U.S. DEPARTMENT OF ENERGY

Bonneville Power Administration

Final Environmental Impact Statement
1992 Columbia River Salmon Flow Measures Options Analysis

AGENCY: Bonneville Power Administration (BPA), DOE.

ACTION: Record of Decision (ROD) on the Final Environmental Impact Statement (EIS) 1992 Columbia River Salmon Flow Measures Options Analysis (1992 Flow Options EIS).

SUMMARY: BPA has decided to implement a proposed action in 1992 as part of an ongoing effort to improve the survival of anadromous fish stocks, especially weak stocks, including the Pacific salmon that National Marine Fisheries Service (NMFS) has listed as endangered or threatened (Snake River sockeye salmon and spring/summer and fall chinook salmon). BPA will store up to 3.0 Million Acre Feet (MAF) of water, above the existing Water Budget of 3.45 MAF, in Grand Coulee and Arrow reservoirs to augment flows in the lower Columbia River during May and June 1992. In addition, BPA will acquire, if necessary, the power lost through this action and the actions to be taken by the U.S. Army Corps of Engineers (Corps) and the Bureau of Reclamation (BR) in 1992 at Snake River system projects and at John Day project to benefit salmon. BPA also will implement those actions in 1992 that the NMFS recommended BPA, BR, and the Corps take to improve survival of Snake River sockeye, spring/summer chinook, and fall chinook salmon.

The proposed action, including actions aimed at improving survival of salmon and steelhead, e.g., improved bypass facilities, improved transportation, expanded predator control, increased law enforcement,

water diversion screening, spill, and a captive rearing program for Snake River sockeye salmon, is aimed at improving survival of salmon and steelhead in the Columbia River Basin. Some of the actions also evaluate or test ways to improve survival of listed salmon stocks. After consideration of the best available scientific evidence, BPA concludes that the proposed action is not likely to jeopardize the continued existence of Snake River sockeye or chinook salmon. The proposed action is also the environmentally preferred alternative. This ROD is based on the results of evaluations addressed in the draft and final 1992 Flow Options EIS, public meetings held after the issuance of the draft and final EIS, consideration of all public and regulatory agency comments received on the draft and final EIS, BPA's Biological Assessment and Supplement to the Biological Assessment, and consultation with NMFS and the U.S. Fish and Wildlife Service (FWS) as required by the Endangered Species Act (ESA) of 1973, as amended.

The 1992 Flow Options EIS was a cooperative effort of BPA, BR, and the Corps. The Corps was the lead agency. The 1992 Flow Options EIS has been adopted by the U.S. Department of Energy (DOE) (Memorandum dated February 10, 1992, from Paul L. Ziemer to Randy W. Hardy) as the National Environmental Policy Act (NEPA) of 1969 compliance document addressing storage and power acquisition actions that BPA will implement in 1992. The 1992 Flow Options EIS addressed the effects of implementing a No-Action Alternative and three action alternatives (each containing a number of different options) to improve in-river migration conditions (flows and temperature) for juvenile and adult salmon in the lower Snake and lower Columbia Rivers in 1992.

The scope of the 1992 Flow Options EIS was limited to flow improvement

measures that could be implemented in 1992. Measures requiring major structural modifications at existing projects were not evaluated because they could not be completed in time to benefit salmon passing through the system in 1992.

In accordance with this decision, the 1992 plan of reservoir regulation and project operations is summarized as follows:

I. Corps Actions

Operate the four lower Snake River projects near minimum operating pool (MOP) from April 1 to July 31, 1992;

Operate John Day project near elevation 262.5 feet from May 1 to August 31, 1992, unless higher pool levels are required to avoid impacts to irrigation intake facilities on the reservoir;

Augment lower Snake River flows with release of 900 Thousand Acre Feet (KAF) or more from Dworshak reservoir between April 15 and June 15, 1992. This water is in addition to any minimum flow release at Dworshak. In addition, 200 KAF will be released from Dworshak in September 1992 to assist migration of adult salmon;

Conduct field studies of a drawdown of Lower Granite and Little Goose pools to elevations below MOP in March 1992, and of the effects of real time water shaping between April 15 and August 30; and

Operate the lower Snake and Columbia River projects as described in the annual Fish Passage Plan and the Project Improvements for the ESA.

II. BPA Actions

Augment lower Columbia River flows at The Dalles for the months of May and June with Water Budget releases and releases from Arrow and

Grand Coulee reservoirs of up to 3.0 MAF, as determined by the April 1 final volume-of-runoff forecast;

Request, and the Corps will implement, continued spill in 1992 at Lower Monumental and Ice Harbor beyond that described in the Fish Spill Memorandum of Agreement (MOA). These spills will be continued in the spring during fish guidance testing. The summer spills, to assist adult migration, will be based on the assumption that the 1992 migration will be similar to that observed in 1991. At John Day, The Dalles, and Bonneville Dams, spill will continue as specified in the MOA and in the Corps' Fish Passage Plan.

BPA will purchase power or forego nonfirm sales, on an as needed basis, to replace the power lost through water storage, flow augmentation or spill for fish.

III. BPA, BR, and Corps Action

BPA and BR will seek to acquire up to 400 KAF of water from the upper Snake River Basin for release between June 16 and August 30, 1992. The difference between water that is available and the target 400 KAF will be made up by releases from Dworshak. Thus, the contribution to flows from the upper Snake River or Dworshak can vary from 0 to 400 KAF depending on water availability in the upper Snake River Basin.

FOR FURTHER PROJECT INFORMATION CONTACT: John Rowan, Chief, Environmental Compliance Section, PGA, Bonneville Power Administration, P.O. Box 3621, Portland, Oregon 97208; Telephone (503) 230-4238. For copies of the 1992 Flow Options EIS, you may contact BPA's document request line: toll-free 800-622-4520, or BPA's Public Involvement

office in Portland. Telephone numbers, voice/TTY, for BPA's Public Involvement office are: 503-230-3478 in Portland; and toll-free 800-622-4519 nationwide.

For general information on NEPA process contact: Carol M. Borgstrom, Director, Office of NEPA Oversight (EH-25), U.S. Department of Energy, 1000 Independence Avenue, SW., Washington, DC 20585, (202) 586-4600 or (800) 472-2756.

Information may also be obtained from:

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Mr. Terence G. Esvelt, Puget Sound Area Manager, P.O. Box C19030, Suite 400, 201 Queen Anne Avenue North, Seattle, Washington 98109-1030, 206-553-4130.

Mr. Thomas V. Wagenhoffer, Snake River Area Manager, 101 ~~West~~ Poplar, Walla Walla, Washington 99362, 509-522-6225.

Ms. Ruth Bennett, Acting Idaho Falls District Manager, 1527 Hollipark Drive, Idaho Falls, Idaho 83401, 208-523-2706.

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SUPPLEMENTARY INFORMATION:

**I. Decision**

BPA has decided to implement a proposed action in 1992 that improves the survival of weak anadromous fish stocks including Snake

River sockeye and chinook salmon. BPA will increase the amount of water stored in Arrow Reservoir in British Columbia, Canada and in Grand Coulee Reservoir, in Washington State, in order to augment flows in the lower Columbia River in May and June 1992 for the benefit of Snake River salmon. The amount of additional water to be stored varies from 0 to 3 MAF as determined by the adjusted April forecast of the January through July runoff. Since this water is in addition to an existing 3.45 MAF of Water Budget, the total amount of water that could be available for flow augmentation for fish in the lower Columbia in May and June of 1992, would be 6.45 MAF.

In addition, BPA has decided to continue the Spill Agreement for Lower Monumental, Ice Harbor, John Day, The Dalles, and Bonneville Dams in 1992, and work with BR to attempt to acquire up to 400 KAF of water from the upper Snake River Basin to augment flows between June 16 and August 30, 1992. BPA will also support the actions being taken by BR and the Corps to benefit fish in the lower Snake and lower Columbia Rivers in 1992.

Finally, BPA has decided to acquire an equivalent amount of power in 1992 from alternative sources to replace, on an as needed basis, that which would have been generated if the additional water to be stored in Arrow, Grand Coulee, and Dworshak had been available for optimal power production. BPA has also decided to acquire an equivalent amount of power in 1992 to replace, on an as needed basis, the power lost due to drawdown of John Day Reservoir and the lower Snake River projects, and spill at Lower Monumental and Ice Harbor.

Nothing in this decision forecloses modifications of the manner in which water is managed should the region experience emergency

conditions or if changed conditions warrant an operational modification. Nothing in this decision prescribes the manner in which non-Federal projects in the United States are to be operated. To the extent practicable, this decision only affects the operation of Arrow, Grand Coulee, and Dworshak storage reservoirs and the eight Federal run-of-river dams and reservoirs downstream of Lewiston, Idaho. Any water acquired from projects in the upper Snake River Basin will be acquired on a willing seller willing buyer basis and its management determined by specific agreement.

## II. Background

The Shoshone-Bannock Indian Tribes of Idaho petitioned NMFS on April 2, 1990, to list the Snake River sockeye salmon as an endangered species under the ESA. A group of conservation organizations filed separate petitions on June 7, 1990, to list the Snake River spring, summer, and fall chinook salmon and lower Columbia coho salmon as threatened under the ESA. In response, Senator Mark Hatfield of Oregon convened a regional assembly of organizations and interests concerned with the plight of the Snake-Columbia River salmon. These interests included public agencies responsible for water management, power production and marketing, and fisheries management; representatives of affected states, and potentially affected economic interests and members of the public concerned with conservation of Pacific Northwest salmon. This assembly known as the "Salmon Summit" held its first formal meeting on June 30, 1990. The mission of the Salmon Summit was to produce a salmon management plan in response to petitions to list the five salmon stocks under ESA. This plan was to

include actions related to salmon harvest, production, habitat, and water management.

Although the Salmon Summit reached no consensus on a long-term plan of action, it did agree on an action plan for 1991 that could be implemented under existing authorities. That plan called for increasing the Water Budget for 1991, drawing down certain reservoirs in the lower Snake River and lower Columbia River, and extending the time the Corps operates its program to transport juvenile salmon downstream by barge and truck. In addition, the Salmon Summit requested the Corps "undertake the process necessary to design a study for Snake River reservoir drawdown during operational year 1992 that would improve the passage of migrants (juveniles) without impeding the upstream migration (adults)." Subsequent agency discussions expanded the original request to include all practical water management measures to improve salmon passage.

NMFS proposed on April 5, 1991, that the Snake River sockeye salmon be listed as an endangered species under ESA. NMFS announced on June 7, 1991, the proposed listing of Snake River spring/summer and fall chinook as threatened species (56 FR 29542; 56 FR 29547).—NMFS declared on November 20, 1991, the Snake River sockeye salmon endangered, effective December 20, 1991 (56 FR 58619). On April 22, 1992, NMFS decided to list Snake River spring/summer chinook and fall chinook salmon as threatened species (57 FR 14653).

The listings create additional responsibilities for all persons whose actions affect these fish. Federal agencies must avoid jeopardy to and support recovery of these species. To enable recovery, NMFS is developing a recovery plan. All persons must also avoid unlawful

takings of these fish. A "taking" includes actions that harass or harm the fish.

Snake River sockeye and chinook salmon are born in fresh water, migrate as smolts down the Snake and Columbia rivers to the Pacific Ocean, and later return to their places of birth to spawn. During this life-cycle, these fish encounter a multiplicity of harmful conditions resulting from human activity.

Improvement of these conditions requires a comprehensive solution addressing all stages of the species' life-cycles. An effective approach toward avoiding jeopardy and achieving recovery cannot concentrate upon only one cause or one stage.

Actions that can be changed to improve conditions for fish include those in the following list.

A. **Hydroelectric Dams.** Forty-eight--including 29 Federal--multipurpose dams were built in the Columbia River Basin beginning in 1912. The multipurpose dams were built to control floods, hold irrigation water, allow navigation and recreation, and produce power.

Some of these dams blocked habitat for the currently listed fish. Idaho Power Company's Hells Canyon Dam blocked chinook salmon historic spawning grounds in the Snake River and its tributaries further upstream. In addition, the Corps Dworshak Dam blocked chinook habitat on the Clearwater River. Before its removal, Sunbeam Dam blocked access by sockeye salmon to Redfish Lake in Idaho.

Dams inhibit juvenile and adult anadromous fish migration. Snake River sockeye and chinook must traverse eight Federal dams as they migrate to the ocean and return to their spawning grounds. In the Snake River, juvenile fish will first pass Lower Granite, and then

Little Goose, Lower Monumental, and Ice Harbor dams, after which they enter the Columbia River. In the Columbia River, these juveniles will first pass McNary, and then pass John Day, the Dalles, and Bonneville Dams.

Changes in reservoir operations and structural modification of the dams can improve survival of anadromous fish. However, an effective solution requires more than improvements at dams. A report in the March-April 1991 edition of the American Fisheries Society Journal states that 214 stocks of salmon are in trouble. More than half of these fish live in areas without dams: coastal streams, the Puget Sound, or the lower Columbia River. Only 76 of the salmon stocks identified by the report have to migrate past Federal hydroelectric dams on the Columbia River.

In addition, NMFS and Idaho Department of Fish and Game studies show that 40 to 60 percent of Snake River salmon die before they reach the first dam on the Snake River: Lower Granite. In addition, many smolts die after they have passed Bonneville Dam. These facts indicate that many juveniles die due to causes other than the hydroelectric system: predators, poor water quality, and poor health. Some of the fish transported and released below Bonneville Dam die from unknown causes.

To the extent that additional water is sought for fish, it is also significant to note that the two large storage dams in the Snake River Basin--the Corps' Dworshak Dam and Idaho Power Company's Brownlee Dam--control only 3 million acre-feet of Snake River average annual flow of 35 million acre-feet. In contrast, 16 million acre-feet, or 46 percent of the Snake River's average annual flow, is

diverted for irrigation. Of this, 6 million acre feet, or 17 percent of the Snake River's average annual flow, is consumed, and 10 million acre-feet returns to the river at a later time.

**B. Land Use.** Cattle grazing, real estate developments, logging, farming, road building, and other land uses have destroyed some salmon habitat. A recent U.S. Forest Service study shows that such practices removed 50 to 75 percent of the pool habitat in the Columbia River Basin. Pools are vital to the survival of both adult and young salmon.

**C. Pollution.** Effluents from cities and industries, along with silt and chemicals from farms, have impaired the quality of the salmon's water.

**D. Irrigation.** Of the average 35 million acre-feet that flows down the Snake River each year, 16 million acre-feet are diverted for irrigation. Only 10 million acre-feet returns to the river. Six million acre-feet are consumed. In addition, diversion dams, dead-end irrigation canals, low flows and high temperatures have blocked salmon from parts of some rivers such as Idaho's Lemhi River. In addition, unscreened irrigation diversions are a source of juvenile anadromous fish mortality.

**E. Mining.** In 1910, miners in Idaho built Sunbeam Dam on the Salmon River. The dam blocked sockeye runs. Mining dams, silt, and chemicals leaching from mines have blocked or polluted streams.

**F. Hatcheries.** In 1991, the Columbia Basin's 51 hatcheries produced an estimated 83 million young salmon. Many biologists worry that the large number of hatchery fish take food and living space away from wild fish. They are also concerned that hatchery fish interbreed

with wild fish, thereby diluting the wild fish's genetic characteristics, and spread disease.

**G. Harvest.** Hatcheries produce 80 percent of the Columbia Basin's annual run of 2.5 million adult salmon. Because harvest levels have been based upon the overall numbers of fish, instead of wild fish, harvest levels have been higher than they should be if wild salmon are to be protected. For example, more than 90,000 sockeye entered the Columbia River's mouth each year between 1980 and 1990. But the Snake River's part of the run was only approximately 73 fish per year. Some estimates show that as much as 41 percent of the sockeye and 74 percent of the fall chinook have been harvested in recent years. Ocean fishing also consumes a great number of salmon. Some estimates show that about 75 percent of all fish harvested are caught offshore.

BPA has actively worked with regional interests to achieve a comprehensive, biologically based, and coordinated approach toward improving troubled fish runs. For its part, BPA has developed a proposed action for river operations that improves survival of fish during downstream and upstream migration. With respect to the listed species, BPA has engaged in extensive consultation with the NMFS and in extensive analyses of the impacts of the operations of hydroelectric projects upon fish and how hydroelectric operations can avoid jeopardy. This analysis included preparation of a biological assessment and participation as a cooperating agency in preparation of the 1992 Flow Options EIS.

BPA's analysis includes projections over the long term: it assesses whether declining populations of the listed species would

level off and indeed increase if operations of the type proposed for 1992 were continued into the future. The analysis leads BPA to this record of decision that the proposed action is not likely to jeopardize the Snake River sockeye or chinook salmon.

In addition, the BPA, Corps, and BOR have commenced the System Operation Review, an environmental analysis that is evaluating potential major changes in Columbia River system operations. These include development of a multiple-use operating strategy for the river system, and renegotiation and renewal of the Pacific Northwest Coordination Agreement and other agreements related to the Columbia River Treaty between the United States and Canada.

## III. Alternatives Considered

Four alternatives were considered in the 1992 Flow Options EIS as ways in which the downstream movement of juvenile salmon could be improved. The "No-Action" Alternative assumed the normal operation of the dams, reservoirs, and fish programs in the Columbia River Basin typical of the years 1985 through 1990.

A number of fish research and management actions are a part of the No-Action Alternative. The Juvenile Fish Transportation ~~P~~rogram would continue as the primary method of moving juvenile salmonids downstream during April through mid-September on the lower Columbia River. Mainstem reservoirs would continue to be operated within normal ranges. Migration of juvenile salmon in the mainstem Columbia would be enhanced by releases of up to 3.45 MAF of water in May and June from Grand Coulee reservoir for the benefit of fish (Water Budget). Flow in the lower Snake River during April, May, and June

would be augmented by releases from Dworshak and Brownlee (Idaho Power Co.). Water would be spilled at lower Snake and lower Columbia River projects in spring and summer to enhance movement of juveniles over dams instead of through turbines. Juvenile and adult fish passage facilities at all eight run-of-river Federal projects would continue to operate. Monitoring of juvenile and adult migration at Federal projects would continue.

A second alternative method of increasing water velocity, hence, potentially improving the movement of juvenile salmon, was to lower the elevations of the mainstem reservoirs. This action would reduce the cross-sectional area of the reservoir, thereby increasing the velocity of a given amount of water. Five different drawdown options were considered in the 1992 Flow Options EIS for lower Snake and lower Columbia River projects. The drawdown options considered for the lower Snake River projects were: draft all four projects to minimum operating pool (MOP); draft all four projects to near spillway crest; draft Lower Granite to 710 feet elevation and the remaining three projects to MOP. Only two drawdown options were considered for the lower Columbia River project. These were drawing all four lower Columbia River projects down to MOP and drawing McNary and John Day down to 337 and 262.5 feet, respectively, and The Dalles and Bonneville to MOP.

A third alternative for increasing velocity was to augment the amount of water flowing through the system. Flow augmentation would increase water velocity and presumably stimulate more rapid downstream migration. Eleven different flow augmentation options were considered for the Snake River and two different options were considered for the

Columbia River. The options for the Snake River projects ranged from a discharge of 600 KAF from Dworshak to unlimited discharge from Dworshak and Brownlee reservoirs.

The two flow augmentation options considered for the Columbia River were similar. They differed in the manner in which water was to be stored and the manner in which water was to be released. These options were defined as the Target 200 option and the Northwest Power Planning Council's Plan. Both options called for the storage of additional water (up to 3 MAF) in Arrow and Grand Coulee Reservoirs for release in May and June. This water is in addition to the existing Water Budget of 3.45 MAF. Target 200 established a target flow. The Council's plan did not. However, the flows under both of these options would, on the average, provide flow at The Dalles during May and June that would vary from about 170 to 270 kcfs. Since the two options would have similar environmental effects, on average, they were treated in the 1992 Flow Options EIS as one option.

The fourth alternative (includes proposed action) considered various combinations of drawdown and flow augmentation. Three different combinations were evaluated. All included Target 200 flow augmentation of the lower Columbia River. The flow augmentation from Dworshak ranged from 600 to 900 KAF. Most included drawdown of the lower Snake River and lower Columbia River projects to near MOP.

The proposed action is the environmentally preferred alternative. It will result in improved conditions for salmon in the Snake and Columbia Rivers. This alternative represents actions whose environmental, social, and economic impacts have been found acceptable by local, State, regional and Tribal governments. It is not likely to

jeopardize the continued existence of Snake River sockeye, spring/summer chinook, or fall chinook salmon in 1992.

## IV. Decision Factors

The decision to implement the proposed action (including the purchase of power from alternative sources that would be associated with the storage of additional water for flow augmentation, drawdown of run-of-river projects, continued spill at Lower Monumental and Ice Harbor, and the acquisition of additional water from upper Snake River Basin projects), is based on the following factors: legal, environmental, Section 7 consultation with NMFS, analytic, and economic.

### A. Legal Factors

NEPA provides that BPA, prior to deciding to undertake a major Federal action significantly affecting the environment, analyze the potential environmental impacts of the proposed action (43 U.S.C. 4332(a)). BPA participated in the requisite analysis in the 1992 Flow Options EIS. In this ROD, BPA announces its decision after considering associated environmental impacts.

ESA requires that Federal agencies, in consultation with NMFS, and on the basis of the best available scientific evidence, ensure that their actions are not likely to jeopardize endangered or threatened species (16 U.S.C. 1536(a)(2)). Consistent with this provision and with regulations describing the consultation process, BPA prepared a Biological Assessment and engaged in formal consultation with NMFS with regard to Snake River sockeye, spring/summer chinook and fall chinook salmon. See 50 C.F.R. Part 402. After the conclusion of consultation and issuance of a

biological opinion by NMFS, BPA, as an action agency, must then determine whether its actions are likely to jeopardize these species (50 C.F.R. 402.15(a)). BPA describes its determination in this ROD.

**B. Environmental Factors**

The 1992 Flow Options EIS focused on those actions that could be implemented in 1992 to improve the migration of juvenile salmon by increasing water velocity in the lower Snake and lower Columbia Rivers during low flow conditions. The evaluation of the proposed action and alternatives in the 1992 Flow Options EIS is part of an ongoing effort to improve the survival of declining stocks of Pacific salmon originating in the Snake River Basin.

The increases in water particle travel time that are associated with construction and operation of the run-of-river projects of the Columbia River Basin have been a source of concern to fishery managers for years. The delays that are associated with low flow years have been of particular concern. Many believe that some improvement in water velocity during low flow conditions will result in a reduction in the time it takes juvenile salmon to migrate past the eight dams and reservoirs in the lower Snake and lower Columbia rivers and, thereby, reduce the time salmon smolts are exposed to predation and other adverse factors and reduce the opportunity for residualism. However, reductions in particle travel time do not necessarily mean reductions in fish migration time. Factors other than flow levels, such as the level of smoltification and water temperatures, also affect travel time. There is disagreement among experts as to the relationships among increased flows, improved travel time, and improved fish survival for juvenile salmon.

The available data are very limited. Additional survival data is needed for salmon and steelhead. To address this need, extensive efforts will be made to collect data and information that will contribute to a long-term plan for the recovery of threatened and endangered Columbia River Basin salmon.

Most regional scientists agree that the limited survival studies on yearling chinook and steelhead show increased smolt survival with increased flow up to approximately 85 to 100 kcfs in the Snake River and 200 to 220 kcfs in the lower Columbia River. There is disagreement among scientists as to whether existing data supports survival benefits for flows above these levels.

For subyearling chinook migrants, the limited studies have been interpreted by different scientists to show: (1) no effect on travel time; (2) some effects on travel time; and (3) some effect only when smolts reach an active migration size. Based on predation studies, models have been developed that assume both a relationship and no relationship between travel time through reservoirs and predation losses. No conclusive studies exist on the relationship between flow and survival for subyearling chinook salmon.

The potential environmental effects that were evaluated in the 1992 Flow Options EIS were: (1) Flow augmentation effects at storage projects associated with a change in storage and release quantities and schedules; (2) the effects at run-of-river projects that would be associated with increased water velocities, increased spill, and reduced pool elevations (drawdown effects in run-of-river projects); and (3) the combined effects of augmentation and drawdown actions.

Potential environmental effects of flow augmentation options at storage projects were determined not to be significant. This is because, in most instances, the proposed storage and release actions were constrained by the operational limits of the affected projects. For example, the flood control and refill objectives that have been established for these projects were met in most options. Only in those cases in which the operational constraints of the storage projects were ignored (e.g., evaluating the effects of unrestricted release to meet some targeted flow) were significant environmental effects predicted.

The principal effect of flow augmentation options on storage projects was how the schedules for filling and drafting were modified during the months of April through June. The constraints to this change were flood control limitations during April through June and the need for the pools to be at or near summer conservation pool elevation by July 31. Unrestricted releases from storage projects would adversely impact resident fish by exposing spawning areas, flushing nutrients out of the pools and entraining resident fish in the discharge. Since unrestricted releases would empty the storage reservoirs, flood areas downstream, and impact refill, these options were eliminated from consideration early in the study process. Augmentation from non-Federal reservoirs in the Snake River Basin was not considered a viable option in the EIS since contributions from these reservoirs would be dependent on complex negotiations that would not be completed in time for the 1992 migration season.

The most significant potential environmental effects would be those associated with measures taken to increase water velocity and

flow in the lower Snake and lower Columbia Rivers. Flow augmentation had fewer environmental effects than did reservoir drawdown. This is because any augmentation during low runoff years would result in flows that are less than or equal to the flows observed during years of higher runoff. Thus, potential effects of higher flows due to augmentation would not be much different from effects of flows during wetter years. Further, the operational limits of discharge from storage projects limit the maximum amount that river flows can be augmented. For example, the maximum discharge from Dworshak is 25 thousand cubic feet per second (kcfs). Thus, the maximum augmentation that can be expected from Dworshak would be somewhere in the range of 20 kcfs, if it were discharging 5 kcfs under normal operations.

In contrast, the effects of drawing down the elevations of run-of-river reservoirs to increase water velocity (reducing the cross-sectional area of the reservoirs) would be significant and directly related to magnitude of the drawdown. For example, the effects of drawing the projects down to run-of-river spillway crest (a 20 to 30-foot drawdown) would be much greater than drawing the projects down to MOP (a reduction of 3 to 5 feet). This is because increasing velocities by drawdown of the mainstem projects is directly related to changes in pool elevations.

Drawdown would have a number of environmental impacts. Riparian habitat would be lost or impacted by the loss of available water. In turn, wildlife and resident fish would be impacted by the loss of these habitats. Banks and shallow water areas would be exposed and erosion would increase. This in turn would degrade water

quality by increasing turbidity and resuspending pollutants and would degrade air quality by increasing the opportunity for wind blown dust from dried out shallow areas. In addition, exposed banks and shallow areas would expose cultural and historical resources to damage and unauthorized removal. Recreation and aesthetics would be adversely impacted by the loss of surface water and the exposure of large expanses of mud flats.

Potential environmental effects are also related to the magnitude of the drawdown. All of the facilities of existing run-of-river projects are designed to be operated at greatest effectiveness in the narrow range of full pool to MOP. Accordingly, the effectiveness of turbines, navigation facilities, fish bypass systems, adult passage systems, and flip lips decrease as pool levels are reduced. Thus, if run-of-river projects are to be operated at pool elevations below MOP, substantial modifications to mitigate environmental effects would be required.

The combination of flow augmentation and drawdown would increase water velocity in direct proportion to the magnitude of the flow augmentation and drawdown. For example, it would be possible to reduce the time it takes a particle of water to travel from the mouth of the Clearwater to just below Bonneville Dam to less than 15.1 days. This would be done by drawing the lower Snake River projects down to near spillway crest, drawing the lower Columbia River projects down to MOP and augmenting existing Water Budget flows (total of about 4.2 MAF).

Reservoir drawdown entails drawing the lower Snake River projects down to near spillway crest. However, it is associated with

a number of adverse impacts on the species it is proposed to benefit. Drawing down the Snake River projects to near spillway crest would result in high nitrogen supersaturation levels, eliminate the operation of existing juvenile bypass facilities, disrupt or eliminate the operation of existing adult passage facilities, and eliminate the opportunity to transport juveniles by barge. Since it was not possible to redesign and retrofit projects to compensate for these adverse effects in time for the 1992 fish migration season (some redesign and retrofit could require several years to complete), drawdown to near spillway crest was eliminated as an option for 1992.

**C. ESA, Section 7 Consultation**

The actions evaluated in the 1992 Flow Options EIS are designed to improve conditions for fish listed and proposed for listing under ESA. Thus, while the EIS is a relevant tool for evaluating the relative impacts of different alternatives and options, ESA considerations will play a determining role in deciding which actions are to be implemented in 1992. Accordingly, biological assessments were prepared by BPA and the Corps pursuant to Section 7 of ESA.

One assessment, addressing the effects of the alternatives on bald eagles and peregrine falcons was evaluated by the U.S. Fish and Wildlife Service (USFWS). The USFWS reported a finding of no adverse effect on these two species in a letter dated February 10, 1992.

The assessments developed by BPA and the Corps for Snake River sockeye, spring/summer chinook, and fall chinook salmon were evaluated by NMFS. The approach NMFS used to evaluate the

1992 operations is illustrated on pages 15 and 16 (Section IV.A.1.) of the Biological Opinion prepared April 10, 1992.

During consultation, NMFS recommended a number of additional actions. In NMFS' view, these additional actions, when coupled with the actions already in place and changes recommended by the 1992 Flow Options EIS, would avoid jeopardizing the continued existence of Snake River sockeye and chinook salmon in 1992. These changes are:

1. Extend the duration of the 900 KAF Water Budget from Dworshak by 15 days (from April 15 - May 31, 1992 to April 15 to June 15, 1992);

2. Replace the temperature control test with a summer flow augmentation action in which 400 KAF of water would be released from either the upper Snake River projects or from Dworshak, or in some combination, to augment Snake River flows between June 16 and August 30, 1992. Any release from Dworshak would be over and above the minimum discharge of 1.2 KCFS;

3. Monitor and evaluate real time flow and fish migration throughout the 1992 fish passage season;

4. Provide 40 percent of the instantaneous flow at Lower Monumental as spill for 12 hours a day from April 15, 1992, until results from the Fish Guidance Efficiency (FGE) tests are available. The 1992 FGE results will then be used to determine appropriate spill, if any, to achieve 70 percent fish passage efficiency through May 31, 1992. Sixty percent of the instantaneous flow at Ice Harbor from April 15 to May 31, 1992, will be spilled for 12 hours per day; and

5. Provide 43 percent of the instantaneous flow as spill for 12 hours per day from June 1 to August 15, 1992, at Lower Monumental and 30 percent of the instantaneous flow at Ice Harbor as spill for 12 hours per day from June 1 to August 22, 1992. If new information indicates that the 1992 migration is not similar to that observed in 1991 and more spill is needed, then consultation with NMFS will be reinitiated.

BPA believes that, although the modifications are conducive to improvement of the listed species, the actions proposed for 1992, even without these modifications, are not likely to jeopardize Snake River sockeye and chinook salmon. This conclusion results from analyses performed in BPA's Biological Assessment for proposed 1992 river operations, and by additional analyses performed through consultation with NMFS (see supplement to BPA's Biological Assessment, July 1992).

The analysis described in BPA's Biological Assessment shows that improvements in migration survival and the captive rearing program are expected to increase the size and productivity of sockeye salmon populations. With regard to the spring/summer chinook salmon species, the analysis described in the Biological Assessment shows an increasing spawning escapement (i.e., increased adult spawning population) trend for the spring component and a relatively stable trend in spawning escapement for the summer component. A combination of the components shows an increasing spawning escapement trend for spring/summer chinook salmon. With regard to the fall chinook species, the analysis described in the Biological Assessment also shows an increasing spawning escapement trend for fall chinook salmon.

The additional analysis described in the July 1992 supplement to the Biological Assessment used juvenile passage conditions within the Columbia River Salmon Passage Model (CRiSP) recommended by NMFS. The results show improved sockeye and chinook salmon juvenile survival for 1992 conditions. The life-cycle analyses for chinook salmon show increasing escapement trends for Snake River fall chinook and spring/summer chinook salmon. The analysis also shows low probabilities of spawning numbers below 50 adults. The summer component of the spring/summer chinook salmon species unit shows a continuing downward trend in escapement. However, when combined with the much higher numbers of the spring component, which is increasing in population trend, the aggregate spring/summer chinook species unit shows an increasing escapement trend and very low probability of population numbers below 50 adults. By showing increasing juvenile survival and adult population numbers, and a decreasing probability of low adult population numbers, this additional analysis supports our conclusion of no jeopardy for 1992 operations.

With regard to the flow modifications recommended by NMFS, there is a lack of data regarding the responses of salmon to incremental changes in flow or velocity. Consequently, scientists differ with respect to the benefits that these changes in flow or velocity provide. However, provision of these flow modifications is not likely to adversely affect the availability of water for fish in 1993. The recommended 400 KAF of flow augmentation for June 16 to August 30, 1992, could reduce the probability of refill of Dworshak and thereby impact the water budget in 1993 or later if the entire

400 KAF were to come from Dworshak. However, use of Dworshak will be limited so that it does not affect the probability of refill in 1993.

BPA's proposed river operations for 1992 included the release of cool water from Dworshak reservoir in August and September to reduce water temperatures in the lower Snake River. This would test whether lower river water temperatures help adult Snake River fall chinook salmon pass upstream. Although NMFS believed that releasing this water would benefit adult fall chinook, it preferred that when available water was insufficient to benefit both juvenile fall chinook in July and adult fall chinook in August, the juveniles should receive priority. That is, the water that would have been used in August for the temperature control test should instead be used in July for juvenile fall chinook migration. BPA biologists believe that (1) returning adult fall chinook would benefit from lower water temperatures in reservoirs and dam ladders, especially in low water years, and (2) flow modification, as proposed by NMFS, would not improve survival of juvenile fall chinook. However, recognizing that scientists differ with respect to the use of this water for adults as opposed to juveniles, BPA has decided to act consistently with NMFS' prioritization. BPA is hopeful that, as we get more information on water availability, some aspects of the temperature control test can still be performed in 1992. BPA also believes that, especially if the experiment is not performed this year, it should be performed in future years. The experiment is necessary to resolve differences in opinion and assess how water temperature affects adult migration. In addition, even if water is not released for temperature control this year, other aspects of the temperature control experiment should

continue, including model development and temperature monitoring. These activities are essential for future water management decisions and should proceed.

Flow modifications can be implemented under existing authorities of BPA, BR, and the Corps, and most of the modifications are consistent with the conditions outlined in the Fish Spill MOA of 1989 among BPA, fisheries agencies, and Indian Tribes. Because these modifications may provide benefits to anadromous fish and will not impair provision of water in 1993, and legal authority to provide these changes exists, BPA has decided to include these changes in river operations proposed for 1992.

**D. Analytical Factors**

1. Scope of Analysis

The scope of BPA's consideration of how its proposed actions for 1992 would affect the environment, and whether its proposed actions are likely to jeopardize Snake River salmon listed or proposed for listing as threatened or endangered, is broad. With respect to environmental impacts, BPA participated in the analysis described in the 1992 Flow Options EIS and considered all publ~~ic~~ comments. With respect to impacts upon species listed or proposed for listing under ESA, BPA prepared its Biological Assessment and engaged in extensive consultation with NMFS. As a result of these consultations, BPA supplemented its analysis, modified the actions that it initially proposed for 1992, and studied NMFS' analysis of its modified proposed actions in NMFS' recently issued Biological Opinion.

The key to avoiding jeopardy and achieving recovery of Snake River sockeye and chinook salmon is increased survival of adults

returning to spawn (spawning escapement). Spawning escapement depends upon actions taken by various entities at all stages of the salmon's life-cycle. Consequently, the extent to which a proposed action affects a listed species, in part, depends upon how previous actions have affected it and subsequent actions will affect it. For example, the extent to which changes in river operations for juvenile migration result in increased adult escapement and, thereby, avoid jeopardy and contribute to recovery, depends, in part, upon habitat conducive to hatching and rearing of smolts prior to their migration, and to a harvest-free or harvest-restricted environment allowing adults to return to spawn. Consequently, BPA has analyzed how hydrosystem operations for 1992, when combined with other effects at various stages of the species' life-cycles, affect survival of anadromous fish. This approach is consistent with NMFS' request that the Biological Assessment evaluate the effects of river operations in terms of survival (NMFS 1991).

As an action agency, BPA has independently performed its analysis and used its own modeling to assess the potential environmental impacts of the proposed action and to determine whether the proposed action is likely to cause jeopardy to listed species. The analysis entails the exercise of professional judgment of BPA's biologists, after consideration of extensive modeling and additional qualitative factors. For a detailed description of this analysis, please see the Biological Assessment and the "Analytical Tools" section of this ROD.

Using its own analysis, NMFS concludes that the proposed action is not likely to cause jeopardy to Snake River sockeye

or chinook salmon. This fact shows that two different approaches have reached the same result.

BPA's analysis takes into consideration some Federal actions for which consultation has not been completed, such as the Snake River sockeye salmon captive rearing program. Such actions are designed to improve conditions for fish and are likely to occur. Inclusion of these actions in BPA's analysis is consistent with NMFS' request that the assessment address all three "phases" of this consultation: (1) specific flow measures described in the EIS; (2) other river system operations, including transport, flows not addressed in the EIS, and predation control; and (3) hydroelectric project operation and maintenance activities. (December 23, 1991, Letter from Regional Director Rolland Schmitten to Corps Director of Planning and Engineering Robert P. Flanagan.) It is also consistent with the direction that appropriate consideration by given to beneficial actions taken by the action agency (50 C.F.R. 402.14(g)(8)).

BPA's analysis takes into consideration harvest activities. Ocean fishing outside the 3-mile limit is regulated by the Federal government under the Fishery Conservation and Management Act of 1976 (16 U.S.C.§ 1801 et seq). Consideration of the adverse effects of harvest is important to considering how river operations affect the survival of Snake River sockeye and chinook salmon. Consequently, BPA incorporates analysis of ocean harvest.

BPA's analysis also considers in-river harvest. Consideration of the adverse effects of in-river harvest is important to considering how river operations affect the survival of Snake River

sockeye and chinook salmon. Consequently, BPA's analysis includes study of in-river harvest.

2. Analytical Tools Used

BPA has used state-of-the-art models and best available scientific information to evaluate the 1992 proposed river operations and mitigation conditions. These models provide information on juvenile passage survival for chinook and sockeye, and multigeneration spawning escapement trends for chinook. They are an essential tool for a comprehensive evaluation of the many factors that combine to affect juvenile system survival to below Bonneville Dam and the long-term population viability of the listed salmon stocks. A comprehensive analysis (relative to a narrower focus on individual actions or life stages) is critical to a jeopardy/no jeopardy determination.

In order to determine whether the proposed hydro operations for 1992 are likely to jeopardize the continued existence of listed species or species proposed for listing, BPA believes it is necessary to analyze available information and data in two ways. First, we have looked at the 1992 hydro operations relative to the 1990 baseline to determine if the operations decrease, effect no change in, or increase survival of juveniles in 1992. Second, where possible we have employed the use of the Stochastic Life Cycle Model (SLCM) (see Biological Assessment, 1992 Operation of the Federal Columbia River Power System, January 13, 1992, Appendix B) to determine the expected spawning escapement trend of each population over the next 40 years if the proposed 1992 hydro operations were continued into the future. Also included in the analyses are actions

that are certain to occur, or that have a high probability of occurring in the near term. These include actions such as installation of additional bypass improvements, better control of predators, extended transportation periods, and reductions in harvest.

BPA believes that the employment of the SLCM or comparable comprehensive life-cycle models is of extreme importance in determining the eventual fate of a population of anadromous fish because of the temporal and spatial distribution of the population. Since in any given year fish from 4 or more brood years are distributed throughout the species' range as rearing juveniles, outmigrants, subadults, or adults, it is extremely unlikely that a single adverse event could jeopardize the species. However, while for any single year it is possible to demonstrate improvement in survival of one or more life stages resulting from a proposed action, it is also possible that such improvement alone could be insufficient to reverse a long-term downward trend in the population. We believe life-cycle modeling must be employed to judge the overall effect of a set of actions on a species. We believe this is appropriate since BPA views the actions proposed for 1992 hydro operations as long-term objectives--unless they are shown to be ineffective or unnecessary.

A fish passage model was used to evaluate juvenile sockeye survival The development of a life-cycle model to project sockeye salmon escapement trends was not complete at the time of this analysis. Sockeye salmon abundance is estimated by calculations of expected sockeye salmon production from captive breeding programs and the natural environment. (See Appendix F of BPA's Biological

Assessment for a complete description of the methodology for estimating sockeye salmon production.)

BPA recognizes the concerns expressed by NMFS in their Biological Opinion regarding the use of CRiSP and SLCM. We realize that the existing data necessary to predict impacts can be improved and that there is a significant level of uncertainty and variability inherent in biological systems. The analyses have attempted to capture some of this uncertainty. BPA has noted in its Biological Assessment that the results of the models should not be used as absolute or specific predictions of future population numbers. Instead, the model results should and can be used to assess the relative change in the passage survival level or in the population trend between the 1990 baseline operation and alternative future conditions. Additional, rigorous analysis will continue to be performed by BPA as we attempt to address the uncertainty in the data. The models are the best available scientific method for a quantitative assessment of the relative effect of the proposed actions. The results of the analyses are valuable and necessary to help determine a jeopardy or no jeopardy conclusion for 1992 river operations.

To assess improvements to survival, NMFS seeks reductions in mortality from baseline levels (Biological Opinion, p. 16). Although NMFS' methodology is different from BPA's, NMFS' approach reaches a similar conclusion and, thereby, corroborates BPA's analysis.

## E. Economic Factors

The potential economic effects of the various options considered were a significant issue to a number of different water resource users. Like environmental effects, economic effects were directly related to the magnitude of the augmentation and drawdown proposal. For example, reserving water (storing in winter and early spring) for the purpose of augmenting flows in spring or summer reduces the amount of water that will be available for hydropower production in winter (the period of highest power demand in the Pacific Northwest) and increases generation at a time when the power has less value.

Drawdown of the lower Snake River and lower Columbia River projects to below MOP would significantly impact most river users since project facilities are typically designed to operate within the range of MOP to full pool. Navigation facilities would be eliminated since there would be insufficient water depth to operate the locks. Loss of navigation would impact other transportation services. Irrigation would be impacted since most operators set the intake ports just below the lowest normal pool level in summer (usually MOP). Loss of irrigation water would result in crops losses, lost capital investments, and secondary and tertiary losses.

Power production would also be impacted since operation of the generators below MOP can be accomplished only at reduced efficiencies. Since operating the generators at reduced efficiencies results in higher mortality of the salmon that pass through the generators, it was assumed in the EIS that the generators would not be operated when the pools were drafted below MOP. Finally, power

production will be affected by refill requirements at both storage and run-of-river projects, the duration of the drawdown, and the requirement to hold the run-of-river pool elevations within a narrow daily range (e.g., 12 to 18 inches). Power production is reduced when the opportunity to vary the daily discharge to meet the variation in daily load is reduced and the longer a pool is held at a lower than normal elevation. Finally, if the pools are held at a low elevation into late summer when inflow is low, power production will be further degraded when discharges are reduced to refill the projects.

BPA has estimated the costs of replacing the energy losses due to the various options to range from $200-$240 million in 1991 dollars for the most severe run-of-river drawdown option to about $78-149 million for the proposed action. These estimates are based on the following assumptions: (1) Firm Energy Load Carrying Capability replacement costs would be about 35 mills/kwh; (2) capacity replacement costs in May and June would be about $4 kilowatt (kW)/month for losses of 1000 to 3000 Megawatts (MW) and about $10 kW/month for capacity losses above 3,000 MW. Capacity replacement costs in other months would be about $4 kW/month; and (3) nonfirm replacement costs would be about 15 mills/kilowatthours. Because of the difficulty of estimating power replacement costs, these numbers should be used as a relative index of power costs, not firm estimates of costs.

## V. Mitigation, Monitoring, and Research

Since the proposed action will improve conditions for endangered and threatened salmon species, no mitigation is required.

In addition to the monitoring called for in the 1992 Flow Options EIS and in the NMFS Biological Opinion, monitoring is an

ongoing activity of a number of Federal, State, Tribal, and regional authorities.

The Corps monitors adult and juvenile fish passage past Federal projects, conducts or sponsors ongoing research on anadromous fish and participates in similar research programs of other organizations, The Corps also operates 17 stations along the river system that monitor water quality. BPA sponsors a wide variety of fish research and enhancement evaluation programs related to reservoir mortality, hatchery production, disease, spawning habitat and numerical modeling of system fish survival. The Fish Passage Center, funded by BPA, monitors each year's juvenile out migration, system operations, fish passage, and power generation data from BPA and the Corps. NMFS, state fish and wildlife agencies and Indian Tribes conduct fish research and monitoring studies.

In 1992, ongoing work under a number of contracts will continue to address the near term needs for measuring survival of both smolts and adults in relation to flow and other environmental variables. For juvenile salmon this work includes: (1) developing the statistical frameworks for survival estimation and analysis; (2) compilation and further analysis of existing travel time and survival data sets to extract additional information; (3) identifying protocols for estimating smolt survival in the Columbia and Snake Rivers; (4) studying the relationship between smolt travel time and flow, physiological condition, stock origin, time of migration, and other environmental factors, through use of existing Passive Integrated Transponder (PIT) tag detectors and other methods; and (5) installation of additional PIT tag facilities. For adult salmon this work

includes performing the multivariate analysis of the survival rates of Columbia River hatchery stocks from coded-wire tag analysis to evaluate flow-related and other environmental effects.

Improved protocols for survival experiments will be available for testing in 1992 including statistical methods powerful enough to reliably examine the causal relationships between river flow and other environmental factors on survival differences. However, implementation in 1992 is dependent upon the support of regional fish and wildlife agencies and Indian Tribes and the return of PIT tag-detected juvenile fish back into the Snake River at Lower Granite Dam using existing PIT tag facilities.

For 1993 and beyond we will have the ability to make individual estimates of smolt survival within selected reaches in the Snake River system and relate these estimates to travel time and other environmental and biological variables. As more PIT tag facilities become operational, we will be able to expand the scope of investigations to study the relationship between smolt survival and flow, fish health, physiology, travel time, and other factors. For adult salmon, we will have the analytical capability to combine estimates of juvenile and adult survival to characterize the relationship between smolt and adult survival and biological and environmental parameters including flow.

Improved analytical techniques will permit us to integrate the concept of survival over the entire life-cycle of Snake and Columbia River salmon stocks. Such improvements will facilitate development of ways to increase adult returns of anadromous fish.

## VI. Conclusion

The proposed plan for improving flow conditions for salmon in the Columbia River Basin in 1992, as developed by the separate actions of BPA and the Corps, is the environmentally preferred alternative of the 1992 Flow Options EIS. It satisfies the request made by the Salmon Summit to recommend a set of actions that would improve passage of juvenile salmon in 1992 without impeding the passage of adults. It is also in general agreement with the recommendations of state and regional agencies in the Columbia River Basin, with the Power Planning Council's Phase II Fish and Wildlife Program Amendments, and with the recommendations presented in the Biological Opinion developed by NMFS. In selecting the preferred alternative, BPA has adopted all practicable means to avoid or minimize environmental harm. Most importantly, using the best available scientific evidence, BPA concludes that its proposed action is not likely to jeopardize Snake River sockeye or chinook salmon.

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