US Army Corps
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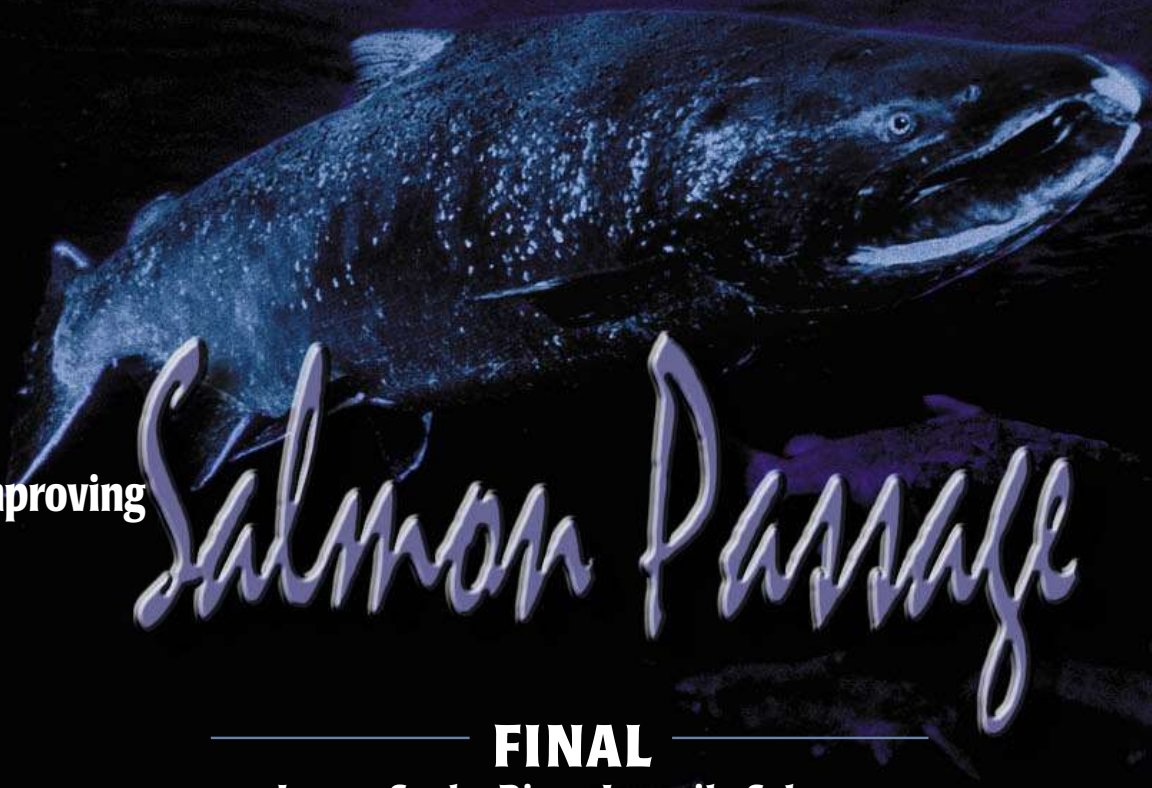
Walla Walla District

SUMMARY



Improving Salmon Passage

FINAL

Lower Snake River Juvenile Salmon Migration Feasibility Report/ Environmental Impact Statement

February
2002

FINAL

Lower Snake River Juvenile Salmon Migration Feasibility Report/ Environmental Impact Statement

Contents

US Army Corps
of Engineers®
Walla Walla District

Dear Concerned Citizen,

The U.S. Army Corps of Engineers (Corps), Walla Walla District's Final Lower Snake River Juvenile Salmon Migration Feasibility Report/Environmental Impact Statement (FR/EIS) represents more than 6 years of work by scientists, engineers, and technical staff. The Bonneville Power Administration, the U.S. Bureau of Reclamation, and the U.S. Environmental Protection Agency were cooperating agencies in the development of this report. Other Federal agencies, including the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, provided essential input. Regional scientists, economists, and stakeholders also provided input.

The Corps operates four dams within a 140-mile stretch of the lower Snake River: Ice Harbor, Lower Monumental, Little Goose, and Lower Granite. The Final FR/EIS explores four alternatives for improving salmon migration through those dams: continue the existing conditions at the dams, maximize transportation of juvenile salmon, make major system improvements (adaptive migration approach), and breach the dams. Based on a thorough evaluation of all the alternatives, the Corps' recommended plan (preferred alternative) is a modified version of major system improvements (adaptive migration) that combines a series of structural and operational measures intended to improve fish passage through the lower Snake River.

This summary document presents an overview of the technical, environmental, and economic effects of the four alternatives. Salmon recovery has economic and environmental implications for the Pacific Northwest. Salmon are a national resource that must be protected and the dams are national investments. As stewards of both resources, we must ensure concerns are recognized and addressed. The decisions we make as a result of this study will have wide-ranging effects. Input from affected agencies, regional entities, tribes, and the public was vital to the development of this study. This active input from the region not only contributed to this study, but also contributed to regional processes that are taking other significant actions toward salmon recovery. These broad regional efforts are directed at reducing impacts associated with habitat, harvest, hatcheries, and hydropower. The Corps' recommended plan will complement these regional actions by assisting in increased salmon survival and aiding in overall salmon recovery.

We encourage you to take time to consider the data, analyses, and rationale found in our report that led to the selection of the recommended plan. Even with the uncertainties, this report and its associated documents contain the best information available to date. The information gained in this extraordinary study is sufficient to support the selection of Alternative 3—Major System Improvements (Adaptive Migration) as the recommended plan. The Corps considers this recommendation to be of critical importance.

For more information about available documents and other sources of information, please refer to the inside back cover of this summary.

In the spirit of the Corps, we say ESSAYONS, "Let Us Try."

Sincerely,

Richard P. Wagenaar
Lieutenant Colonel, Corps of Engineers

Introduction

This summary provides an overview of the analysis conducted during the Lower Snake River Juvenile Salmon Migration Feasibility Study (Feasibility Study). The results of this comprehensive analysis are documented in the Final Feasibility Report/Environmental Impact Statement (FR/EIS) and its 21 appendices. The Feasibility Study focused on the relationship between the four dams on the lower Snake River (collectively called the Lower Snake River Project) and their effects on juvenile fish traveling toward the ocean. However, as the past 6 years have shown, the technical considerations, potential implications, and interest in the Feasibility Study reach far beyond the immediate lower Snake River area. Local, regional, and national public interest in the study has been extremely high.

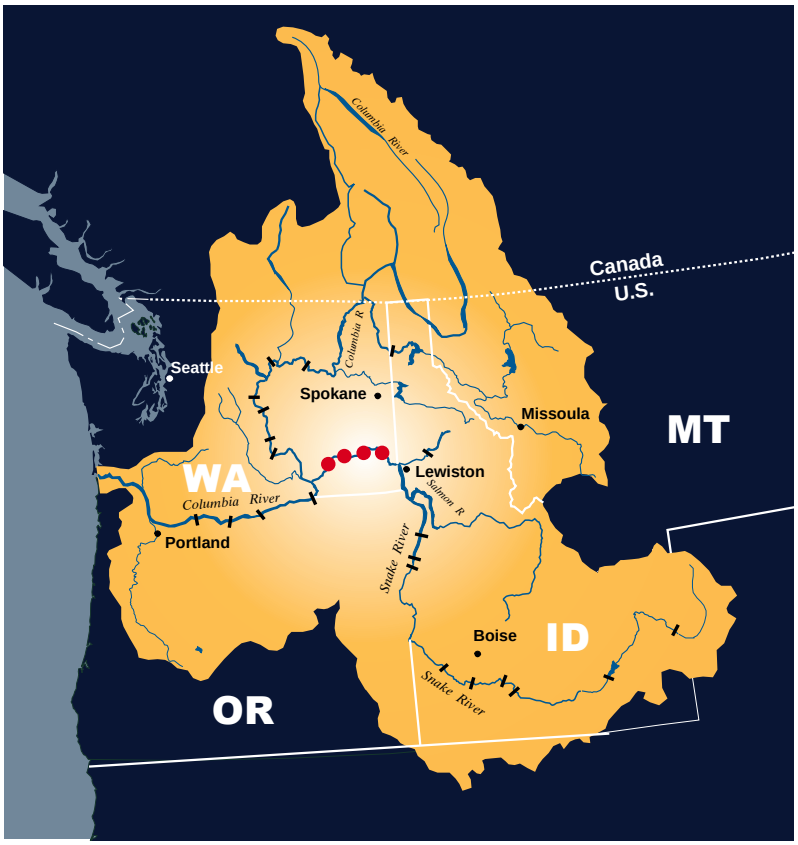
The genesis of this Feasibility Study was the National Marine Fisheries Service (NMFS) *1995 Biological Opinion for the Reinitiation of Consultation on 1994-1998 Operation of the Federal Columbia River Power System and Juvenile Transportation Program in 1995 and Future Years* (1995 Biological Opinion). In 1998, NMFS issued a supplement to the 1995 Biological Opinion, and in 2000, it issued an updated Biological Opinion on Federal Columbia River Power System operations. The Corps' Feasibility Study, and the resulting Final FR/EIS, respond to the reasonable and prudent alternative in these documents. Improvements in juvenile passage survival through the Lower Snake River Project, implemented as a result of this Feasibility Study, would be a step towards NMFS' regional survival and recovery goals for the salmon and steelhead species listed under the Endangered Species Act.

Many of the region's scientists, engineers, and economists have contributed to the Feasibility Study and other related regional processes. The Final FR/EIS includes the best available information on the biological effectiveness, engineering components, costs, economic effects, and other environmental effects associated with four alternatives. It also reflects the extensive agency, peer, and public review process undertaken for the Draft FR/EIS. In the Final FR/EIS, the Corps identifies Major System Improvements (Adaptive Migration) as the recommended plan (preferred alternative) and explains the process for selecting that alternative.

Defining the Problem

The decline of salmon and steelhead in Pacific Northwest rivers is a complex problem. It is not possible to point to one specific cause. The situation currently facing the salmon has been years in the making. The problem stems from a variety of interrelated sources that regional scientists are working hard to evaluate and understand. Historically, the runs have been affected by overfishing, poor ocean conditions, reduced spawning grounds, dams and reservoirs (Federal and non-Federal), and general habitat degradation. Several of these conditions continue today, along with predation, estuary destruction, and competition from hatchery fish and non-native fish.

Although many of these causes are known and the region has worked to correct some of them, the outstanding causes and their collective effect has resulted in the continued decline of some Columbia-Snake River Basin salmon and steelhead populations. Under the Endangered Species Act, NMFS listed the Snake River sockeye salmon as endangered in 1991. In 1992, Snake River spring/summer chinook and Snake River fall chinook salmon were listed as threatened. In 1997, lower Snake River steelhead were listed as threatened. By 1999, NMFS had placed another nine anadromous fish species throughout the Columbia River Basin on the Endangered Species List. Although this study focuses on the relationship between the Lower Snake River Project and the four listed lower Snake River stocks, defining the problem (and finding potential solutions) necessarily involves looking at the overall regional salmon decline and at causes above and beyond the four lower Snake River dams.

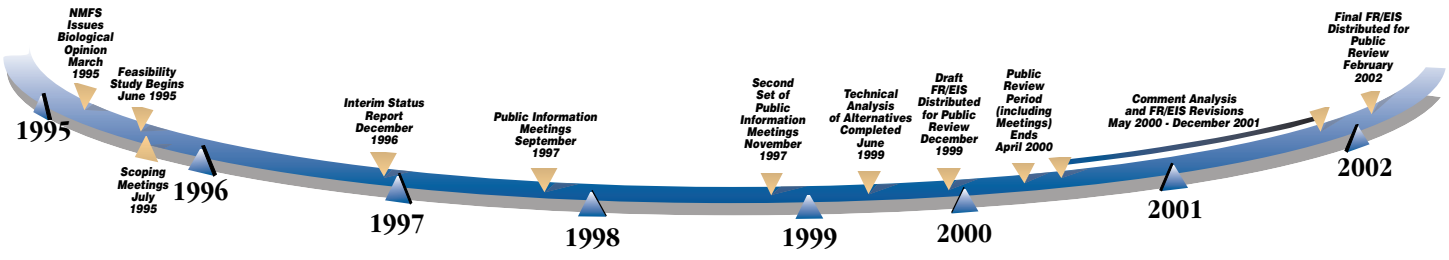


The Feasibility Study–In the Beginning

On March 2, 1995, NMFS issued its *Biological Opinion for the Reinitiation of Consultation on 1994 to 1998 Operation of the Federal Columbia River Power System and Juvenile Transportation Program in 1995 and Future Years*. The 1995 Biological Opinion established measures necessary for the survival and recovery of Snake River salmon stocks listed under the Endangered Species Act. This Feasibility Study evolved as a result of the NMFS 1995 Biological Opinion.

The Feasibility Study was officially announced to the public on June 5, 1995. In July 1995, the Corps conducted public scoping meetings to initiate the Feasibility Study and begin the National Environmental Policy Act process, a formal Federal environmental review process. The stated purpose of the Feasibility Study was to evaluate and screen structural alternative measures that may increase the survival of juvenile anadromous fish through the Lower Snake River Project (which includes the four locks and dams operated by the Corps on the lower Snake River: Ice Harbor, Lower Monumental, Little Goose, and Lower Granite) and assist in the recovery of listed salmon and steelhead stocks. In December 1996, the Corps issued the Interim Status Report, which marked the decision point to elevate dam breaching—removal of the earthen embankments and shutdown of hydropower operations at all four dams to allow for a near-natural flow—as the drawdown alternative that would be evaluated in the environmental impact statement.

Because the alternatives considered in this study would affect resources of concern to all people of the Pacific Northwest, the Corps structured the Feasibility Study process to involve participation of the whole region. Several Federal agencies, states, and tribes were direct participants in the Feasibility Study process. The U.S. Bureau of Reclamation, Bonneville Power Administration, and the U.S. Environmental Protection Agency are all cooperating agencies of the Feasibility Study. The Corps also made efforts to solicit input from Native American representatives, elected officials, other Federal and state agencies, and special interest groups (e.g., those concerned about impacts on river transportation, recreation, wildlife, irrigation, electrical rates, etc.) throughout the region to define and evaluate the primary alternatives identified for improving juvenile salmon and steelhead survival rates. During the alternative development stage, the Corps also provided numerous opportunities for public input through Regional Roundtable Workshops and a series of public information meetings held in 1997 and 1998.



The Feasibility Study–In the Beginning.....Cont.

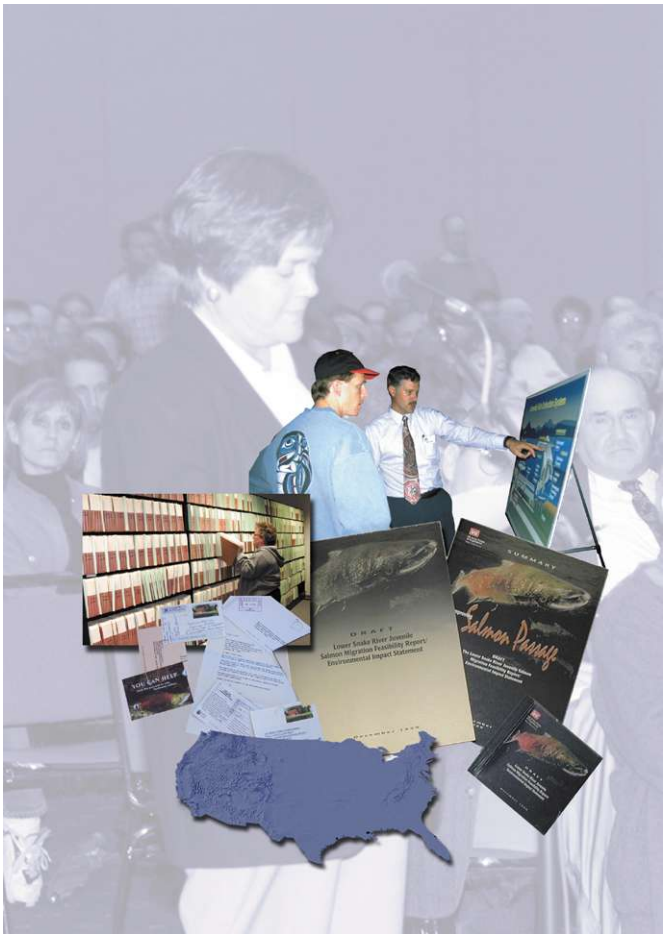
From 1997 to late 1999, the Corps formulated alternatives and analyzed impacts of those alternatives, not only to the salmon and steelhead, but also to other resources and to the people of the Pacific Northwest. Biological data was collected and analyzed to allow for the best possible comparison of alternatives and their associated effects on the migration of juvenile salmon and steelhead, and on other environmental resources. Most of the data related to anadromous fish was provided by NMFS and a workgroup called the Plan for Analyzing and Testing Hypotheses (PATH). PATH was composed of state, tribal, and Federal scientists from within and outside the region. Engineering analysis and design reviews of the alternatives were also conducted to present key engineering and cost information as well as the engineering/construction process necessary for implementation. Additional economic data was collected and analyzed to allowfor an accurate cost comparison of the alternatives at both the regional and national levels. The Drawdown Regional Economic Workgroup (DREW), a group of regional economists convened for the Feasibility Study, provided input on the economic issues associated with the alternatives. All of this biological, environmental, engineering, and economic information was collected, reported, and evaluated in the Draft FR/EIS and its associated appendices.

The Feasibility Study–Release and Review of the Draft FR/EIS

The Draft FR/EIS and its associated appendices were released for public review and comment in December 1999. The Draft FR/EIS synthesized the biological, environmental, engineering, and economic information and evaluation to allow for a comparison between four selected alternatives. It provided a means to determine how each alternative would affect other uses and to consider the consequences of changing the way the Corps currently operates the Lower Snake River Project.

The comment period on the Draft FR/EIS began December 1999 and extended through April 30, 2000. Formal public meetings were conducted after the Draft FR/EIS was distributed for public review. In conjunction with the Federal Caucus (a group of Federal agencies with interests in salmon recovery efforts), a series of 15 formal meetings was held around the region in February and March 2000 to provide an opportunity for public questions, and comments on the Draft FR/EIS, the Corps' John Day Drawdown Study, and the Federal Caucus Conservation of Columbia Basin Fish "All H" Paper. A total of nearly 9,000 participants (consisting of stakeholders, special interest groups, elected officials, and individuals from the public) presented 1,787 oral and taped comments. Most meetings consisted of an open house, formal agency presentations, a question-and-answer session, and a public comment session. Oral comments, taped comments, and written comments were all accepted at the meetings. In addition to oral and taped comments, the Corps received over 230,000 written comment documents from the public during the comment period. Written comments were received in the form of individual letters, reports, notecards, petitions, e-mails, etc. Judging from the variety of locations from which comments were received, interest in the Feasibility Study is dispersed over the entire country. See Appendix U of the Final FR/EIS or the website (www.nww.usace.army.mil/lsr) for responses to public comments.

Over 230,000 Comment Documents Received from Coast to Coast



The Feasibility Study–Arriving at the Final FR/EIS

Review of Public Comments

The Corps evaluated each comment document received and oral/taped comments from the public meetings so that issues of concern could be identified and considered by technical experts. Issues raised by the public were summarized into issue statements which are provided, along with a response, in Appendix U to the Final FR/EIS. Issues raised through the comment/response process were used in the development of the Final FR/EIS and associated appendices.

Review of New Documents

In the interim period between the draft and this final document, NMFS released a new Biological Opinion on Federal Columbia River Power System operations in December 2000. The NMFS 2000 Biological Opinion, which supersedes the previous opinions, addresses juvenile salmon migration and approaches for improving survival during this migration. The Final FR/EIS considers the applicable aspects of the NMFS 2000 Biological Opinion. The Final FR/EIS also considers the U.S. Fish and Wildlife Service Biological Opinion and the Federal Caucus' Basinwide Recovery Plan released in December 2000.

Release of the Final FR/EIS.

The Corps released the Final FR/EIS and its 21 associated appendices in February 2002. The Final FR/EIS incorporates evaluation of additional data, comments, and other information gathered since release of the draft document. The Final FR/EIS also provides river managers, users, and the general public with the information and evaluation processes that were used to select a preferred alternative.

The Final FR/EIS combines the format of a traditional Corps feasibility planning document and a National Environmental Policy Act EIS. The FR/EIS and associated technical appendices provide: 1) a complete presentation of study results and findings; 2) compliance with applicable statutes, Executive Orders, and policies; 3) a sound and documented basis with which both Federal and regional decision makers can judge the recommended solution; 4) scope, schedule, budgets, and technical performance requirements for the implementation of the selected alternative; and 5) documentation for subsequent funding for the implementation of specific measures associated with the recommended plan (preferred alternative).

At least 45 days after release of the Final FR/EIS to the public, the Corps will prepare a Record of Decision documenting the recommended action resulting from the Feasibility Study process.

The Four Dams

The Snake River is the principal tributary to the Columbia River, draining approximately 109,000 square miles in Idaho, Wyoming, Utah, Nevada, Washington, and Oregon. Flows in the lower Snake River are highest in the spring (average annual peak of approximately 165,000 cubic feet per second) and lowest in late summer (averaging 25,000 cubic feet per second). The Lower Snake River Project features four locks and dams in the state of Washington: Ice Harbor Dam, Lower Monumental Dam, Little Goose Dam, and Lower Granite Dam. The dams became operational between 1961 and 1975. The four dams are all run-of-river facilities, which means that they have limited storage capacity in their reservoirs and pass water through the dam at about the same rate as it enters the reservoir. All four of these dams are multiple-use facilities that provide navigation, hydropower, irrigation, recreation, and fish and wildlife conservation benefits. These dams were not built to control floods.

Juvenile fish from the lower Snake River drainage system may have to travel past as many as eight Federal dams before reaching the Pacific Ocean. This Feasibility Study focuses on how best to improve the survival of juvenile fish as they pass through the Lower Snake River Project. Federal and private dams on the middle and upper Snake River are not included in this study. The four dams on the mainstem Columbia River are addressed in the Feasibility Study, where appropriate, because they are part of the corridor juvenile salmon travel between the Lower Snake River Project and the ocean.

Ice Harbor Dam

Ice Harbor Dam, near river mile 10 (as measured from the Snake River's joining with the Columbia River), was placed in service in 1961. It is nearest to the point where the Snake River flows into the Columbia River. There are more than 4,000 acres of Corps-managed lands surrounding the dam and its reservoir, Lake Sacajawea. The reservoir extends 31.9 miles upstream. The dam has three 90-megawatt and three 110-megawatt generators, and a 90-foot-high, 86-foot-wide single-lift navigation lock. The spillway has 10 spillbays. Benefits are derived from the dam's hydroelectric power generation, seven developed recreation areas, navigation lock, wildlife habitat areas, irrigation water, fish passage facilities, and two port facilities.

Lower Monumental Dam

Lower Monumental Dam, near river mile 42, was placed in service in 1969. There are more than 9,100 acres of Corps-managed lands surrounding the dam and its reservoir, Lake Herbert G. West. The reservoir extends 28.7 miles upstream. The dam has six 135-megawatt generators and a 100-foot-high, 86-foot-wide single-lift navigation lock. The spillway has eight spillbays. Benefits are derived from the dam's hydroelectric power generation, six developed recreation areas, navigation lock, wildlife habitat areas, fish passage facilities, provision for irrigation water, and one port facility.

Little Goose Dam

Little Goose Dam, near river mile 70, was placed in service in 1970. There are more than 4,800 acres of Corps-managed lands surrounding the dam and its reservoir, Lake Bryan. The reservoir extends 37.2 miles upstream. The dam has six 135-megawatt generators and a 100-foot-high, 86-foot-wide single-lift navigation lock. The spillway has eight spillbays. Benefits are derived from the dam's hydroelectric power generation, seven developed recreation areas, navigation lock, wildlife habitat areas, fish passage facilities, three port facilities, and provision for irrigation water.

Lower Granite Dam

Lower Granite Dam, near river mile 107, was placed in service in 1975. Of the four dams, it is the farthest upstream. There are more than 9,200 acres of Corps-managed lands surrounding the dam and its reservoir, Lower Granite Lake. The reservoir extends 39.3 miles upstream. The dam has six 135-megawatt generators and a 100-foot-high, 86-foot-wide single-lift navigation lock. The spillway has eight spillbays. Benefits are derived from the dam's hydroelectric power generation, 13 developed recreation areas, navigation lock, wildlife habitat areas, fish passage facilities, water for six municipal and industrial pump stations, and three port facilities on Lower Granite Lake.

How the Dams Operate

Spillway

The spillway is a series of gates along the top of the dam that can open, allowing water to spill. Water is passed through the spillway to release excess flows. At times, to assist in juvenile fish migration, the Corps voluntarily spills additional water through the spillways.

Navigation Lock

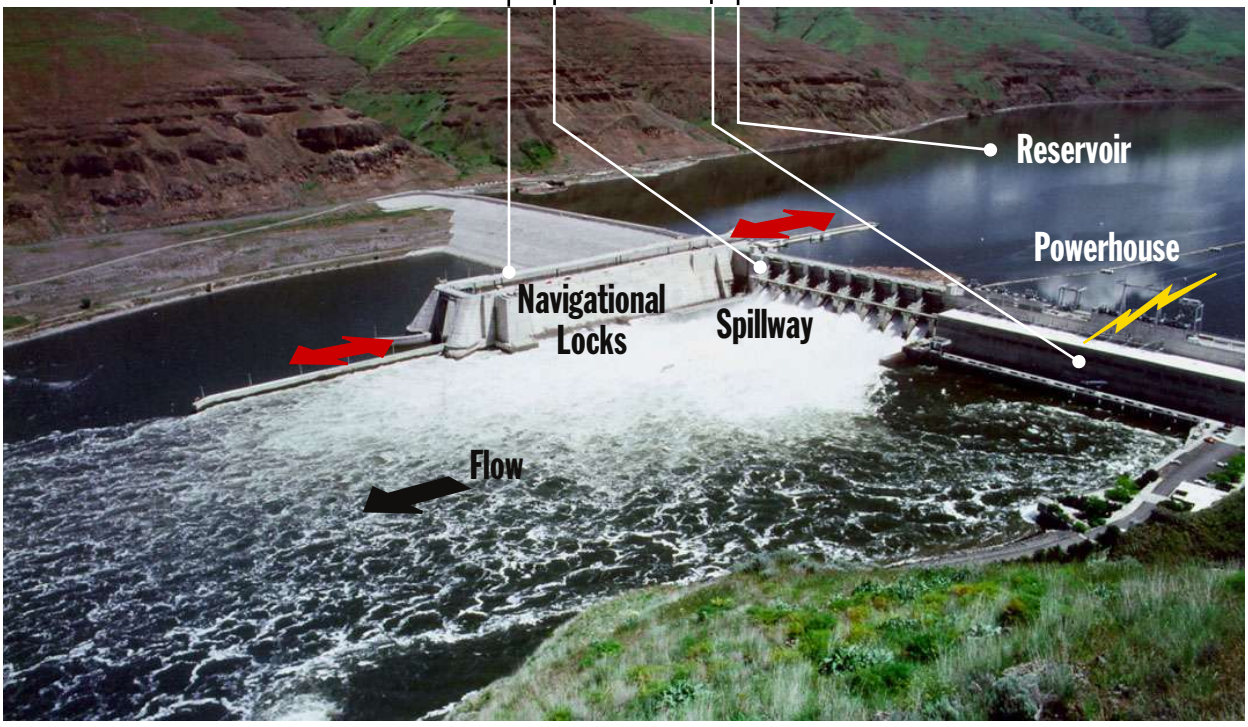
A navigation lock lifts and lowers boats and barges between the lower river level downstream of the dam and the higher reservoir level. Boats enter the lock, the gates close behind them, and the lock is slowly filled or drained until its water level is even with the destination water level. Then the gates are opened and the boats move from the lock to continue either upriver or down river.

Powerhouse

The powerhouse portion of the dam houses large generators for producing electricity. The water in the reservoir passes through turbine intakes in the powerhouse, rotating the turbines at 90 revolutions a minute, and then passes into the river downstream of the dam.

Reservoir

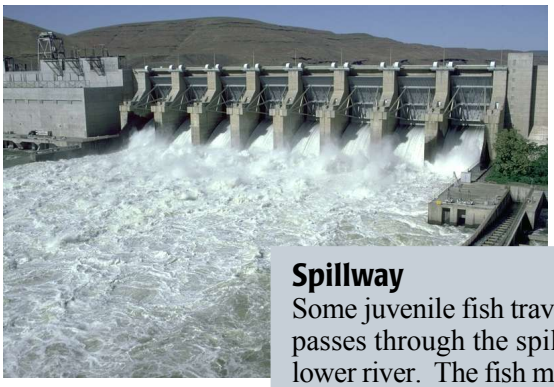
Spanning the river, the dam forms a physical barrier that impedes the river's flow, forming an artificial lake or reservoir. Water pools behind each dam covering land that was previously exposed, allowing navigation and creating opportunities for recreation, irrigation, and water supplies.



How Fish Currently Pass the Dams

Turbines

Some juvenile fish may enter the intake openings of the powerhouse, move with water through the turbines, and exit on the other side. The fish may experience trauma from pressure changes, turbulent water conditions, or striking the machinery. About 90 to 95 percent of fish entering the turbines at each dam survive past that dam.



Spillway

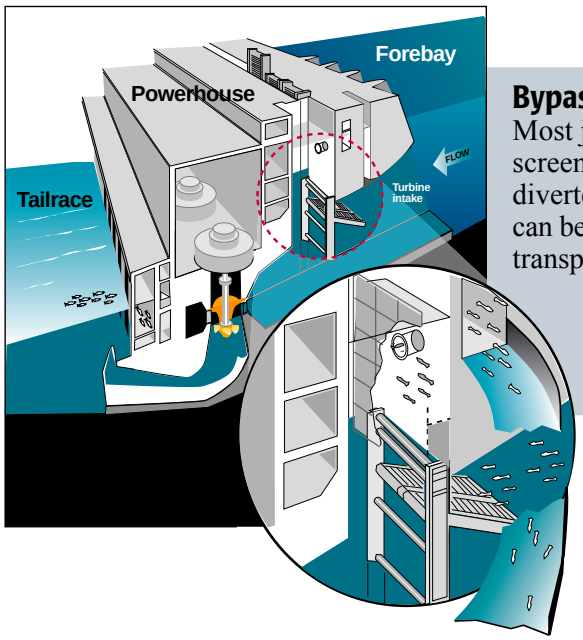
Some juvenile fish travel in water that passes through the spillway to the lower river. The fish may be damaged passing through each spillway or be affected by harmful elevated dissolved gases in the water. About 98 percent of fish passing through the spillway at each dam survive past that dam.

In a free-flowing river, fish encounter natural structural obstacles, but rarely any as large as one of the lower Snake River dams. The height difference between the river on the downstream side of a dam and the reservoir behind the dam is approximately 100 feet. With this in mind, the four lower Snake River dams, as well as other dams on the system, were designed with features to aid the migration of both juvenile and adult fish. In the last 25 years, the Corps has consistently investigated and adopted new technologies for maximizing the number of fish that safely pass the dams in both directions. Successful features at the lower Snake River dams include adult fish ladders, juvenile bypass systems, and the fish transportation program.

For adult fish returning from the Pacific Ocean to spawn, fish ladders and devices to attract fish to the entrances of the ladders are the primary aid to their passing the dams. Fish ladders have been in place since the dams were built.

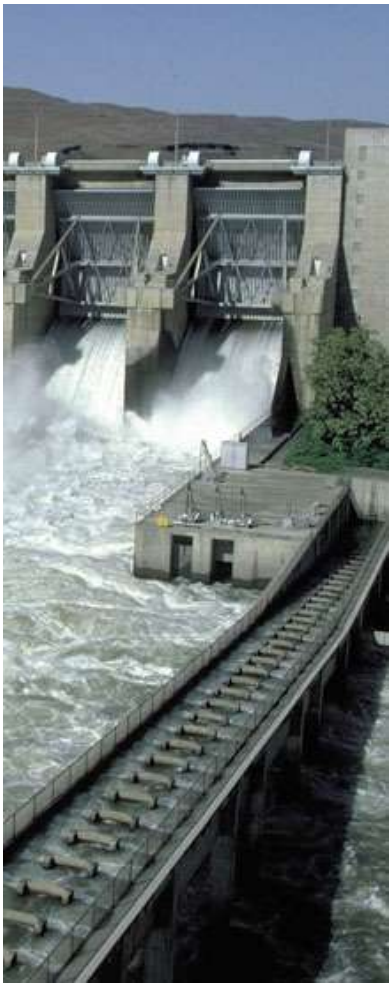
For juvenile fish traveling downriver, the dams and reservoirs present a more complex set of hazards. In the reservoirs near the dams, where the water is deep and slow, fish move slower than they do upstream. Slower water exposes juvenile fish to resident fish predators for a longer time. In addition, spill below the dam increases turbulence and exposure of juvenile salmon to predatory birds.

When juvenile fish arrive at a dam, they can pass it in three ways: through the turbines, through the spillway, or through bypass systems, where most are diverted to trucks or barges for transport downriver.



Bypass

Most juvenile fish are guided away from the turbines by submerged screens and collected into channels that bypass the dam. They can be diverted into the river below the dam, into holding tanks where they can be loaded onto barges or trucks, or directly loaded on to barges and transported past the remaining lower Snake River and Columbia River dams. The collected and transported fish may suffer delays and handling stress. About 98 to 99 percent of the transported fish survive to the point of release below Bonneville Dam.



Fish Passage: What We Have Already Achieved

Adults

When the lower Snake River dams were built in the 1960s and early 1970s, scientists and engineers had a good understanding of what features adult fish needed to pass upstream to spawn. So, as part of the initial construction, fish ladders were installed to assist adult fish passage. Improvements to these ladders have been made at all four dams. Since 1996, the cumulative survival for adult salmon through all four lower Snake River dams and reservoirs ranges from 92 to 98 percent. The survival rate through each dam and reservoir is 96 to 100 percent.

Juveniles

At the time of construction, much less was known about juvenile salmon migration and how the dams might affect the migration, although by the time Lower Granite was constructed and completed in 1975, it had juvenile bypass facilities built in. By studying fish behavior, as well as river and dam conditions, scientists have worked with engineers over the years to design more effective fish passage systems for juveniles. The modifications the Corps has implemented at each dam to improve juvenile fish passage are noted on the next page.

Spread-the-risk Policy

Currently, the Corps, in coordination with NMFS, manages juvenile fish passage to "spread the risk." This spread-the-risk policy balances the number of fish that pass through the Lower Snake River Project in the river versus those that are diverted and transported below Bonneville Dam by barge or truck. About 50 to 65 percent of all fish traveling through the lower Snake River are diverted and collected for transport. The remainder are left in the river.

The spread-the-risk policy is necessary because the long-term positive and negative effects of both in river and juvenile fish transport are not clear. Balancing the two approaches is a prudent course of action while there is still some uncertainty because it ensures that no inadvertent reduction in survival occurs if one approach is significantly favored over another.

Direct Survival Rates

Short-term (direct) survival of juvenile fish through the Lower Snake River Project is measurable, and the numbers are generally positive. The average survival through a dam and reservoir on the lower Snake River for most stocks of juvenile salmon is in the low 90 percent range. Cumulative survival for juvenile salmon through all four dams and reservoirs is over 80 percent. Cumulative survival for juvenile salmon through all eight dams on the Columbia-Snake River System generally ranges from 45 to 60 percent.

Delayed/Indirect Mortality

Regional scientists find that delayed (indirect) mortality is far less straightforward and more difficult to measure than direct survival. Scientists do not know the cause of mortality for a certain portion of salmon who make it to the ocean as juveniles, but then do not return upriver to spawn as adults. Some suspect that a portion of this "extra mortality" is delayed mortality that may occur after juvenile salmon have passed Bonneville Dam. Scientists are unsure whether this delayed mortality could be caused by passing in the river through the series of eight dams and reservoirs from Lower Granite Dam to Bonneville Dam, from the transportation of fish by barge or truck, or by non-hydropower related causes.

Fish Passage Facilities at the Lower Snake River Project

Dams	Lower Granite	Little Goose	Lower Monumental	Ice Harbor
Adult Fish Passage Facilities (Fish Ladders/Fish Counting Stations)	●	●	●	●
Juvenile Fish Passage Facilities				
• Removable Spillway Weir	○			
• Standard Length Submerged Screens			○	○
• Extended Submerged Bar Screens	○	○		
• Vertical Barrier Screens	○	○	○	○
• Collection/Holding Facilities	○	○	○	
• Truck and Barge Loading Facilities	○	○	○	
• Sampling and Marking Facilities	○	○	○	○
• Passive Integrated Transponder Tag Detection & Deflector System	○	○	○	
• Prototype Surface Bypass Collectors and Behavioral Guidance System	○			
Operational Activities				
• Voluntary Spill	○	○	○	○
• Minimum Operation Pool	○	○	○	○
• Flow Augmentation	○	○	○	○

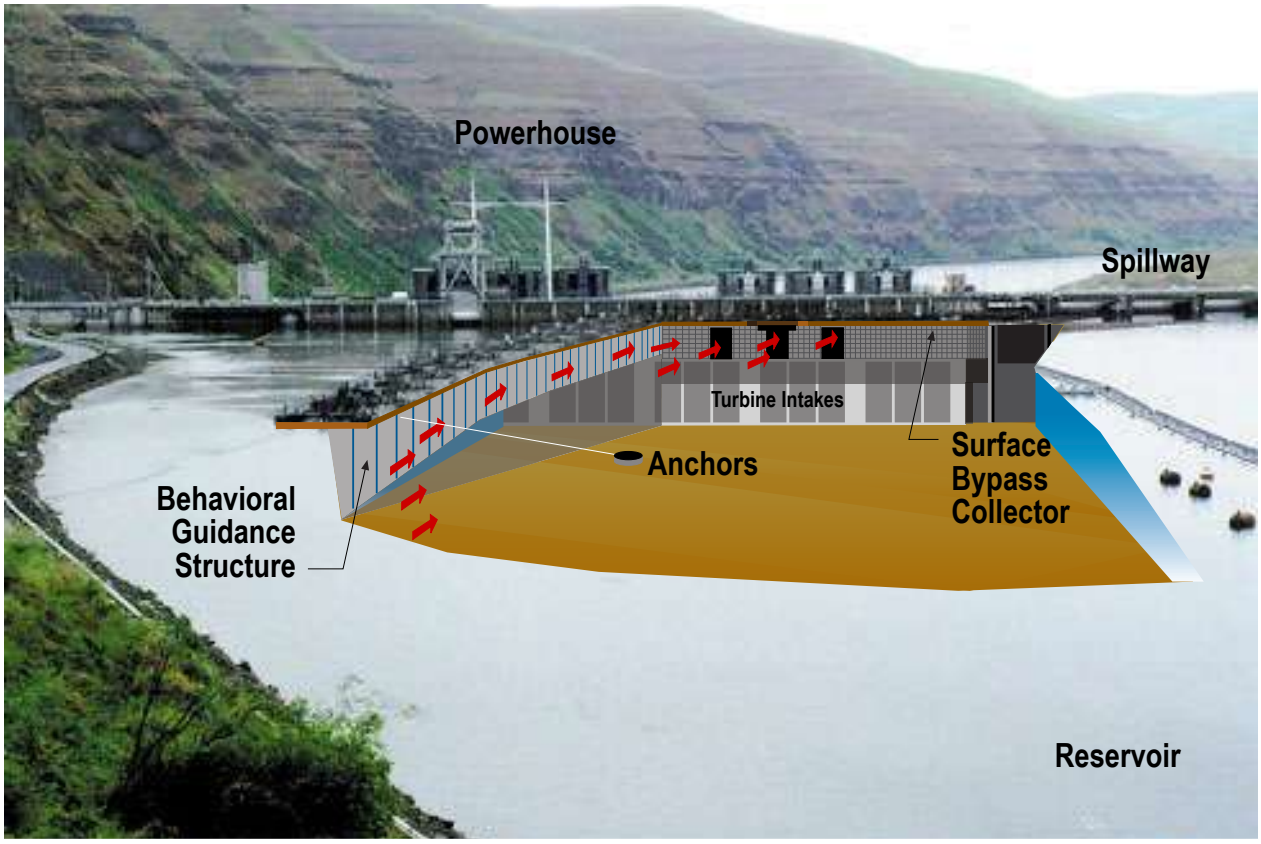
New Technology for Fish Passage

Some of the alternatives discussed in the Final FR/EIS consider implementation of several recently developed and/or tested technological improvements to increase survival through the Lower Snake River Project. Brief descriptions of surface bypass and behavioral guidance structures, removable spillway weirs, turbine improvements, and technology for reducing total dissolved gas are provided here.

Even though survival rates through the Lower Snake River Project dams are high, prototype systems of the surface bypass, behavioral guidance structure, and removable spillway weir have been tested at Lower Granite Dam to see if survival and passage conditions can be improved. Preliminary tests indicate increased fish passage efficiency through a combined system, including submerged screens. Development of additional system technologies is one of the measures recommended in the NMFS 2000 Biological Opinion on Federal Columbia River Power System operations.

Surface Bypass

This technology takes advantage of the natural behavior of juvenile fish to migrate near the surface. With screen bypass passage systems, salmon must dive down deep toward the turbine intake before being guided by submerged screens up into a bypass channel. The prototype surface bypass structure tested at Lower Granite Dam was 375 feet long with a series of vertical slots located in front of one half of the powerhouse. The surface bypass attracts surface-oriented fish in the dam forebay and directs them through the vertical slots into a collection structure. From there they can be routed through a low-volume spillway, or can be routed through the dam to be collected for transport in trucks or barges to the downstream side of Bonneville Dam. It is believed generally that surface bypass reduces stress on migrating fish because they do not experience the pressure changes associated with screen bypass systems.



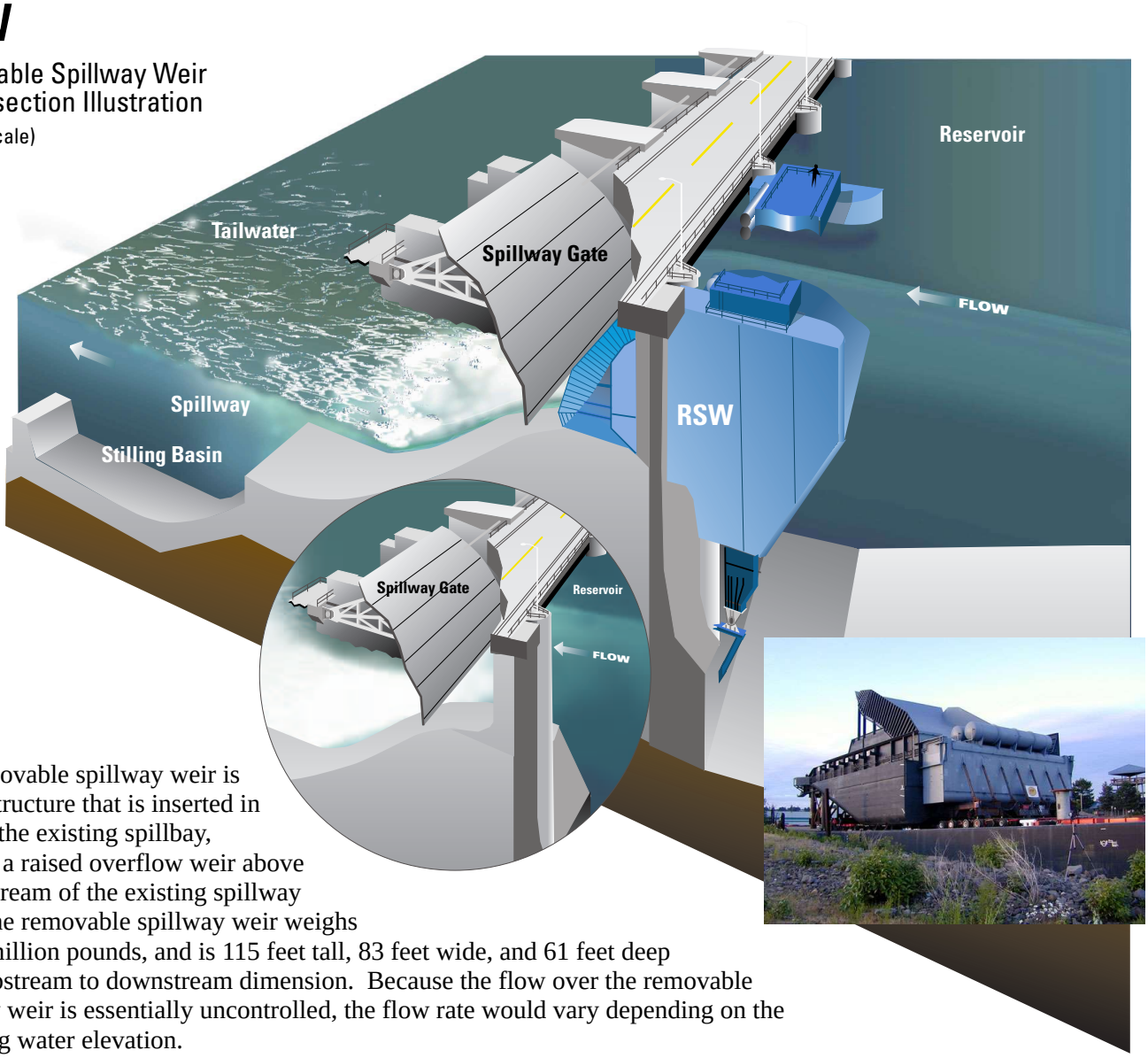
Surface Bypass
Representation of a Surface Bypass and Behavioral Guidance Structure
(Not to Scale)

Removable Spillway Weirs

The removable spillway weir is a new technology that would provide more flexibility for adjusting the balance between in river and barge or truck transportation for migrating juvenile salmon. Basically, when it is desirable to keep juvenile fish in the river instead of using the juvenile transport system, the surface bypass would be shut off, and the behavioral guidance structure could be used to guide fish to the removable spillway weirs.

RSW

Removable Spillway Weir
Cross-section Illustration
(Not to Scale)



The removable spillway weir is a steel structure that is inserted in front of the existing spillbay, creating a raised overflow weir above and upstream of the existing spillway crest. The removable spillway weir weighs over 2 million pounds, and is 115 feet tall, 83 feet wide, and 61 feet deep in the upstream to downstream dimension. Because the flow over the removable spillway weir is essentially uncontrolled, the flow rate would vary depending on the incoming water elevation.

The removable spillway weir would provide a surface attraction flow and a less stressful method of passing juvenile fish than existing spillway passage routes. The structure raises the spillway crest where fish pass through the dams with the flow. Raising the spillway would provide a more effective passage route for fish than the current dive they have to take through the dams in the existing 50-foot-deep gated flow. The expected advantages of the removable spillway weirs are:

- **Improved passage conditions for fish (less stress)**
- **More efficient fish passage (more fish per unit of flow)**
- **Potential for reduced spill due to better fish passage efficiencies**
- **Potential lower gas supersaturation and improved water quality**
- **Potential power generation benefits (due to more water available)**
- **Emergency removal capability for major flood events.**

Behavioral Guidance Structures

While the surface bypass measures aim to keep more juvenile fish near the surface, the goal of the behavioral guidance structure is to direct fish horizontally. Just as they tend to stay near the surface, migrating fish also favor the zones where water velocity is highest. The behavioral guidance structure is a steel wall, 80 feet deep sloping to 55 feet deep at the upstream end to the contour of the reservoir bottom. It is 1,100 feet long and floats. The behavioral guidance structure directs fish away from the powerhouse and towards the surface bypass when it is in use, or towards the spillway and the removable spillway weir.

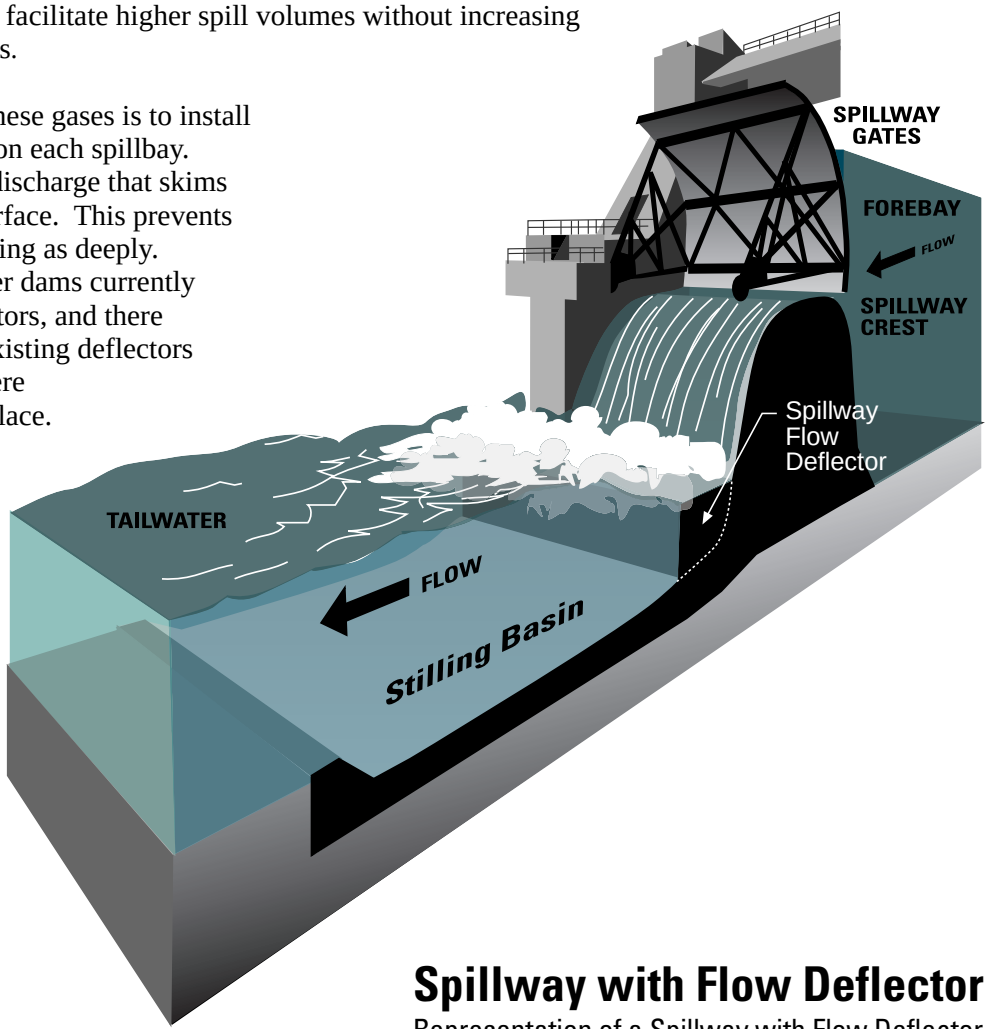
Turbine Improvements

Although maximum efforts are being made to prevent juvenile fish from passing through the turbines, some fish will still travel through the dam by this route. In the turbines, fish can be harmed by rapid changes in pressure, turbulence, and contact with surfaces. Scientists are investigating and pinpointing zones where injuries occur. Possible measures for preventing injuries are reducing the gaps between the turbine blades and hub, using smoother surface materials on turbine parts, and changing operational efficiency of the turbines.

Technology for Reducing Total Dissolved Gases

In the late 1970s, the Corps began intentionally spilling water (know as voluntary spill) to pass juvenile fish over the dams. Water is released through the spillway, carrying fish downstream to the basin below the dam. When the falling water plunges into the water below, air can be trapped and dissolved under pressure. This raises the percentage of total dissolved gases. High total dissolved gases can result in injury or death to fish. The NMFS 2000 Biological Opinion calls for enhanced spill and spillway improvements to facilitate higher spill volumes without increasing harmful total dissolved gas.

One option for reducing these gases is to install a spillway flow deflector on each spillbay. These devices produce a discharge that skims the stilling basin water surface. This prevents the spill water from plunging as deeply. All four lower Snake River dams currently have spillway flow deflectors, and there are plans for improving existing deflectors and adding deflectors where they are not currently in place.

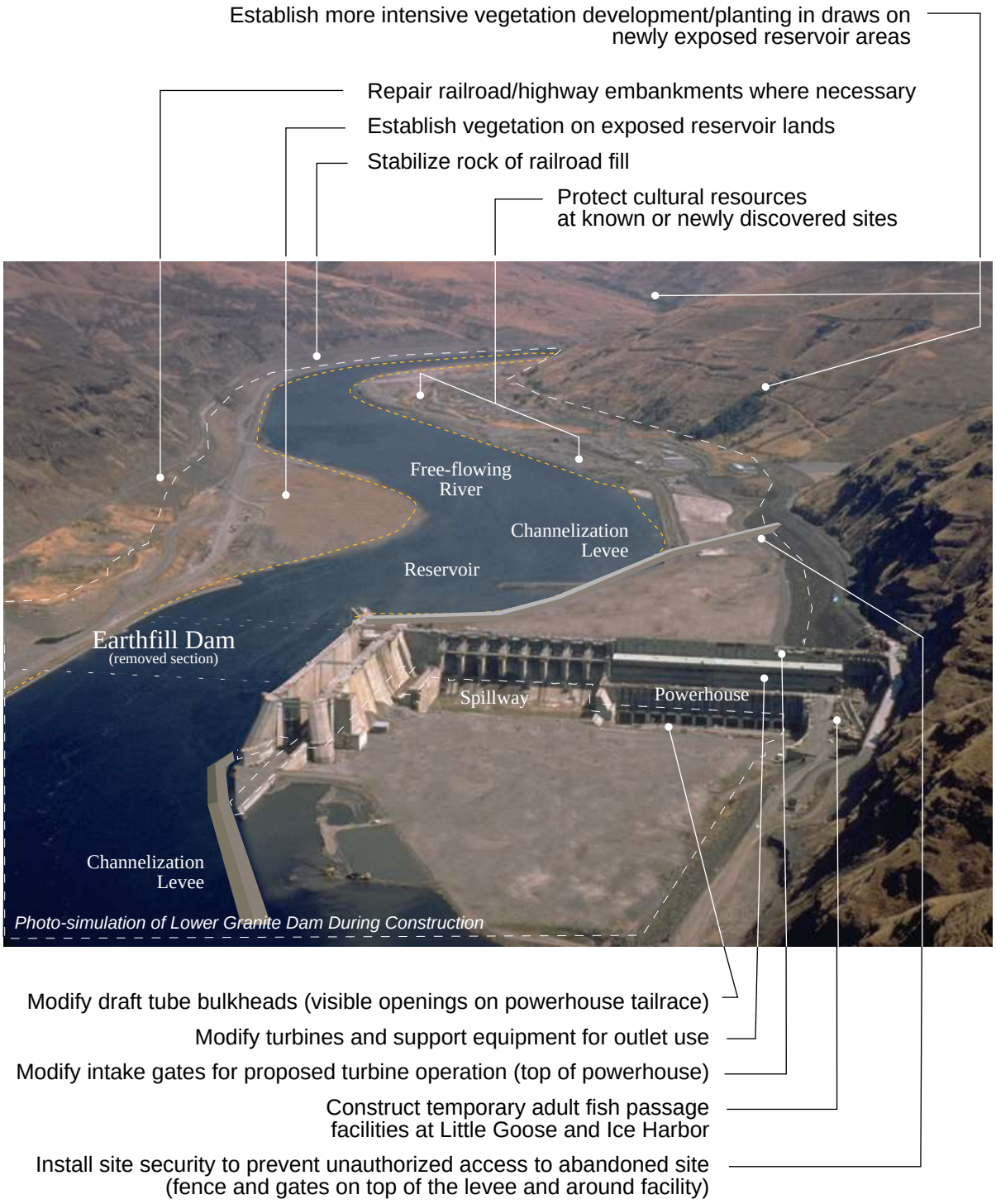


Spillway with Flow Deflector

Representation of a Spillway with Flow Deflector
(Not to Scale)

Description of Dam Breaching

Dam breaching would create a 140-mile stretch of river with near-natural flow by removing the earthen embankment section of each dam and eliminating the reservoirs. The powerhouses, spillways, and navigation locks would not be removed, but would no longer be functional. All facilities for transporting fish would cease to operate, as would hydropower operation and navigation on the lower Snake River. The illustration below shows some of the specific measures involved in dam breaching.



Uncertainty in the Analyses of the Effects of the Alternatives

When evaluating the effects of the alternatives on the environmental resources and economic factors summarized in this document, it is important to note that some of the analyses carry with them varying degrees of uncertainty. Uncertainty is inherent in any planning effort, especially when the period of implementation may span several years, as is likely for this FR/EIS. Information might be unavailable, incomprehensive, and scientifically untestable or reflect wide natural variability in the resource studied. There are also uncertainties in the assumptions and models used to extrapolate this information to future conditions. Relevant uncertainties are described in the FR/EIS, where appropriate.

The relative importance of uncertainties will depend on how they influence efforts to compare the potential benefits and costs of the alternative actions. For this Feasibility Study, noticeable uncertainty exists in the effects analyses for salmon, recreation, and economics. Although space in this summary document is too limited to elaborate on these uncertainties, the uncertainties in environmental effects of each alternative are identified, described, and quantified when possible in the resource sections of Chapter 5 in the Final FR/EIS. These uncertainties are also summarized in Chapter 6 of the Final FR/EIS and in Appendix J, Plan Formulation.

Effects of the Alternatives

The four alternatives evaluated in the Final FR/EIS are **Alternative 1—Existing Conditions, Alternative 2—Maximum Transport of Juvenile Salmon, Alternative 3—Major System Improvements (Adaptive Migration), and Alternative 4—Dam Breaching.** The Corps has selected Alternative 3 as the recommended plan (preferred alternative). This alternative has been modified slightly since the Draft FR/EIS to provide more of a focus on adaptive migration, reflecting the strategies in the 2000 NMFS Biological Opinion. Adaptive migration is an approach that provides greater flexibility to switch between in river migration and barge or truck transportation as conditions require, and as new information becomes available.

The features and major effects of the alternatives are summarized here, followed by a discussion of the effects of each alternative on the key environmental resources and economic factors evaluated in the Final FR/EIS. Included is a discussion of salmon, resident fish, water quality and flow, sediment, vegetation and wildlife, air quality, cultural resources, Native American Indians, transportation, water supply and irrigation, electric power generation, recreation, and economic factors. It also describes the effects on people, in terms of the economic health of the communities and businesses that depend on the resources, not only along the Snake River, but also throughout the Pacific Northwest.

Before making its selection of a recommended plan (preferred alternative), the Corps evaluated the implications of each alternative. The Corps recognizes that actions taken as a result of this Feasibility Study can affect us all. The Feasibility Study is just one piece of Pacific Northwest salmon recovery efforts that encompass harvest, hatcheries, habitat, and hydropower issues.

Summary Comparison of the Four Final FR/EIS Alternatives

1 Alternative 1—Existing Conditions

Every FR/EIS has a starting point from which all other alternatives are measured. Alternative 1 is the baseline or no action alternative under which the Corps would continue operating the four lower Snake River dams according to their current configurations, including all fish passage programs now in operation. About 50 to 65 percent of the fish would be transported via truck and barge, while the remainder would migrate in river. This alternative does not mean that no further improvements would be made. The Corps, as part of its ongoing development plans and in response to changes in agency requirements, plans to improve technology at the dams to promote fish passage. The Corps' current plan calls for turbine improvements, structural modifications to fish facilities at Lower Granite Dam, new fish barges, adult fish attraction modifications, trash boom at Little Goose Dam, modifications to fish separators, added cylindrical dewatering screens, and more or improved spillway flow deflectors.

Features

- No major changes to fish passage systems, spill, juvenile transport
- Continued flow augmentation

Key Effects

- Slightly reduced extinction risks for listed stocks (Cumulative Risk Initiative [CRI]) —Pre-1995 operations
- Continued juvenile fish passage for listed stocks
- Continued hydropower generation
- Continued navigational activity
- Continued irrigation and water supply
- No major economic impacts

2 Alternative 2—Maximum Transport of Juvenile Salmon

Most of the improvements planned for Alternative 1 would also be included in Alternative 2. The emphasis in this alternative, however, is operating the existing facilities to maximize the passage of fish through the existing collectors into trucks or barges for transport downriver. Voluntary spill to bypass fish would be minimized. The majority of the juveniles would be collected in the existing facilities and transported past the dams. Under this alternative, there would be no need to modify spillway flow deflectors, because voluntary spill would be minimized. Some juvenile fish would still pass through the dam turbines.

Features

- Maximized juvenile fish transport with current systems
- Minimized voluntary spill
- Continued flow augmentation

Key Effects

- Slightly reduced extinction risks for listed stocks (CRI)—Pre-1995 operations
- Slightly reduced juvenile fish passage for listed stocks
- Continued hydropower generation
- Continued navigational activity
- Continued irrigation and water supply
- No major economic impacts
- Reduced total dissolved gases (voluntary spill)

Summary Comparison of the Four Final FR/EIS Alternatives

3 Alternative 3—Major System Improvements (Adaptive Migration)

Alternative 3—Major System Improvements (Adaptive Migration) is the Corps' recommended plan (preferred alternative). This alternative would balance the passage of fish between in river and transport methods to minimize risks and provide for the flexibility of adaptive migration. Alternative 3 would include all of the existing or planned structural configurations from Alternative 1 and most structural configurations found under Alternative 2—Maximum Transport of Juvenile Salmon. This alternative also includes major system improvements that would improve effectiveness and increase flexibility for optimizing migration routes within seasons and years. Surface bypass collectors, behavioral guidance structures, and removable spillway weirs could be installed at one to four dams, if testing warrants, to maximize adaptive migration capabilities.

Features

- Testing of surface bypass systems to optimize in river passage and transport
- Optimized voluntary spill
- Continued flow augmentation
- Operational modifications for flow augmentation and transportation

Key Effects

- Slightly reduced extinction risks for listed stocks (CRI)—Pre-1995 operations
- Slightly increased juvenile fish passage for listed stocks
- Continued hydropower generation
- Continued navigational activity
- Continued irrigation and water supply
- No major economic impacts
- Reduced total dissolved gases (voluntary spill)

4 Alternative 4—Dam Breaching

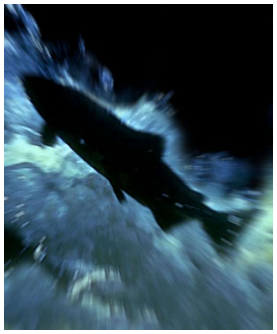
This alternative consists of breaching the four dams and creating a 140-mile stretch of river with near-natural flow. This would involve removing the earthen embankment section of each dam and eliminating reservoirs behind all four of the dams. Under this alternative, all facilities for transporting fish would cease to operate. A river with near-natural flow can be achieved by removing only the embankment. The powerhouses, spillways, and navigation locks would not be removed, but would no longer be functional.

Features

- Removal of dam embankments
- Conversion of reservoirs into riverine environment
- Shutdown of navigation lock
- Shutdown of power generation
- End of juvenile fish transport program on the lower Snake River
- Reevaluation of fish and wildlife mitigation
- Expanded protection of cultural resources
- Modifications to some reservoir facilities
- Continued flow augmentation

Key Effects

- Moderately reduced extinction risks for fall chinook and steelhead (CRI)—Pre-1995 operations
- Slightly reduced extinction risks for spring/summer chinook (CRI)—Pre-1995 operations
- Moderately increased fish passage for listed stocks
- Loss of hydropower generation; raised electric rates
- Loss of navigational capacity; impact on other transportation systems; increased transportation costs
- High sediment movement
- Impacts to irrigation and water supplies
- Short-term gain and long-term loss of jobs and income
- Change in recreation opportunities
- Reduced total dissolved gases (no voluntary or involuntary spills)
- Increased risk of major economic impacts



The EFFECTS Salmon

Background

Of the 12 anadromous fish stocks within the Columbia-Snake River System that are listed under the Endangered Species Act or that are candidates for listing, the Snake River stocks are: Snake River sockeye salmon, Snake River spring/summer chinook salmon, Snake River fall chinook salmon, and Snake River steelhead. Anadromous fish hatch in freshwater streams, rear in streams or lakes as juveniles, migrate downriver to the ocean, mature in the ocean, and then return upstream to spawn. This summary focuses on the effects of the alternatives on the juvenile lifestage of the listed salmon and steelhead stocks as they migrate downriver through the Lower Snake River Project. Conclusions about the effects of the alternatives on adult anadromous fish and species such as Pacific lamprey and American shad can be found in Chapter 5.5 of the Final FR/EIS; these effects are generally minimal.

Analyses Used

NMFS used two primary sets of analyses to help quantify the likely effects to the listed Snake River stocks—one developed by the Plan for Analyzing and Testing Hypotheses (PATH), and the other known as the Cumulative Risk Initiative (CRI).

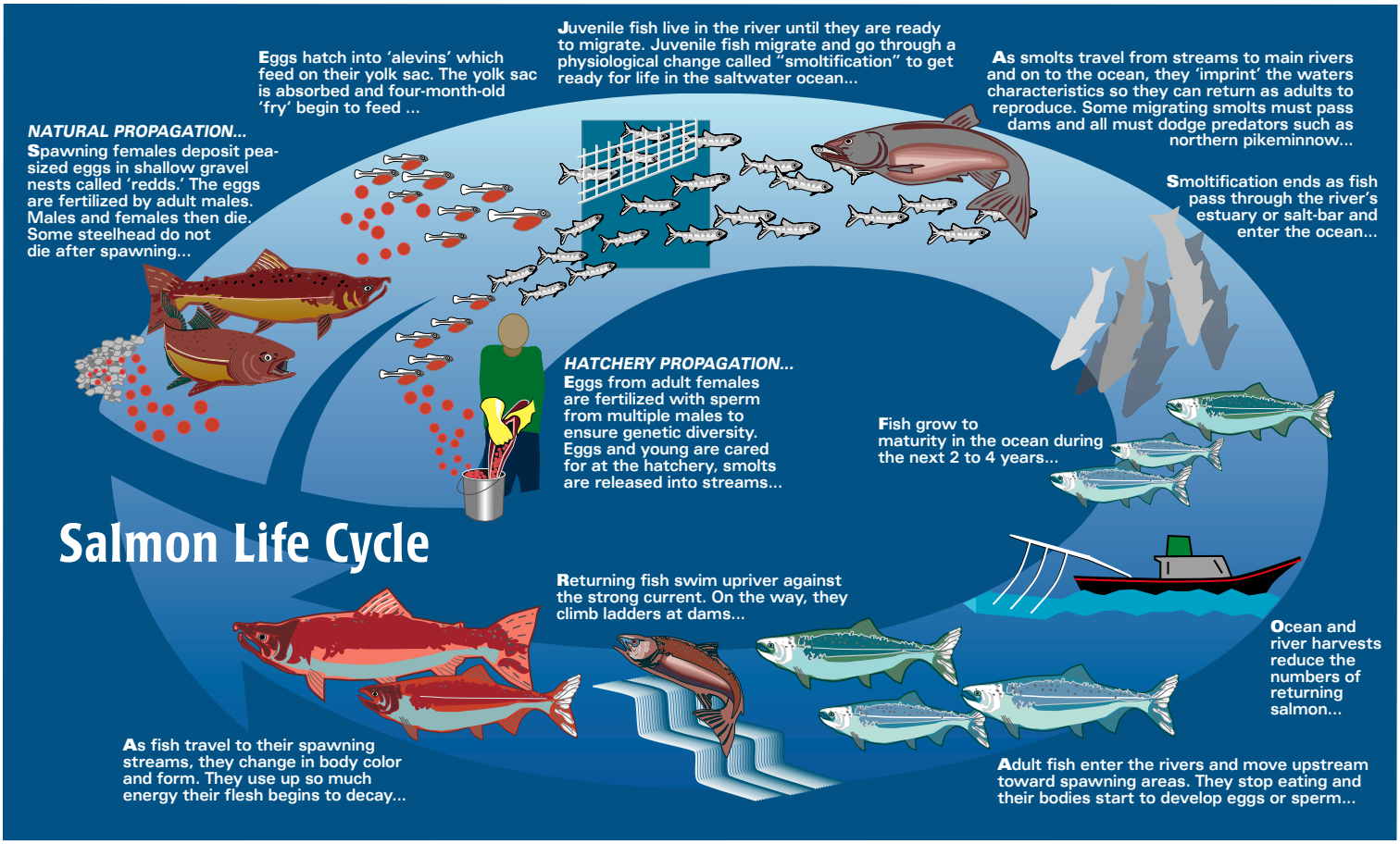
The PATH analysis developed models that predict the likelihood of achieving survival and recovery of the listed Snake River stocks. The PATH model results were influenced by the effects of direct and indirect mortality. Direct mortality occurs while fish pass through the hydrosystem. Indirect mortality is assumed to occur after fish have left the hydrosystem, but is caused by having passed through the hydrosystem, including transportation. PATH defined indirect mortality in two general categories, differential delayed transport mortality and extra mortality. NMFS' evaluation (Appendix A) of these two categories stated, "Debate about the importance of post Bonneville effects of dams has been highly contentious and data with which to estimate these parameters are generally poor."

The CRI analysis estimated the likelihood of extinction of listed fish stocks occurring within specified time periods. It compared how certain actions, including those outside of the hydrosystem, affect the chance of the selected stocks meeting the NMFS definition of acceptable risk of extinction criteria. The CRI analysis also evaluated the effects that a delay in implementing actions would have on the chances of specific stocks going extinct.

The EFFECTS Salmon

Both CRI and PATH analyses relied on many assumptions for their predictions. Lack of specific values for many components in both lifecycle analyses generated outcomes with a high degree of uncertainty. Overall, PATH results indicate that the chance of meeting NMFS survival and recovery criteria for the four listed species under Alternative 1 would likely be the same or slightly better than Alternatives 2 and 3. Alternative 4 provides the highest probability of meeting the survival and recovery criteria under the PATH analysis. Both the CRI and PATH analyses indicate that further improvements in the hydrosystem passage system are unlikely to recover listed Snake River stocks unless there is an improvement in juvenile fish survival downstream of Bonneville Dam, either through such factors as improved fish conditions or improved timing of entry into the ocean. However, PATH does not address whether it is necessary to breach the dams. NMFS 2000 Biological Opinion on Federal Columbia River Power System operations indicated the need for improvements in all areas of impact: harvest, hatcheries, habitat, and hydrosystem. The Biological Opinion states:

> "Although breaching is not essential to implementation of the initial actions called for in the Reasonable and Prudent Alternative (RPA) which constitute a non-breach approach, the RPA requires that the Action Agencies prepare for the possibility that breaching or other hydropower actions could become necessary."



The Bottom Line

While a considerable amount of information and analysis has been developed to assess the alternatives, the bottom line is that no single alternative stands out as the “silver bullet” for listed stocks.

The chart below summarizes the effects on salmon by alternative based on the NMFS anadromous fish analysis that incorporates certain aspects of both CRI and PATH. The specific differences, distinctions, and details of both CRI and PATH are discussed in the FR/EIS and Appendix A, Anadromous Fish Modeling.

SEE TABLE ON NEXT PAGE

Anticipated Effects of Each Alternative on Snake River Anadromous Fish

Alternatives	Extinction 1/	Recovery 1/	Juvenile Survival 2/	Adult Survival 3/	Habitat 4/
Alternative 1- Existing Conditions 5/					
SPRING/SUMMER CHINOOK					
FALL CHINOOK					
STEELHEAD					
SOCKEYE					
PACIFIC LAMPREY	6/	6/			
Alternative 2 - Maximize Transportation 5/					
SPRING/SUMMER CHINOOK					
FALL CHINOOK					
STEELHEAD					
SOCKEYE					
PACIFIC LAMPREY	6/	6/			
Alternative 3 - Major Systems Improvements (Adaptive Migration) 5/					
SPRING/SUMMER CHINOOK					
FALL CHINOOK					
STEELHEAD					
SOCKEYE					
PACIFIC LAMPREY	6/	6/			
Alternative 4 - Dam Breaching 5/					
SPRING/SUMMER CHINOOK					
FALL CHINOOK					
STEELHEAD					
SOCKEYE					
PACIFIC LAMPREY	6/	6/			

1/ Extinction and Recovery parameters are estimates limited to the contributions of lower Snake River hydrosystem actions as evaluated by CRI (Extinction) and PATH (Recovery). They are represented by the NMFS lambda estimates reported in Table 6-3 of the FR/EIS main report.

2/ Estimate of effects based on total system juvenile passage survival through the eight lower Snake/lower Columbia River Federal mainstem dams, with and without transportation, as applicable to the alternative operations using ranges found in the FR/EIS.

3/ Estimate of effects based on total system adult passage survival through the four lower Snake River dams.

4/ Habitat effects are estimated based on fish passage, rearing, and spawning.

5/ Alternative 1 is change through time relative to existing conditions; Alternatives 2, 3, and 4 are compared to Alternative 1.

6/ No estimate of extinction or recovery is available for Pacific lamprey (not an ESA-listed species).

The EFFECTS
Resident Fish

In addition to the migrating anadromous fish that are the focus of this study, there are resident fish that occupy the lower Snake River and the reservoirs behind the four dams. These resident fish do not migrate to the ocean; they spend their entire lives in the river and the reservoirs created by the dams. Some of the fish are native and others have been introduced as sports fish. The common species are northern pikeminnow, rainbow trout, common carp, smallmouth bass, crappie, catfish/bullhead, and yellow perch. Most of these fish prefer calmer and warmer water than do the anadromous fish. The bull trout, although not common in the lower Snake River, is listed as threatened under the Endangered Species Act.

Alternatives 1, 2, and 3—Existing Conditions, Maximum Transport of Juvenile Salmon, and Major System Improvements

Under Alternatives 1, 2, and 3, none of the proposed actions are likely to have an effect on resident fish. Although, if voluntary spill is reduced under Alternatives 2 and 3, the resulting lower total dissolved gases could benefit resident fish.

Alternative 4—Dam Breaching

Under Alternative 4, there would be some negative effects on resident fish. In the short term, if the dams were breached, the rapid lowering of the reservoirs could strand some fish in shallow pools that would eventually stagnate. In addition, high turbidity and sediment in the water could cause trauma and injury, low water elevations could expose more fish to predators, and breaching could negatively affect spawning and overwintering habitat in the short term.

In the long term, the resident fish population would be altered because some species would not thrive in a faster flowing river. Declines in crappie, peamouth, pumpkinseed, bluegill, yellow perch, bullhead, and largemouth bass would be expected. Other species, including the chiselmouth, redside shiner, speckled dace, sucker, sculpin, white sturgeon, northern pikeminnow, bull trout, and smallmouth bass might benefit from near-natural river conditions.

The EFFECTS

Water Resources

The Feasibility Study looks at the effects of the alternatives on water flow, suspended sediment, temperature, contaminants, and dissolved gases, which are the qualities of lower Snake River water resources that can have direct effects on anadromous fish.

Alternative 1—Existing Conditions

Under the current conditions represented by this alternative, water velocity varies considerably throughout the reservoir. Directly downstream of the dams, the water is turbulent and fast moving for a short distance. Turbidity (the amount of suspended particulate matter in water) tends to decrease as the water velocity is reduced in the reservoir. Water temperatures throughout the Snake River can be very warm during portions of the year; however, cold water is released at certain times from Dworshak Dam upstream to aid in cooling water temperature in the lower Snake River to benefit fish. Contaminants are not a significant water quality issue under current conditions. While there is always some dissolved gas in turbulent water, the dams tend to increase total dissolved gas downstream due to voluntary and involuntary spill. The improvements proposed under this alternative would slightly reduce total dissolved gases.

Alternatives 2 and 3—Maximum Transport of Juvenile Salmon and Major System Improvements

Under these alternatives, water flow and water quality conditions would be the same as for Alternative 1. Dissolved gases could decrease slightly because there would be less voluntary spill to cause elevated dissolved gas concentrations.

Alternative 4—Dam Breaching

Under this alternative, flow velocities would increase and depths would decrease throughout the lower Snake River. Suspended sediment (50 to 75 million cubic yards of material) could be released during dam breaching and could adversely affect aquatic organisms and other beneficial uses during the first 2 years after dam breaching. Water temperatures would be more like they were before the dams went into operation. Higher daily fluctuations in water temperatures, such as those observed before the dams were built, may occur. In a river with near-natural flow, there would be no spillway flows, so total dissolved gas concentrations would decrease.

The EFFECTS

Sediment

Closely related to water quality is the amount of sediments found in the river. The dams reduce sediment movement in the lower reservoirs and trap sediments above Lower Granite Dam. The Lower Granite reservoir currently captures an average sediment load of 3 to 4 million cubic yards per year. It has been estimated that 100 to 150 million cubic yards of sediment have accumulated behind the four lower Snake River dams since their construction. Approximately half these sediments are fine-grain silts and the remainder is coarser sands.

Alternatives 1, 2, and 3—Existing Conditions, Maximum Transport of Juvenile Salmon, and Major System Improvements

The amount of sediment buildup would not change under the first three alternatives.

Alternative 4—Dam Breaching

Dam breaching could result in significant movement of sediments. It is estimated that 50 to 75 million cubic yards of existing sediments may be eroded and moved downstream. The majority of fine-grain silts would move quickly in the first few years following breaching. The coarser sands would move slowly downstream over 5 to 10 years. These existing and future sediments could move freely downstream toward McNary Dam and may cause temporary adverse effects on food supplies for fish and bottom-feeding aquatic organisms. In addition, silt and sand now accumulated behind the dams could cause damage to pumps, valves, and other water system components.

Resuspension of sediments following dam breaching could result in exposing chemical contaminants that have been contained in reservoir sedimentation. Total DDT, dioxin, manganese, and un-ionized ammonia are of concern. DDT could potentially affect the biological system, and un-ionized ammonia concentrations may exceed EPA water quality criteria for the protection of aquatic life.

The EFFECTS
Vegetation and Wildlife

The lower Snake River region is steppe and shrub-steppe terrain with bunchgrass and sagebrush predominant around the dams. There are 87 species of mammals and 257 species of birds in the study area. These include deer, elk, bear, waterfowl, songbirds, and raptors. A number of vegetated islands were inundated when the dams were built. Agricultural and transportation activities have also affected vegetation and wildlife in the area. The Corps developed and manages 62 Habitat Management Units (approximately 9,300 acres) on lands around the reservoirs for wildlife conservation. Through purchase or lease, the Corps has acquired 24,000 acres of land for off-site mitigation.

Alternative 1—Existing Conditions

This alternative would not have appreciable effects on either vegetation or wildlife.

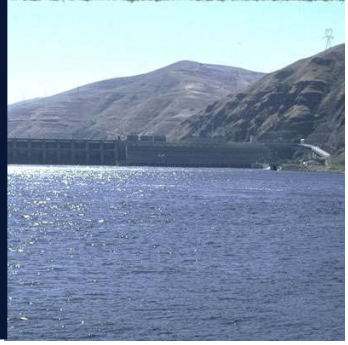
Alternatives 2 and 3—Maximum Transport of Juvenile Salmon and Major System Improvements

These alternatives would not have appreciable effects on vegetation or most wildlife. However, reduced in-river transport under Alternative 2 could decrease the number of birds that prey on juvenile fish because there will be fewer fish in the river.

Alternative 4—Dam Breaching

Under Alternative 4, approximately 14,000 acres of land that are now under the reservoirs would be drained and exposed. In the short term, this would have an adverse effect on wildlife directly dependent on reservoir conditions, as well as on game birds, big game, small mammals, and amphibians and reptiles. Loss of open water habitat would have short-term negative effects on waterfowl. Increased mudflats and open islands would have short-term positive effects on shorebirds and colonial-nesting birds.

The Corps would manage plantings of native species to support wildlife native to the area and control undesirable vegetation that would encroach on the exposed shorelines. In the long term, as vegetation becomes reestablished, breaching the dams would have positive effects on most wildlife groups through the expected development of a more contiguous riparian zone and increased area of other habitat types, such as shrub-steppe and grassland. This assumes that the iparian zone and adjacent uplands would be managed for the wildlife resources



The EFFECTS
Air Quality

The main air quality issues for the four alternatives are construction-related fugitive dust emissions, emissions associated with loss of barge transportation, fugitive dust from exposed sediments, and emissions associated with replacement power generation.

Alternative 1—Existing Conditions

The changes to the four dams under this alternative are not anticipated to affect air quality. Hydropower-produced electricity is considered a clean source of energy with regard to air emissions.

Alternative 2—Maximum Transport of Juvenile Salmon

Again, as with Alternative 1, changes to the four dams under this alternative are not anticipated to affect air quality.

Alternative 3—Major System Improvements

Because Alternative 3 involves possible construction of several structural improvements, there could be a slight localized increase in dust associated with construction equipment and haul roads used during construction of the surface bypass, removable spillway weirs, and other modifications.

Alternative 4—Dam Breaching

Under Alternative 4, there would be local impacts to air quality during the dam breaching process. Removing the four embankments would be a large-scale construction project, resulting in dust and emissions. Commercial river transportation would be eliminated, and the use of more trucks and trains would increase some emissions. Dust would also arise from newly exposed land when the reservoirs empty, but dust would decrease as new vegetation covered the land.

If the four dams were breached, approximately 3,033 megawatts of the total peaking capacity would likely be replaced in part by 1,550 megawatts from new plants fueled by natural gas. The Feasibility Study analysis looked at the dams as part of the Western Systems Coordinating Council. This council manages the interconnected power system that includes all or part of 14 western states, two Canadian provinces, and a small area of northern Mexico. The analysis indicates that total emissions (from operation of replacement powerplants) throughout this system would increase 4 million tons per year if the dams were breached.

The EFFECTS
Water Supply

Water from the lower Snake River is used to irrigate crops, supply backup water for municipal systems and industries, enhance wildlife habitat, and water livestock. In the counties adjacent to the four lower Snake River reservoirs, 19 percent of the agricultural land is irrigated, most of which is located in Franklin (68 percent) and Walla Walla (29 percent) counties. Nearly all of the water for irrigation comes from 12 pumping stations near Ice Harbor Dam. There are also eight municipal and industrial pumping stations along the Snake River. Some additional irrigation water comes from wells, some of which are influenced by the reservoirs.

Alternatives 1, 2, and 3—Existing Conditions, Maximum Transport of Juvenile Salmon, and Major System Improvements

Under the first three alternatives, there would be no changes in the current water supply.

Alternative 4—Dam Breaching

If the dams were breached, pumping station intakes that currently withdraw water from the reservoirs would be above the new water level. Pump modifications would be required for Snake River water to be pumped for irrigation and other water uses. If irrigation water from the Snake River was no longer available, the economic impact in terms of lowered farmland value could equal $134,240,000. Pump modification costs calculated for municipal and other industrial water users were estimated to range from $11,514,000 to $55,214,000. Irrigation wells within one mile of the reservoirs could also require modifications, which were estimated to cost $56,447,000. These costs combined would result in an annual average cost of $15,424,000 over the 100-year period of analysis used for this study. This average cost was calculated using a 6.875 percent interest rate.

Another potential impact of Alternative 4—Dam Breaching is the release of silt and sand now accumulated behind the dams, which could cause damage to pumps, valves, and other water systems components. Most of the costs identified would be non-Federal costs.

The EFFECTS

Cultural Resources

Cultural resources in the Snake River Basin are a rich source of information about prehistoric and historic human use and occupation dating back almost 11,000 years. Cultural resources include sacred places, prehistoric archaeological sites, historic sites, and traditional cultural places. Sacred places include but are not limited to burial grounds, cemeteries, or locations of ceremonial use and focus. Prehistoric archaeological sites typically include villages, open campsites, rock shelters, and rock features or alignments. Historic sites include archaeological resources and structures, buildings, and objects that represent Euro-American influences. Traditional cultural places are areas and resources that are associated with cultural practices or beliefs of a living community that are rooted in that community's history and are important in maintaining the continuing cultural identity of the community.

There are approximately 375 known prehistoric and historic archaeological sites within the reservoirs of the four lower Snake River dams, some of which are partially or completely inundated. Negative impacts to cultural resources result from high water flows, wave action, and human activities (e.g., vandalism). Cultural resources are protected by law.

Alternatives 1—Existing Conditions

There would be no change from current conditions under this alternative. Current efforts related to cultural resources protection would continue.

Alternatives 2 and 3—Maximum Transport of Juvenile Salmon and Major System Improvements

There would be a slight increase in wave action impacts from additional barge traffic under Alternative 2 compared to Alternative 1. However, that number is very small; therefore, the expected change in number of barge trips would have little effect on potential wave action impacts. Alternative 3 would also produce a temporary slight increase in wave action during installation of new bypass systems. Otherwise, there would be no change from current conditions under these alternatives.

Alternative 4—Dam Breaching

This alternative would expose sites that have been inundated for decades. While this would make cultural resources accessible for study and tribal use, it would also expose them to the fluctuations of a river with near-natural flow, erosion, vandalism, and trampling by animals. In the event of dam breaching, the Corps would conduct a comprehensive inventory to identify and assess cultural resource conditions and develop an appropriate resource management strategy to help protect these sites.

The EFFECTS

Native American Indians

The FR/EIS discusses the following Native American Indian tribes and bands whose interests and/or rights may be affected by the proposed Federal actions described in the FR/EIS:

Confederated Tribes of the Umatilla Indian Reservation

Confederated Tribes and Bands of the Yakama Nation of the Yakama Reservation

Nez Perce Tribe of Idaho

Confederated Tribes of the Colville Indian Reservation

Wanapum Band

Confederated Tribes of the Warm Springs Reservation of Oregon

Shoshone-Bannock Tribes of the Fort Hall Reservation

Shoshone-Paiute Tribes of the Duck Valley Reservation

Burns Paiute Tribe of the Burns Paiute Indian Colony

The Spokane Tribe of the Spokane Reservation

Coeur d'Alene Tribe

Kalispel Indian Community of the Kalispel Reservation

Kootenai Tribe of Idaho

Northwestern Band of the Shoshoni Nation.

Five tribes—the Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian Reservation, the Yakama Nation, the Confederated Tribes of Warm Springs Reservation of Oregon, and the Shoshone-Bannock Tribes of the Fort Hall Reservation— provided specific input because of their close cultural and economic links to the salmon and the lower Snake River. Impacts to tribal circumstances may be viewed in terms of tribal ceremonial, subsistence, and commercial harvest of salmon, and tribal access to lands significant to the tribes.

A Tribal Circumstances report was prepared by a private consultant in association with the Columbia River Inter-Tribal Fisheries Commission. The following alternative analysis was derived from that report.

Tribal salmon harvest numbers presented in that report were based on preliminary PATH data weighted by its scientists and extended by the Drawdown Regional Economic Workgroup (DREW) Anadromous Fish Workgroup to represent all Snake River wild and hatchery stocks. Due to concerns associated with the weighting process, unweighted PATH results were used in all other analyses for this Feasibility Study.

Alternatives 1, 2, and 3—Existing Conditions, Maximum Transport of Juvenile Salmon, and Major System Improvements
According to the Tribal Circumstances report, Alternatives 1 and 2 offer limited hope of salmon recovery within a timeframe considered reasonable by the five tribes represented. The report does not address Alternative 3, but the impacts of Alternative 3 are likely to compare closely with those for Alternative 2. There would be no change in tribal land use under any of these alternatives.

Alternative 4—Dam Breaching
According to the Tribal Circumstances report, this alternative would produce 2.4 times more tribal harvest of Snake River wild salmon and steelhead stocks compared to Alternative 1 (2.6 times more harvest than Alternative 2). At the 50-year benchmark, estimated tribal wild and hatchery harvest would increase by about 1.7 million pounds. The Tribal Circumstances report concludes that only this alternative would redirect river actions toward significant improvements of the cultural and material circumstances of the tribes.

Approximately 14,000 acres of previously inundated land would be exposed under this alternative. The Tribal Circumstances report states that the tribes would benefit from implementation of this alternative by gaining access to lands once used for cultural, material, and spiritual purposes.

The EFFECTS

Transportation

The Federally maintained, 465-mile-long Columbia-Snake Inland Waterway is formed by the eight dams and lock facilities on the lower Columbia and Snake Rivers. Each of the eight dams maintains a system of locks with sufficient depth to accommodate commercial barges. This system provides inland waterborne navigation from Lewiston, Idaho, to the Pacific Ocean, carrying commodity shipments from inland areas of the Pacific Northwest as far away as North Dakota. Tugs, barges, log rafts, and recreational boats use the locks throughout the year.

Downriver commodity shipments are about nine times the volume of the upriver movements. This is primarily because of the large movements of grain bound for Columbia River export terminals. Columbia-Snake Inland Waterway transport accounts for approximately 40 percent of grain arriving at downriver export terminals.

Grain products, mostly wheat and barley, make up 78 percent of the shipments passing through the Ice Harbor navigation lock. Wood chips and logs are about 16 percent of the river transport loads and petroleum products account for about 3 percent. The yearly average of commodities traveling through the Ice Harbor navigation lock from 1987 through 1996 averaged about 3.8 million tons per year.

Any major changes to this mode of transportation would affect other regional transportation systems and the economics of shipping goods.

Alternatives 1, 2, and 3—Existing Conditions, Maximum Transport of Juvenile Salmon, and Major System Improvements

Under the first three alternatives, the navigation locks would continue to operate as they do now. None of these alternatives would cause major changes in commodity shipping patterns.

Alternative 4—Dam Breaching

This alternative would have a significant impact on commercial shipments because barge transportation would no longer be available through the lower Snake River. To move these commodities, including an estimated 126.6 million bushels of grain annually, additional truck or rail transportation would be needed. Commodities would be rerouted by truck to river elevators on the Columbia River or shipped by rail directly to export terminals. Transportation costs would increase because barge transport is less costly and, in some cases, more direct than other transportation modes. Major improvements in rail and highway capacity would be needed to accommodate the shift. The projected increase in cost per bushel of grain is estimated to range from 6 cents in Oregon to 21 cents in Montana. The costs for transporting other commodities are anticipated to increase by about 5 percent. The average annual cost associated with transportation would be approximately $38 million. This cost has been revised from the average annual cost of $24 million reported in the Draft FR/EIS. During review of the Draft FR/EIS independent reviewers and the public raised questions about the assumption that grain-handling capacity could be expanded and other infrastructure improvements could be made without upward pressure on average costs. In response to these concerns, marginal costs and revenue of infrastructure improvements were compared and costs in excess of marginal revenue (fees and other revenue from handling and transporting grain that would be diverted from the lower Snake River) were added to the National Economic Development (NED) costs of dam breaching.

The EFFECTS
Transportation.....CONT.

Approximately 29 percent of the grain would likely be diverted to rail transport. This increase in volume would require improvements to railroad infrastructure in terms of mainline railroad upgrades, short-line railroad upgrades, additional rail cars, and increased export terminal rail car shortage. These improvements are estimated to cost from $50 million to $89 million. The rest of the grain would likely be moved by trucks. Breaching the dams would result in a decrease of about 1.9 million truck miles in Idaho (because grain would be shifted to rail transport), but there would be an increase of approximately 3.9 million truck miles in Washington (because trucks would carry grain the additional miles to reach the Columbia River ports). If the dams are breached, required highway improvements are estimated to range from $84 million to $101 million. River and country grain elevator improvements would also be required. The cost of these elevator improvements is estimated to range from about $60 million to over $352.3 million. The additional traffic, due to increased transportation of goods, could increase highway and rail safety concerns.

The EFFECTS
Electric Power Generation

The Columbia River and its tributaries are extensively developed for hydroelectric power, with over 250 Federal and non-Federal dams constructed since the 1930s, including 30 major multi-use facilities built by Federal agencies. These facilities, on average, account for about 60 percent of total regional energy needs and 70 percent of total electric generating capacity. Hydropower generation has kept Pacific Northwest electricity rates low. Surplus hydropower is also an important export. The four lower Snake River dams have a peaking capacity of 3,033 megawatts, which accounts for approximately 5 percent of energy produced in the Pacific Northwest. Bonneville Power Administration distributes and markets hydropower generated by these facilities.

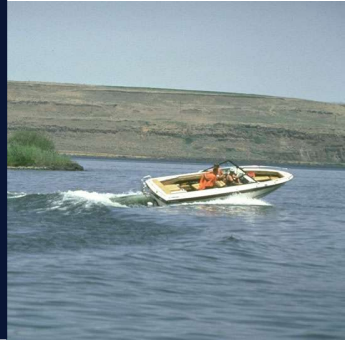
Alternatives 1, 2, and 3—Existing Conditions, Maximum Transport of Juvenile Salmon, and Major System Improvements

Under the first three alternatives, the dams would continue to produce hydropower. Hydropower generation from existing facilities could increase as projected by power needs. There are no changes anticipated in electricity rates resulting from actions under these alternatives.

Alternative 4—Dam Breaching

If the four dams were breached, the four lower Snake River hydropower facilities would no longer be operated or produce hydropower electricity. The loss of this approximately 3,033 megawatts of peaking capacity could require the construction and operation of alternative power sources. Lost hydropower could be replaced by a more expensive form of electric generation, which could result in increased costs of $251 to $291 million per year. The costs involved in replacing this electric power capacity could result in electric rate increases for residences and businesses in the Pacific Northwest. Depending on what facilities are built and how they are funded, residential electrical bills could increase from $1.20 to $6.50 per month. Pacific Northwest aluminum companies, which are extremely large consumers of electricity, could see average monthly increases between $170,000 and $940,000.

The economic analysis of power impacts was based on the assumption that any new replacement generating facilities would be natural gas-fired combined-cycle combustion (CC) turbine plants. Since hydropower generation releases no air emissions, the replacement of the hydropower generation with thermal-based plants would increase air pollution by over 4 million tons per year. To see if the effects of Alternative 4 on air pollution could be reduced, a study was done to evaluate a conservation replacement strategy, where thermal generation resources, renewable resources, or conservation could be used to replace the hydropower generation lost with dam breaching. It was determined that conservation and renewable resources could be used to replace the hydropower generation from the four lower Snake River dams and result in no net change in air pollution from the existing conditions.The costs would be similar to, but higher than, the replacement with natural gas-fired CC turbine plants. The implementation of conservation/renewables would, however, require considerable government intervention, including subsidies, and implementation long before the dams were breached. The CC plant replacement strategy would require almost no government intervention or subsidies.



The EFFECTS

Recreation and Tourism

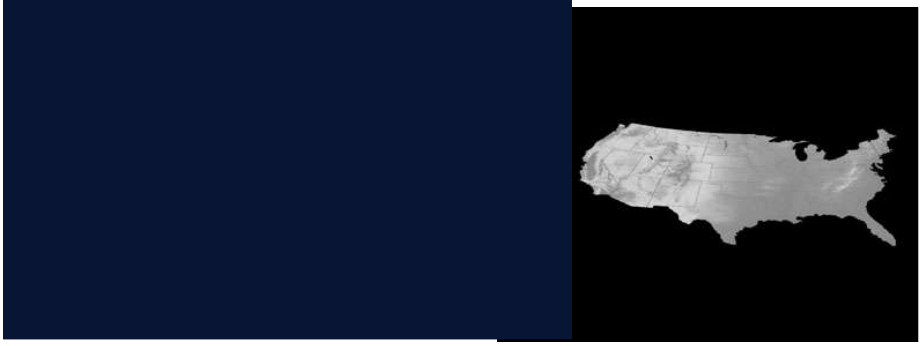
The lower Snake River, its reservoirs, dams, and adjacent shorelines offer both land- and water-based recreational activities. Water-based recreational activities include fishing, water-skiing, boating, windsurfing, and swimming. Boat launch ramps, beaches, marinas, and other facilities have been developed to support these activities. Land-based activities such as picnicking, camping, hunting, and hiking are also popular and take place at facilities along the reservoirs. The dams and reservoirs are also important recreational sites, receiving significant numbers of visitors throughout the year. Powerhouse tours and adult fish viewing are popular visitor activities at the dams. There are 33 developed recreational sites around the lower Snake River reservoirs. Approximately 2 million visitors use these facilities each year.

Alternatives 1, 2, and 3—Existing Conditions, Maximum Transport of Juvenile Salmon, and Major System Improvements

There would be little impact on recreation activities under these three alternatives. Current use patterns would generally continue, although the demand for recreation opportunities would likely increase as the regional population grows. Alternatives 2 and 3 could produce improvement in fishing-related opportunities and use of facilities if fish population levels increase.

Alternative 4—Dam Breaching

Breaching the four dams would change current developed recreation areas and dispersed recreation sites, as well as recreation activities and visitation. The existing reservoirs would be replaced by a river with near-natural flow. Some activities that occur on reservoirs, such as certain types of boating, fishing, and wildlife viewing, could also occur on a river with near-natural flow. However, 29 of 33 developed recreation areas would either be closed or would require extensive modifications. Many current dispersed sites dependent on water access or viewing would no longer be used, but new dispersed sites would develop in the future as the river shoreline stabilized and beaches and views developed. Water-based recreation activities would change from flat-water to river-oriented and use patterns would shift over several years. After an initial decrease in use, both recreational fishing and general recreation would be expected to increase within 10 years as the river is restored and if fish respond to regional salmon recovery efforts. Recreation use surveys were conducted to project the number of visitors and associated value under each alternative. The analysis based on the results of these surveys identified net average annual recreation benefits of $71 million under Alternative 4. This benefit reported in the Final FR/EIS was revised (down from $82 million in the Draft FR/EIS) after additional analyses were conducted in response to comments received from independent technical reviewers, the public, and government reviewers. This value does not directly correspond to local expenditures by visitors. Rather, it represents a measureof the utility that visitors would obtain from the near-natural river recreation experience.



The EFFECTS

Economic Uses

Actions taken to improve fish passage and survival along the lower Snake River could have economic and social effects on local communities, the Snake River region, the Pacific Northwest, and the nation as a whole. The economic and social effects of actions related to the lower Snake River have been analyzed by numerous entities throughout the region. To reduce conflicting analyses and pool resources for a more efficient effort, the Corps convened the Drawdown Regional Economic Workgroup (DREW) to develop a combined economic and social analysis. Members of DREW included representatives of various Federal and regional agencies, tribal representatives, and other interested parties.

DREW conducted the technical analyses to assess the potential economic and social effects of the four alternatives. Primary areas of analysis included power, recreation, transportation, irrigation, water supply, commercial fishing, avoided costs, implementation costs, and tribal circumstances. The final analysis addresses potential economic and social effects at three geographic scales—national, regional, and local. National and regional effects are addressed in separate accounting stances. The National Economic Development (NED) account displays changes in the economic value of the national output of goods and services, while the Regional Economic Development (RED) account addresses changes in the distribution of regional economic activity. Local effects—specifically those to potentially affected local communities and tribes—are addressed under separate accounts. The results of the tribal analysis conducted as part of the Feasibility Study are discussed in the Native American section of this summary document (page 35). The results of the NED, RED, social, and community analyses are discussed in this section (Effects of Economic Uses) and the following section (Effects on Regional Economic Development, Social Resources, and Communities).

National Economic Development

The NED account addresses the net effects of a proposed action upon the nation. NED analysis is concerned only with economic efficiency at the national level. Economic gains achieved by one region at the expense of another region are not measured as NED benefits. NED costs and benefits are expressed in dollars. The NED analysis conducted for this study addresses power, recreation, transportation, water supply, commercial fishing, tribal circumstances, and implementation/avoided costs. There are no dollar benefits or costs presented or tribal circumstances or flood control. NED benefits associated with increased tribal harvest are included in the commercial fishing totals. Ceremonial and subsistence harvests are assigned a food value in the commercial fishing totals. They are not assigned an additional intrinsic dollar value.

Economic Uses

Summary of Average Net Annual Economic Effects, 1998 Dollars in Thousands of Dollars at 6.875 percent Discount Rate

	Alternative 2	Alternative 3	Alternative 4
Costs			
Implementation Costs	-	(22,880)	(48,790)
Power	-	-	(271,000)
Transportation	-	-	(37,813)
Water Supply	-	-	(15,424)
Avoided Costs	-	(10)	-
Total Cost	-	*(22,890)*	*(373,027)*
Benefits			
Avoided Costs	-	-	33,570
Recreation	1,405	1,437	71,255
Commercial Fishing	160	158	1,486
Implementation Costs	3,460	-	-
Power	8,500	8,500	-
Total Benefits	*13,525*	*10,095*	*106,311*
Net Benefits	**13,525**	**(12,795)**	**(266,716)**

Notes:

1. These costs and benefits, calculated for a 100-year period of study extending from 2005 to 2104, are discounted using a 6.875 percent discount rate and converted to 1998 dollars.
2. Costs and benefits are presented for Alternatives 2 through 4 net of the base case (Alternative 1—Existing Conditions).
3. A positive monetary value indicates that the alternative being evaluated has a lower cost or greater benefit than Alternative 1—Existing Conditions. A negative monetary value (in parentheses) indicates that the evaluated alternative has a higher cost or lower benefit than Alternative 1—Existing Conditions. Positive monetary values, therefore, represent benefits, while negative values represent costs.

Source: Appendix I, Economics (Table ES-11).

Economic Uses

NED costs are:

- Implementation costs, including all project-related construction and acquisition costs; interest during construction; and operation, maintenance, repair, replacement, and rehabilitation costs. Implementation costs also include water acquisition from U.S. Bureau of Reclamation, mitigation costs for fish and wildlife programs, and cultural resources protection (Alternatives 3 and 4)
- Cost increases associated with the shift from hydropower to more expensive forms of replacement power (Alternative 4—Dam Breaching)
- Transportation cost increases associated with the shift of barge-transported commodities to more costly truck and rail systems (Alternative 4—Dam Breaching)
- Construction/operation and maintenance costs for irrigation and water supply systems (Alternative 4—Dam Breaching)
- Avoided costs—costs incurred under Alternative 3—Major System Improvements that would not be incurred under Alternative 1—Existing Conditions, or under Alternatives 2 and 4 (turbine maintenance and replacement, lock and dam maintenance, etc.).

NED benefits are:

- Costs incurred under Alternative 1—Existing Conditions that would be avoided under Alternative 4—Dam Breaching. These include operations, maintenance, repair, and replacement costs, as well as the costs associated with the rehabilitation of existing infrastructure
- Recreation benefits from increased fish runs and the shift to a near-natural river
- Commercial fishing benefits from increased fish runs
- Implementation costs for fish-related improvements that would not be incurred under Alternative 2—Maximum Transport of Juvenile Salmon
- Power benefits from increases in system hydropower generation (Alternatives 2 and 3).

Passive Use Estimates

Economists generally recognize that there is a benefit associated with knowing that a resource exists, even if no use is made of it. These values are typically referred to as passive use, non-use, or existence values. There are, however, disagreements about how to measure passive use values. Although DREW initially requested that an original passive use survey be conducted for this study, this was not possible. Passive use values were estimated by transferring and adapting values from other passive use studies. Corps Planning Guidance does not allow passive use values to be included in NED analysis. However, since these values could be useful as a social indicator, they were calculated as part of the Feasibility Study to provide additional information for the decision maker to consider.

The passive use value estimates for salmon were calculated on a per fish basis based on the preliminary PATH results, which have been updated since the passive use analysis was completed. Values were calculated for Alternatives 2 through 4 net of Alternative 1. Under Alternative 2, net gains over Alternative 1 were estimated to range from $0.25 million to $4.02 million per year. Salmon and steelhead runs projected for Alternative 3—Major System Improvements were less than those projected for Alternative 1—Existing Conditions, resulting in an estimated net average annual reduction ranging from about $0.7 million to about $31.1 million per year. Passive use values for Alternative 4—Dam Breaching ranged from $22.8 million to $301.5 million per year. The passive use value of a near-natural lower Snake River was estimated at $420 million per year.

Using the more recent 1999 PATH model results would lower the estimated passive use value for Alternative 4 and reduce the difference between Alternatives 1 through 3 and Alternative 4. The passive use values associated with the near-natural river would not change.

The EFFECTS

Regional Economic Development, Social Resources, and Communities

The RED account measures the impacts that the types of economic effects addressed in the NED account would have upon the regional economy. Direct changes in one sector of the economy have indirect and induced effects distributed throughout the regional economy. Economic activity within one industry ("direct" activity) generates activity in others as firms purchase services and materials as inputs ("indirect" effects) and employees spend their earnings within the local economy ("induced" effects).

The following discussion addresses the regional effects that the proposed alternatives would have upon the lower Snake River region and the Pacific Northwest. This section also summarizes the potential effects of the proposed alternatives upon local communities and low income and/or minority populations.

Lower Snake River Region

Regional impacts under Alternatives 2 and 3 would be relatively minor. There could be minor job gains associated with implementation costs, avoided costs, and anadromous fish harvest.

Alternative 4—Dam Breaching would result in a number of jobs in the region being permanently lost, with others permanently gained. Job losses are anticipated as a result of projected reductions in irrigated farmland, reductions in spending by the Corps, and the loss of barge transportation and cruise ship operations. Permanent job gains are expected to result from replacement power facilities, changes in recreation activity, and long-term implementation expenditures. Permanent job losses are projected to be larger than permanent gains, with a net long-term loss of 1,372 jobs in the lower Snake River region.

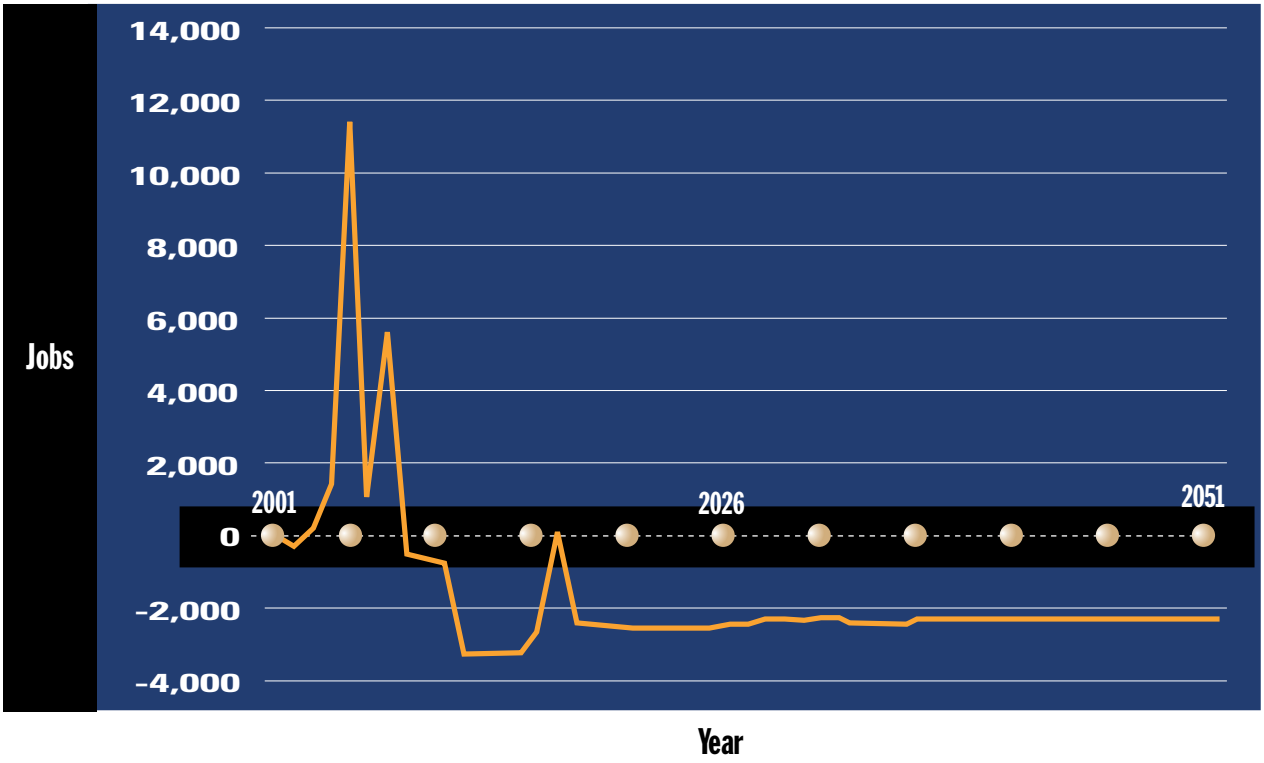
Breaching the dams would generate a substantial number of short-term jobs in the lower Snake River. These jobs are primarily expected to occur as a result of construction activities associated with replacement power facilities, recreation facilities, transportation infrastructure, pump and well modification, and project implementation. Relatively large short-term employment is expected to be associated with power plant construction (5,572 jobs) and transportation facilities construction (6,982 jobs). These totals represent the maximum annual employment that would occur in each case. The maximum short-term employment gain projected for any one year is 14,871.

The EFFECTS
Regional Economic Development, Social Resources, and Communities

Pacific Northwest

The preceding section only addresses those changes that are expected to occur in the lower Snake River area. Alternative 4—Dam Breaching would also have effects that would either occur throughout the Pacific Northwest or in an area of the region outside of the lower Snake River area. Additional jobs would be permanently lost, with others permanently gained. Job losses would mainly be associated with projected increases in electricity bills (2,382 jobs). Permanent job gains are expected to result from replacement power facilities (located outside the lower Snake River area), changes in transportation, and changes in commercial and ocean recreational fishing. There would also be short-term job gains associated with construction activities that would take place outside the lower Snake River area (power plant construction and railcar storage construction).

The overall regional impacts of Alternative 4—Dam Breaching for the Pacific Northwest are illustrated in the figure below, which shows the projected annual net change in employment for project years 1 through 50. This figure illustrates that the maximum annual net employment gain for the region as a whole would be 11,384 jobs in project year 5. In the long term, the projected number of permanent job losses is expected to be larger than permanent gains, with a net long-term loss of 2,290 jobs in the region as a whole.



Source: FR/EIS Appendix I, Economics, Figure 6-4.

Communities

Under Alternatives 2 and 3, effects on communities would generally be minor. Some communities upriver may be adversely affected by lower probabilities of salmon recovery. Uncertainty surrounding the future of the dams may negatively affect some communities. Coastal communities could receive minor economic benefits from increased fish runs if salmon returns increase significantly.

Under Alternative 4, upriver communities would likely gain jobs from recreation and tourism associated with a near-natural river and increased fish runs. Job losses may occur in the forest products sector as a result of the loss of river navigation. Communities in the reservoir subregion would likely experience a net decrease in employment due to reductions in Corps employment and increased pressure on family farms. Downriver communities would lose jobs if farms currently irrigated from the Ice Harbor reservoir go out of business. These losses would be partially offset by gains in transportation-and power generation-related employment. Coastal communities would receive economic benefits from increased fish runs.

Adverse community effects perceived by residents of communities in the lower Snake River region include decreases in population, tax revenues, businesses, property values, agricultural base, decreased quality of schools, as well as increased traffic congestion and business failures. Other lower Snake River region communities with more tourist-oriented economics perceived benefits. Residents of Southern Idaho communities perceived impacts ranging from somewhat beneficial to very adverse. Beneficial effects were associated with increased fish runs. Negative effects included increased transportation and utility costs.

Low Income and/or Minority Populations

Tribal representatives stated that Alternatives 1, 2, and 3 would do “little or nothing” to correct the cumulative inequities that tribes have suffered from construction and operation of the four dams. Under Alternative 4—Dam Breaching, increased salmon runs would benefit the tribes, as would the exposure of approximately 14,000 acres of currently inundated lands. Conversely, Hispanic workers employed on farms irrigated from the Ice Harbor reservoir would be disproportionally affected if these farms go out of business as a result of Alternative 4—Dam Breaching.

The Recommended Plan (Preferred Alternative)

Based on a thorough examination of the best available biological, economic, social, environmental, and other related information, the Corps has selected a recommended plan (preferred alternative). The recommended plan is a modified version of Alternative 3—Major System Improvements (Adaptive Migration), with increased focus on adaptive migration capabilities. The alternative analysis and evaluation of impacts summarized in this document and described in detail in Chapter 5 of the Final FR/EIS include all components or actions contained in the recommended plan.

The recommended plan combines a series of the structural and operational measures described and evaluated in the FR/EIS for Alternative 3 that are intended to improve fish passage through the four lower Snake River dams. This alternative provides the maximum operational flexibility for juvenile fish passage; it optimizes in river passage when river conditions are best for fish and optimizes the juvenile transportation program when that operation is best for fish. It also allows for optimized combined passage when necessary for spread-the-risk operation or to conduct needed research. These improvements are not only intended to reduce direct mortality associated with dam passage, but also to reduce stress on juvenile fish, reduce total dissolved gas, and improve operational reliability.

Selection of the Recommended Plan (Preferred Alternative)

The rationale for selecting the recommended plan (preferred alternative) is a composite of analyses, information briefings, evaluations, technical expertise, and comments concerning the factors evaluated as part of the Feasibility Study. The selection of the recommended plan resulted from the evolution and development of the extraordinary collection of scientific data and information presented in the FR/EIS, its associated appendices, and supporting research materials and reports. The Corps believes the information collected represents the best available science and information to date.

The key factors supporting the selection of this alternative were:

- High current juvenile and adult salmon and steelhead survival rates through the Lower Snake River Project
- Proposed improvements provide the maximum flexibility of all alternatives in terms of optimizing both in river migration conditions and transport conditions
- Lesser magnitude of uncertainty in current biological information
- Minimal economic impacts to users
- Compatibility with NMFS and USFWS 2000 Biological Opinions
- Minimal effects to other environmental resources.

Other factors considered in this selection include, but were not limited to, those effects associated with social and community resources, Native Americans, technical feasibility, effectiveness of structural modifications, regional acceptability, public comments, and length of implementation.

Components of the Recommended Plan (Preferred Alternative)

The structural and operational measures identified for the recommended plan (preferred alternative) are considered to be technically feasible, implying that the Corps has the capability to design, construct, and operate these measures.

Structural Measures

The structural improvements associated with the recommended plan can be placed into two categories. The first category is near-term improvements, consisting of modifications to existing systems using current technology. These require little or no additional study or research. Near-term improvements can be implemented relatively quickly (within the first 5 years after the final Record of Decision is signed). The second category is long-term improvements. These improvements require additional evaluation, prototype development, and testing. Therefore, these improvements take more time to put into place. The actual determination on if, where, how, and when these long-term improvements are implemented would be contingent on the prototype testing and evaluation results. Implementation would also be dependent on a continued need for improvements in the hydropower system.

Near-term improvements proposed are:

- Complete installation of spillway flow deflectors at Lower Monumental and Little Goose
- Upgrade auxiliary fish ladder water supply systems at Ice Harbor, Lower Monumental, Little Goose, and Lower Granite
- Modify extended submerged bar screens at Little Goose and Lower Granite
- Use additional barges for transport with upgraded mooring facilities at Lower Granite.

Long-term improvements proposed are:

- Install new juvenile facility at Lower Granite
- Install new cylindrical dewatering screens at all dams
- Replace submerged traveling screens with extended-length submerged bar screens at Ice Harbor and Lower Monumental
- Install new wet separators at Lower Monumental and Little Goose
- Install turbine improvements (as powerhouses are rehabilitated)
- Install removable spillway weirs with or without behavioral guidance structure at all four dams
- Install two-unit powerhouse surface bypass with or without dewatering system at Lower Monumental and Lower Granite
- Build full-length powerhouse occlusion structure at Little Goose.

Components of the Recommended Plan (Preferred Alternative)

Operational Measures

In addition to current operational measures and continued participation in ongoing monitoring, evaluation, and regional coordination programs, there are two principal areas where potential future operational changes for the lower Snake River need to be further investigated. These areas are:

- Develop and implement biological rules for flow augmentation
- Develop and implement biological rules for smolt transportation, including optimal spill for salmon.

The Corps plans to coordinate with Federal agencies to establish these specific rules for both smolt transportation and flow augmentation. All such operational rule development will continue to be regionally coordinated in a manner consistent with the NMFS 2000 Biological Opinion.

Comparison with Other Alternatives

Sensitivity and trade-off analyses were conducted and considered for each alternative.

During these analyses **Alternative 1—Existing Conditions** was eliminated because it failed to meet the biological requirements in the NMFS 2000 Biological Opinion. Due to the major uncertainty related to the delayed mortality of transported fish, **Alternative 2—Maximum Transport** was ranked lowest of the remaining alternatives because it maximized the collection and transport of juvenile salmon and steelhead.

Although **Alternative 4—Dam Breaching** had a number of positive benefits, it was ranked lower than the recommended plan (preferred alternative) for the reasons including, but not limited to, the following:

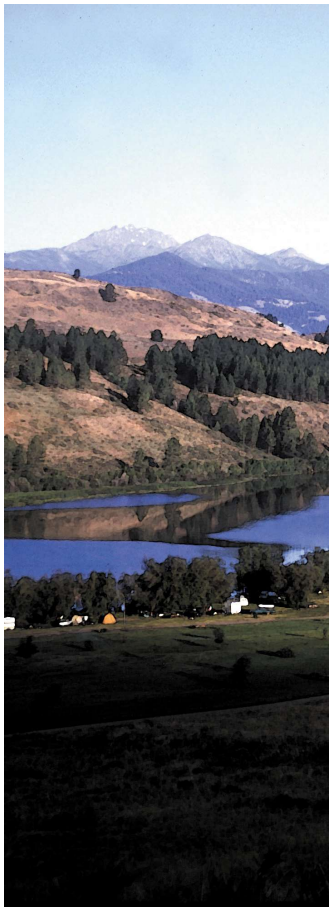
- **Determination that breaching is not necessary at this time to recover listed salmon and steelhead stocks (breaching has not been determined necessary at this time by the NMFS 2000 Biological Opinion)**
- **Maximum negative economic impacts to current system users (i.e., loss of power, navigation, and irrigation)**
- **High sediment movement in the short term**
- **Uncertainty of possible harmful effects associated with the potential resuspension of contaminants in sediments**
- **High degree of uncertainty in the implementation and longest period before positive benefits to listed stocks**
- **Most negative impact to low-income and minority populations.**

Summary Comparison of the Effects of the Alternatives

Resource List	Alternative 2 Maximum Transport	Alternative 3 Adaptive Migration	Alternative 4 Dam Breaching (Short Term)	Alternative 4 Dam Breaching (Long Term)
Aquatic Resources–Anadromous Fish	●	●	○	●
Aquatic Resources–Resident Fish	●	●	○	●
Water Resources				
Sediment	●	●	○	○
Temperature	●	●	●	●
Dissolved Gas	●	●	●	●
Contaminants	●	●	○	●
Terrestrial Resources	●	●	○	●
Air Quality				
Fugitive Dust Emissions	●	●	○	●
Transportation Emissions	●	●	●	●
Replacement Power Emissions	●	●	○	○
Water Supply/Irrigation	●	●	○	○
Cultural Resources	●	●	●	●
Native American Indians (Tribal values)	●	●	●	●
Transportation (Navigation)	●	●	○	○
Electric Power	●	●	○	○
Recreation and Tourism	●	●	○	●
Implementation/Avoided Costs (Economics)	●	○	○	○
Social Effects	●	●	○	○

● A positive effect ● Minimal or notable change in effect ○ A negative effect

Source: Condensed from Table 6-14 of Final FR/EIS, which also includes comparisons for lamprey, bull trout, traffic safety, geological resources, aesthetic resources, etc.



Consistency with Planned Regional Salmon Recovery Efforts

Of all the alternatives investigated in the FR/EIS, the recommended plan (preferred alternative) most closely matches recommendations in the NMFS 2000 Biological Opinion for the Lower Snake River Project. The NMFS 2000 Biological Opinion concluded that dam breaching on the lower Snake River is not necessary at this time, but reserved this action as a contingency management alternative if the listed stocks continue to decline in the near future (2005 to 2008). The Corps' selection of a modified version of Alternative 3—Major System Improvements (Adaptive Migration) as the recommended plan (preferred alternative) is consistent with this conclusion. The plan includes implementation of the actions applicable to the Corps as recommended in the NMFS 2000 Biological Opinion and the USFWS 2000 Biological Opinion for system operations, configuration measures, habitat restoration, and continued research and monitoring activities (or alternative measures that result in achieving the current or revised established performance standards).

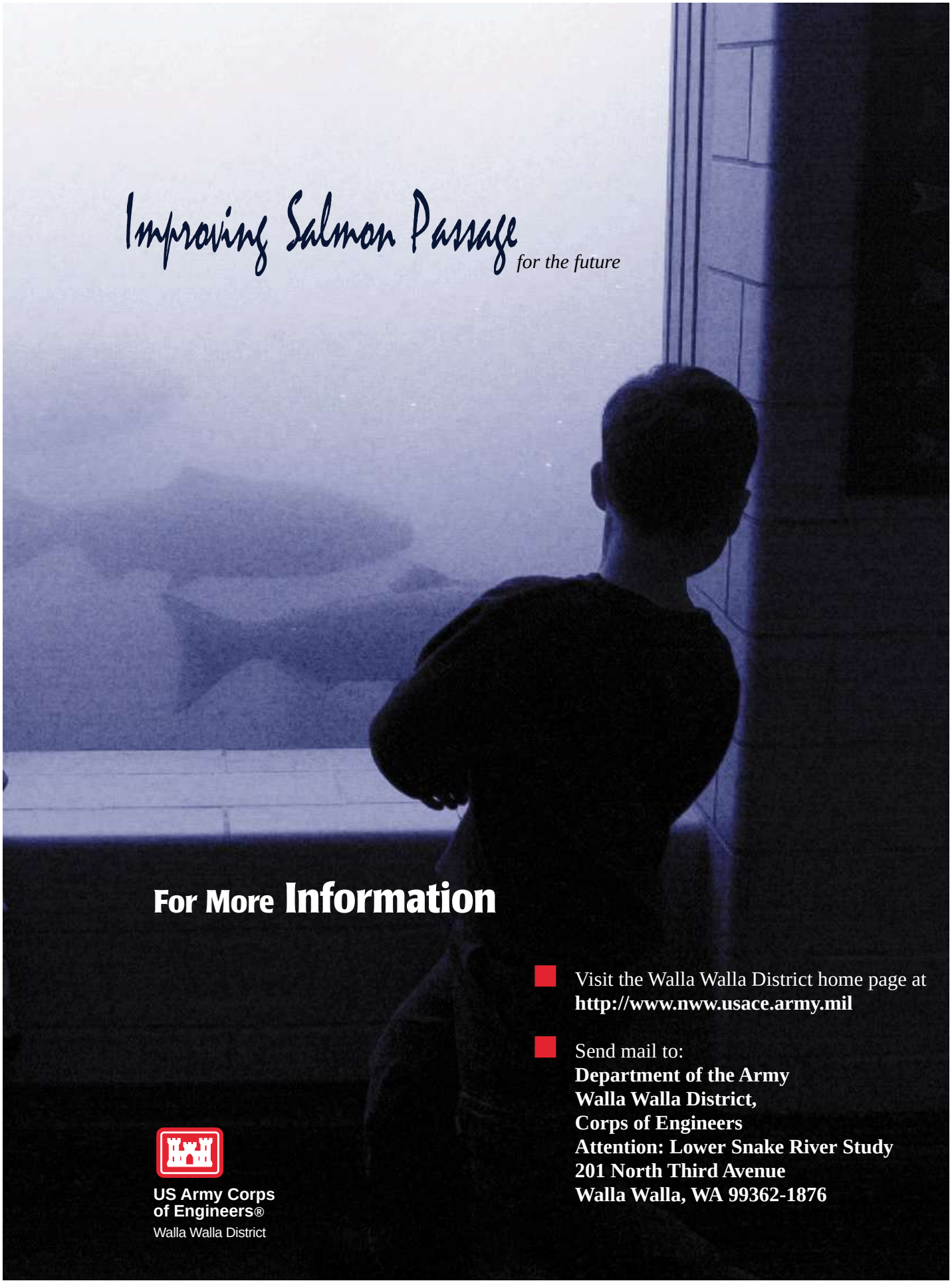
In implementing the Biological Opinions' lower Snake River actions, the Corps will also contribute to the attainment of the goals identified in the *Conservation of Columbia Basin Fish: Final Basinwide Salmon Recovery* dated December 2000. This strategy was developed by several Federal agencies (including the Corps) as part of the Federal Caucus. It is a comprehensive, long-term plan to recover 12 anadromous fish stocks and other listed species (i.e., bull trout and sturgeon) in the Columbia-Snake River Basin.

Where Do We Go From Here?

A final Notice of Availability will appear in the Federal Register indicating that the Final FR/EIS is ready for release to the public. The public will have at least 45 days to consider the recommendation and the rationale before a Record of Decision (ROD) is signed. During the preparation of the ROD, the Corps will consider new data, science, objections, comments, or opinions brought forward to the Corps during the 45-day period.

The Final FR/EIS, including the recommended plan (preferred alternative) and ROD, will be forwarded to the Northwestern Division Engineer for approval and signature. Since the recommended plan (preferred alternative) is consistent with existing project authorities and does not require additional Congressional authorization, the Division Engineer is slated as the signatory of the ROD. However, many of the proposed actions will be included in the Corps' regular appropriation and budget process, which provides opportunity for input from Congress.

The short-term and long-term actions described in the recommended plan (preferred alternative) will be folded into the existing processes for consideration and coordination with the Regional recovery efforts, as they proceed towards implementation. Any further National Environmental Policy Act documentation that is needed will be completed as the specifics and details of construction and implementation, etc., become available on future proposed actions.



Improving Salmon Passage *for the future*

For More Information

Visit the Walla Walla District home page at
http://www.nww.usace.army.mil

Send mail to:
Department of the Army
Walla Walla District,
Corps of Engineers
Attention: Lower Snake River Study
201 North Third Avenue
Walla Walla, WA 99362-1876

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