



Chapter 1

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1. Introduction

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1.1 Historical Overview

Historically, runs of spring/summer chinook salmon (*Oncorhynchus tshawytscha*) were found throughout the accessible and suitable reaches of the Snake River and its tributaries. On the Snake River, they spawned as far upstream as Auger Falls in Idaho, some 930 miles from the mouth of the Columbia River. Fall chinook (*O. tshawytscha*) were also widely distributed in the mainstem of the Snake River (as far upstream as Shoshone Falls, Idaho) and the lower reaches of its tributaries. Snake River sockeye salmon (*O. nerka*) were found in five lakes in the Stanley Basin, Big Payette Lake on the North Fork of the Payette River in Idaho, and Wallowa Lake in the Grande Ronde River Basin. Steelhead, the anadromous form of rainbow trout (*O. mykiss*), were also widely distributed in most accessible and suitable habitats.

Both the distribution and abundance of these anadromous fish species have declined significantly. As a result, on November 20, 1991, the National Marine Fisheries Service (NMFS) declared the Snake River sockeye salmon endangered effective December 20, 1991 (56 Federal Register [FR] 58619). Snake River spring/summer chinook and Snake River fall chinook salmon were listed as threatened on April 22, 1992 (57 FR 14653). Critical habitat was designated for Snake River sockeye, spring/summer chinook, and fall chinook on December 28, 1993 (58 FR 68543). Snake River wild steelhead was formally listed as threatened on August 18, 1997 (62 FR 43937). Table 1-1 identifies the current status of listings for Columbia River salmon and trout species under the Endangered Species Act (ESA) of 1973, as amended.

Many past and present anthropogenic (human-caused) factors have contributed cumulatively to the decline of the anadromous fish runs within the Snake River Basin. For example, between 1910 and 1967, several hundred miles of spawning area were lost because dams were built upstream from Hells Canyon Dam. Approximately 46 percent of the pre-dam anadromous fish habitat in the Snake River Basin was blocked by the construction of Brownlee Dam in 1958. This dam originally had fish passage facilities, but they were not successful in maintaining upstream runs. In addition, completion of Hells Canyon and Oxbow Dams, downstream of Brownlee Dam, further blocked access to 247 miles of habitat in the Snake River (U.S. Bureau of Reclamation [BOR], 1993).

Hells Canyon Dam is the current barrier to upstream migration of adult fish on the Snake River. Similarly, Dworshak Dam, completed in 1974, is a barrier to upstream migration on the North Fork Clearwater River.

Factors contributing to the decline of runs in the Snake River Basin are discussed in the following subsections:

1.1.1 Harvest

Historically, harvest of Snake River salmon and steelhead has occurred in the Snake River, mainstem and estuarine waters of the Columbia River, and in marine waters of the North Pacific. Although current management policies highly restrict harvest and include extensive monitoring, much less restrictive approaches in the past have helped to decrease overall fish populations, thus reducing the number of adults needed to maintain sustainable run populations. Harvest continues to contribute significantly to reduced numbers of returning adults for some salmon and steelhead stocks.

Table 1-1. Federally Listed, Proposed, or Candidate Anadromous Fish Species (Evolutionarily Significant Units [ESUs]) in the Columbia River Basin

Species and ESU (Status, Fed. Reg. Month/Year)	Primary Region of Origin ^{1/}			
	Snake River	Upper Columbia River (above McNary Dam)	Middle Columbia River (Between McNary and Bonneville Dams)	Lower Columbia River (Below Bonneville Dam)
Snake River Fall Chinook Salmon (T, 4/92)	X		X (Deschutes)	
Snake River Spring/Summer Run Chinook Salmon (T, 4/92)	X		X (Deschutes)	
Snake River Sockeye Salmon (E, 11/91)	X		X (Deschutes)	
Snake River Steelhead (T, 8/97)	X		X (Deschutes)	
Upper Columbia River Spring Chinook Salmon (E, 3/99)		X		
Upper Columbia River Steelhead (E, 8/97)		X (Below Priest Rapids Dam)	X	
Middle Columbia River Steelhead (T, 3/99)				
Southwest WA/Columbia River Coastal Cutthroat Trout (T, 4/99)			X (Below The Dalles Dam)	X
Lower Columbia River/Southwest WA Coho Salmon (C, 7/95)			X (Below The Dalles Dam)	X
Lower Columbia River Chinook Salmon (T, 3/99)				X
Lower Columbia River Steelhead (T, 3/98)				X
Columbia River Chum Salmon (T, 3/99)				X
Upper Willamette River Chinook Salmon (T, 3/99)				X
Upper Willamette River Steelhead (T, 3/99)				X

^{1/} Minor exceptions to distribution region may occur.

E = Endangered, T = Threatened, C = Candidate

1.1.2 Loss of Habitat

Land uses throughout the Columbia and Snake river basins have altered the original habitat significantly. For example, loss of riparian areas along streams from logging, farming and urban development, water diversion (including unscreened diversion) and impoundment of free flowing rivers in tributaries as much as on the mainstem, and increased infrastructure (e.g., roads, facility development, and added areas of impervious surfaces) have changed the original habitat and decreased or eliminated favorable habitat conditions. Salmon and steelhead runs adapted to habitat conditions over many thousands of years. In many areas of the Columbia and Snake river basins, these conditions have been significantly changed, or no longer exist.

1.1.3 Estuary Destruction

Estuarine habitat involves critical life stages for anadromous juvenile fish transitioning from freshwater to marine waters or when they return from marine waters to freshwater as adults. This transition involves the physiological changes needed to survive in saline and freshwater systems. Also, for some juvenile anadromous fish species (particularly chinook salmon), the estuary provides important habitat for rearing. The habitat available in the lower Columbia River estuary has been altered and the aerial extent diminished through filling, diking, and other development, thus decreasing the original habitat that was available to support larger fish populations.

1.1.4 Hatchery Salmonids

Large-scale hatchery programs have been implemented throughout the Columbia and Snake river basins as mitigation for loss of habitat and to enhance anadromous fish runs. These programs have been in operation for many decades. In recent years, however, the use of hatcheries has been extensively questioned. Issues include hatchery practices and high hatchery fish harvest rates that may be detrimental to wild runs; potential loss of desirable wild fish genetic characteristics through interbreeding with hatchery fish in the wild; competition between hatchery and wild fish for habitat and food; and predation by hatchery fish on wild fish. Many of these issues are the subject of ongoing research but may contribute to the overall decrease in wild fish populations.

1.1.5 Dams and Reservoirs

Dams and reservoirs have altered the natural characteristics of the Columbia and Snake Rivers, thus changing or eliminating many of the habitat conditions needed to sustain anadromous fish runs. These changes include, for example, inundation of spawning and rearing habitat; total blockage of access to large areas of historical habitat; alteration of depth, flow, and velocity; water quality changes; direct and indirect mortality (e.g., mortalities due to passage through turbines or delayed mortality may occur at a later time due to passage through the hydrosystem or fish being transported); increased predation in reservoirs, and others.

1.1.6 Other Human-related Problems

In addition to the above factors, use of the Columbia and Snake river basins for timber harvest, farming, industrial facilities, urbanization, water supply for municipal and industrial purposes, and other effects directly related to human activities, has

contributed cumulatively to habitat changes that have often not been favorable for supporting healthy anadromous fish populations.

Each of the above factors either individually or in combination may be major contributors to the decline of anadromous fish runs in the Snake River Basin.

While the cumulative impact of overfishing and habitat degradation is considerable, NMFS has determined that the cumulative mortality of spring/summer chinook passing mainstem hydroelectric dams to be an important contributor to the decline of this species in the Columbia River. However, NMFS has determined that no single factor can be isolated as a primary cause of the decline in numbers of listed species (NMFS, 1995). Therefore, a multi-faceted ecosystem approach to species recovery with unified Federal coordination is desired to reverse the declines.

Historically, the main focus of salmon recovery efforts was to develop methods that reduce direct fish passage mortality from the hydrosystem. Examples include operating turbines at levels that reduce injuries or mortality, improving turbine designs, or collecting and transporting juveniles downstream past dams. In more recent years, a major concern has also been the indirect effects of the hydrosystem. For example, one major question is how to improve overall survival by increasing survival of juvenile fish after they have passed Bonneville Dam. While mortality of fish downstream of Bonneville is generally caused by natural processes (e.g., predation, competition, ocean productivity), some may result from anthropogenic factors (e.g., poor fitness of hatchery fish, degradation of the estuary) which may include delayed effects of the hydrosystem on fish survival. This mortality component, characterized as delayed mortality, is a major area of research and development relating to operations of the Lower Snake River Project (the name for the Corps' four lower Snake River facilities combined).

Two sources of delayed mortality have been hypothesized as they relate to the hydrosystem; one being the effects of fish transport, and the other indirect effects to fish from passing through the hydrosystem. The amount of delayed mortality that actually results either from fish being transported or passing through the hydrosystem has not been fully developed and will remain a major area of study in the future.

1.2 Feasibility Study Process

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 ESA.

The U.S. Army Corps of Engineers' (Corps') response to the 1995 Biological Opinion and, ultimately, this Feasibility Study evolved from a System Configuration Study (SCS) initiated in 1991. The SCS was undertaken to evaluate the technical, environmental, and economic effects of potential modifications to the configuration of Federal dams and reservoirs on the Snake and Columbia Rivers to improve survival rates for anadromous salmonids. This process began in response to the Northwest Power Planning Council's (NPPC's) *Fish and Wildlife Program Amendments (Phase II)* issued in December 1991 (NPPC, 1991).

The SCS was conducted in two phases. Phase I of the SCS was completed in June 1995. This was a reconnaissance-level assessment of multiple concepts, including

drawdown, upstream collection, additional reservoir storage, migratory canal, and several other alternatives for improving conditions for anadromous salmonid migration. The results of the study were reported in the *Columbia River Salmon Migration Analysis, System Configuration Study, Phase I* (Corps, 1994). Alternatives that displayed the most potential benefit to anadromous fish were carried into Phase II (see Appendix J, Plan Formulation).

Since 1995, Phase II has developed into a major program containing many separate and specific studies. Evaluation of structural changes for juvenile salmon migration improvements within the lower Snake River are only a portion of the total program. This growth in the scope of Phase II was considered necessary to adequately and efficiently respond to the requirements for multiple evaluations addressed in the 1995 Biological Opinion.

In December 1996, the Corps issued the *System Configuration Study, Phase II, Lower Snake River Juvenile Salmon Migration Feasibility Study, Interim Status Report* (Corps, 1996a) in response to the 1995 Biological Opinion requirement for a preliminary decision regarding the selection of drawdown alternatives. The alternatives evaluated in the *Interim Status Report* included:

- Existing conditions
- Three alternatives for lower Snake River drawdown, including:
 1. Seasonal drawdown, near spillway crest
 2. Seasonal drawdown, near natural river levels
 3. Permanent drawdown, near natural river levels
- System improvements that could be accomplished without a drawdown, primarily through facilities that would improve downstream passage of juvenile fish.

None of these alternatives specifically incorporated a dam breaching scenario.

The findings published in the *Interim Status Report* indicated there was insufficient information at the time for the Corps to make a recommendation on the best configuration of the hydropower system to safely pass juvenile salmon in the lower Snake River. However, preliminary conclusions on the drawdown options indicated that seasonal spillway crest and seasonal natural river should be eliminated from further consideration. Consequently, the Corps recommended the continued investigation of three courses of action to improve salmon migration:

- Current fish programs
- Maximum collection and transport of juveniles with and without installation of surface bypass/collectors
- Dam breaching with permanent drawdown of all four lower Snake River reservoirs to a near-natural river.

Evaluation of breaching only one, two, or three dams was not considered because removal of only one dam would eliminate major navigation and restrict options for collection and transportation of juvenile fish.

Because a decision on the best configuration of the hydrosystem for passage of juvenile salmon on the lower Snake River could not be made in 1996, a second decision point in 1999 was established, as identified in the 1995 Biological Opinion. This decision point was subsequently shifted to 2001. The second decision point involving structural or operational changes to the lower Snake River dams resulted in the December 1999 document, *Draft Lower Snake River Juvenile Salmon Migration Feasibility Report and Environmental Impact Statement* (FR/EIS). The Draft FR/EIS was released for public review and comment. As a result of the review process, the document was revised and updated, culminating in this Final FR/EIS.

In the interim period between the draft and this final document, two new Biological Opinions for the operation of the FCRPS were released in December 2000. One opinion was prepared by NMFS and addresses anadromous salmon and steelhead. The other was prepared by the U.S. Fish and Wildlife Service (USFWS) and focuses primarily on bull trout in the Columbia River Basin and Kootenai River sturgeon. The main emphasis in this FR/EIS is on the NMFS opinion because it has direct bearing on juvenile salmon migration and approaches for improving survival during this migration, particularly past the four dams on the lower Snake River.

The NMFS opinion supercedes the previous opinions developed in 1995 and 1998. Many of the aspects of the 2000 opinion, however, involve the current and future operation of the Corps' lower Snake River dams that were included in the 1995 and 1998 Biological Opinions.

This Final FR/EIS incorporates considerations of the applicable aspects of the NMFS 2000 Biological Opinion. Federal agencies involved in the development of this FR/EIS, besides the Corps, are the cooperating agencies: Bonneville Power Administration (BPA), U.S. Environmental Protection Agency (EPA), BOR, and other participating agencies, including NMFS and USFWS.

1.3 Purpose and Need

A primary responsibility of the Corps in implementing long-term biological opinion alternatives is to conduct a study of those measures that are associated with dams and reservoirs and that influence migration through the hydrosystem. The purpose of the *Lower Snake River Juvenile Salmon Migration Feasibility Study* (Feasibility Study) is 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 lowermost dams operated by the Corps on the Snake River—Ice Harbor, Lower Monumental, Little Goose, and Lower Granite) and assist in the recovery of listed salmon and steelhead stocks. Incorporated into this evaluation is the analysis of direct effects from the hydrosystem (e.g., mortalities that might occur as a result of passage through a turbine), and delayed or indirect effects that may occur after fish have passed through the hydrosystem (e.g., effects that may result in mortality after fish have passed below Bonneville Dam (possibly delayed mortality due to stress from passage or transport)).

This FR/EIS combines the format of a traditional Corps feasibility planning document and an 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 Congressional authorization (if

necessary) and/or subsequent funding for the implementation of any specific alternatives that need regional and Federal support. Therefore, in addition to describing the evaluation and screening of alternative measures that may increase the survival of juvenile anadromous fish through the Lower Snake River Project, this FR/EIS also meets the Corps' need to comply with the National Environmental Policy Act (NEPA).

1.4 Background

Numerous studies and decision documents have been prepared by the Corps and other FCRPS operating and resource agencies that address salmon recovery and improved conditions for salmon survival. Important documents that provide specific background to this study on the lower Snake River include the *Final Columbia River System Operation Review EIS* (BPA et. al., 1995); the *Columbia River Salmon Flow Measures Options Analysis (OA) EIS* (Corps, 1992); and the *Corps Interim Columbia and Snake River Flow Improvement Measures for Salmon Final Supplemental EIS* (Corps, 1993). These documents are incorporated by reference. Several of these documents and significant events are discussed in more detail in Appendix R, Historical Perspectives. This FR/EIS tiers off previous studies and is being prepared directly in response to the requirements outlined in the 1995 and 1998 opinions.

1.4.1 1995 Biological Opinion

In the 1995 Biological Opinion, NMFS determined that the planned and proposed actions for operation and juvenile transport programs were likely to jeopardize the continued existence of listed spring/summer chinook salmon. The 1995 Biological Opinion presented a “reasonable and prudent alternative” (RPA) for operation of the FCRPS. In the 1995 Biological Opinion, NMFS concluded that implementation of the RPA was not likely to jeopardize listed Snake River salmon. In the course of review and through the adaptive management process, NMFS further modified the RPA on November 14, 1996. These modifications primarily addressed ongoing fish enhancement projects at Bonneville Dam and provided clarification for some typographical errors in the 1995 Biological Opinion (e.g., places where spring/summer chinook salmon were inadvertently substituted for “fall” chinook salmon in the incidental take statements).

The RPA in the 1995 Biological Opinion provided the basis for the actions contemplated in the Draft FR/EIS released in December 1999. As described above, the RPA was designed to provide measures for the survival (and eventual recovery) of spring/summer chinook, fall chinook, and sockeye salmon. The RPA used an adaptive management approach for increasing survival and the probability of recovery of listed salmon by:

- Improved bypasses
- Increased spills and spring/summer flows
- Reduced fish handling
- Better fish transportation conditions.

Decision points outlined in the 1995 Biological Opinion included:

- 1996 — The Corps was to complete an interim status report on natural river drawdown, spillway crest drawdown, and surface collectors (Corps, 1996a).

The completed report provided the basis for a preliminary decision on drawdown of the lower Snake River reservoirs.

- 1996 — Engineering and design work on preferred drawdown alternative and surface bypass systems, unless the Corps and NMFS agree on a different course of action.
- December 1998 — Engineering and design work to be completed.
- 1999 (extended to 2001) — NEPA compliance in time to ensure a decision on drawdown or surface bypass systems.

1.4.2 1998 Biological Opinion

On August 18, 1997, NMFS announced the proposed listings of Snake River and Upper Columbia River Steelhead ESUs (62 FR 43937). An ESU is defined as a distinct population segment of vertebrate fish or wildlife that is: 1) substantially reproductively isolated from other nonspecific (same species) population units, and 2) represents an important component in the evolutionary legacy of the species (Waples, 1991).

The Federal operating agencies transmitted their *Biological Assessment for 1998 and Future Operation of the Federal Columbia River Power System, Upper Columbia and Lower Snake River Steelhead* to NMFS on January 21, 1998 (NMFS, 1998). This Biological Assessment (BA) included a request to consult further on lower Columbia River steelhead, which had only been proposed for listing at that time. On March 13, 1998, the lower Columbia River Steelhead ESU was listed as “threatened” by NMFS and was included in the consultation. Consultations ensued over the next two months and on May 14, 1998, NMFS issued its Supplemental Biological Opinion to the March 2, 1995 Biological Opinion (NMFS, 1998).

The 1998 Biological Opinion endorsed most parts of the 1995 Biological Opinion except that it modified plans for fish transportation and spill frequency. It also modified the spill criteria at Lower Granite in light of the success of new extended length screens and modified flow dates and specifications for spill operations at lower Snake River dams. The 1998 Biological Opinion laid out numerous specific terms and conditions for operations of the FCRPS to reduce juvenile and adult mortality.

The conclusions of the 1998 Biological Opinion were that the biological requirements of juvenile and adult Snake River steelhead and spring/summer chinook salmon are similar and that what helps one species will likely help the other. It was also determined that existing information is not sufficient to determine if the interim operations will meet the long-term biological needs of the listed species.

The 1998 Biological Opinion considered the alternative actions from the Interim Status Report (Corps, 1996a). These alternatives were needed to help with recovery of listed species evaluated in the Draft FR/EIS. Importantly, the 1998 Biological Opinion found that lifecycle analyses for estimating probability of survival and recovery did not exist at that time.

In March 1999, NMFS listed six additional anadromous fish ESUs in the Columbia River Basin. These included three chinook salmon ESUs, one Columbia River chum salmon ESU, and two more listings of steelhead ESUs. As a result, the recovery actions on the lower Snake River required further coordination to ensure actions on

the lower Snake River would not adversely affect recovery plans for other Columbia River Basin listed fish and wildlife.

NMFS performed additional modeling for use in its evaluations, designated the CRI. The model evaluates the sensitivity of changes in a specific life-history stage and the relative effect of changes in other life-history stages on achieving biological goals and objectives. The analysis determines if one or multiple H combinations (habitat, hatcheries, harvest, and hydropower) exist and are able to achieve the biological objectives related to recovery of ESA-listed species.

1.4.3 2000 NMFS and USFWS Biological Opinions

The 1995 and 1998 Biological Opinions on the operation of the FCRPS were effective until the 2000 Biological Opinion was signed. A new BA that addresses the effects of the FCRPS on listed species in the Columbia River Basin was completed on December 21, 1999. This BA was developed as part of the continuing consultation between the Federal agencies (“action agencies”) that operate and market power from the FCRPS (BPA, Corps, and BOR), NMFS, and USFWS. The BA was submitted to NMFS and USFWS for review. These agencies responded with two Biological Opinions, which were released as final documents in December 2000 (see Section 1.1).

The action area for the NMFS 2000 Biological Opinion encompasses the mainstem Columbia and Snake Rivers from Chief Joseph Dam and Hells Canyon Dam down to and including the estuary and plume (nearshore ocean) of the Columbia River. This opinion supersedes all previous opinions NMFS has issued, including the 1995 and 1998 Biological Opinions. However, it provides a continuum from these previous opinions and incorporates many of their planning objectives.

The NMFS 2000 Biological Opinion, like many of the previous opinions, includes a RPA. The RPA establishes performance standards that would avoid jeopardizing the continued existence of listed species or adversely modifying their critical habitat. These standards are established in three tiers including:

- Population-level: needed for the listed population to achieve an adequate likelihood of survival and recovery
- Life-stage specific: needed across the lifecycle to achieve the population level performance standards
- Categorized action in habitat, harvest, hatcheries, and hydropower. These standards are applicable to all activities in the specific category and are intended to achieve the life-stage-specific performance standards.

The categorized performance standards in hydropower are very focused on the project operations of Federal dams on the Columbia and Snake Rivers. The full details of the standards are presented in Sections 6.1 and 9.7 and Appendix D of the NMFS 2000 Biological Opinion.

The hydropower actions presented to meet the performance standards are primarily aimed at improving fish passage survival. Specific measures include:

- Enhanced spill and spillway improvements to facilitate higher spill levels without exceeding harmful total dissolved gas (TDG) levels
- Improved flow management

- Physical improvements to both juvenile and adult fish passage facilities
- Increased use of barges and less reliance on trucks to transport summer migrants
- Continuation of spill at collector projects to maximize the survival rate of inriver migrants.

The RPA in the NMFS 2000 Biological Opinion includes nearly 200 action items that are part of the overall approach for the entire FCRPS to meet the performance standards. Many of these actions are specifically aimed at improving passage survival of salmonids through the four dams and reservoirs on the lower Snake River. The RPA also includes an annual and multiyear planning process to refine, implement, evaluate, and adjust ongoing efforts to achieve performance standards. Under the 2000 NMFS Biological Opinion, both annual (1-year) and 5-year plans will be developed and implemented. The plans will cover all operations, configurations, research, monitoring, and evaluations leading to the full attainment of the performance standards by 2010.

In addition, the RPA calls for annual progress reports with major progress reports in 2003, 2005, and 2008. It also requires the pursuit of other ways to avoid jeopardy in the future, including possible breaching of lower Snake River dams, if necessary. The 2005 report will be a rigorous mid-point review. The 2008 report must include a determination of whether or not (under certain conditions) to pursue breaching if NMFS issues a report indicating the efforts to meet performance standards have failed following one of these reviews. Specific steps are described in the 2000 Biological Opinion for advanced planning to reduce the time needed to seek congressional authorization for breaching, which should reduce the time needed for possible implementation. This should avoid delays in schedule if breaching becomes a preferred approach.

1.5 Scope

This FR/EIS provides river managers, users, and the general public with the information and evaluation processes that were used to select a preferred alternative. It also assists these groups in determining how each alternative affects other uses and considers the consequences of changing the way the lower Snake River currently operates.

This first section of this FR/EIS lays the groundwork for later sections and describes the background on how the FR/EIS has arrived at this point in the review process. This section also describes major entities and programs that are involved in the management of the Columbia River System, with particular emphasis on those that manage the system and the effects it may have on listed species. Subsequent sections describe the existing Lower Snake River Project, detail the alternatives developed through this EIS process, discuss the effects of changing how the system functions, and explain the tradeoffs among uses that the various alternatives would precipitate. These sections include:

- **Chapter 2—Affected Projects and Programs.** This chapter describes key features of the Lower Snake River Project, with specific details on each facility (i.e., Ice Harbor, Lower Monumental, Little Goose, and Lower Granite).

- **Chapter 3–Plan Formulation.** This chapter identifies the four alternatives that were evaluated. It also describes other potential actions that may affect the survival of juveniles, but were outside the scope of this FR/EIS. Finally, it addresses alternatives that were considered but eliminated from further consideration for various reasons.
- **Chapter 4–Affected Environment.** This chapter describes current conditions for a number of resource areas (e.g., fish, wildlife, water quality, historic resources, recreation, economics, and others). The current condition of each resource area is described in terms of past and present natural and human actions that have incrementally resulted in the status and condition of the resource today. Ongoing effects on affected resources are cumulative effects that help describe the overall health or status of each resource area. This comprehensive analysis provides the basis upon which the alternatives are evaluated in Section 5.
- **Chapter 5–Environmental Effects of Alternatives.** This chapter evaluates the potential direct, indirect, and cumulative effects of each alternative (1 through 4) on the affected resources and in fulfilling the need for action. The cumulative effects of each alternative are considered in each section. The alternatives are evaluated for each resource area by considering how the alternative actions will effect each resource with respect to any continued incremental effects of ongoing cumulative impacts. The cumulative analysis of reasonably foreseeable future actions.
- **Chapter 6–Plan Selection/Implementation.** This chapter provides detailed information on the evaluations and approaches that were used in the selection of the preferred alternative. This chapter also describes the steps and regulatory processes for implementing the preferred alternative.
- **Chapter 7–Public Involvement.** This chapter describes the public involvement activities (e.g., scoping meetings, informational meetings, newsletters, internet sites) that have taken place to date for this FR/EIS.

Chapters 1 through 7 introduce and address the environmental consequences of the alternatives. Chapters 8 through 13 provide information on compliance with other regulations, information required by the NEPA process, or useful supporting documentation:

- **Chapter 8–Compliance with Applicable Federal Environmental Statutes and Regulations**
- **Chapter 9–Literature Cited**
- **Chapter 10–Glossary**
- **Chapter 11–List of Preparers**
- **Chapter 12–Distribution List.**
- **Chapter 13–Index**

The main text of this FR/EIS is further supported by more detailed technical appendices (Technical Appendices A through U) that address specific topics (e.g., anadromous fish biology, economics, engineering).

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. The ultimate decision and process for decision making in this study is regional in scope and therefore several Federal agencies, states, and tribes were direct participants in the Feasibility Study process. The BOR, BPA, and EPA were all cooperating agencies of this study. The Corps also worked with American Indian representatives, elected officials, other Federal and state agencies, and special interest groups throughout the region. The Corps has gathered input from interested parties to define and evaluate the primary alternatives identified for improving juvenile salmon and steelhead survival rates.

1.5.1 Scoping and Public Involvement

The Feasibility Study was officially announced to the public on June 5, 1995. On that date, the Corps' notice of intent to prepare a Draft FR/EIS was published in the *Federal Register* (Monday, June 5, 1995, Vol. 60, No. 107, p. 29578).

In July 1995, the Corps conducted four public scoping meetings to initiate the Feasibility Study and begin the NEPA process. Each public meeting consisted of an open house and formal meeting. Since the scoping meetings, the Corps has conducted numerous other regional meetings, known as Regional Roundtable Workshops, as well as public outreach meetings to allow the public an opportunity to participate further in the study. Four public information meetings were held throughout the region in September 1997 and another five were conducted in November 1998 (see Appendix O, Public Outreach Program, for additional details).

Formal public meetings were conducted after the Draft FR/EIS was distributed for public review. The series of 15 formal meetings around the region in cooperation with the Federal Caucus, included presentations on the Draft FR/EIS, John Day Drawdown Study, and the Conservation of Columbia Basin Fish All-H Paper. These regional meetings held in February and March 2000 provided an opportunity for formal public questions and comments. A total of nearly 9,000 participants consisting of stakeholders, special interest groups, elected officials, and individuals from the public presented 1,786 oral and taped comments about the two studies and the Federal Caucus paper. Most meetings consisted of an open house, formal agency presentations, a question and answer session, and a public comment session. Oral comments were limited to 3 minutes in length. At some of the meetings, the attendance was so large the oral comments continued late into the night. Not all those wishing to speak stayed late enough to do so, although many provided taped comments instead. Written comments were also 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. The comment period began December 1999 and extended through April 30, 2000. Written comments were received via mail, e-mail, fax, the Corps' web site, and hand-delivery. For a summary of the oral and written comments received and the responses to these comments, please see Appendix V, Response to Public Comments. Appendix O, Public Outreach Program, contains a detailed description of public involvement activities to date on the FR/EIS.

1.5.2 Screening Analysis

The technical analyses and screening of potential options in the Feasibility Study have been conducted in a variety of ways, including the use of workgroups. For example, there were workgroups for carrying out complex biological and economic evaluations. The Drawdown Regional Economic Workgroup (DREW) was a group

of regional economists studying the economic issues associated with alternative actions on the lower Snake River.

The Plan for Analyzing and Testing Hypotheses (PATH) workgroup was a group of state, tribal, Federal, and independent scientists from within and outside the region that projected salmon and steelhead survival rates under various alternatives. PATH is a structured program of formulating and testing hypotheses involving the fundamental biological issues surrounding recovery of ESA-listed salmon and steelhead species in the Columbia River Basin. PATH evaluated all aspects of lifecycles of listed salmon and steelhead to determine the overall present and future population trends. One of the key aspects of this evaluation was estimates of delayed mortalities that occur to juvenile fish after they are collected, transported downstream, and released below Bonneville Dam. The causes of this delayed mortality are not known, but the rate of return of adult fish arriving below Bonneville Dam that had been transported as juveniles is often lower than similar groups of fish that migrate in-river. (This implies that a higher rate of mortality occurs with transported fish below Bonneville Dam.)

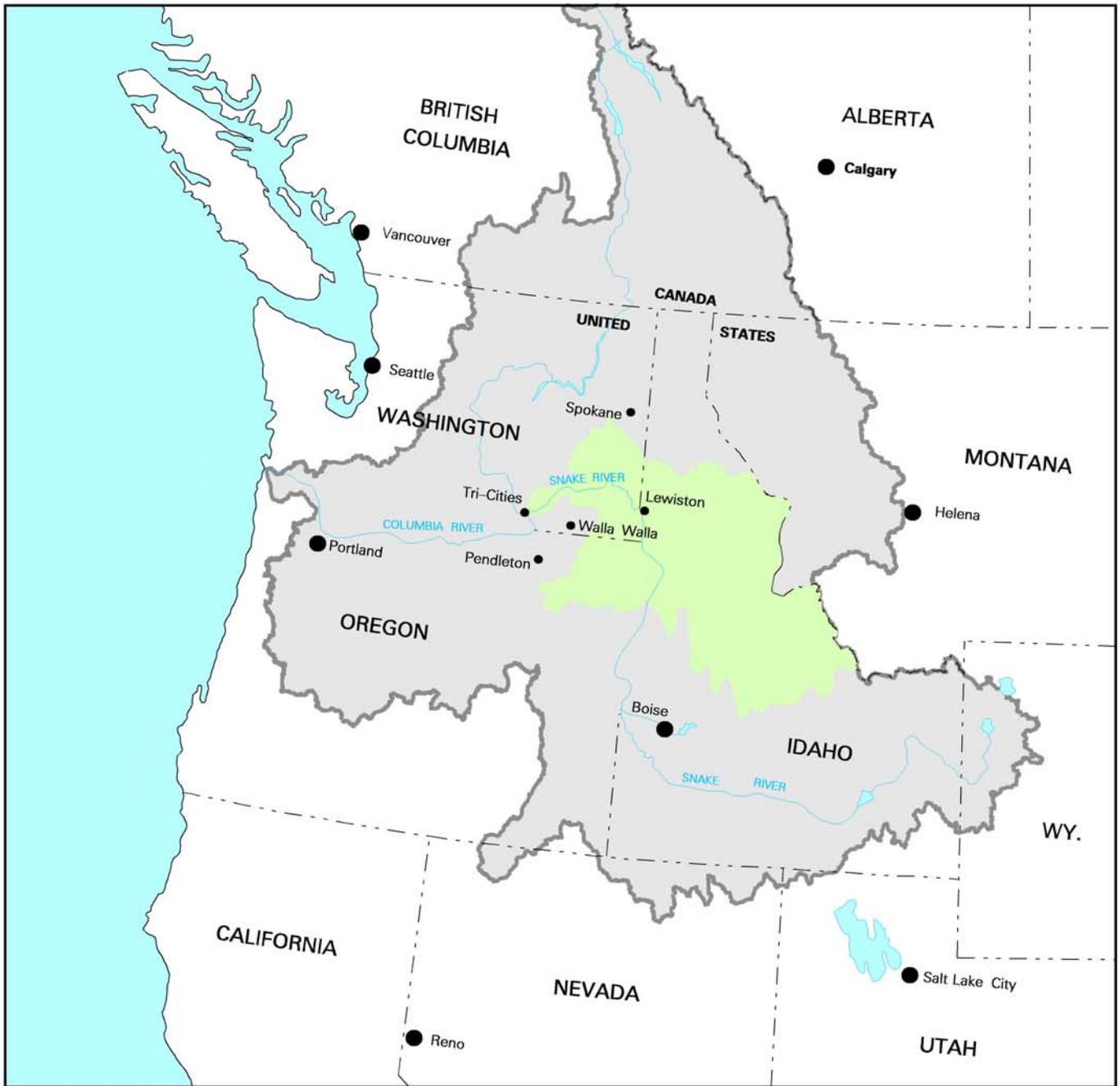
NMFS performed additional modeling for use in its evaluations. This additional modeling has been designated the CRI. It was developed by NMFS' Northwest Fisheries Science Center in Seattle, Washington. The model evaluates the sensitivity of changes in a specific life-history stage and the relative effect of changes in other life-history stages on achieving biological goals and objectives. The analysis determines if one or multiple H combinations (habitat, hatcheries, harvest, and hydropower) exist and are able to achieve the biological objectives related to recovery of ESA-listed species.

In addition to the workgroups, there were also engineers and planners that designed and evaluated specific structural changes that could help more salmon and steelhead pass safely through the dams. The results of these efforts were incorporated into this FR/EIS.

1.5.3 Geographic and Jurisdictional Scopes

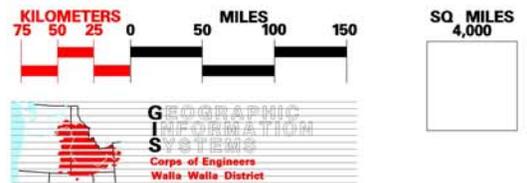
The geographic and jurisdictional scopes for the proposed action were based on the purpose and needs identified in Section 1.2, Purpose and Need. The proposed actions contemplated would be implemented as appropriate at each of four dams along the lower Snake River.

The FR/EIS coverage of the affected environment and environmental consequences focuses on the 140-mile-long lower Snake River reach between Lewiston, Idaho, and the Tri-Cities in Washington (Figures 1-1 and 1-2). The study area does slightly vary by resource area in the FR/EIS because the affected resources have widely varying spatial characteristics throughout the Lower Snake River Project. From a socioeconomic perspective, the effects of a permanent drawdown could be felt throughout the whole Columbia River Basin region, with the most pronounced effects taking place in the counties of southeast Washington.



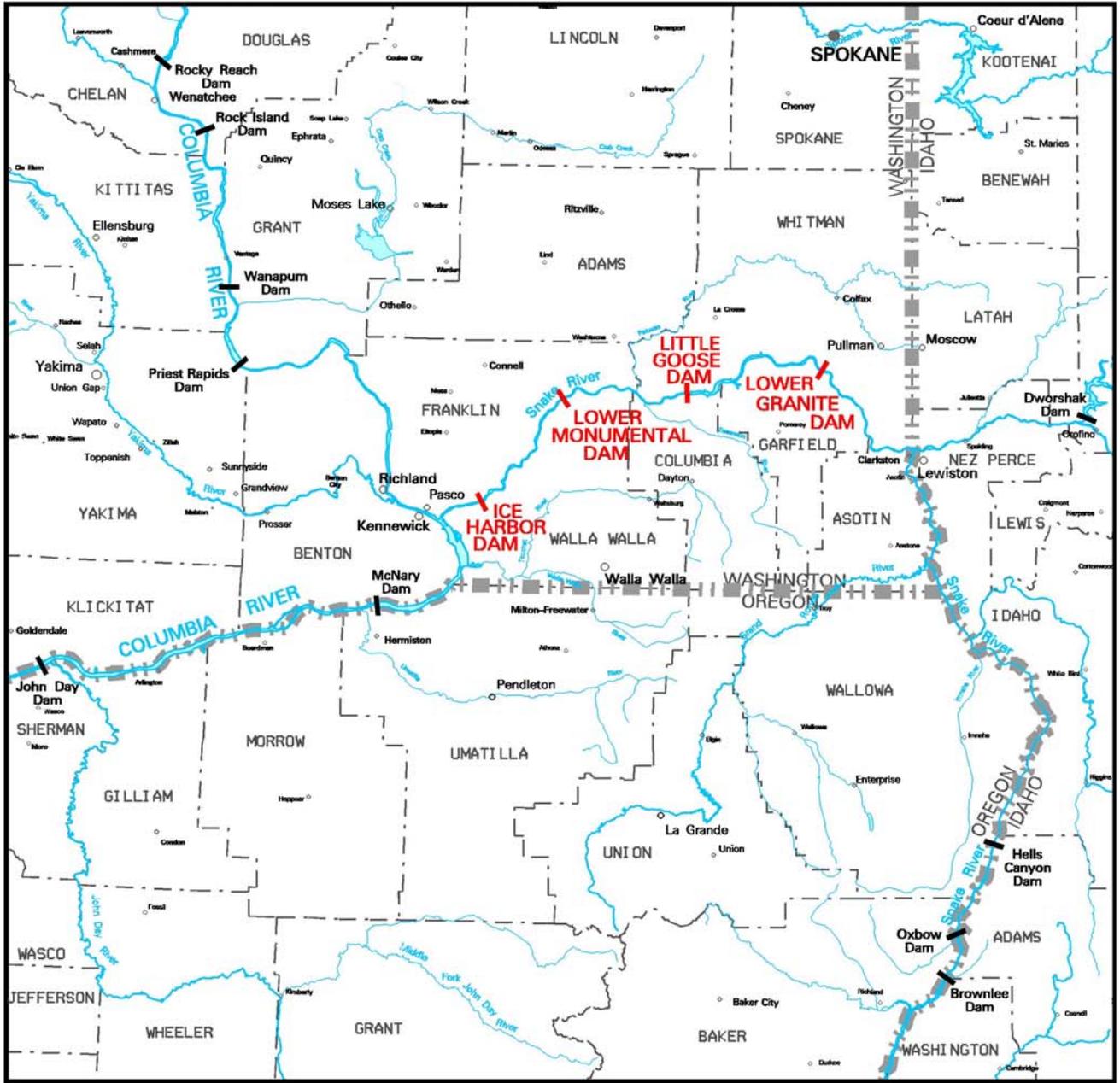
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Lower Snake River Basin
 Columbia River Basin

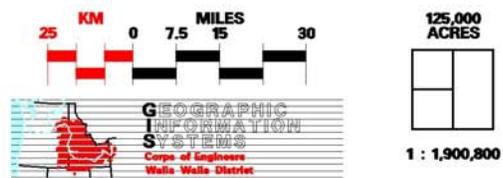
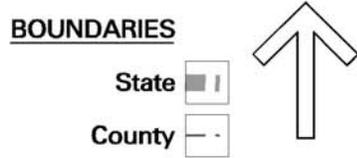


Lower Snake River
 Juvenile Salmon Migration Feasibility Study

Figure 1-1.
PROJECT VICINITY



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LOWER SNAKE RIVER
 Juvenile Salmon Migration Feasibility Study

Figure 1-2.
**REGIONAL
 BASE MAP**

1.5.4 Regional Forum

This FR/EIS examines a number of alternatives that address just hydropower actions on the four lower Snake River dams. In order to meet the much broader needs of ESA-listed salmon of the entire Columbia River Basin, an inter-Governmental forum involving Federal, state, tribal, and other representatives for decisionmaking was formed. The forum, named the Regional Forum, is multi-leveled (see Figure 1-3).

The overall objective of the Regional Forum is for the technical teams to explore relevant facts and perform analyses, as necessary, in order to define the issues regarding ESA-listed salmon and steelhead in the Columbia River Basin. If an issue cannot be resolved at the technical levels, the issue is raised to the manager level for resolution. The main intent of the Regional Forum is to allow the Executive Committee, the Implementation Team, and the various technical teams to have opportunities for discussions of both scientific and management issues.

The Regional Forum includes the Technical Management Team which makes decisions about the in-season operation of the FCRPS to benefit salmon. In addition, it includes a parallel System Configuration Team (SCT) that was established to consider modifications to the physical structures of dams in the hydro system. PATH (see Section 1.4.2) is under the direction of the Implementation Team. PATH's decision analysis has been focused on alternative hydrosystem actions that may be used to prevent the extinction and aid in the recovery of listed stocks.

The Fish Passage Operations and Maintenance Coordination Team (FPOM) is an interagency team through which the Corps coordinates operations and maintenance (O&M) in response to fish passage issues at the Corps' mainstem Columbia River and lower Snake River projects. The Corps coordinates the annual Fish Passage Plan through the FPOM and coordinates priorities for O&M funding with FPOM. Active participation on the team is from the Corps, Columbia River Inter-Tribal Fish Commission (CRITFC), Fish Passage Center (FPC), Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), and NMFS. The FPOM is chaired by the Corps.

The Water Quality Team (WQT) provides scientific and technical recommendations and advice on water quality issues. The team's current emphasis is on water temperature and TDG in the Columbia River Basin.

The Implementation Team assists with resolution of the issues generated by the WQT and Integrated Scientific Review Team (ISRT), as well as others. The Executive Committee deals with issues at the policy level.

The results of this FR/EIS are major components of the overall Regional Forum's decisionmaking process. However, the Regional Forum is not only focused on the lower Snake River. In addition, work or studies on other projects in the basin (e.g., Bonneville, The Dalles, John Day, and McNary) are included in the Regional Forum's scope of activities in planning recovery efforts for ESA-listed fish.

Regional Forum Organization

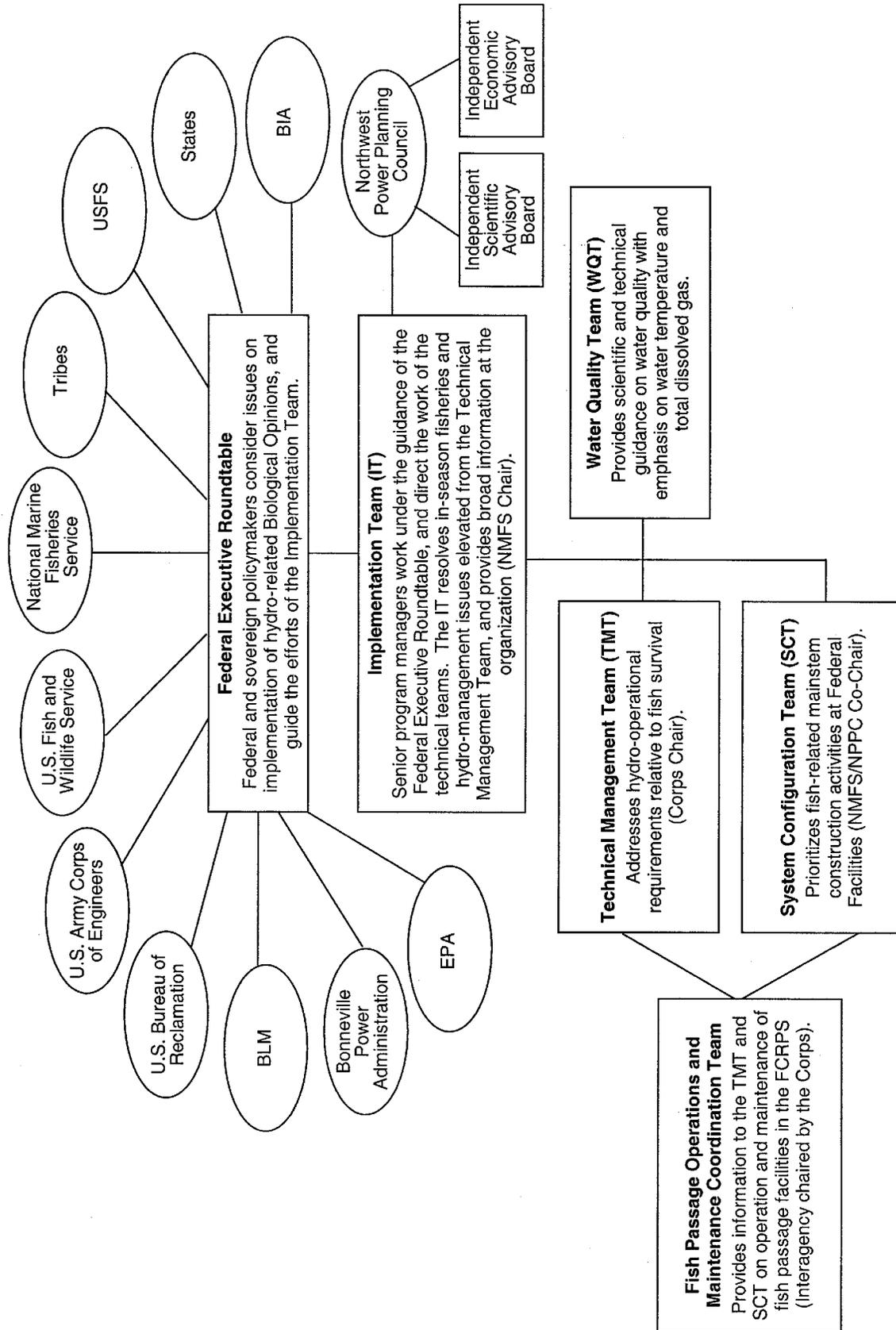


Figure 1-3. Regional Implementation Organization Chart

1.5.5 Additional Fish and Wildlife Planning Groups and Activities in the Columbia River Basin

A number of resource agencies, tribes, organizations, stakeholders, and the public have direct interest or responsibilities in developing management plans that affect recovery efforts of ESA-listed fish species in the Columbia River Basin and the operation of the FCRPS. The following identifies some of the main organizations and their roles in planning efforts for listed anadromous fish in the basin. Appendix R, Historical Perspectives, provides a more detailed description of the historical perspective of events or processes since 1990 that have led to the development of this FR/EIS.

1.5.5.1 U.S. Army Corps of Engineers/Bureau of Reclamation

The Corps and BOR are responsible for the operation and maintenance of Federal dams in the FCRPS. For example, major facilities under the Corps' management include the four lower Columbia mainstem dams (i.e., McNary, John Day, The Dalles, and Bonneville), the four dams on the lower Snake River (Lower Granite, Little Goose, Lower Monumental, and Ice Harbor), and Chief Joseph and Dworshak Dams. The BOR is responsible for other mainstem Federal projects such as Grand Coulee Dam. Corps and BOR facilities affect biological, economic, social, and other resources in the Columbia River Basin. Both agencies are involved in the evaluations and implementation of measures that address ESA-listed fish species affected by their respective facilities.

1.5.5.2 Federal Energy Regulatory Commission

Major non-Federal dams are owned, operated, and maintained by various entities including Public Utility Districts (PUDs) (e.g., Chelan, Douglas, and Grant counties) and private utilities (e.g., Idaho Power Company). These non-Federal dams are regulated by the licensing process of the U.S. Federal Energy Regulatory Commission (FERC). Similar to the Corps and BOR facilities, the public and private utility projects also affect the resources of the Columbia River Basin. Through a licensing process, measures are evaluated and implemented that address ESA-listed fish species affected by FERC-licensed facilities.

1.5.5.3 Bonneville Power Administration

BPA markets and distributes power generated from Federal dams in the Columbia River Basin and other generating plants. The agency sells the power to public and private utilities and large industries, and it builds and operates transmission lines that deliver electricity. BPA funds a wide range of fish and wildlife programs throughout the Columbia River Basin. Funding for these programs is derived from revenues produced through sales of power generated from Federal dams in the Columbia River Basin.

1.5.5.4 National Marine Fisheries Service

In the Pacific Northwest, NMFS' responsibilities are to conserve, protect, and manage Pacific salmon, groundfish, halibut, and marine mammals and their habitats under the ESA and other laws. Species in the Columbia River include salmon, steelhead, and other anadromous fish. NMFS prepared the 2000 Biological Opinion which addressed anadromous fish aspects of the FCRPS.

1.5.5.5 U.S. Fish and Wildlife Service

The responsibilities of the USFWS are similar to NMFS, but apply to resident fish, wildlife, and plant species and their habitat. USFWS also prepared a Biological Opinion in 2000 which addressed the resident fish, wildlife, and plant species aspects of the FCRPS. In addition, the USFWS has prepared the Fish and Wildlife Coordination Act Report (FWCAR) for the Corps' FR/EIS (see Appendix M, Fish and Wildlife Coordination Act Report).

1.5.5.6 U.S. Environmental Protection Agency

The EPA is responsible for managing and enforcing water quality regulations in the nation's waters. It also regulates discharge of pollutants into water and air. Under the Clean Water Act, EPA, the states, tribal governments, other Federal agencies, and private landowners will implement numerous programs throughout the Columbia River Basin that are aimed at watershed and tributary improvements to meet requirements of the Clean Water Act. These programs will be implemented in the mainstem and tributaries and will focus on improving water quality, restoration of habitat, and recovery of ESA-listed species. The EPA also conducts various studies throughout the Columbia River Basin. For example, it is currently developing a Total Maximum Daily Loading (TMDL) program on the lower Snake River, which includes the Lower Snake River Project and upstream tributaries.

1.5.5.7 Federal Caucus/Basinwide Recovery Strategy

The Federal Caucus includes NMFS, Corps, BOR, BPA, EPA, Bureau of Indian Affairs (BIA), Bureau of Land Management (BLM), USFWS, and United States Department of Agriculture (USDA) Forest Service. The primary role of the Federal Caucus is to develop a comprehensive multi-species recovery plan that describes a range of potential Federal activities that could meet ESA obligations and rebuild Columbia Basin stocks (Basinwide Recovery Strategy). Non-federal (tribe, state, local, and private) activities are also considered in the Basinwide Recovery Strategy to the extent that they contribute to recovery of ESA-listed species in the Columbia River basin. The multi-species recovery plan is focused on the so-called four H's (hydro, habitat, harvest, and hatcheries), which are broad categories of the human activities that may affect listed species in the Columbia River System. The plan is not a decision document. Its content is neither regulatory or binding in nature. Rather, it presents a set of strategies, goals, and overall direction toward which the agencies in the Federal Caucus will commit to direct their programs and policies.

1.5.5.8 Columbia River Basin Forum

The Columbia River Basin Forum (formerly known as the Three Sovereigns) was formed to allow regional governments, interested parties, and the general public the opportunity to discuss management approaches for Columbia River Basin resources and to determine if regional agreement can be made on possible alternatives. The goal of the Columbia River Basin Forum (which has representatives from the Tribes, state, and Federal governments) is to develop regionally agreed upon recommendations for fish and wildlife recovery. A goal of the Columbia River Basin Forum is to improve the coordination of the many decision processes in the Columbia River Basin.

1.5.5.9 Tribal Caucus

There are 13 Federally recognized tribes and one non-Federally recognized Indian community in the study area. The 13 Federally recognized Indian tribes have management authority for fish, wildlife, and water resources within their reservations, as well as other legal rights included in Treaties and Executive Orders. These tribes are members of the Tribal Caucus. The primary role of the Tribal Caucus is to identify consensus views among the participating tribes. The 13 tribes are the Confederated Tribes of the Colville Reservation (Colville), the Confederated Tribes of the Umatilla Indian Reservation (Umatilla), the Confederated Tribes of the Warm Springs Reservation (Warm Springs), the Confederated Tribes and Bands of the Yakama Nation (Yakama), the Nez Perce Tribe (Nez Perce), the Spokane Tribe of the Spokane Reservation, the Coeur d'Alene Tribe, the Kalispel Indian Community of the Kalispel Reservation, the Kootenai Tribe of Idaho, the Shoshone-Bannock Tribes of the Fort Hall Reservation, the Burns-Paiute Tribe of the Burns Paiute Indian Colony, and the Shoshone-Paiute Tribes of the Duck Valley Reservation. The one non-Federally recognized Indian community is the Wanapum Band.

1.5.5.10 Columbia River Inter-Tribal Fish Commission (CRITFC)

The CRITFC is the technical support and coordinating agency for fishery management policies of the four Columbia River treaty tribes. These tribes include: the Warm Springs, the Yakama, the Umatilla, and the Nez Perce. Membership is composed of the fish and wildlife committees of these tribes. CRITFC responsibilities include fisheries research and analyses, advocacy, planning and coordination, harvest control, and law enforcement.

1.5.5.11 Wy-Kan-Ush-Mi Wa-Kish-Wit

Wy-Kan-Ush-Mi Wa-Kish-Wit is the Columbia River Anadromous Fish Plan of the Nez Perce, Umatilla, Warm Springs, and Yakama tribes. The plan provides a framework for restoration of Columbia River salmon.

1.5.5.12 State Agencies

Washington, Oregon, Idaho, and Montana represent distinct management entities with authority over fish, wildlife, and water resources within their jurisdictions. The agencies in these states have developed a number of management and recovery plans for fish and wildlife in the Columbia River Basin.

1.5.5.13 Columbia Basin Fish and Wildlife Authority

The Columbia Basin Fish and Wildlife Authority (CBFWA) was established to coordinate the efforts of its members (state, tribal, and Federal fish managers) to protect and enhance fish and wildlife resources by:

1. Coordinating the fish and wildlife activities of concern to the members
2. Facilitating the members' involvement in the implementation of the NPPC's Fish and Wildlife Program
3. Interfacing with water and land planning and management authorities of the Columbia River Basin.

1.5.5.14 Northwest Power Planning Council

The NPPC is a regional agency of the states of Idaho, Montana, Oregon, and Washington that was created under the authority of the Pacific Northwest Electric Power Planning and Conservation Act of 1980. The NPPC's primary role is to conduct long-range energy and fish and wildlife planning in the region. The NPPC has three distinct tasks:

1. Prepare a regional conservation and electric power plan to meet future energy needs, giving first priority to cost-effective energy conservation and second priority to cost-effective renewable resources.
2. Prepare a program to protect, mitigate, and enhance fish and wildlife, including spawning grounds and habitat, on the Columbia River and its tributaries.
3. Ensure widespread public involvement in the formulation of the power plan and the NPPC's Fish and Wildlife Program.

The NPPC makes recommendations to BPA on the utilization of ratepayer funds for the Fish and Wildlife Program. The Fish and Wildlife Program is revised periodically and will respond to the decisions made in the FR/EIS process.

1.5.5.15 Multi-Species Framework/Ecosystem Diagnosis and Treatment Analysis

In response to two scientific reviews on the NPPC's Fish and Wildlife Program, a science-based framework was initiated to help guide management policy. The framework is used to develop options for future management of the Columbia River Basin, including the biological, social, and economic effects of the options. The Hydro Work Group of the Federal Caucus and the Framework Project staff jointly evaluated alternative measures for system configuration and operations and agreed to the specifications of those measures in seven Framework Project alternatives and three Federal scenarios. The joint group also coordinated the analysis of hydrosystem operations, the biological studies and evaluations, and other Federal and Framework Project tasks related to the hydrosystem.

The Framework Project will characterize a set of alternative futures for the Columbia River basin that focus on a long-term vision for the region. The Framework Project uses an analytical technique called ecosystem diagnosis and treatment (EDT) to compare the ecological effects of various alternatives and describe their economic, social, and cultural impacts. The analysis focuses on long-term conditions and emphasizes habitat actions.

1.6 Alternatives

This FR/EIS analyzes a range of possible actions on the lower Snake River. Other aspects of the Columbia River and upper Snake River operations are addressed under other related study processes. For example, there are several related processes underway that address structural and operational changes in other parts of the Columbia River System (see Section 3.5, Other Potential Actions Outside the Scope of the FR/EIS, for additional discussion of these related processes). Many alternatives were considered and are being considered in this study process. As described above, there are numerous study groups and collaborative efforts underway that have assisted in the evaluation of alternatives.

Since the beginning of the Feasibility Study, alternatives have been identified and given numbering or lettering schemes to serve as unique identifiers. However,

different study groups have used slightly different numbering or lettering schemes. Rather than try to carry forward the complex, and often conflicting, numbering and lettering schemes, this FR/EIS uses short names to label the alternatives that are considered in detail (Table 1-2). The alternatives that are considered in detail include:

- **Alternative 1—Existing Conditions** (commonly called Alternative A1 in supporting study reports and A-1 by PATH)—the existing hydrosystem operations under the 1995 and 1998 Biological Opinions.
- **Alternative 2—Maximum Transport of Juvenile Salmon** (called Alternative A2a in supporting study reports and A-2 by PATH)—the existing hydrosystem operations and maximum transport of juvenile salmon, but without surface collectors or other major improvements.
- **Alternative 3—Major System Improvements** (called Alternative A2d in supporting study reports and A-2' by PATH)—the existing hydrosystem operations but with major system improvements that could be accomplished without a drawdown. This alternative emphasizes adaptive migration which involves development of major system improvements that provide improved conditions for either in-river migration of juvenile fish or collection and transport downstream by barge or trucks. This alternative provides the flexibility and opportunity to adjust downstream migration management strategies to achieve optimum passage conditions for survival with dams in place.
- **Alternative 4—Dam Breaching** (called Alternative A3 in supporting study reports and A-3 by PATH)—drawdown of the four lower Snake River reservoirs (Lower Granite, Little Goose, Lower Monumental, and Ice Harbor) to near-natural river conditions.

Table 1-2. Alternative Designations for this FR/EIS and Previous Designations in Other Reports

FR/EIS Alternative	Supporting Studies/Other Alternative Designations	PATH Alternative
Alternative 1—Existing Conditions	A1	A-1
Alternative 2—Maximum Transport of Juvenile Salmon	A2a	A-2
Alternative 3—Major System Improvements	A2d	A-2'
Alternative 4—Dam Breaching	A3	A-3

1.7 Authority

The Lower Snake River Project (which is the name for the Corps' four lower Snake River facilities combined) was constructed and is operated and maintained under laws that may be grouped into three categories: 1) laws initially authorizing construction of the project (i.e., Public Law 79-14); 2) laws specific to the project passed subsequent to construction; and 3) laws that generally apply to all Corps projects. Using these and other authorities, the Corps operates multiple-use water resource development projects to balance operation of individual functions with operations for all functions. This operation is coordinated with BPA, BOR, and other regional interests. The authorized uses of the Lower Snake River Project are power generation

and inland navigation, fish and wildlife, irrigation, and recreation. (These facilities operate as run-of-river dams and are not authorized for flood control). These uses have been authorized under several public laws (Table 1-3).

Table 1-3. Authorized Uses of Lower Snake River Project Facilities

Authorized Uses	Authorizing Laws
Navigation	Public Law 79-14
Irrigation	Public Law 79-14
Recreation	Public Law 78-534
Hydroelectric Power	Public Law 79-14
Fish/Wildlife	Public Law 85-624

Source: Corps, 1992

This Feasibility Study was conducted with consideration of authorization legislation and other laws including ESA; the Pacific Northwest Electric Power Planning and Conservation Act; the Fish and Wildlife Coordination Act; Section 216 of the 1970 Flood Control Act; River and Harbor Act of 1945; Sections 103, 105, and 905 of the 1986 Water Resources Development Act; Water Supply Act; Federal Water Pollution Control Act; and the water resources appropriations bills passed by Congress in 1996, 1997, and 1998. In particular, the ESA requires all Federal agencies to ensure that actions taken by the agency are not likely to jeopardize the continued existence of a species that has been listed as threatened or endangered or result in the destruction or adverse modification of critical habitat. In addition, the ESA provides agencies with the responsibility to carry out programs for the conservation of listed species.