will be reviewed by the Council to develop the best strategy to meet biological goals and objectives. The Council will provide for public involvement prior to its decision on the drawdown strategy. It is the intent of the Council to have the Snake River drawdown strategy implemented by April 1995, unless shown to be structurally or economically infeasible, biologically imprudent or inconsistent with Sections 4(h)(5)-(7) of the Northwest Power Act.

## 3.5A Drawdown Evaluation

An integrated, multidisciplinary planning effort is necessary to demonstrate and develop the Snake River reservoir drawdown strategy. The development of the reservoir drawdown strategy will focus on the four lower Snake River projects and will include an operations plan, design plan, mitigation plan and biological plan. The plans will determine the best method for implementing the reservoir drawdown strategy while mitigating impacts to other users of the river.

### Operations Plan

The operations plan will consist of a detailed program for the implementation of reservoir drawdowns and will include, but is not limited to, the following elements:

- criteria for depth and duration of drawdown;
- the sequence in which reservoirs will be lowered and refilled;
- rates of drawdown and refill;
- provisions for refilling mainstem reservoirs following the drawdown period;
- plans for using water evacuated from the mainstem reservoirs to enhance downstream flows for fish migration;
- operations required for juvenile fish passage;
- operations required for adult fish passage;



- evaluation of shifting flood control responsibilities during drawdown period to the lower Snake River projects and among storage projects in the Columbia River Basin to provide additional storage at other projects; and
- procedures for planning, coordinating and implementing reservoir operations.

## Design Plan

The design plan will consist of a feasibility analysis, preliminary design work and preliminary cost estimates for structural modifications needed to implement the operations plan. The design plan will be developed in conjunction with the operations plan. The design plan will consider measures to permit operation of the following facilities at lower reservoir elevations:

- adult fishways;
- turbines and associated facilities;
- turbine intake screens and fish bypass facilities;
- collection and transportation facilities for juvenile migrants;
- physical devices and other measures to control nitrogen gas supersaturation and any other conditions such as sedimentation that may be associated with reservoir operations; and
- any additional design activities necessary to evaluate the modifications needed to facilitate implementation of the mitigation provisions of this amendment.

## Mitigation Plan

The mitigation plan will consist of measures to mitigate the impact of the reservoir drawdown strategy to the extent practicable. The Council anticipates that reservoir drawdown will have both economic and environmental impacts. Mitigation of these impacts is an integral and necessary part of any overall changes that would involve such drawdowns. Consistent with the mitigation section of these amendments (Section 8), the costs of mitigating impacts should be shared regionally and/or nationally so that local communities, industries, businesses and other entities that depend on the Snake River do not bear a disproportionate share of the burden. Development of the mitigation plan should proceed concurrently with development of the operations and design plans. The mitigation plan should address:

- stability of bridges, railways, levees and other structures that may be affected by implementation of the operations plan;
- impact of reservoir drawdown on the economic sectors affected by disruption of barge traffic on the lower Snake River, shifting lock maintenance operations into the drawdown period, alternative naviga-

tion and commodity shipping strategies, construction of additional storage facilities for products of commerce, measures to facilitate other means of transportation, relief for increased shipping costs, loss of market access, and other measures;

- impacts of reservoir drawdowns on resident fish, wildlife (particularly threatened or endangered species), recreational users and the recreational industry, and other environmental values;
- impacts on irrigation, including cost and other requirements necessary to relocate irrigation pipe inlets and to supply water; and
- impacts on county, state or federal roads and transportation corridors.

## Biological Plan

The biological plan will analyze the effects of pool drawdown on salmon, steelhead, resident fish and wildlife. This should include the analysis of available information and any new information that results from interim tests. The effects of drawdown on fish survival should be compared to alternative means to enhance survival. The biological plan should be coordinated with the design and operations plans, particularly in regard to development of drawdown alternatives.

## Interim Plans

By November 1, 1992, interim plans prepared pursuant to this section should be submitted to the Council for review and approval. At that time, the Council will establish an implementation schedule for further steps in the development of a reservoir drawdown program. Final plans should be submitted by November 1, 1993, for Council review and approval. The Council will provide for public involvement prior to its decisions. Given the critical status of Snake River salmon runs, the schedule will reflect an expedited time frame for implementation. The Council's determination to approve, reject or amend a plan will be based upon whether the operations plan and design plan provide for improved survival of Snake River salmon and steelhead to meet rebuilding targets, and whether implementation would be structurally or economically infeasible, biologically imprudent, or inconsistent with Sections 4(h)(5)-(7) of the Northwest Power Act.

### Bonneville and Corps of Engineers

1. In consultation with the fishery managers of the Snake River Basin, starting as early as possible in 1992, conduct any tests necessary to assist in the formulation of the plans called for in this measure.

### **Council, Bonneville, Corps of Engineers and Bureau of Reclamation**

2. Establish a committee to coordinate analyses conducted by the federal agencies and oversee the development of the plans described in this section. The committee, chaired by the Council, will consist of a representative from each of the following: Corps of Engineers, Bonneville, Bureau of Reclamation, Idaho, Montana, Oregon, Washington and Indian tribes. The committee's work will facilitate regional involvement in ongoing federal processes relating to lower Snake River reservoir drawdowns and will help prevent unnecessary duplication between federal and Council-sponsored efforts. The Council will provide ongoing coordination with other interested parties in the region, and will be responsible for overseeing the development, scheduling and completion of the plans called for in this section.

### **Bonneville**

3. In coordination with the committee, fund independent technical resources as needed to enable the committee to review the adequacy of analyses conducted by the federal agencies and to conduct their own analyses when the committee or the chair deem appropriate. Funding will be based on a scope of work approved by the Council no later than February 1992.

### **Federal Project Operators and Regulators**

4. Implement approved plans in accordance with the schedule adopted by the Council. To ensure prompt implementation of any plans approved by the Council, federal implementing agencies should incorporate the planning process and its results into ongoing administrative processes including, but not limited to, National Environmental Policy Act and Endangered Species Act processes.
5. Incorporate the specifications of such approved plans in all system planning and operations performed under the Columbia River Treaty, the Pacific Northwest Coordination Agreement, Congressional authorizations and appropriations, all related rule curves, and other applicable procedures affecting river operations and planning; and implement approved reservoir drawdown plans as "firm" requirements.

### **Congress and Corps of Engineers**

6. It is possible that refilling the four lower Snake River reservoirs that have been drawn down to near spillway crest elevation would reduce lower Columbia River navigation channels one or two feet. To address these potential impacts, the Council requests that: a) Congress consider authorizing dredging to

maintain a 40-foot navigation channel; b) the Corps begin any necessary National Environmental Policy Act process; and c) the parties time these actions to be consistent with implementation of the lower Snake River drawdown program.

## **3.6 ADDITIONAL MEASURES TO INCREASE SURVIVAL**

In this section, the Council identifies actions that should begin right away, so that the results can be used by the end of 1993. Included are additional longer-term actions to augment flows, reduce temperatures or otherwise further improve fish survival in the Columbia River Basin. These measures should be in addition to and not displace measures already initiated. Parties conducting tests and evaluations should report progress to the Council no less than semiannually, beginning May 30, 1992, and submit final reports by the end of 1993. The results will be reviewed by the Council as soon as available to develop the best strategy to meet rebuilding targets. The object of the process outlined below is to identify and remove impediments to these measures, and expeditiously implement those that achieve rebuilding targets unless shown to be structurally or economically infeasible, biologically imprudent or inconsistent with Sections 4(h)(5)-(7) of the Northwest Power Act.

### **3.6A John Day Drawdown**

#### **Corps of Engineers, Bonneville, Washington, Oregon and Others**

1. Identify and report to the Council by March 15, 1992, any measures that can be implemented promptly to remove limiting conditions and allow the John Day Reservoir to be operated at a lower level without adversely affecting present users, even if the measures do not achieve minimum operating pool level. For example, if localized dredging around certain irrigation pump intakes would allow the pumps to function effectively at lower reservoir levels and therefore allow the pool to be operated at lower levels, this should be reported to the Council together with an estimate of the time to complete and cost of the dredging.
2. Beginning immediately: determine requirements, including cost of measures, time to complete, and mitigation of impacts to reservoir users, to permit annual operation of John Day Reservoir at minimum operating pool level (257 feet elevation) from May 1 to August 31; and evaluate potential biological impacts of such an operation. Report these findings to

the Council as soon as feasible and not later than November 1, 1992.

3. Following Council review of the findings described in Section 3.6A2, above, and in consultation with user groups along the reservoir, prepare and implement a mitigation plan consisting of measures to mitigate the economic and other impacts of the reservoir drawdown to the extent practicable. Consistent with the mitigation provisions of this amendment (Section 8), the costs of mitigation impacts should be shared so that local communities, industries, businesses and other entities that depend on the John Day Reservoir do not bear a disproportionate share of the burden. The plan should address, but not be limited to:
  - a. Design, engineering, permitting, equipment and installation costs of relocating irrigation intakes and enlarging pumps as required for irrigators to continue operations adjacent to the reservoir (or providing alternative means of moving irrigation water to application).
  - b. Devising alternative, higher efficiency means of moving water to applications, including irrigation canals or pipelines from McNary Reservoir or other cooperative ventures to exploit economies of scale. To the extent pumping energy efficiencies can be achieved by Bonneville customers, Bonneville should finance and/or purchase such energy savings as a means of offsetting capital costs to users.
  - c. Impacts of reservoir drawdowns on resident fish, wildlife (particularly threatened or endangered species and existing wildlife refuges), recreationists and the recreation industry, and other environmental values.
  - d. Stability of bridges, railways, levees and other structures that may be affected by implementation of the plan.

### 3.6B Additional Storage

#### **Bureau of Reclamation, Corps of Engineers, Bonneville, Idaho, Oregon and Others**

1. Beginning in 1992 and concluding by the end of 1993, conduct a cooperative appraisal of the potential for new Snake River Basin storage to provide additional water for lower Snake River flow augmentation to aid migrating salmon and steelhead, or to provide added flood control storage that would augment salmon and steelhead flows. Identify and make preliminary evaluation of engineering, hydrologic, economic and environmental aspects of potential sites. In addition, expeditiously explore short-term options to develop storage capacity for at least 200,000 acre-feet of water. The Bureau and oth-

ers should give highest priority to potential new storage opportunities that:

- a. have highest refill probability;
- b. are or can be associated with new water supplies made available by the Council-mandated Bureau water conservation projects under this program;
- c. are located where they provide opportunities to shape flows to benefit fish migration (without intervening barriers);
- d. are located where they provide opportunities to moderate instream temperatures to benefit fish migration; and
- e. are not subject to state or other regulation that will preempt stored water or otherwise substantially impair employment of the projects to benefit fish migration.

### 3.6C Water Measures

Augmenting flows for salmon and steelhead will require a mix of measures because no single alternative is likely to eliminate the need for all other alternatives. This section puts a high priority on measures such as water banks, water efficiency improvements, water transactions and the like. In calling for these measures, the Council does not intend to alter or affect the water rights or authorities of states, Indian tribes, the United States, or any individual. Rather, it seeks to define a role for ratepayers in providing incentives to augment streamflows for salmon and steelhead, and to encourage water management by the states and others that contributes to sustainable salmon and steelhead runs.

#### **Idaho, Oregon, Washington and Bureau of Reclamation**

1. Organize a water use advisory committee with membership from state, federal, tribal, water user, utility and conservation interests, Bonneville and the Council. With advice and assistance from the committee, recommend options to secure, by the end of 1996, at least 1 million acre-feet of additional water from the Snake River Basin, and more if possible, to aid spring and summer migrants, using water efficiencies, market mechanisms, water transactions and the like.

Recommendations should include:

- a. incentive and regulatory programs;
- b. ways to use existing institutional structures and resolve legal and institutional barriers such as those raised by Idaho water managers to benefit fish flows;
- c. changes in law, policy and administration to facilitate increases in flows for fish;

- d. methodologies to determine the cost-effectiveness of various water alternatives;
  - e. funding sources for such measures; and
  - f. a framework for determining priorities among water alternatives.
2. Submit a work plan and budget for staff or contractor assistance to accomplish this work and submit recommendations no later than the end of 1993.

### **Bonneville**

3. Fund travel and related expenses for committee members, and staffing and contractor expenses shown in the work plan and budget approved by the Council.

### **Bureau of Reclamation, U.S. Geological Survey, U.S. Department of Agriculture and Soil Conservation Service**

4. Evaluate the potential for water conservation, water efficiency or other measures in the above listed agency programs with the most potential to benefit anadromous fish, and least impact on third parties. Include an evaluation of potential to use crop rotation programs to facilitate dry-year option water leasing activities. Report to the Council and the states' water committee.

### **Bonneville, Corps of Engineers and Bureau of Reclamation**

5. Under the auspices of the Columbia River Water Management Group, fund a review of the current water supply forecasting system, including:
  - a. potential for accuracy improvements of volume forecasts;
  - b. potential for forecasting the shape of runoff;
  - c. benefits of expanding telemetered snow monitoring system; and
  - d. resolution of the institutional barriers for the installation of hydrologic measurement sites in existing and proposed wilderness areas.

Should the review identify methods for improving accuracy or significant benefits elsewhere, Bonneville, the Bureau, the Corps or the states should fund implementation of those methods.

## **3.6D River System Investigations**

### **Bonneville, Corps of Engineers and Bureau of Reclamation in Consultation with the Council and Other Parties**

1. Evaluate seasonal exchanges, long-term nonfirm transactions, options for storing water above power rule curves, accelerated acquisition of winter peaking conservation and renewables, efficient direct application of renewable resources, wholesale and

retail price structures, and other changes in power system operations that could increase flows for salmon and steelhead, or offset the cost of improving salmon and steelhead flows. Complete and report to the Council not later than the end of 1993. Include, among alternatives examined in the System Operations Review, a full range of system coordination alternatives to facilitate such alternative power system operations. Take steps to include the Idaho Power Company in the coordinated system.

## **3.6E Flood Control Examinations**

### **Corps of Engineers and Others**

1. Re-examine all Columbia River Basin flood control strategies and rules to identify modifications, including alternatives to impoundment that could yield more useful or shapeable flows for fish, such as alternative structural and non-structural flood protection measures. Such evaluations should include, but not be limited to: the possibility of shifting flood control storage to the space provided when lower Snake River and John Day reservoirs are pulled down to minimum operating pool or lower; the effects and trade-offs required of reduced levels of flood protection, including decreasing the rainfall factor of safety; and separating system flood control from local flood control storage requirements, favoring local flood control requirements, in upper basin storage projects. Submit final report not later than the end of 1993.

## **3.6F Research and Monitoring**

### **Flow, Velocity and Salmon Survival**

During the 1980s, the region made unsatisfactory progress in evaluating the relationship between spring and summer flow, velocity and fish survival, notwithstanding concerted efforts by several parties. A lack of consensus on the issues has hindered conclusion of this debate. The importance of this relationship is such that continued stalemate is a serious problem. The Council joins with the National Marine Fisheries Service and other regional interests in insisting that this relationship immediately receive the highest priority in the region's research efforts.

### **Council**

1. Promptly fund an independent, third-party scientific evaluation of all new and existing information and analysis on river velocity and survival of juvenile spring, summer and fall chinook and sockeye salmon. The contractor(s) for these evaluations should be independent of institutional constraints and biases,

and not representative of regional federal agencies, fisheries agencies, tribes or utilities. The results of this review and evaluation shall be submitted to the Council by June 15, 1993.

2. By August 1993, based on the independent, third-party, scientific evaluation, initiate an amendment process, to be concluded by October 1993, if possible, to adopt program amendments stating the Council's position on the relationship between flow, velocity, travel time and survival of juvenile spring, summer and fall chinook, sockeye salmon and steelhead.

#### **Bonneville**

3. As soon as possible, fund additional, independent, third-party scientific evaluations to determine the relationship of flow and water velocity to the travel time and survival of juvenile spring, summer and fall chinook and sockeye salmon. The contractor(s) or university-based research team for these evaluations should be independent of institutional constraints and biases, and not be representatives of regional federal agencies, fishery agencies, tribes or utilities. Bonneville's Scientific Review Group, or an independent procurement process, should assist in developing the technical aspects of the request for proposals and help review, rate and select the independent contractor(s).
4. The independent contractor(s) should report their research design, efforts and results to date to the Council by July 15, 1993, and quarterly thereafter.
5. Continue to fund, on an expedited basis, ongoing evaluations in this research area of emphasis.

#### **Fishery Managers**

6. Make available from hatcheries or other appropriate sources the required numbers of juvenile salmon necessary to conduct the flow, travel time and survival studies called for in Section 3.6F3-3.6F5, above.

### **PIT Tags<sup>3</sup>**

#### **Bonneville**

7. Fund on an expedited basis application of PIT tags, installation of detectors, and other salmon marking techniques for evaluations.
8. Fund the installation of juvenile salmon PIT tag detection facilities at Little Goose, Lower Monumental, John Day, McNary and Bonneville dams, to facilitate assessments of naturally producing stocks and improve the quality of monitoring the effects of juvenile and adult fish passage. Installation should be in coordination with the Corps of Engineers and the fishery managers.

## **Gas Supersaturation**

#### **Bonneville**

9. Fund a study of gas supersaturation and its effects on salmon and steelhead passing through dam turbines, collection and bypass systems, spillways, adult ladders and other means, particularly in connection with possible reservoir drawdowns.

## **Smolt Monitoring**

#### **Fish Passage Center, Council and Other Parties**

10. Continue existing monitoring efforts on flows, fish passage, water conditions, smolt condition, etc.

## **Resident Fish and Wildlife**

#### **Idaho, Montana, Oregon and Washington, in Coordination with Appropriate Indian Tribes**

11. By February 28, 1993, review, compile and submit to the Council all existing information on the impacts of salmon and steelhead flow operations on resident fish or wildlife. In addition, identify specific research, monitoring and evaluation activities needed to determine the potential impacts of salmon and steelhead flow operations on resident fish and wildlife, particularly native species, in and around Hungry Horse, Libby, Grand Coulee, Brownlee and Dworshak reservoirs. Use this information to develop analytical methods or biological rule curves for reservoir operations, similar to those being developed by the Montana Department of Fish, Wildlife and Parks for Hungry Horse and Libby reservoirs. Include an evaluation of impacts on recreation and the recreational industry.

#### **Bonneville**

12. Fund research, monitoring and evaluation activities needed to determine the potential impacts of salmon and steelhead flow operations on resident fish and wildlife, particularly native species, in and around Hungry Horse, Libby, Grand Coulee, Brownlee, Dworshak and other reservoirs.

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3. PIT tags are used for identifying individual salmon for monitoring and research purposes. This miniaturized tag consists of an integrated microchip that is programmed to include specific fish information. The tag is inserted into the body cavity of the fish and decoded at selected monitoring sites.

## 3.7 SCREENS

When the first hydroelectric dams were constructed in the mainstem of the Columbia River, many people believed that providing adequate upstream passage over the dams for adult salmon returning to spawn was sufficient to sustain salmon and steelhead runs. Since that time, research has shown that juvenile salmon and steelhead heading downstream also suffer a significant mortality rate as they encounter the dams.

Pressure changes within each turbine are the primary cause of juvenile salmon deaths. The impact of the moving turbine blades and the shearing action of water in the turbine can also cause injuries or death. In addition, juvenile salmon and steelhead may be stunned after passing through the turbines, thus increasing their vulnerability to predators, especially squawfish, which are abundant at the base of each dam. The Council recognizes the need to address all phases of mainstem salmon survival, including installation of juvenile fish screening and bypass systems.

In this section, the Council establishes performance standards and sets schedules for the installation of new or improved screens and bypass systems at Snake and Columbia river federal dams. Additionally, the Council calls for monitoring and evaluation of existing screens and new screen designs to improve their effectiveness and ensure the availability of functional screens for anticipated changes in flow/velocity regimes.

### 3.7A Performance Standards

#### Corps of Engineers

1. Install and provide operational fish passage screens and bypass systems at all unscreened federal mainstem dams according to the following schedule:
  - a. *Lower Monumental*. Provide operational screening and bypass systems by March 1992.

- b. *Ice Harbor*. Provide an interim screening and sluiceway bypass operation by March 1993. Provide a completed and operational screening and low-velocity flume bypass system by March 1996.
  - c. *The Dalles*. Provide operational screening and bypass system by March 1998.
2. Ensure a 98-percent or greater salmon survival rate in all bypass and collection facilities from the deflector screens to the end of the bypass system outfall. Where possible, increase survival of smolts in the area below the bypass release points by removing fish predators, protecting migrants from predation by birds, providing alternative release sites or modifying bypass operations.

#### Corps of Engineers and Mid-Columbia Public Utility Districts

3. Achieve fish passage efficiencies of at least 70 percent and 50 percent for spring and summer migrants, respectively, at all mainstem Columbia and Snake river projects that have juvenile fish bypass facilities installed.

### 3.7B Measures

#### Corps of Engineers

1. Complete evaluation, design and prototype testing of extended-length fish screens and, if effective, install them according to the schedule in Table 1. In view of slippage in past schedules, maintain this schedule unless it is wholly impracticable because of Congressional funding limitations or instructions, physical infeasibility, or because the Council determines installation should not occur.
2. During design and preparation for installation of fish passage facilities, evaluate and report to the Council concerning modifications that may be needed to accommodate alternative flow and velocity measures outlined in Section 3.5.

Table 1  
Extended-Length Fish Screen Projects Schedule

Project	Completion Date
McNary	March 1995
Lower Granite	March 1996
Little Goose	March 1996
John Day	March 1998
The Dalles	March 1998

3. Install fish guidance improvements, including lowered submersible traveling fish screens, streamlined trashracks and turbine intake extensions at Bonneville Dam Second Powerhouse by March 1993.
4. Expedite evaluation of fish passage efficiency at Bonneville Dam First Powerhouse and report to the Council modifications that may be needed to meet the standards in Section 3.7A, above. Expedite rehabilitation of old generating units.
5. Install state-of-the-art juvenile fish size separator and flume at Lower Granite Dam to improve the existing fish collection and bypass system. Complete installation by March 1996.

#### **Corps of Engineers, Bonneville and Other Parties**

6. Continue to implement fully the 1989 Fish Spill Memorandum of Agreement.

#### **Corps of Engineers and Other Parties**

7. Explore promising new approaches to fish bypass technologies, including the use of sound to guide fish. Should results of this research indicate high efficiencies at costs lower than screen modifications, and no persuasive biological or other considerations that would preclude use of a new technique, bring a proposal to the Council for incorporating it into bypass strategies.

#### **Douglas County Public Utility District**

8. Subject to Federal Energy Regulatory Commission approval, ensure that the installed juvenile fish bypass system tailored to the unique features of Wells Dam continues to operate effectively and in accordance with the terms and conditions of the 1990 Wells Settlement Agreement.

#### **Chelan County Public Utility District**

9. Subject to Federal Energy Regulatory Commission approval:
  - a. Complete testing and evaluation of a prototype juvenile fish screening and bypass system at Rocky Reach Dam and report the results of such tests and evaluation to the Council by August 31, 1993. The evaluation should compare the effectiveness of the prototype screening and bypass system with the best available bypass system. If the tested system is not effective, the Chelan County Public Utility District should evaluate, design and install an alternative collection and bypass system at Rocky Reach Dam similar to the surface water downstream passage sluiceways at The Dalles and Ice Harbor dams.

- b. Complete installation at Rock Island Dam of a juvenile fish screening and bypass system, as set forth in the Rock Island Settlement Agreement.
- c. Subject to Federal Energy Regulatory Commission approval, develop plans for spills at Rocky Reach and Rock Island projects by March 1 of each year, as set forth in the stipulated agreement for Rocky Reach Dam and the 1986 Settlement Agreement for Rock Island Dam.

#### **Grant County Public Utility District**

10. Subject to Federal Energy Regulatory Commission approval:
  - a. Complete testing and evaluation of prototype juvenile fish screening and bypass systems at Wanapum and Priest Rapids dams and report the results of such tests and evaluation to the Council and the Federal Energy Regulatory Commission.
  - b. Complete installation at Wanapum Dam of a fully operational juvenile fish screening and bypass system by March 1, 1998, or inform the Council of the reasons why this date cannot be met.
  - c. Complete installation of a fully operational juvenile fish screening and bypass system at Priest Rapids Dam by March 1, 1997, or inform the Council of the reasons why this date cannot be met.
  - d. Subject to Federal Energy Regulatory Commission approval, provide an increased level of spill at both Wanapum and Priest Rapids dams to improve fish survival for 80-percent of both the spring and summer salmon migrations, while avoiding dissolved gas supersaturation problems. The Mid-Columbia Coordinating Committee will have the responsibility to govern the timing and distribution of spill. Implement such a plan for spill each year at Wanapum and Priest Rapids dams until juvenile fish screening and bypass systems are installed and operational at each project.

#### **Mid-Columbia Public Utility Districts**

11. Subject to Federal Energy Regulatory Commission approval, coordinate and consult with the fish and wildlife agencies and tribes through the three coordinating committees (Wells, Rock Island and mid-Columbia) in the design of prototype bypass system studies, as well as research, evaluation and all other activities required in this section to achieve the most effective permanent solutions to juvenile fish passage problems in the mid-Columbia. By March 20 of each year, develop and submit to the Federal Energy Regulatory Commission, members of the coordinating committees and the Council an annual fish passage and project operational and maintenance plan.

The annual fish passage plan for the mid-Columbia public utility district projects should be coordinated with the various annual implementation plans developed under the auspices of the Fish Operations Executive Committee. At the request of the tribes, fish and wildlife agencies or public utility districts, the Fish Operations Executive Committee and/or the Council will help resolve any disputes related to achieving the objectives of this plan.

#### **Eugene Water and Electric Board**

12. Subject to Federal Energy Regulatory Commission approval, make improvements to the existing juvenile fish screen cleaning and bypass facilities at the Leaburg Canal Hydroelectric Project by December 31, 1992, and ensure that the fish bypass and screen cleaning systems continue to operate effectively. Ensure that the juvenile fish passage efficiency of the Leaburg screen and bypass system is not reduced when the Eugene Water and Electric Board's proposal to raise the elevation of Leaburg Lake is implemented. Assume full responsibility for annual operation and maintenance of these facilities.
13. Subject to Federal Energy Regulatory Commission approval, design and construct a permanent screening and bypass system for juvenile migrants at the Walterville Canal Hydroelectric Project. The juvenile fish bypass facilities should be completed and operational no later than November 11, 1995. Assume full responsibility for annual operation and maintenance of these facilities. If the Walterville relicense application is delayed, take prompt action to complete the screening and bypass facilities on schedule by either preparing and filing a fish passage facility plan with the Federal Energy Regulatory Commission under Article 34 of the existing license or amending the existing license. In the event the Regulatory Commission's approval is earlier than anticipated in the Eugene Water and Electric Board's proposed schedule, make a good faith effort to accelerate completion of the Walterville juvenile fish bypass facilities.

### **3.8 PREDATION**

Hydropower development in the Columbia Basin resulted in an environment that favors salmon predators. Conditions beneficial to predatory fish include increased predator spawning habitat, slightly warmer water temperatures, and the introduction of millions of hatchery fish that are diseased and ill-suited to escape predation. Other factors that improve predator success include concentrations of smolts at hydropower facilities, and the incapacitation of smolts passing through generator turbines. These modifications also have increased predation by birds.

In this section, the Council calls for measures to reduce predation, including a squawfish management program that employs targeted fisheries or other measures to achieve the removal of about 20 percent of the squawfish population, with the expectation that this will lower reservoir salmon mortality by 25 percent. A comprehensive monitoring and evaluation program will evaluate the effectiveness of predator control efforts. These efforts will then be modified if necessary.

#### **3.8A Performance Standard**

##### **Bonneville, Corps of Engineers and Mid-Columbia Public Utility Districts**

1. Reduce squawfish population by about 20 percent, with the expectation that this will lower salmon mortality in reservoirs by 25 percent, in the Snake and Columbia rivers.

#### **3.8B Measures**

##### **Bonneville and Other Parties**

1. Implement, monitor and evaluate long-term effectiveness of an expanded squawfish demonstration project. Evaluation should quantify changes in predator populations and in the overall rate of predation. Provide an annual report to the Council on the effectiveness of this program beginning October 1992.

##### **Corps of Engineers, Bonneville and Federal Energy Regulatory Commission**

2. Evaluate and expeditiously implement measures to reduce smolt mortality due to fish and avian predation at bypass system release sites. These measures should include, but not be limited to, modifications to existing bypass system outfall structures, modification of project or bypass system operations, or other measures intended to disperse juvenile fish releases below dams.

##### **National Marine Fisheries Service**

3. Continue to evaluate the extent of interactions between marine mammal and salmon populations.

##### **Mid-Columbia Public Utility Districts**

4. Subject to Federal Energy Regulatory Commission approval, develop a coordinated study plan with the fishery managers to evaluate the extent of predation on juvenile salmon migrating through the five mid-Columbia River reservoirs. By October 1993, all five reservoirs should be indexed for predator populations. The public utility districts should prepare a comprehensive report on the extent of predation and predator indexing in the five mid-Columbia River



reservoirs by January 1994. The three mid-Columbia coordinating committees should consult with the Council to determine the need for predator control programs. If the mid-Columbia coordinating committees and the Council jointly determine that predator control programs are warranted, then the public utility districts will implement, monitor and evaluate measures to alleviate juvenile salmonid predation in the appropriate reaches of the five mid-Columbia reservoirs beginning in June 1994.

### 3.9 TRANSPORTATION

In coordination with the region's fish and wildlife agencies and Indian tribes, the Corps of Engineers operates a large-scale program to collect and transport juvenile salmon and steelhead. This program has been an integral part of the region's fish passage enhancement measures since 1981.

The Council recognizes that despite considerable research and evaluation on the benefits of transportation, much disagreement remains. Nonetheless, in the near term, especially in low water conditions, transportation is one of the few tools the region has to improve salmon survival. In the longer term, depending on results of continuing evaluation, transportation may be useful in the mix of techniques the region will employ to decrease salmon mortality associated with their migration through the reservoirs. Transportation is unlikely to be a panacea, and improvements over the present system are undoubtedly possible. Moreover, investment in such improvements and continuing evaluation are relatively inexpensive, so regardless of the final decision on transportation's long-term role, the region will not regret the effort and expenditure.

Accordingly, the Council calls on the Corps, in collaboration with the tribes, state fishery managers and the National Marine Fisheries Service, to aggressively evaluate and implement these potential transportation program improvements, using the services of outside contractors and other available parties, as needed, to accelerate implementation of these measures.

The Council believes that the fishery managers, through the Fish Transport Oversight Team, are best able to decide when and where to employ smolt transportation. At the same time, it is apparent that additional information is needed regarding when and how transportation benefits fish survival. In addition, several innovative ideas for alternative transportation collection systems, techniques and management have been suggested during the amendment process. These should be investigated. The region would benefit from a regular infusion of creative ideas for the improvement of transportation management and operations from a broad spectrum of interests. The Council encourages other parties to come forward with creative ideas for transporta-

tion, and calls on the transportation operators to take these ideas into full account.

#### Fishery Managers

1. Conduct smolt transportation under conditions where the available scientific evidence indicates that the survival from smolt to adult return to the spawning ground will be greater with transportation than without transportation. Continue smolt transportation as a key element of juvenile passage survival until a more cost-effective and biologically sound strategy is found.
2. In consultation with other experts, prepare guidelines for present and future management of the smolt transportation program according to Section 3.9.1, including scientific justification for when and where transportation should be conducted. Present the guidelines to the Council by March 1, 1993.
3. Participate in the evaluation of smolt transportation and provide test fish during all flow years from hatcheries or other appropriate sources. If a suitable source of test fish is not found or if fish cannot be provided for other reasons, report immediately to the Council and suggest alternative evaluations.

#### Fishery Managers and Corps of Engineers

4. The Fish Transportation Oversight Team should include representatives from the region's fishery agencies, tribes and the Corps. Through the Fish Transportation Oversight Team, prepare annual transport guidelines reflecting Sections 3.9.1 and 3.9.2, plus an annual report of transportation improvements and evaluations reflecting Sections 3.9.5, 3.9.8 and 3.9.9. Submit annual transport guidelines and an annual report to the Fish Operations Executive Committee and the Council by March 15 of each year.

To the extent possible, when planning implementation of river operations and other program measures, do so in a manner that accommodates the Fish Transportation Oversight Team's planned transportation program for that year.

5. Subject to Fish Transportation Oversight Team finding that risks to smolts are within acceptable levels, evaluate the effectiveness of transportation to increase juvenile survival to adult spawning stage in all water conditions, a variety of alternative fish passage conditions and collection points. The Corps should take the lead in coordinating this evaluation. The evaluation should focus on spring, summer and fall chinook, especially in the Snake River. To the extent possible, include evaluation of the benefits and opportunities of transportation for sockeye salmon as well. Incorporate and coordinate this research with the Fish Passage Development and Evaluation Program whenever possible. The Corps should re-

port to the Council on the outline of a transport evaluation program by January 30, 1993.

6. Continue to collect information on the biological effects of smolt transportation for use in comparative evaluations of alternative mainstem survival strategies.

#### **Corps of Engineers**

7. Conduct and fund smolt transportation activities at those times and locations specified in the guidelines prepared by the Fish Transportation Oversight Team developed in Section 3.9.4.
8. In cooperation with the fishery managers, as a high priority, evaluate techniques for improving transportation for fall chinook, especially in the Snake River. Report to the Council by January 30, 1993, and annually thereafter, on options available, needed facility modifications and research needs. Include in the evaluation the extended use of barges to transport fall chinook even during times of low fish numbers as an alternative to truck transport. Also, evaluate the use of refrigeration or other sources of cool water, reduced densities, and other stress reduction techniques to improve transport effectiveness, particularly for fall chinook.
9. On an expedited basis, improve salmon transportation by upgrading facilities and improving operations. Improvements should include: reducing smolt holding periods to no more than two days, minimizing fish densities, reducing stress in holding areas through shading or other means, and developing smolt release strategies, including dispersing fish to minimize predation. Immediately evaluate: a) measures to reduce loading densities during peak migration periods; b) varied smolt transit times; c) the feasibility of constructing and operating acclimation facilities below Bonneville Dam; and d) alternative release sites further downriver. Report to the Council by the end of 1993 on the status of these improvements and evaluations, and on the feasibility of increasing transport benefits.
10. Expedite funding for a preliminary evaluation of: a) the feasibility of constructing and operating alternative fish bypass and collection facilities at the upstream end of Lower Granite Reservoir and nearby tributaries for downstream migrating salmon and steelhead; b) the feasibility of constructing an alternative stream channel or pipeline structure adjacent to or in the river to transport smolts to below Bonneville Dam; and c) the feasibility and benefits of net pens to increase survival of transported fish in reducing mortality associated with bypass outfall areas. The evaluation will include preliminary engineering, as well as economic and biological parameters. Report results of all evaluations by December 31, 1992.

#### **Bonneville**

11. Continue to conduct research on the survival of hatchery, wild and naturally spawning chinook salmon from headwater production areas and sites to mainstem transport sites to determine the extent of mortality prior to transportation. Determine the cause (i.e., water quantity, water quality, food supply, disease, smolt quality, predation, etc.) of any high mortality rates prior to transport.

#### **Fishery Managers, Federal River Operators and Other Parties**

12. Evaluate means by which safe and timely migration of salmon through the reservoirs can be improved for inriver migration, collection and transportation. Report to the Council by March 15, 1993, and annually thereafter.